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FEASIBILITY STUDY PLAN FOR TRUMAN ANNEX DICHLORODIPHENYLTRICHLOROETHANE MIXING AREA NAS KEY WEST FL

3/1/1992

IT CORPORATION

FEASIBILITY STUDY PLAN
TRUMAN ANNEX 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

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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 Feasibility Study (FS) Plan is prepared by IT Corporation (IT) to identify and recommend as appropriate, specific measures to correct a release at Installation Restoration (IR) Site 3 (Truman Annex 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 Remedial Investigation (RI) conducted by IT at IR Site 3. Information that will be collected from the performance of a future Phase II Remedial Investigation will also be used as part of the FS. The EPA document "Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA," October 1988, has been used as a reference in developing the Feasibility Study Plan.

1.1 Feasibility Study Plan Approach

Subsequent to the completion of the Phase II RI to the point that the remedial action objectives are established and are approved by the USEPA, the FS effort will be initiated. The following sections describe the various tasks associated with the performance of the FS at Truman Annex DDT Mixing Area. The FS Plan presents site background, environmental setting, existing data and scope of work for the FS. The FS plan will include a description of the general approach to investigating and evaluating potential remedies. The FS will be performed following the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", USEPA Publication No. EPA/540/G-89004. The FS plan will consist of the following main tasks:

Task 1: Development and Screening of Remedial Alternatives

- Identify general response actions appropriate to the remedial action objectives
- Identify potential treatment technologies capable of achieving the needed response actions
- Screen identified technologies, select representative processes
- Identify chemical specific, action specific and site specific Applicable or Relevant and Appropriate Requirements (ARARs)

- Assemble selected processes into remedial alternatives
- Screen alternatives for effectiveness, implementability and cost

Task 2: Detailed Analysis of Alternatives

- Further define alternatives as necessary
- Analyze alternatives against seven evaluation criteria
- Compare each alternatives' relative evaluation against the other alternatives

Figure 1-1 depicts an overview of the FS process.

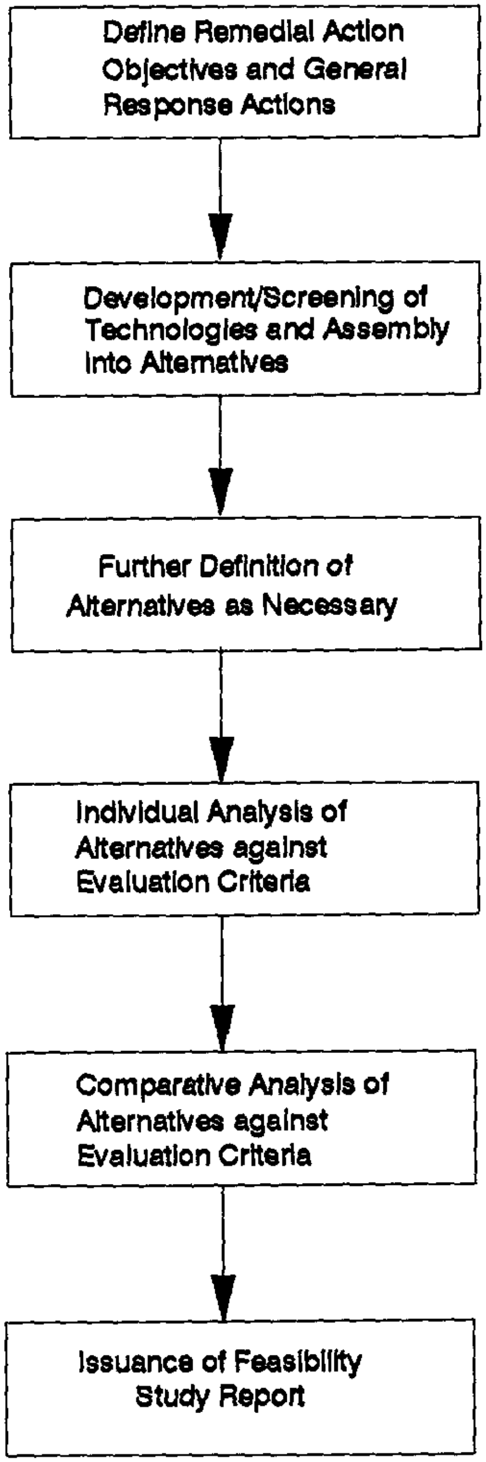

Figure 1-1: Overview of the Feasibility Study Process

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 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 (Boca Chica and Key West) 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.

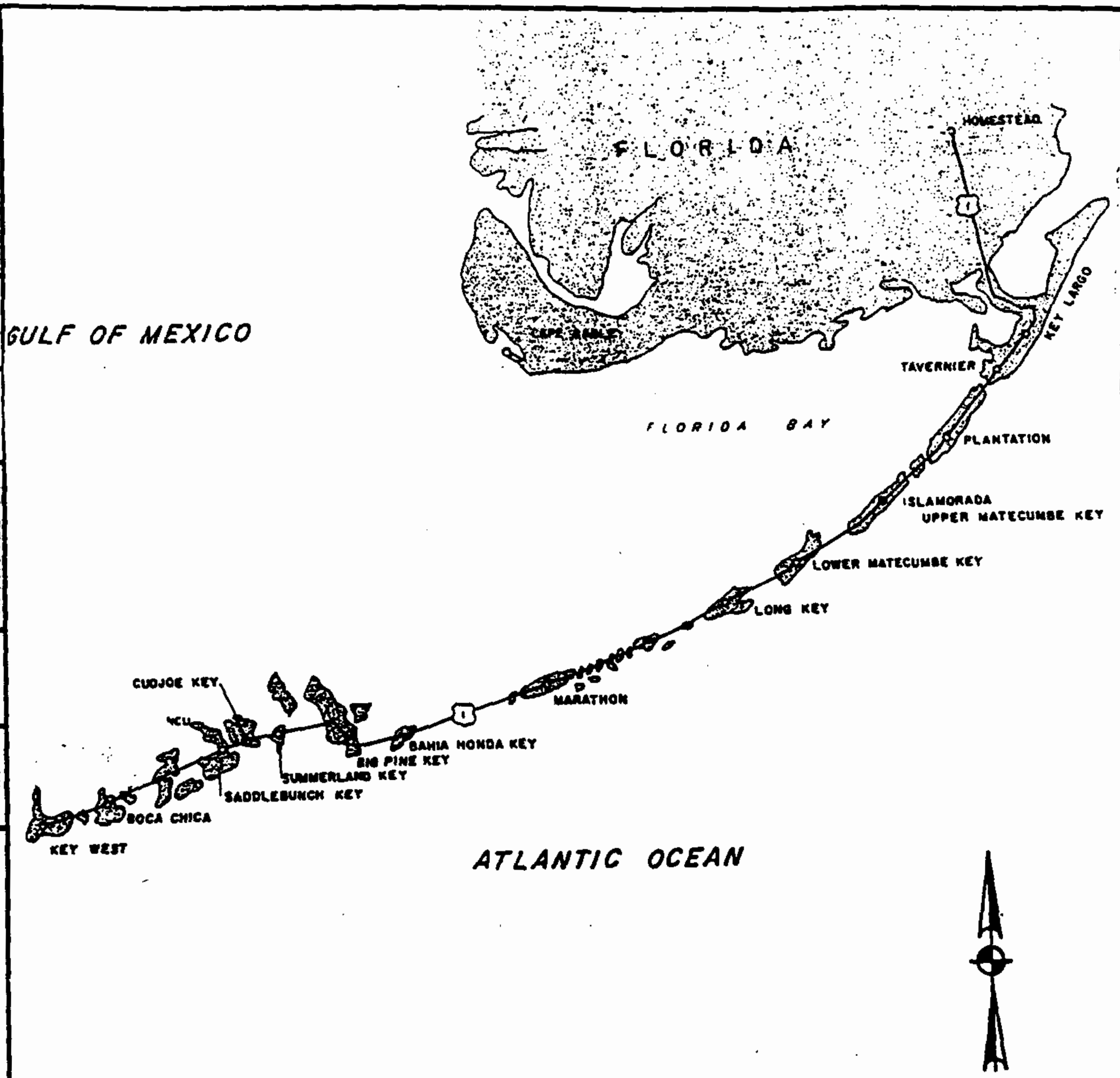

FIGURE 2-1
REGIONAL MAP
FLORIDA KEYS

Prepared for:
NAS-KEY WEST
KEY WEST, FL

INTERNATIONAL TECHNOLOGY CORPORATION

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Do Not Scale This Drawing

During the period of December through April, the Key West receives approximately 25 percent of the total annual precipitation, which, over the years, have averaged 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 installation 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 remedial investigation yielded hydraulic conductivity values of 72 gpd/sq.ft. and 1024 gpd/sq.ft. and transmissivity values ranging from 70,000 gpd/ft. to 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. Hence, the groundwater at the site will be 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 Development and Screening of Remedial Technologies and Alternatives

The primary objective of this phase of the FS is to develop an appropriate range of remedial alternatives 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 achieve remedial action objectives for each media (i.e. soil, groundwater and surface water) where an unacceptable present or future exposure is identified by the risk assessment or where applicable ARARS are not met.

3.1 Description of the Current Situation

The following sections describe the site conditions, geology, hydrogeology, and existing analytical data at IR Site 3. Information was obtained from a review of available data, the results of 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.

3.1.1 Site Description

The Truman Annex DDT Mixing Area is located on the western side of Key West as depicted in Figure 3-1, at the former site of Building 265 and is shown in detail in Figure 3-2. The site covers an area of about 0.25 acres and is located approximately 1,100 feet inland from the coastline in an area that is subject to restricted vehicular and pedestrian traffic. The site is underlain by highly permeable soils with no surface water drainage or holding features present.

From the 1940's to the early 1970's, 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 disposal. Discharges at the site were by accidental spillage.

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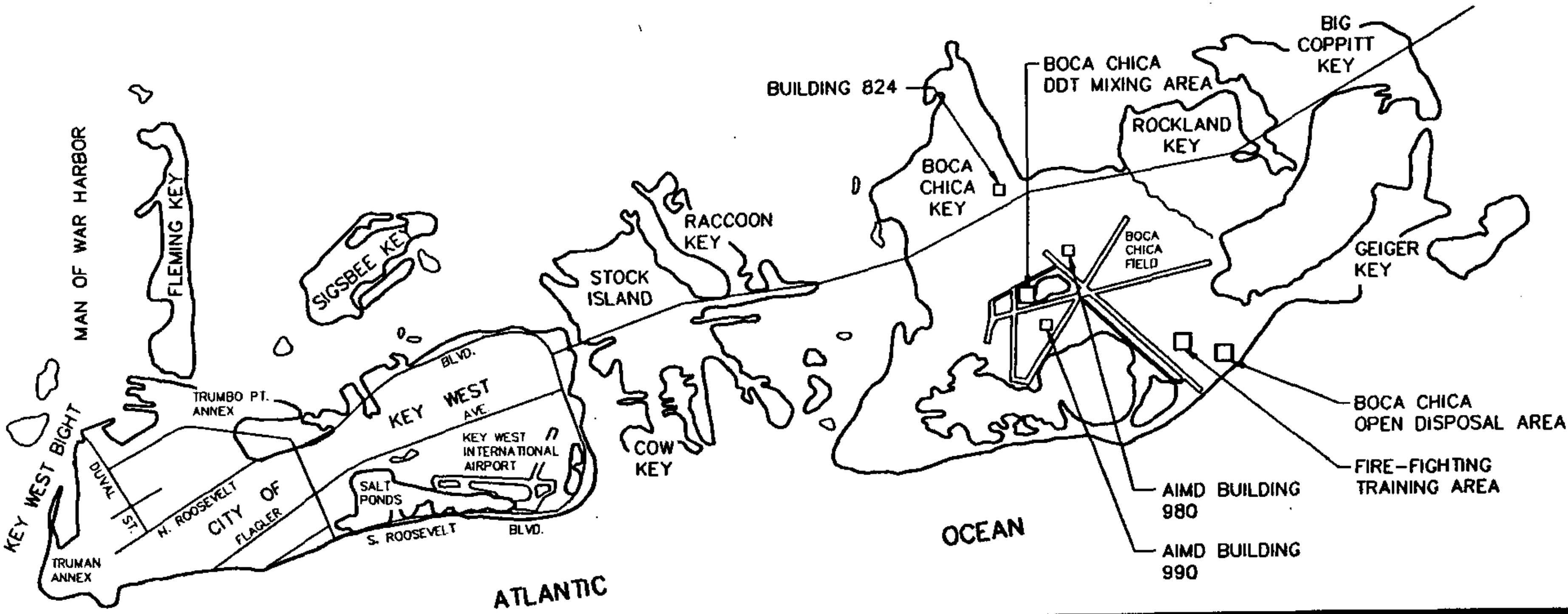

NOT TO SCALE

SOURCES: 1) FREDERICK H. HILDERBRANDT, INC.
ENGINEERS-SURVEYORS-PLANNERS
15321 S. DIXIE HWY., SUITE 202
MIAMI, FLORIDA 33157

2) GERAGHTY AND MILLER, INC.

FIGURE 3-1

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

Prepared for:

NAS - KEY WEST
KEY WEST, FLORIDA

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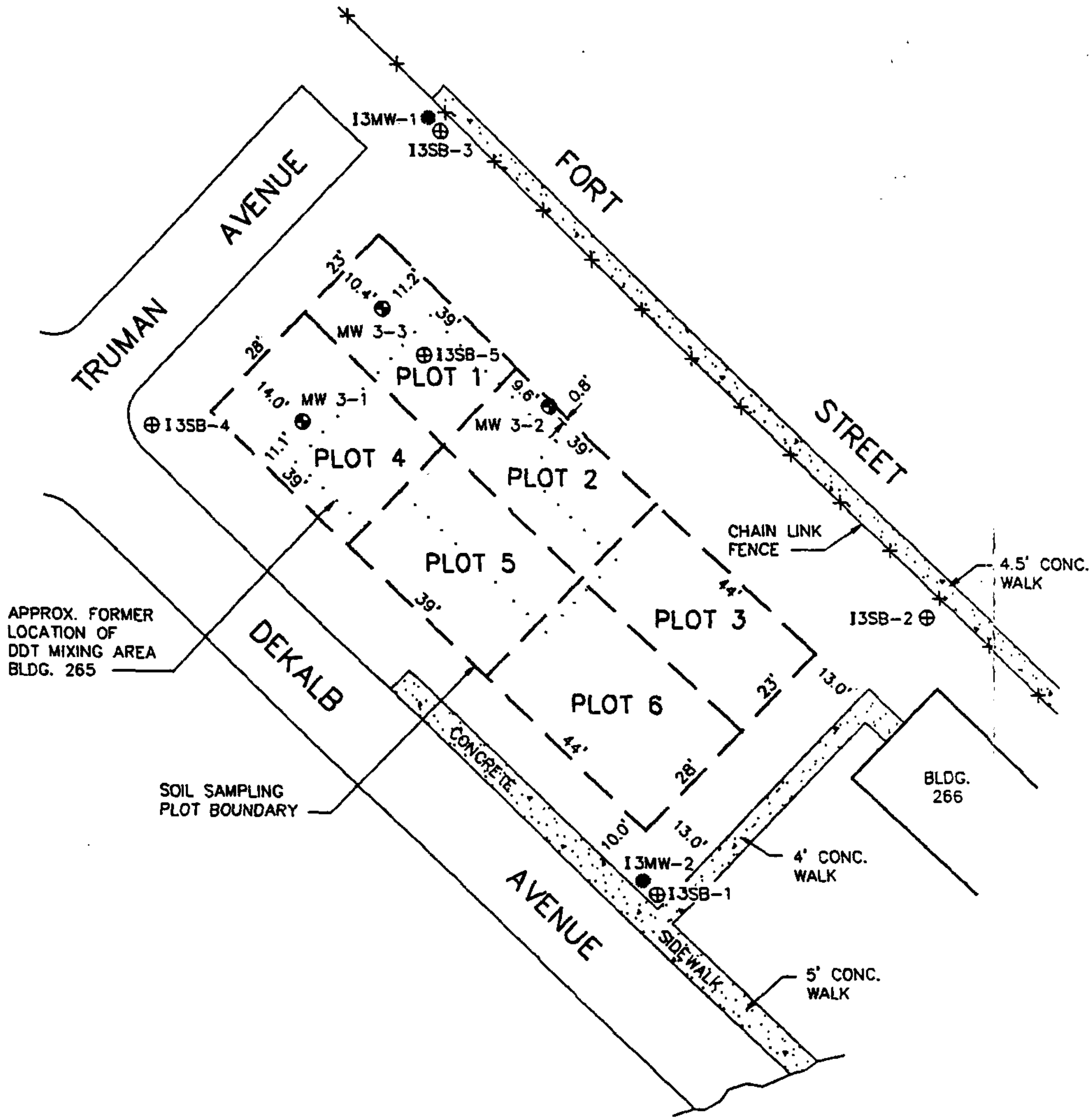

SOIL SAMPLES

COMPOUND	STANDARDS* µg/l	PLOT 1	PLOT 2	PLOT 3	PLOT 4	PLOT 5	PLOT 6	MW3-2	MW3-1
4,4 - DDT	1000	220,000	86,000	100,000	79,000	17,000	9100	1800	6000
4,4 - DDD	1500	34,000	6700	80,0000	68,000	2000	1200	-	83,000
4,4 - DDE	1000	30,000	20,000	33,000	26,000	9100	8700	-	8600
BETA - BHC	NE	-	-	2900	4700	800	-	89	2300
DIELDRIN	NE	28,000	-	6800	4400	-	-	-	-

GROUNDWATER SAMPLES

COMPOUND	STANDARDS* µg/l	MW3-1	MW3-2	MW3-3
ALPHA - BHC	0.05	-	-	0.11
BETA - BHC	0.05	1.0	7.0	0.91
DIELDRIN	0.05	0.47	-	1.8
4,4 - DDD	0.15	2.1	0.77	-
4,4 - DDE	0.1	-	-	0.19
4,4 - DDT	0.1	-	-	0.21
HEPTACHLOR EPOXIDE	0.0039	-	0.14	-

NE = NOT ESTABLISHED

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

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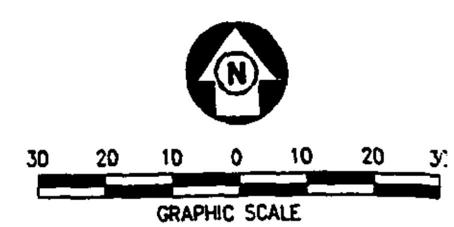


LEGEND

- MW 3-1 — IT CORP. MONITORING WELL
- PLOT # — PLOT BOUNDARY & NUMBER
- I3SB-1 — PROPOSED SOIL BORING
- I3MW-1 — PROPOSED MONITORING WELL

FIGURE 3-2

INVESTIGATION & SAMPLING LOCATIONS
TRUMAN ANNEX
DDT MIXING AREA

Prepared for:

NAS - KEY WEST
KEY WEST, FLORIDA

INTERNATIONAL TECHNOLOGY CORPORATION

3.1.2 Geologic and Hydrogeologic Setting

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

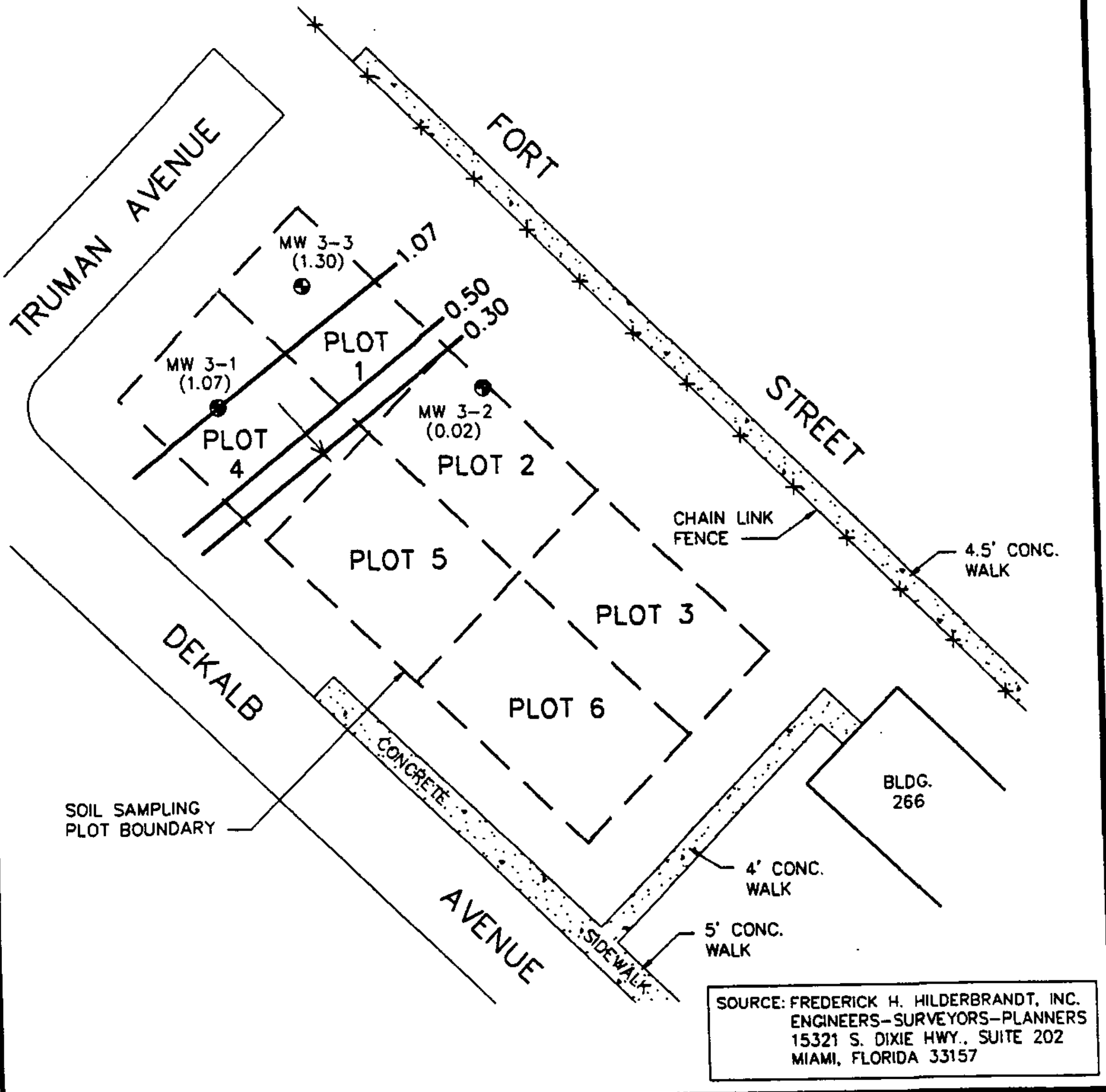
Information was gathered from soil boring logs to construct the geologic framework necessary to assess the potential for contaminant migration. Visual observations depicted a top soil cover with small areas of sparse grass cover. The material encountered during the installation of monitoring wells ranged from poorly sorted limestone fill mixed with gravel at the surface, to sandy limestone fill that was well sorted with depth. The recorded observations from the visual classification of soils demonstrate a very dense material from 0-5 feet BLS. The water table is present at approximately 5 feet BLS where the density of the material encountered changes from very hard to soft. The soft material encountered is suspected to be part of the Miami Oolite formation.

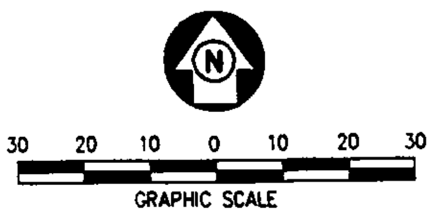
Geotechnical data was obtained from analysis of a composite soil sample collected from ground surface to approximately 2 feet BLS. Grain size analysis indicated a well graded natural material with grain sizes ranging from gravel to clay. The pH was determined to be 8.35 and is indicative of the occurrence of carbonate properties in soils/rocks in the area. The ion exchange capacity was 89.97 meq/g and the total organic carbon content of the soil sample was reported to be 8,700 parts per million. The permeability of the composite soil sample was reported at 6.55×10^{-7} cm/sec which is characteristic of a very impermeable material.

Groundwater levels were measured in the three monitoring wells installed at this site and groundwater contours were calculated using these wells to define the water table as shown in Figure 3-3. Based on the contours, groundwater flow is to the south-southeast towards the Atlantic Ocean.

3.1.3 Existing Data

During a previous study by consultants Geraghty and Miller, 18 composite soil samples were collected at the site. The site was divided into six plots and three sampling points were selected in each plot. Soil samples were collected at depths of 0 to 1, 1 to 2, and





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MW 3-1	IT CORP. MONITORING WELL
(1.07)	GROUNDWATER ELEVATION
0.50	GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)
→	GROUNDWATER FLOW DIRECTION ARROW

FIGURE 3-3

GROUNDWATER ELEVATION CONTOUR MAP – AUGUST, 1990
TRUMAN ANNEX
DDT MIXING AREA

Prepared for:

NAS – KEY WEST
KEY WEST, FLORIDA

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STARTING DATE: 9/27/91 | DRAWN BY: L. NIST | LAST REV DATE: 2/19/92 | DRAWN BY: L. NIST | CHECKED BY: SP | APPROVED BY: MH | INITIATOR: S. PILLAI | PROJ. MGR.: M. HAMPTON | DRAWING NO.: 441c2111 | PROJ. NO.: 595392 | CAD FILE: FIG4-5.DWG | ARCHIVED: | PLOT @ 1=1

2 to 3 feet BLS at each of the sampling points in each plot. The laboratory analyses of these composite samples indicated that DDT and other pesticides such as BHC were present in soil samples taken at the site. Information regarding the specific locations of these sampling points is not available.

The following additional information was discerned from the Phase I RI work conducted at the site. A groundwater study of the site indicates that cadmium, iron, and sodium are present in concentrations above their established standards. Iron and sodium are considered to occur naturally at the site, but cadmium is more indicative of groundwater contamination.

Seven different pesticide compounds have also been detected in the groundwater above their established standards. Figure 3-2 lists the levels and locations at which organic contamination was found in all media. Pesticide concentrations in the groundwater suggests that leaching may be occurring at the site. IT considers this site to be impacted with respect to pesticides. The tables in Appendix A summarize the analytical results for samples collected during the Phase I RFI.

Groundwater at the site flows to the south-southeast and towards the Atlantic Ocean. Although analytical data on groundwater flow does indicate pesticide migration to be occurring in a southeasterly direction at the site, it has not been determined whether pesticide concentrations are leaching into the Atlantic Ocean. If pesticides are leaching into the waters of the ocean, human beings may ingest these materials indirectly through the consumption of seafood.

Based upon the data presented to date, the presence of seven pesticide compounds have been confirmed at the site. Since the pesticide contamination levels fall within acceptable ranges as calculated in a preliminary baseline risk assessment performed by IT in February 1990 (as part of the Phase I-RI study), immediate remedial action was not deemed necessary. However, due to the bioaccumulating nature of these compounds and the frequent exposure of personnel in this area, IT recommended the following: (1) restriction of all access to the site (i.e., fencing); (2) performance of a quantitative baseline risk assessment.

In order to further delineate contamination in all media and to add to the existing database, a Phase II RI is to be carried out at the site. Additional soil borings and monitoring wells are being installed and samples from all media will be collected for lab analysis during the Phase II RI. A background sampling and analysis program is also being performed during the Phase II RI to obtain background analytical data in all media. 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 is also included in the Phase II RI.

3.1.4 Additional Data To Be Obtained

The FS investigation for Truman Annex DDT Area will require the accumulation of additional site-specific information which may restrict or influence response actions, technologies or formation of remedial 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 City of Key West.

- Determination of the storm surge levels experienced in the Truman Annex location

- Any known restrictions placed by local authorities on construction contractors working in close proximity to a residential area frequented by tourists.

- 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 the NAS Key West command have for the site and surrounding area.

3.2 Alternative Development Process

The remedial alternative development process may be viewed as consisting of a series of analytical steps that involves making successively more specific definitions and evaluations of potential remedial activities. These steps are described in the following subsections.

3.2.1 Development of Remedial Action Objectives

Remedial action objectives consist of medium-specific or operable unit-specific goals for protecting human health and the environment. The remediation objectives developed will be as specific as possible but not so specific that the range of alternatives that can be developed is unduly limited.

Remedial action objectives aimed at protecting human health and the environment will specify:

- The contaminant(s) of concern
- Media of concern, exposure route(s), and potential receptor(s)
- An acceptable contaminant level or range of levels for each exposure route (i.e., a preliminary remediation goal)

Remedial action objectives for protecting human receptors will express both a contaminant level and an exposure route, rather than contaminant levels alone, because protectiveness may be achieved by preventing or reducing exposure (such as capping an area of the site, or limiting access) as well as by reducing contaminant levels. Because remedial action objectives for protecting environmental receptors typically seek to preserve or restore a resource (e.g. groundwater), environmental objective(s) will be expressed in terms of the medium of interest and target cleanup levels, whenever possible.

Although the preliminary remediation goals are established on readily available information [e.g. reference doses (Rfds) and risk-specific doses (RSDs)] or frequently used standards (e.g. ARARs), the final acceptable exposure levels will be determined on the basis of the results of the baseline risk assessment and the evaluation of the expected residual exposures and associated action-specific risks for each alternative. Contaminant levels in each media will be compared with these acceptable levels and include an evaluation of the following factors:

- Whether the remediation goals for all carcinogens of concern, including those with goals set at the chemical-specific ARAR level, provides protection within the risk range of 10^{-4} to 10^{-6}.
- Whether the remediation goals set for all non-carcinogens of concern, including those with goals set at the chemical-specific ARAR level are sufficiently protective at the site.
- Whether environmental effects (in addition to human health 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.

3.2.2 Development of General Response Actions

General response actions describe those actions that will satisfy the remedial action objectives. General response actions at IR Site 3 may include treatment, containment excavation, extraction, disposal, institutional actions or a combination of such actions. In developing alternatives, combinations of general response actions will be identified.

3.2.3 Identification Volumes or Areas of Media

During the development of alternatives, an initial determination will be made of areas or volumes of media to which general response actions might be applied. This initial determination will be made for each medium of concern at the site. To take interactions between media into account, response actions for areas or volumes of media will be refined after site-wide alternatives have been assembled.

Careful judgement will be applied in defining the areas or volumes of media and will include a consideration of not only acceptable exposure levels and potential exposure routes, but also site conditions and the nature and extent of contamination. At IR Site 3 where there are areas which vary in terms of contaminant concentration levels, it will be useful to define areas and volumes for remediation on the basis of the site-specific relationship of volume (or area) to contaminant level. Since areas or volumes of media are defined on the basis of site-specific considerations such as volume versus concentration relationships, the volume or area addressed by the alternative will be reviewed with respect to the remedial action objectives to ensure that feasible alternatives can be assembled to reduce exposure to protective levels.

3.2.4 Identification and Screening of Remedial Technologies and Process Options

In this step, the universe of potentially applicable technology types and process options will be reduced by evaluating the options with respect to technical implementability. The term "technology types" refers to general categories of technologies, such as chemical treatment, thermal destruction, immobilization, capping, or dewatering. The term "technology process options" refers to specific processes within each technology type such as precipitation, ion exchange, and oxidation reduction.

Technology types and process options will be identified by drawing on a variety of sources including references developed for application to Superfund sites and more standard engineering texts not specifically directed toward hazardous waste sites.

During this step, process options and entire technology types will be eliminated from further consideration on the basis of technical implementability. This is accomplished by using readily available information from the RI site characterization on contaminant types and concentrations and onsite characteristics to screen out technologies and process options that cannot be effectively implemented at the site.

The screening of technologies will be documented in a figure which will provide adequate information and will be included in the FS report.

3.2.5 Evaluation of Process Options

In this step of alternative development, the technology processes considered to be implementable will be evaluated in greater detail before selecting one process to represent each technology type. One representative process will be selected, if possible, for each technology type to simplify the subsequent development and evaluation of alternatives without limiting flexibility during remedial design. The representative process will provide a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site may not be selected until the remedial design phase.

Process options will be evaluated using the same criteria - effectiveness, implementability, and cost - that are used to screen alternatives prior to the detailed analysis. An important distinction to make is that at this time these criteria are applied only to technologies and the general response actions they are intended to satisfy and not to the site as a whole. Furthermore, the evaluation will typically place emphasis on effectiveness factors at this stage with less focus directed at the implementability and cost evaluation.

Because of the limited data on innovative technologies, it will not be possible to evaluate these process options on the same basis as other demonstrated technologies. Typically, if innovative technologies are judged to be implementable they are retained for evaluation either as a "selected" process option (if available information indicates that they will provide better treatment, fewer or less adverse effects, or lower costs than other options), or they will be "represented" by another process option of the same technology type.

3.2.6 Assemble Alternatives

In assembling alternatives, general response actions and the process options chosen to represent the various technology types for each medium or operable unit are combined to form alternatives for the site as a whole.

3.3 Alternatives Screening Process

Before beginning screening, alternatives will have been assembled primarily on medium-specific considerations and implementability concerns. Typically, few details of the individual process options will have been identified, and the sizing requirements of technologies or remediation timeframes would not have been fully characterized. Furthermore, interactions among media, which may influence remediation activities, would have usually not been fully determined, nor would site wide protectiveness requirements have been addressed. Therefore, at this point in the process, such aspects of the alternatives will need to be further defined to form the basis for evaluating and comparing the alternatives before their screening.

3.3.1 Specific Objectives

Alternatives will be initially developed and assembled to meet a set of remedial action objectives for each medium of interest. During screening, the assembled alternatives will be evaluated to ensure that they protect human health and the environment from each potential exposure pathway of concern at the site or those areas of the site being addressed as part of an operable unit. If it is found that an alternative is not fully protective, a mechanism to reduce exposure levels for one or more media will be sought to attain an acceptable risk level and retain the alternative in the FS.

3.3.2 Refinement of Alternatives

Alternatives will be defined to provide sufficient quantitative information to allow differentiation among alternatives with respect to effectiveness, implementability, and cost.

After the alternatives have been better refined with respect to types and volumes of media, the performance of technology process options will be evaluated more fully with respect to their effectiveness, implementability, and cost such that differences among alternatives can be identified. The following information will be developed, as appropriate, for the various technology processes used in an alternative:

- Size and configuration of onsite extraction and treatment systems or containment structures for groundwater extraction technologies will be necessary to evaluate which compounds impose the greatest limit on extraction technologies, either because of their chemical/physical characteristics, concentration, or distribution in groundwater.

- Time frame in which treatment, containment or removal goals can be achieved. The remediation time frame is often interdependent on the size of a treatment system or configuration of a groundwater extraction system. The time frame may be determined on the basis of specific remediation goals (e.g., attaining groundwater remediation goals in 10 years), in which case the technology is sized and configured to achieve this; the time frame may also be influenced by technological limitations (such as maximum size consideration, performance capabilities, and/or availability of adequate treatment systems or disposal capacity).

- Rates or flows of treatment - These will also influence the sizing of technologies and time frame within which remediation can be achieved.

- Spatial requirements for constructing treatment or containment technologies or for staging construction materials or excavated soil or waste.

- Distances for disposal technologies - These include approximate transport distances to acceptable offsite treatment and disposal facilities and distances for water pipelines for discharge to a receiving stream or a POTW.

- Required permits for offsite actions and imposed limitations - These include National Pollutant Discharge Elimination System (NPDES), pretreatment, and emission control requirements; coordination with local agencies and the public; and other legal considerations. These may also encompass some action-, location-, and chemical-specific ARARs.

3.3.3 Screening Evaluation

Defined alternatives will be evaluated against the short and long-term aspects of three broad criteria: effectiveness, implementability, and cost. Because the purpose of the screening evaluation is to reduce the number of alternatives that will undergo a more thorough and extensive analysis, alternatives will be evaluated generally in this phase. However, evaluations will be sufficiently detailed to distinguish among alternatives.

Initially, specific technologies or process options were evaluated primarily on the basis of whether or not they could meet a particular remedial action objective. During alternative screening, the entire alternative will be evaluated as to its effectiveness, implementability, and cost.

3.3.3.1 Effectiveness Evaluation

A key aspect of the screening evaluation is the effectiveness of each alternative in protecting human health and the environment. Each alternative will be evaluated as to its effectiveness in providing protection 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 remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the hazardous substances or contaminated media by the use of treatment that decreases the inherent threats or risks associated with the hazardous material.

3.3.3.2 Implementability Evaluation

Implementability, as a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action alternative will be used during screening to evaluate the combinations of process options with respect to conditions at a specific site. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete; it also includes operation, maintenance, replacement, and monitoring of technical components of an alternative, if required, after the remedial action is complete. 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.

The determination that an alternative is not technically feasible and is not available will usually preclude it from further consideration unless steps can be taken to change the conditions responsible for the determination.

3.3.3.3 Cost Evaluation

Absolute accuracy of cost estimates during screening may not be achieved. The focus will be to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives will be sustained as the accuracy of cost estimates improves beyond the screening process. The procedures used to develop cost estimates for alternative screening will be similar to those used for the detailed analysis; the only differences would be in the degree of alternative refinement and in the degree to which cost components are developed.

Cost estimates for screening alternatives typically will be based on a variety of cost-estimating data. Bases for screening cost estimates may include cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates as modified by site-specific information.

4.0 Detailed Analysis of Alternatives

The detailed analysis of alternatives consists of the analysis and presentation of the relevant information needed to allow decision makers to select a site remedy. During the detailed analysis, each alternative will be assessed against the evaluation criteria listed below:

- Overall Protection of Human Health and the Environment - The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

- Compliance with ARARs - The assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required and how it is justified.

- Long-term Effectiveness and Permanence - The assessment of alternatives against this criterion evaluates the long-term effectiveness of alternatives in maintaining protection of human health and the environment after response objectives have been met.

- Reduction of Toxicity, Mobility, and Volume Through Treatment - The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.

- Short-term Effectiveness - The assessment against this criterion examines the effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy until response objectives have been met.

- Implementability - This assessment evaluates the technical and administrative feasibility of alternatives and the availability of required goods and services.

- Cost - This assessment evaluates the capital and operation and maintenance (O&M) cost of each alternative.

- State (Support Agency) Acceptance - This assessment reflects the state's (or support agency's) apparent preferences among or concerns about alternatives.

- Community Acceptance - This assessment reflects the community's apparent preferences among or concerns about alternatives.

The latter two criteria (State and Community Acceptance) are usually not included in the Feasibility Study Report but are developed independently by the USEPA subsequent to receiving draft versions of the FS Report. The results of the assessment are arrayed to compare the alternatives and identify the key tradeoffs among them.

4.1 Overall Protection of Human Health and the Environment

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

Evaluation of the overall protectiveness of an alternative will focus on whether a specific alternative achieves adequate protection and will describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment, engineering, or institutional controls. This evaluation also allows for consideration of whether an alternative poses any unacceptable short-term or cross-media impacts.

4.2 Compliance with ARARs

This evaluation criterion is used to determine whether each alternative will meet all of the ARARs that have been identified in previous stages of the FS process. The detailed analysis will summarize which requirements are applicable or relevant and appropriate to an alternative and describe how the alternative meets these requirements. When an ARAR is not met, the basis for justifying one of the six waivers allowed under CERCLA will be discussed.

The following will be addressed for each alternative during the detailed analysis of ARARs.

- Compliance with chemical-specific ARARs (e.g., maximum contaminant levels) - this factor addresses whether the ARARs will be met, and if not, whether a waiver is appropriate.

- Compliance with location-specific ARARs (e.g., preservation of historic sites) - As with other ARAR-related factors, this involves a consideration of whether the ARARs will be met or whether a waiver is appropriate.

- Compliance with action-specific ARARs (e.g., RCRA minimum technology standards) - It must be determined whether ARARs will be met or will be waived.

4.3 Long-term Effectiveness and Permanence

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

- Magnitude of residual risk - This factor assesses the residual risk remaining from untreated waste or treatment residuals at the conclusion of remedial activities, (e.g., after soil containment and/or treatment are complete, or after groundwater plume management activities are concluded). The potential for this risk will be measured by numerical standards such as cancer risk levels or the volume or concentration of contaminants in waste, media, or treatment residuals remaining on the site. The characteristics of the residuals will be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumlate.

- Adequacy and reliability of controls - This factor assesses the adequacy and suitability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site. It will include an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and environmental receptors is within protective levels. This factor also addresses the long-term reliability of management controls for providing continued protection from residuals. It includes the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathway and the risks posed should the remedial action need replacement.

4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This evaluation criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. This preference will be satisfied when treatment is used to reduce the principal threats at a site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

This evaluation will focus on the following specific factors for a particular remedial alternative:

- The treatment processes the remedy will employ, and the materials that will be treated

- The amount of hazardous materials that will be destroyed or treated, including how the principal threat(s) will be addressed

- The degree of expected reduction in toxicity, mobility, or volume measured as a percentage of reduction (or order of magnitude)

- The degree to which the treatment will be irreversible

- The type and quantity of treatment residuals that will remain following treatment

- Whether the alternative would satisfy the statutory *preference for treatment* as a principal element

In evaluating this criterion, an assessment will be made as to whether treatment is used to reduce principal threats, including the extent to which toxicity, mobility, or volume are reduced either alone or in combination.

4.5 Short-term Effectiveness

This evaluation criterion addresses the effects of the alternative during the construction and implementation phase until remedial response objectives are met (e.g., a cleanup target has been met). Under this criterion, alternatives will be evaluated with respect to their effects on human health and the environment during implementation of the remedial action. The following factors will be addressed as appropriate for each alternative:

- Protection of the community during remedial actions - This aspect of short-term effectiveness addresses any risk that results from implementation of the proposed remedial action, such as dust from excavation, transportation of hazardous materials, or air-quality impacts from a stripping tower operation that may affect human health.

- Protection of workers during remedial actions - This factor assesses threats that may be posed to workers and the effectiveness and reliability of protective measures that would be taken.

- Environmental impacts - This factor addresses the potential adverse environmental impacts that may result from the construction and implementation of an alternative and evaluates the reliability of the available mitigation measures in preventing or reducing the potential impacts.

- Time until remedial response objectives are achieved - This factor includes an estimate of the time required to achieve protection for either the entire site or individual elements associated with specific site areas or threats.

4.6 Implementability

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

- Technical feasibility

  - Construction and operation - This relates to the technical difficulties and unknowns associated with a technology. This was initially identified for specific technologies during the development and screening of alternatives and will be addressed again in the detailed analysis for the alternative as a whole.

- Reliability of technology - This focuses on the likelihood that technical problems associated with implementation will lead to schedule delays.

- Ease of undertaking additional remedial action - This includes a discussion of what, if any, future remedial actions may need to be undertaken and how difficult it would be to implement such additional actions.

- Monitoring considerations - This addresses the ability to monitor the effectiveness of the remedy and includes an evaluation of the risks of exposure should monitoring be insufficient to detect a system failure.

- Administrative feasibility

  - Activities needed to coordinate with other offices and agencies (e.g., obtaining permits for offsite activities or rights-of-way for construction)

- Availability of services and materials

  - Availability of adequate offsite treatment, storage capacity, and disposal services

  - Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources

  - Availability of services and materials, plus the potential for obtaining competitive bids, which may be particularly important for innovative technologies

  - Availability of prospective technologies

4.7 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

- Engineering expenses - Costs of administration, design, construction supervision, drafting and treatability testing.
- License or Permit costs - Administrative and technical costs necessary to obtain licenses and permits necessary to obtain licenses and permits for installation and operation of offsite activities.
- Startup 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, a five percent (5%) discount rate for 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.

4.8 State Acceptance

This assessment evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. This criterion will be addressed in the Record of Decision (ROD) once comments on the FS report and proposed plan have been received. This evaluation will not be contained in the FS Report

4.9 Community Acceptance

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. As with state acceptance, this criterion will be addressed in the ROD once comments on the FS reports and proposed plan have been received. This evaluation will not be contained in the FS Report.

4.10 Presentation of Individual Analysis

The analysis of individual alternatives with respect to the specified criteria will be presented in the FS report as a narrative discussion accompanied by a summary table. This information will be used to compare the alternatives and support a subsequent analysis of the alternatives in the remedy selection process. The narrative discussion for each alternative will provide (1) a description of the alternative and (2) a discussion of the individual criteria assessment.

The alternative description will provide data on technology components (use of innovative technologies will be identified), quantities of hazardous materials handled, time required for implementation, process sizing, implementation requirements, and assumptions. These descriptions, by clearly articulating the various waste management strategies for each alternative, will also serve as the basis for documenting the rational of the applicability or relevance and appropriateness of potential Federal and State requirements. Therefore, the significant ARARs for each alternative will be identified and integrated into these discussions.

The narrative discussion of the analysis for each alternative will present the assessment of the alternative against each of the criteria. This discussion will focus on how, and to what extent, the various factors within each of the criteria are addressed. The uncertainties associated with specific alternatives will be included when changes in assumptions or unknown conditions could affect the analysis.

The FS will also include a summary table highlighting the assessment of each alternative with respect to each of the nine criteria.

4.11 Comparative Analysis of Alternatives

Once the alternatives have been described and individually assessed against the criteria, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. This is in contrast to the preceding analysis in which each alternative was analyzed independently without a consideration of other alternatives. The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs that must balance can be identified.

4.12 Presentation of Comparative Analysis

The comparative analysis will include a narrative discussion describing the strengths and weaknesses of the alternatives relative to one another with respect to each criterion, and how reasonable variations of key uncertainties could change the expectations of their relative performance.

The presentation of differences among alternatives can be measured either qualitatively or quantitatively, as appropriate, and will identify substantive differences (e.g., greater short-term effectiveness concerns, greater cost, etc.). Quantitative information that was used to assess the alternatives (e.g., specific cost estimates, time until response objectives would be obtained, and levels of residual contamination) will be included in these discussions.

4.13 Post-FS Selection of the Preferred Alternative

Following completion of the FS, the results of the detailed analyses, when combined with the risk management judgements become the rationale for selecting a preferred alternative and preparing the proposed plan. Therefore, the results of the detailed analysis will serve to highlight the relative advantages and disadvantages of each alternative so that the key tradeoffs can be identified.

4.14 Technical Memorandum

The EPA will be provided with two technical memorandums. Technical Memorandum No. 1 will present the Remedial Action Objectives developed in the initial stage of the FS. Technical Memorandum No.2 will present the draft summary of the Remedial Alternatives assembled and the results of the initial screening of these alternatives. Appropriate comments on the technical memorandum will be incorporated into the Draft FS Report.

4.15 Draft Report

A draft FS report will be prepared and presented to the EPA for review and comments. A Final FS report will then be finalized by incorporating comments received from EPA in the Draft FS report and resubmitted for final approval. The report will then be available for public review.

Appendix A
Summary of Analytical Data
IR Site 3, Truman Annex DDT Mixing Area

TABLE A-6

DATA SUMMARY - SITE 3
Truman Annex, DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392

MEDIA	CLASS	PARAMETER	CSC	MINIMUM* CONCENTRATION	MAXIMUM CONCENTRATON
Groundwater	Inorganics	Cadmium	10	11.4	13.9
		Iron	300	425	895
		Sodium	160,000	534,000	1,140,000
	Pesticides/PCB	Alpha-BHC	.05	---	.11
		Beta	.05	.91	7.00
		Dieldrin	.05	.47	1.80
		4,4-DDD	.15	.77	2.10
		4,4-DDE	.10	---	.19
		4,4-DDT	.10	---	.21
		Heptachlor epoxide	.0039	---	.14
Soil Sample	Pesticides/PCB	4,4-DDT	1,000	1,800	220,000
		4,4-DDD	1,500	2,000	83,000
		4,4-DDE	1,000	8,600	33,000

NOTE:

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

TABLE 3-12

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS FOR SOIL SAMPLES
Site 3 - Truman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:		20	20	20	20	20	20	30	30
COMPOUND	CSC								
4,4-DDT	1,000	220,000*	86,000	100,000	79,000	17,000	9,100*	1,800	6,000
4,4-DDD	1,500	34,000*	6,700	80,000	68,000	2,000	1,200	BDL	83,000
4,4-DDE	1,000	30,000*	20,000*	33,000*	26,000*	9,100*	8,700*	560*	8,600*
Beta-BHC	NE	BDL	BDL	2,900	4,700	600	BDL	69	2,300
Dieldrin	NE	28,000	ND	6,800*	4,400	BDL	ND	BDL	BDL
Alpha-chlordane	270	BDL	ND	ND	ND	ND	ND	BDL	ND
Gamma-chlordane	270	BDL	BDL	ND	ND	BDL	ND	BDL	ND
Aldrin	21	BDL	ND	ND	ND	ND	ND	ND	ND

TABLE 3-12

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS FOR SOIL SAMPLES
Site 3 - Truman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:	Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:	20	20	20	20	20	20	30	30

NOTE:

BDL = *Below detection limit*
ND = Not detected
NE = Not established
MW = *Monitoring well*

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

NAS Site 3, Plot 2: Dilution factor of 50. Value for 4,4-DDE represents an estimated value less than the detection limit at this dilution
NAS Site 3, Plot 4: Dilution factor of 2,000. Value for 4,4-DDE represents an estimated value less than the detection limit at this dilution
Site 3, Plot 2: Dilution factor of 2,000. Value of 4,4-DDE repersents an estimated value less than the detection limit at this dilution
Site 3, Plot 1: Dilution factor of 5,000. Values for dieldrin, 4,4-DDE and 4,4-DDD are estimated values less than the detection limit at this dilution
Site 3, Plot 3: Dilution factor of 2,000. Values for dieldrin, 4,4-DDD are estimated values below the detection limit at this dilution
Site 3, Plot 4: Dilution factor of 2,000. Value for 4,4-DDE represents an estimated value less than the detection limit at this dilution
Site 3, Plot 5: Dilution factor of 500. Values for 4,4-DDE and 4,4-DDT are estimated values below the detection limit at this dilution
Site 3, Plot 6: Dilution factor of 400.

TABLE 3-13

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC COMPOUNDS (VOLATILES AND SEMI-VOLATILES) IN SOIL
Site 3 - Truman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:		18, 19	18, 19	18, 19	18, 19	18, 19	18, 19	27, 29	28, 29
COMPOUND	CSC								
1,2,4-trichlorobenzene	340,000	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	NE	ND	ND	ND	ND	ND	ND	ND	ND
Diethylphthalate	14,000,000	ND	BDL	BDL	BDL	BDL	ND	420	ND
Methylene chloride	47,000	BDL	BDL	BDL	BDL	10	BDL	ND	BDL
Acetone	1,700,000	BDL	880+	78+	BDL+	ND	ND	ND	BDL
Chrysene	NE	BDL	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthlate	340,000	BDL	BDL	BDL	ND	ND	ND	460+	BDL
Benzo(a)pyrene	NE	BDL	ND	ND	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	NE	BDL	ND	ND	ND	ND	ND	ND	ND
Toluene	5,100,000	ND	ND	ND	ND	ND	BDL	ND	ND

TABLE 3-13

ANALYTICAL DETECTIONS FOR VOLATILE ORGANIC COMPOUNDS (VOLATILES AND SEMI-VOLATILES) IN SOIL
Site 3 - Truman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/kg (ppb)

LABORATORY SAMPLE IDENTIFICATION:		Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:		18, 19	18, 19	18, 19	18, 19	18, 19	18, 19	27, 29	28, 29
COMPOUND	CSC								
Chlorobenzene	510,000	ND	ND	ND	ND	ND	1,600	ND	ND
Ethylbenzene	1,700,000	ND	ND	ND	ND	ND	1,500	ND	ND
Total xylene	34,000,000	ND	ND	ND	ND	ND	8,200	ND	ND

NOTE:

MW = *Monitoring well*
NE = Not established
ND = Not detected at the instrument detection limit
BDL = Detected but below *instrument quantitation limit*
+ = Values were off scale due to a matrix interference

TABLE 3-14

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS)
IN SURFACE/SUBSURFACE SOIL SAMPLES
Site 3 - *Truman Annex DDT Mixing Area*
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in mg/kg (ppm)

LABORATORY SAMPLE IDENTIFICATION:		Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:		21	21	21	21	21	21	31	31
COMPOUND	CSC								
Aluminum	NE	263	560	949	115	821	1,790	116*	863
Arsenic	NE	27.4	6.6	16.6	27.9	12.8	3.7+	BDL	7.3
Barium	850	BDL	BDL	BDL	28.5	BDL	BDL	BDL	BDL
Beryllium	65	ND	ND	ND	ND	ND	BDL	ND	ND
Cadmium	NE	BDL	1.3	ND	ND	ND	ND	ND	ND
Calcium	NE	356,000	392,000	613,000	290,000	335,000	333,000	317,000	359,000
Chromium	NE	4	4.6	6.9	2.7	4.9	6.3	2.4	3.9
Copper	NE	24.2	26.8	17.3	10.1	14	11.8	BDL	4.2
Iron	NE	732*	1,050*	779*	745*	1,340*	1,200*	117*	825
Lead	NE	110	87.1	85.2	76.3	115	50.2	6.2	30.4
Magnesium	NE	1,540*	1,830*	2,590*	784*	1,640	2,410*	664*	1,040
Manganese	NE	9.6	14.7	15.3	5	13.7	16.4	2	10.8
Mercury	NE	0.05	0.15	0.11	ND	0.08	0.04	0.04	0.04
Nickel	340	ND	ND	ND	ND	ND	BDL	ND	ND

TABLE 3-14

ANALYTICAL DETECTIONS FOR TARGET ANALYTE LIST (INORGANICS)
IN SURFACE/SUBSURFACE SOIL SAMPLES
Site 3 - Truman Annex *DDT Mixing Area*
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in mg/kg (ppm)

LABORATORY SAMPLE IDENTIFICATION:		Site 3, Plot 1	Site 3, Plot 2	Site 3, Plot 3	Site 3, Plot 4	Site 3, Plot 5	Site 3, Plot 6	Plot 2, NAS Site 3	Plot 4, NAS Site 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 3-2	MW 3-1
ASSOCIATED METHOD BLANKS:		21	21	21	21	21	21	31	31
COMPOUND	CSC								
Potassium	NE	ND	ND	ND	116	ND	BDL	ND	ND
Silver	51	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	NE	BDL	BDL	1,310	1,140	BDL	1,030	919	1,060
Vanadium	NE	BDL	BDL	BDL	BDL	BDL	BDL	ND	BDL
Zinc	NE	89.9*	114*	129	35.0*	106*	70.3*	12.3	20.5

NOTE:

* = Values estimated due to interference
+ = Post digestion spike out of control limits, while adsorbance was less than 50% of spike adsorbance
ND = Not detected at instrument detection limit
BDL = Detected, but below instrument quantitation limit
NE = Not established
MW = Monitoring well

TABLE 3-15

ANALYTICAL DETECTION FOR TARGET ANALYTE LIST (INORGANICS)
FOR GROUNDWATER SAMPLES
Site 3 - Truman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		03-01-GW	03-02-GW	03-03-GW	03-ER
FIELD SAMPLE LOCATION:		MW 3-1	MW 3-2	MW 3-3	equipment rinsate
ASSOCIATED METHOD BLANKS:		7	7	7	8
COMPOUND	CSC				
Aluminum	NE	711	BDL	981	ND
Arsenic	50	ND	20.4	18.1	ND
Barium	1,000	BDL	BDL	BDL	ND
Cadmium	10	11.4	ND	13.6	13.9
Calcium	NE	1,670,000	455,000	1,150,000	ND
Copper	1,000	25.4	ND	BDL	ND
Iron	300	425	895	540	BDL
Lead	50	8.4	5.6	15.8	8.6
Magnesium	NE	74,200	143,000	63,600	ND
Manganese	50	BDL	BDL	BDL	ND
Mercury	2	ND	ND	0.2	0.2
Potassium	NE	21,900	49,700	22,700	ND
Silver	50	ND	ND	ND	ND
Sodium	160,000	534,000	1,140,000	567,000	ND
Zinc	5,000	336	46.1	357	400

NOTE:

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

TABLE 3-16

ANALYTICAL DETECTIONS FOR PESTICIDE/PCB ANALYSIS FOR GROUNDWATER SAMPLES
Site 3 - Turman Annex DDT Mixing Area
NAS-Key West
Key West, Florida
IT Project No. 595392
Units are in ug/L (ppb)

LABORATORY SAMPLE IDENTIFICATION:		03-01-GW	03-02-GW	03-03-GW	03-ER
FIELD SAMPLE LOCATION:		MW 3-1	MW 3-2	MW 3-3	equipment rinsate
ASSOCIATED METHOD BLANKS:		5	5	5	6
COMPOUND	CSC				
Alpha-BHC	0.05	ND	ND	0.11	ND
Beta-BHC	0.05	1.0*	7.0*	0.91*	ND
Gamma-GHC	4	ND	ND	1.4*	ND
Dieldrin	0.05	0.47	BDL	1.8*	ND
4,4-DDD	0.15	2.1*	0.77	BDL	ND
4,4-DDE	0.1	ND	ND	0.19	ND
4,4-DDT	0.1	ND	ND	0.21	ND
Heptachlor epoxide	0.0039	ND	0.14	ND	ND

NOTE:

* = Compound analyzed at a secondary dilution factor
ND = Not detected at instrument detection limit
BDL = Detected, but below instrument quantitation limit
MW = Monitoring well