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DRAFT FINAL TREATABILITY STUDY IMPLEMENTATION PLAN FOR SITE 9 FUEL FARM AND PIERS TRUMBO POINT ANNEX NAS KEY WEST FL
10/1/1989
IT CORPORATION

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FINAL DRAFT

TREATABILITY STUDY IMPLEMENTATION PLAN SITE 9

CONTAMINATION INVESTIGATION
NAVAL AIR STATION - KEY WEST
KEY WEST, FLORIDA
CONTRACT NO. N62467-88-C-0196

Prepared By:
IT CORPORATION
3012 U.S. HIGHWAY 301 NORTH, SUITE 1000
TAMPA, FLORIDA 33619

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TREATABILITY STUDY IMPLEMENTATION PLAN
SITE 9 - FUEL FARM AND PIERS - TRUMBO POINT ANNEX
NAVAL AIR STATION-KEY WEST (UIC N00213)
KEY WEST, FLORIDA

PREPARED FOR

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

PREPARED BY

IT CORPORATION
3012 U.S. HIGHWAY 301 N., SUITE 1000
TAMPA, FLORIDA 33619

OCTOBER 1989

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ACRONYMS AND SYMBOLS

TITLE	DEFINITION
ACGIH	American Council of Governmental and Industrial Hygienist
ADI	Average Daily Intake
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society of Testing and Materials
BW	Body Weight
CAG	Carcinogenic Assessment Group
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGA	Combustible Gas Analyzer (Exposimeter)
CLP	USEPA Contract Laboratory Program
CNO	Chief of Naval Operations
CPR	Cardio Pulmonary Resuscitation
CRPO	Community Relations Plan Outline
CRQL	Contract Required Quantification Limits
C_s	Concentration of Soil
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DDT	Dichloro-Diphenyl-Trichloroethane
DDD	Dichloro-Diphenyl-Dichloroethane
DDE	Dichloro-Diphenyl-Dichloro-Ethylene
DMP	Data Management Plan
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DPDO	Defense Property Disposal Office
DQO	Data Quality Objectives
EFD	Engineering Field Division
EIC	Engineer-in-Charge
EP	Extraction Procedure/Exposure Period
FAC	Florida Administrative Code
FDER	Florida Department of Environmental Regulations
FEV/FVC	Forced Expiratory Volume/Forced Vital Capacity
FGFFC	Florida Game and Fresh Water Fish Commission
FID	Flame Ionization Detector

ACRONYMS AND SYMBOLS (Continued)

TITLE	DEFINITION
FOC	Field Operations Coordinator
FS	Feasibility Study
FSP	Field Sampling Plan
GAC	Granular Activated Carbon
G&M	Geraghty and Miller
gpm	Gallons per Minute
HRS	Hazard Ranking System
HSC	Health and Safety Coordinator
HSP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments of 1984
IAS	Initial Assessment Study
IBM PC	International Business Machine Corp. Personal Computer
ICRP	International Council on Radiation Protection
IR	Average Soil Ingestion Rate
IRP	Installation Restoration Program
IT	IT Corporation
ITAS	IT Analytical Services
LBG	Leggette, Brashears, and Graham, Inc.
LEL	Lower Explosive Limit
LIMS	Laboratory Information Management Systems
mg/kg	Milligrams/Kilogram
mg/L	Milligrams/Liter
MS DOS	Microsoft Disk Operating System
MSA	Mine Safety Administration
MSL	Mean Sea Level
NACIP	Navy Assessment and Control of Installation Pollutants
NAS	Naval Air Station
NAVENENVSA	Naval Energy and Environmental Support Activity
NAVFACENGCOM	Navy Facilities Engineering Command

ACRONYMS AND SYMBOLS (Continued)

TITLE	DEFINITION
NCP	National Oil and Hazardous Substances Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NEPPS	Naval Environmental Protection Support Service
NFA	No Further Action
NIOSH	National Institute of Occupational Safety and Health
NPSS	Naval Environmental Protection Support Service
OSHA	Occupational Health and Safety Administration
OVA	Organic Vapor Analyzer
PAO	Public Affairs Officer
PC	Personal Computer
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PID	Photoionization Detector
PMP	Project Management Plan
ppb	Parts per Billion
PPE	Personnel Protection Equipment
ppm	Parts per Million
q	Cancer Potency Factor
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
R	Acceptable Incremental Lifetime Cancer Risk
RA	Risk Assessment or Remedial Action
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RV	Recreational Vehicle
SAP	Sampling and Analysis Plan

ACRONYMS AND SYMBOLS (Continued)

TITLE	DEFINITION
SARA	Superfund Amendments and Re-authorization Act
SCBA	Self Contained Breathing Apparatus
SI	Site Inspection
SMAC 20	Simultaneous Analysis Complete
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SOW	Statement of Work
TCL	Target Compound List
TDS	Total Dissolved Solids
TLV	Threshold Limit Value
TRC	Technical Review Committee
ug/L	Micrograms/Liter
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WBGT	Wet Globe Bulb Temperature Index

P1ACRONM.LST

1.0 INTRODUCTION

Trumbo Point Annex Fuel Farm at the Naval Air Station (NAS) in Key West, Florida has been found to have subsurface liquid phase and dissolved hydrocarbon contamination. The contamination was detected during the preliminary investigation conducted under the Naval Installation Restoration Program (IRP).

The fuel farm located on the northwest corner of the Trumbo Point Annex (Figures 1-1 and 1-2) has been used as a distribution and storage facility for various types of fuels since 1942. There were 28 storage tanks in use until 1985, however, some storage tanks have since been abandoned. Geraghty and Miller (G&M) has performed several hydrogeologic investigations of the site confirming subsurface contamination. A G&M report subtitled "Subsurface Hydrocarbon Investigation at Trumbo Point Annex, NAS-Key West, Florida, June 1985" confirms diesel fuel contamination near Storage Tank D-4. Monitoring Well MW-4, installed in this area, showed the presence of liquid-phase hydrocarbon thickness varying between 0.03 to 1.39 feet.

In September, 1988, G&M prepared and submitted a pilot study work plan for remediating the subsurface contamination at the Trumbo Point Annex Fuel Farm. The pilot study work plan includes evaluation of several remedial alternatives and final selection of a set of remedial steps to be implemented for obtaining design data for a full scale remedial system. There are four proposed phases of work to be performed in this plan, of which the first phase - pilot study work plan has been completed by G&M. The remaining three phases are:

- Phase II - Implementation of pilot study work plan
- Phase III - Feasibility study and design
- Phase IV - Remedial action

The following work plan describes the procedures to implement the pilot study work plan (Phase II) which is included herein as Appendix A.

2.0 IMPLEMENTATION OF PILOT STUDY WORK PLAN

The overall effort required to implement the pilot study work plan can be categorized into five distinct tasks. The tasks are as follows:

- Task 1 - Logistics - Establishing site requirements and scheduling
- Task 2 - Design and Specifications - Designing and obtaining necessary material and equipment
- Task 3 - Mobilization - Staging all materials on site
- Task 4 - Construction - Installing infiltration gallery and treatment skid
- Task 5 - Operation - Monitoring treatment system performance

Each of the above tasks consist of several steps that are to be completed prior to proceeding with the subsequent tasks. The results of preceding tasks will be used in performing the succeeding task. Therefore, the tasks will be performed in sequence. An outline of the above five tasks consisting of relevant steps is included in Appendix B.

2.1 LOGISTICS

First, the local office of the Florida Department of Environmental Regulation (FDER) in Marathon, Florida will be advised of the proposed pilot study to be implemented at NAS in Key West, Florida. A copy of this implementation plan will be submitted for their review.

A preliminary project organization chart identifying project personnel responsible for the implementation of the work plan is shown in Figure 2-1.

A specific site for "construction staging area" will be designated as storage area for excavated soils, equipment and other materials. Location of the ground water pilot treatment plant will be agreed upon by all parties; FDER, Navy and local authorities. Access to utilities such as electricity and water will be provided after the location of the ground water treatment plant is established.

A schedule for the performance of all the tasks is shown in Figure 2-2.

2.2 DESIGN AND SPECIFICATIONS

A design and specifications package will be generated. This task will involve sizing and specifying materials, equipment, pumps, piping, tanks, etc. Construction drawings will be generated to be used during actual installation. Revisions made during installation will be reflected on the drawings for future reference.

2.2.1 Infiltration Gallery
Due to the relative low hydraulic conductivity of the soils in the vicinity of the fuel farm, the infiltration gallery recovery method was selected by G&M over recovery wells to increase ground water yield. The infiltration gallery will consist of a trench backfilled with pea-gravel and a collection sump in the center. Due to lack of pump test data, it is not possible to project the actual ground water yield from the proposed recovery sump. Based on hydraulic conductivity data, it is projected that the flow rate from the infiltration gallery will be in the range of 10 - 25 gallons per minute (gpm).

2.2.2 Piping
Piping to be used to pump ground water from the sump to the treatment systems and from the treatment system to the discharge point will be two inch diameter Schedule 40 PVC. Pipe will be buried underground wherever possible. Half inch galvanized pipe will be used for the recovered petroleum product from the sump to the storage tank.

2.2.3 Field Site Trailer
An on-site trailer equipped with a telephone will be used for office, first aid, and storage. Tools, spare parts, supplies and other incidentals will also be stored in the on-site trailer.

2.2.4 Recovery Pumps
The recovery sump will be equipped with a dual pump system versus the filter scavenger pump recommended in the pilot study work plan report. Filter scavenger pumps are useful in open pits and may be used during dewatering operation (if necessary). The dual pump system, which consists of a hydrocarbon pump and a water pump, has proven to be effective remediating several hydrocarbon contaminated sites throughout Florida and in other parts of the country.

The hydrocarbon pump features a specially designed probe which differentiates between hydrocarbon and water. The probe will turn on the pump when the free phase hydrocarbon level exceeds a preset level and then shuts down the pump when free phase hydrocarbon level drops below an eighth of an inch, thereby preventing the submersible pump from pumping water. The pump can pump up to 35 gpm.

Ground water will be pumped using a submersible pump to create and maintain a "cone of depression" which would promote flow of free phase hydrocarbons into the sump. The pump operation will be controlled by a level probe which will maintain a specified level of water in the recovery sump below the surrounding water table. The probe will shut down the pump if free phase hydrocarbon came too near the pump intake, thereby preventing free phase hydrocarbon from entering the treatment system.

2.2.5 Product Storage Tank
The recovered free phase hydrocarbon will be pumped directly into an above ground 5,000 gallon steel storage tank. The storage tank will be equipped with a tank full switch which will shut down the recovery operation to prevent overfilling.

2.2.6 Ground Water Treatment

Ground water recovered at the Trumbo Point Annex Fuel Farm and piers will be contaminated with soluble diesel components which consists of both volatile and semi-volatile organics. There will be two types of contaminated ground water recovered during the implementation of this work plan; one, ground water removed during installation of the infiltration gallery and the other, ground water pumped from the recovery well. The former will be heavily laden with sediment and will be stored in tank trucks for disposal at an appropriate facility on the mainland, after analyzing for total petroleum hydrocarbons (TPHs, EPA 418.1). The ground water pumped from the recovery well will be treated in an above-ground skid-mounted pilot treatment system.

The pilot treatment system will consist of an air stripper followed by two polishing carbon adsorption columns in series to process up to 50 gpm of ground water. Figure 2-3 shows the proposed ground water treatment system flow diagram. Air stripping is a process by which contaminated water is brought into contact with a large volume of air, such that volatile organic contaminants (VOCs) undergo a phase change (from liquid phase to vapor phase). This results in the majority of the VOCs being discharged to the atmosphere.

The air stripper will consist of an air blower, packed tower, flow totalizer, distribution spray nozzle and de-mister.

The effluent from the air stripper, free from VOCs but still contaminated with semi-volatiles and non-volatiles, will be pumped through the carbon adsorption columns. Granulated activated carbon (GAC) has been successfully used to remove non-volatile organics from ground water to non-detectable levels.

Two carbon adsorption columns will be used in series for ground water treatment. These units will be designed to process flow rates up to 50 gpm. The carbon usage rate would vary upon the incoming concentration of hydrocarbons. Isotherm data will be used to estimate carbon usage rates. The second carbon adsorption column called the "scavenger" will be used to prevent any breakthrough of contaminants that might take place in the primary unit and leave the site without treatment. Effluent samples from the discharge of the primary unit will be taken to determine the presence of hydrocarbons by analyzing for polynuclear aromatic hydrocarbons (USEPA Method 610). Ground water will also be pre-filtered through filter bags (5-10 microns) prior to introducing it into the carbon units.

The final effluent will meet drinking water standards for organics and will be reinjected upgradient of the infiltration gallery with the approval of the FDER. Reinjection of treated ground water will be done by FDER-approved method of leach bed. This will consist of a network of four inch diameter perforated pipes placed horizontally two to three feet below ground. The pipes will be covered with geotextile and pea-gravel to prevent plugging by fine clay particles. Typical leach bed vary from two to five hundred square feet of area and are site specific, depending upon the hydraulic conductivity of the soil. A twelve by twenty feet leach bed will be installed at the Trumbo Point Annex.

Provisions will be provided to operate both the air stripper and carbon adsorption columns, combined and separately. This will be achieved by installing by-pass lines around the air stripper and the carbon adsorption columns. Each treatment process will be independently evaluated for its effectiveness in removing contaminants from the ground water. Sampling ports will be provided on both the inlet and outlet of the treatment system. Pilot data obtained will be used in scale-up of full scale treatment system.

If the proposed treatment system does not effectively remove the contaminants, "reverse osmosis" will be evaluated. Reverse osmosis (RO) uses semi-permeable membranes and high pressure to force pure water through the membrane. The membrane rejects organic and inorganic materials and allows passage of water. RO systems are readily available but are expensive to run, and therefore, were not proposed as the first option for ground water treatment.

2.3 MOBILIZATION

All necessary equipment and personnel will be mobilized to NAS-Key West site prior to construction. Treatment skid, 5,000 gallon product tank, PVC pipe, PVC liner, field site trailer, vacuum truck for dewatering, etc. will be shipped as per schedule. Personnel responsible for excavation will mobilize their heavy equipment. Prior arrangements will be made to receive shipments and store them on-site. A checklist of materials shipped and received on-site will be made before mobilizing construction personnel.

2.4 CONSTRUCTION

This task will be performed as per the design and specifications prepared in Task-2. Any change or modifications necessary will be presented to the EIC for approval prior to construction.

Construction will be supervised by the construction coordinator who will be responsible for all activities on-site.

2.4.1 Treatment Skid

A skid mounted treatment system will be fabricated and shipped to NAS-Key West site for installation. An eight feet by twelve feet by six inch concrete slab will be poured for installation of the skid.

2.4.2 Infiltration Gallery Sump

The infiltration gallery sump will be constructed of 24 inch diameter by 12 feet long perforated galvanized steel culvert pipe capped at the bottom. This sump will be emplaced at the center of the trench to a depth of approximately 12 feet. This will provide a continuous hydraulic conduit for both free phase hydrocarbon and ground water from the surrounding soils to flow into the sump. A trench of about five feet wide by twenty feet long and twelve feet deep will be excavated on-site. The proposed location of the infiltration gallery is shown in Figure 1-2. The infiltration gallery will be constructed similar to Figures 3 and 4 of the pilot study work plan in Appendix A. The exact dimensions of the trench will be dictated by field conditions encountered during actual implementation of this work plan. The inner core (3 feet) of the infiltration gallery will be constructed of pea gravel while the annular space will be filled with washed medium to coarse grained sand as show in Figure 4 of the pilot study (Appendix

A). The sand will prevent fine clay particles from clogging the path of fluid flow.

All excavated soils will be stored on top of plastic liners and covered with plastic liners to prevent further contamination of the surrounding area. The excavated soils will be segregated by the degree of contamination present using an organic vapor analyzer (OVA). OVA readings of 500 parts per million (ppm) and above will be categorized as "excessively contaminated," 10-499 ppm as "contaminated" and less than 10 ppm "not contaminated". The above guidelines have been set by the FDER and will be followed to minimize costs. Only those samples found to be "excessively contaminated" may require disposal. Therefore, excavated soils will be stored by classification on top of plastic liners and covered with plastic liners versus drums due to the non-hazardous classification of fuel contaminated soil. Several methods of disposal for the "excessively contaminated" soil will be considered such as incineration, thermal desorption, soil venting, landfarming, etc. A recommendation will be made after the volumes of each classified soil are estimated.

The following analyses which are frequently performed as part of disposal permit requirement, will be required for those soils that will require off-site disposal.

- EP Toxicity-EPA Method 1310 with an EPA Method 7420 or 7421 analysis for lead;
- Ignitability-EPA Method 1010 or 1020. It should be noted that soils which fail this test cannot automatically be considered characteristically hazardous. In the event that the soils fail this test, IT will contact Elisa Anderson, FDER, Ft. Myers, Florida, to obtain a ruling for disposal of the soils. IT will arrange for the disposal of the soils at an appropriate facility on the mainland.
- Arsenic-EPA Method 7060
- Cadmium-EPA Method 7131
- Chromium-EPA Method 7191
- Lead-EPA Method 7421
- Total halogens-bomb digestion followed by EPA Method 300.

2.4.3 Observation Wells

Four 2 inch diameter by 12 feet deep PVC observation wells will be installed in the vicinity of the infiltration gallery sump. These wells will be used for monitoring the radius of influence from recovery operations.

2.5 OPERATION

The skid-mounted pilot ground water treatment system will be operated continuously with minimum operator attention. The treatment system will be equipped with an auto-teledialer which will dial three designated telephone numbers (until the call is acknowledged) in case there is a malfunction in the operation of the system. Daily inspection of the pilot ground water treatment system during the first week of start-up, followed by weekly inspections, will be performed by IT personnel from the Deerfield Beach office. During these visits, samples of both the influent and the effluent will be taken and analyzed for both EPA-602, purgeable aromatic hydrocarbons analysis, and EPA-610, polynuclear aromatic hydrocarbons analysis. Weekly sampling will be done during the first month, followed by bi-weekly sampling during the remaining life of the project. The analytical data obtained from these samples will be valuable in evaluating the effectiveness of the pilot ground water treatment system. The removal efficiency and operating characteristics will be monitored for both of the treatment processes separately. A quarterly status report will be submitted to the EIC for review.

The recovered oil from the site will be transported by tank truck to the nearest non-hazardous waste fuel recycling facility on the mainland. The waste recycling facility will provide a manifest documenting proper disposal of the recovered fuel to the Navy.

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		APPROVED BY				

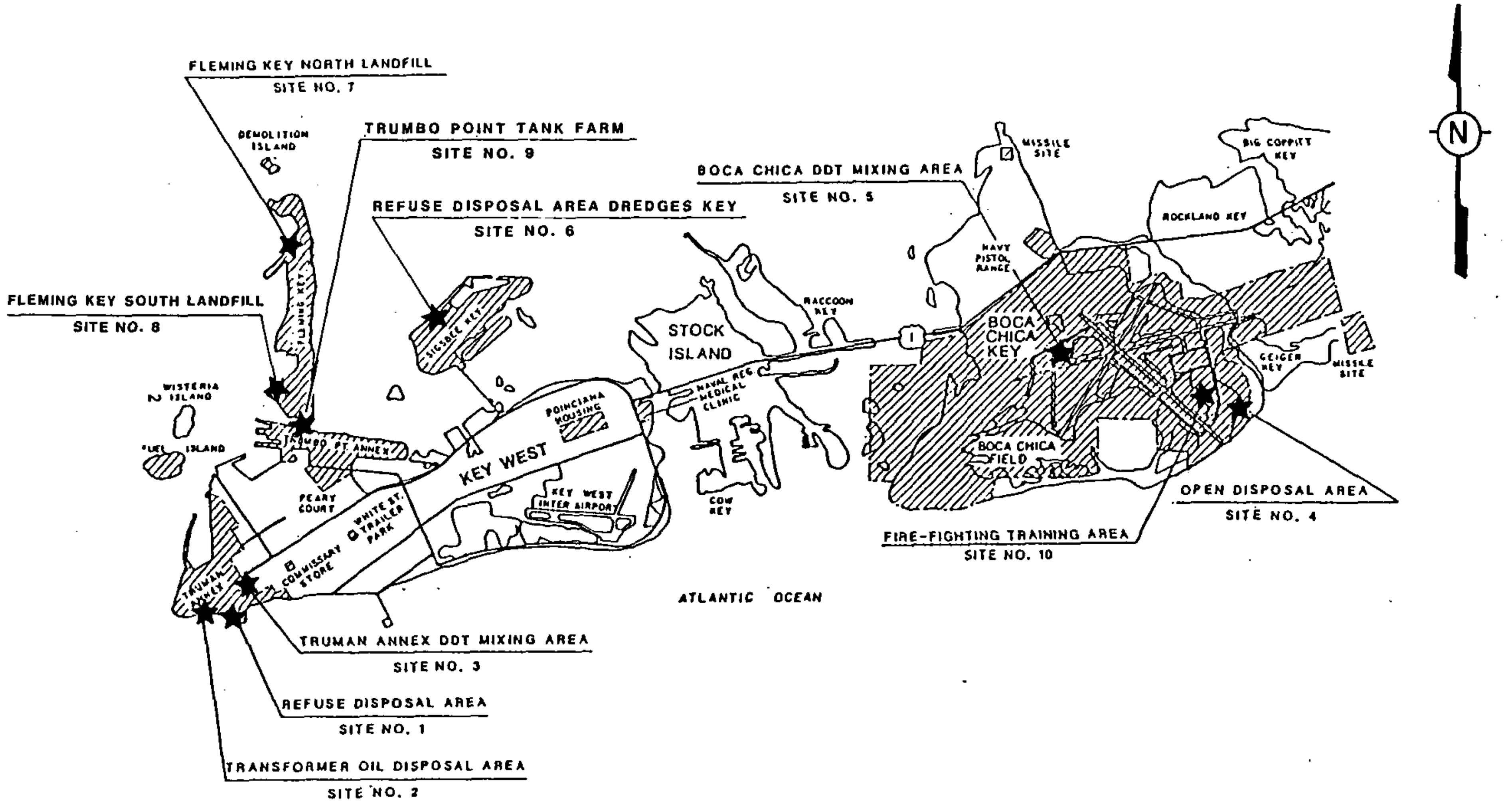


FIGURE 1-1

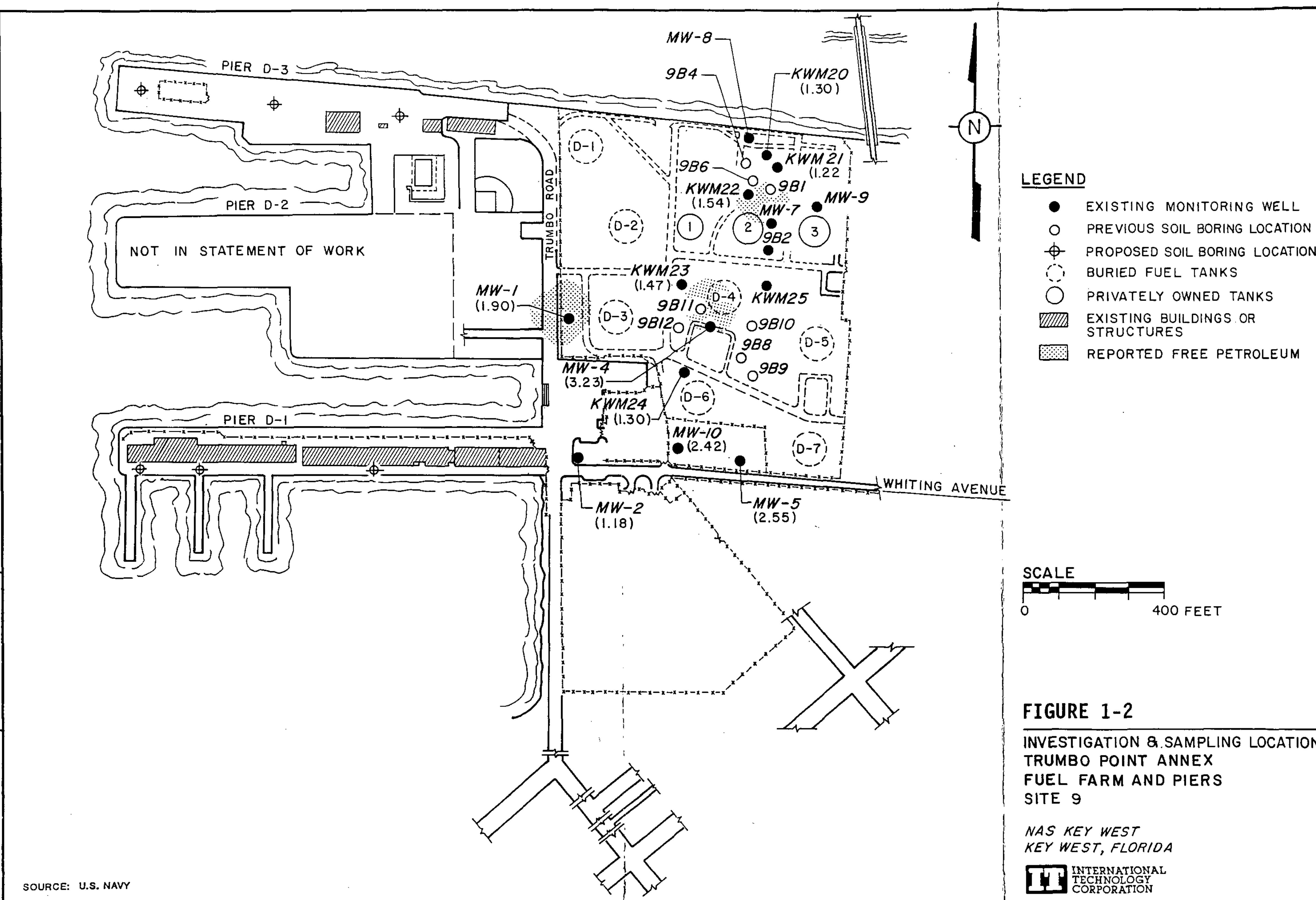
LOCATIONS OF NAVAL ACTIVITIES AND STUDY SITES

NAS KEY WEST
KEY WEST, FLORIDA

INTERNATIONAL TECHNOLOGY CORPORATION

NOT TO SCALE

SOURCE: GERAGHTY AND MILLER, INC.



DRAWING NO.: 453000-A-10
PROJECT NO.: 453000
INITIATOR: B. BARRETT
PROJ. MGR.:
DATE LAST REV.:
DRAWN BY:
STARTING DATE: 10-17-89
DRAWN BY: C.K. ROBERTSON

FIGURE 1-2

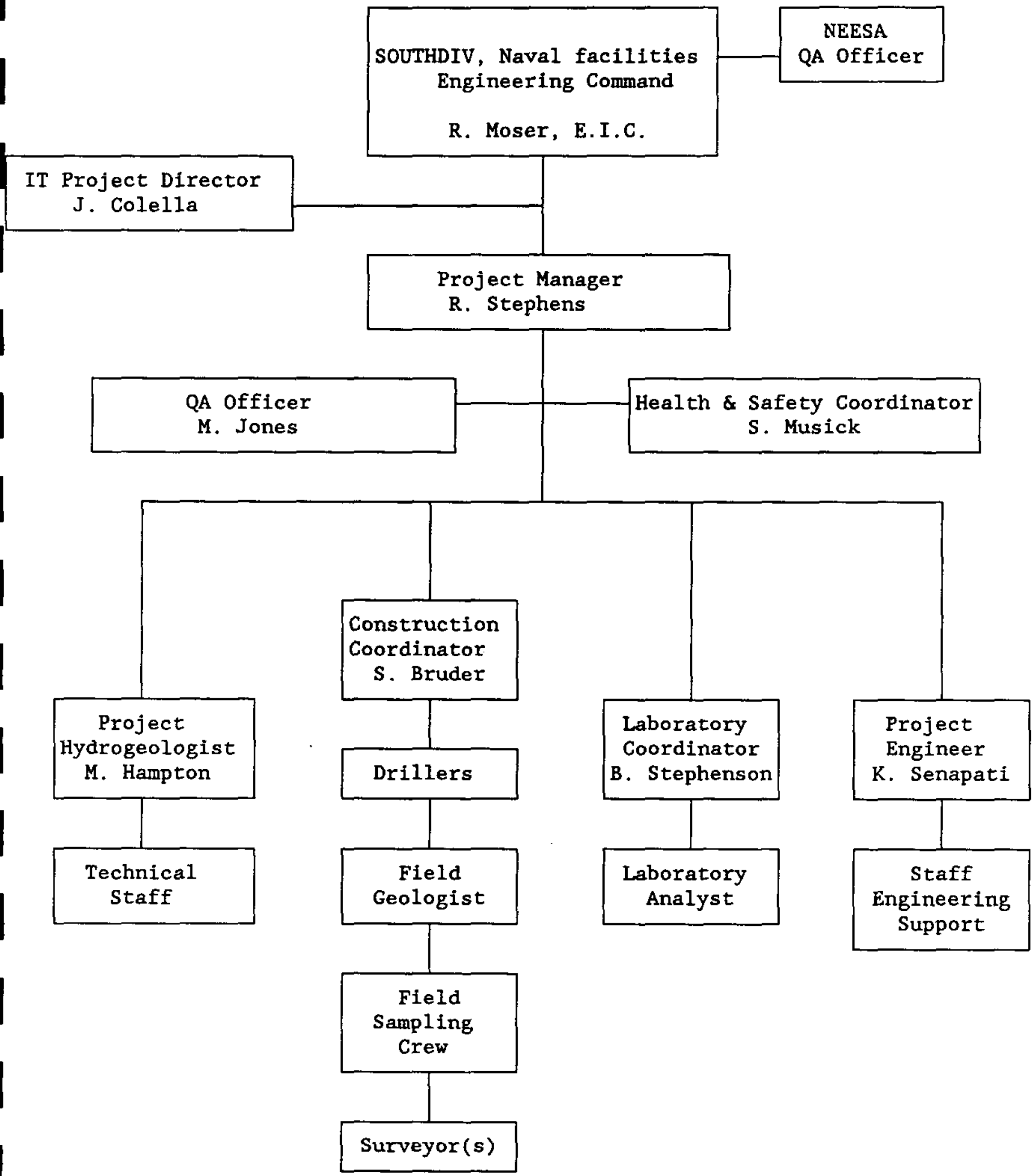
INVESTIGATION & SAMPLING LOCATIONS
TRUMBO POINT ANNEX
FUEL FARM AND PIERS
SITE 9

NAS KEY WEST
KEY WEST, FLORIDA

INTERNATIONAL TECHNOLOGY CORPORATION

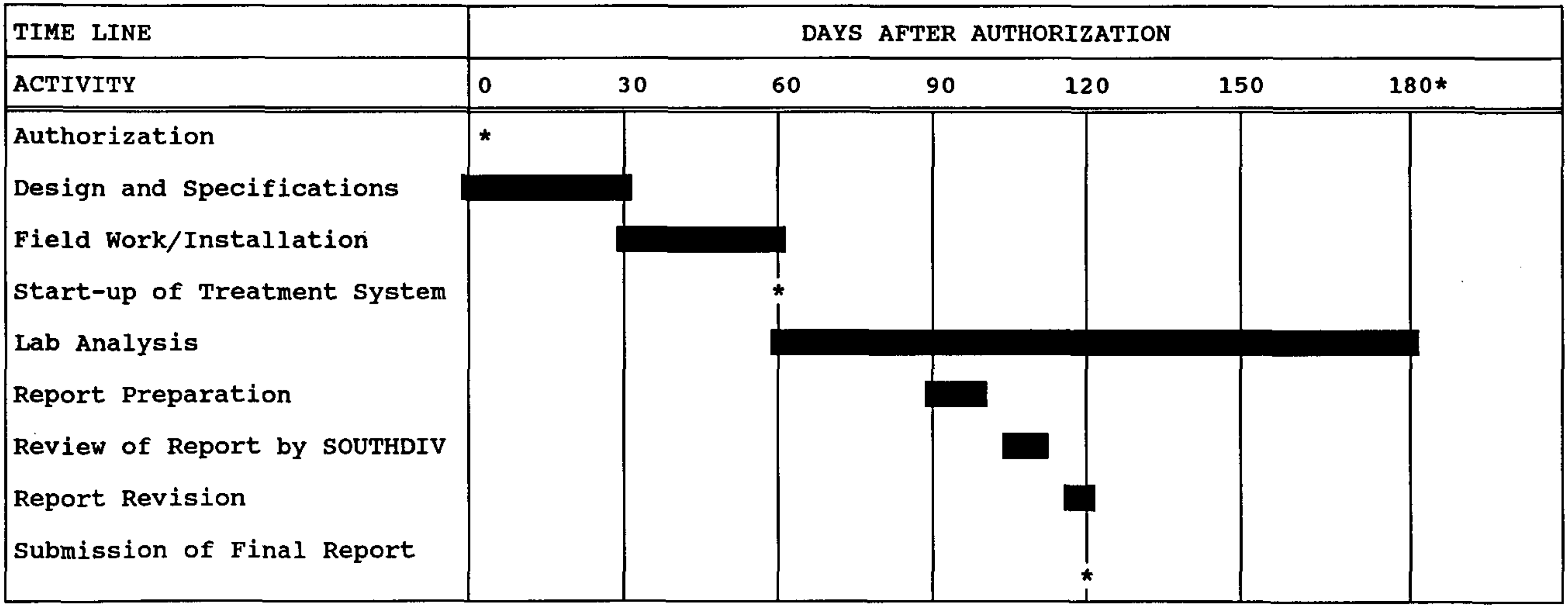
BRUNING 72425

FIGURE 2-1
PROJECT ORGANIZATION CHART
TREATABILITY STUDY IMPLEMENTATION PLAN
NAS-KEY WEST
KEY WEST, FLORIDA



FINAL DRAFT - NOT FOR PUBLIC RELEASE

FIGURE 2-2
PROPOSED PROJECT SCHEDULE
TREATABILITY STUDY IMPLEMENTATION PLAN
NAS-KEY WEST
KEY WEST, FLORIDA



* The life of the project is estimated to be 180 days but may require extension depending on the performance of the system.

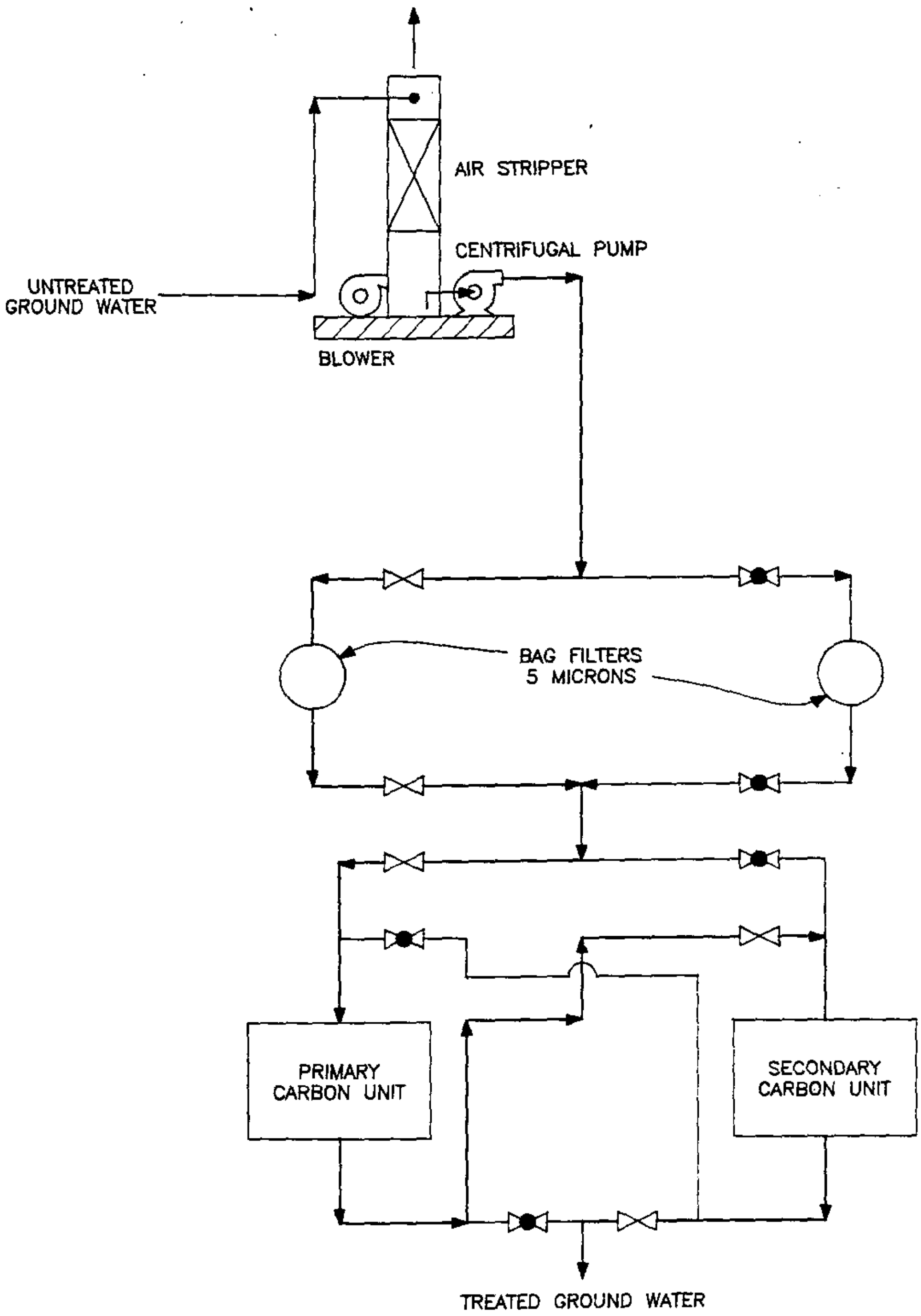


FIGURE 2-3

PROPOSED SKID MOUNTED
GROUND WATER TREATMENT SYSTEM
FLOW DIAGRAM

NAS KEY WEST
KEY WEST, FLORIDA

INTERNATIONAL TECHNOLOGY CORPORATION

LEGEND:

VALVE OPEN

VALVE CLOSED

DWG. NO.: 453005-A-20 | PROJ. NO.: 453005
INITIATOR: | PROJ. MGR.:
DRAFT. CHCK. BY: | ENGR. CHCK BY:
DATE LAST REV.: | DRAWN BY:
STARTING DATE: 10/17/89 | DRAWN BY: D. HIGGS

ACAD\GENERAL\KEYWEST1

APPENDIX A

PILOT STUDY WORK PLAN FOR REMEDIATING LIQUID-PHASE HYDROCARBONS SURROUNDING TANK D-4 AT THE TRUMBO POINT FUEL FARM NAVAL AIR STATION KEY WEST, FLORIDA

PILOT STUDY
WORK PLAN FOR REMEDIATING SUBSURFACE LIQUID-PHASE HYDROCARBONS SURROUNDING TANK D-4 AT THE TRUMBO POINT FUEL FARM, NAVAL AIR STATION, KEY WEST, FLORIDA

Prepared for

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

Contract No. N62467-87-C-0026
Amendment No. 2

G&M Project No. TFO290KW04

September 1988

Prepared by

GERAGHTY & MILLER, INC.
Ground-Water Consultants
3820 Northdale Boulevard, Suite 200B
Tampa, Florida 33624

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FIGURES

TABLES

INTRODUCTION

Since October 1985, Geraghty & Miller, Inc., (G&M) has provided architect/engineering services which includes hydrogeologic consulting investigations for the Naval Facilities Engineering Command, Southern Division, (Navy) at the Naval Air Station (NAS) in Key West, Florida (Figure 1). This work has been conducted in connection with the Naval Installation Restoration Program (NIRP) which is designed to identify, investigate, and remediate sites where past use or disposal of hazardous-substances occurred on Naval and related facilities.

In April 1988, the Navy contracted G&M to prepare the following Pilot Study work plan. The goal of the work plan is to test and evaluate a method for remediating subsurface liquid-phase and dissolved hydrocarbon contamination at the Trumbo Point Annex Fuel Farm at the NAS in the vicinity of tank D-4 (Figure 2). Prior to preparing the work plan, several remedial alternatives were screened resulting in the selection of one alternative for evaluation during a pilot study. This information was then used to prepare the work plan which describes the selected remedial alternative and outlines how the pilot study will be performed. The preparation of the work plan is the first of four phases of work to be performed, ultimately leading to remediation of hydrocarbon contamination in this area. The subsequent three phases include a Phase II-Pilot Study, Phase III-Feasibility Study, and Phase IV-Remedial Action. The information gained during Phase II will be used to perform Phases III and IV.

The following document discusses the background conditions at the site, the screening and preliminary selection of a remedial alternative, and presents a work plan for performing a pilot study.

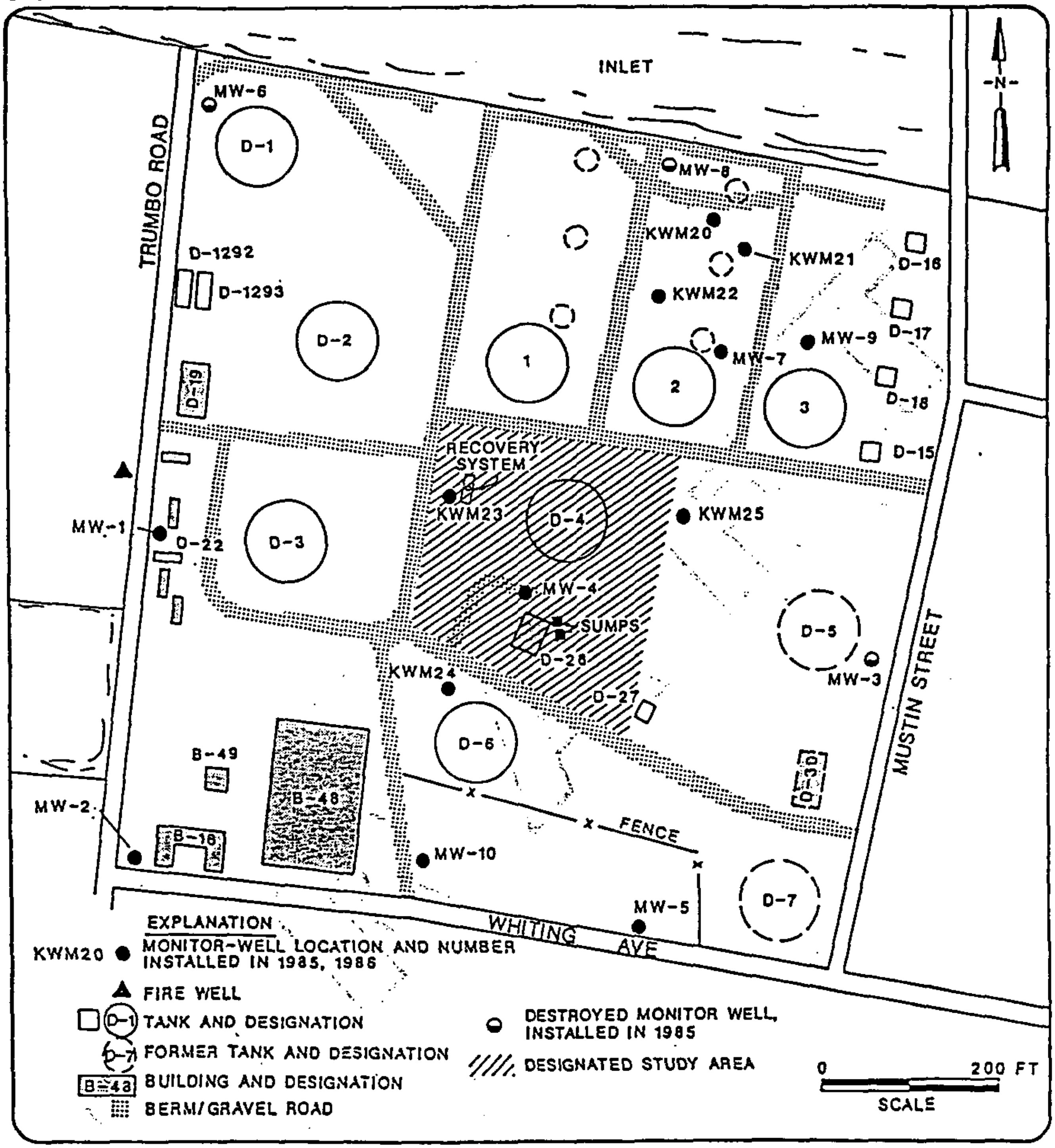
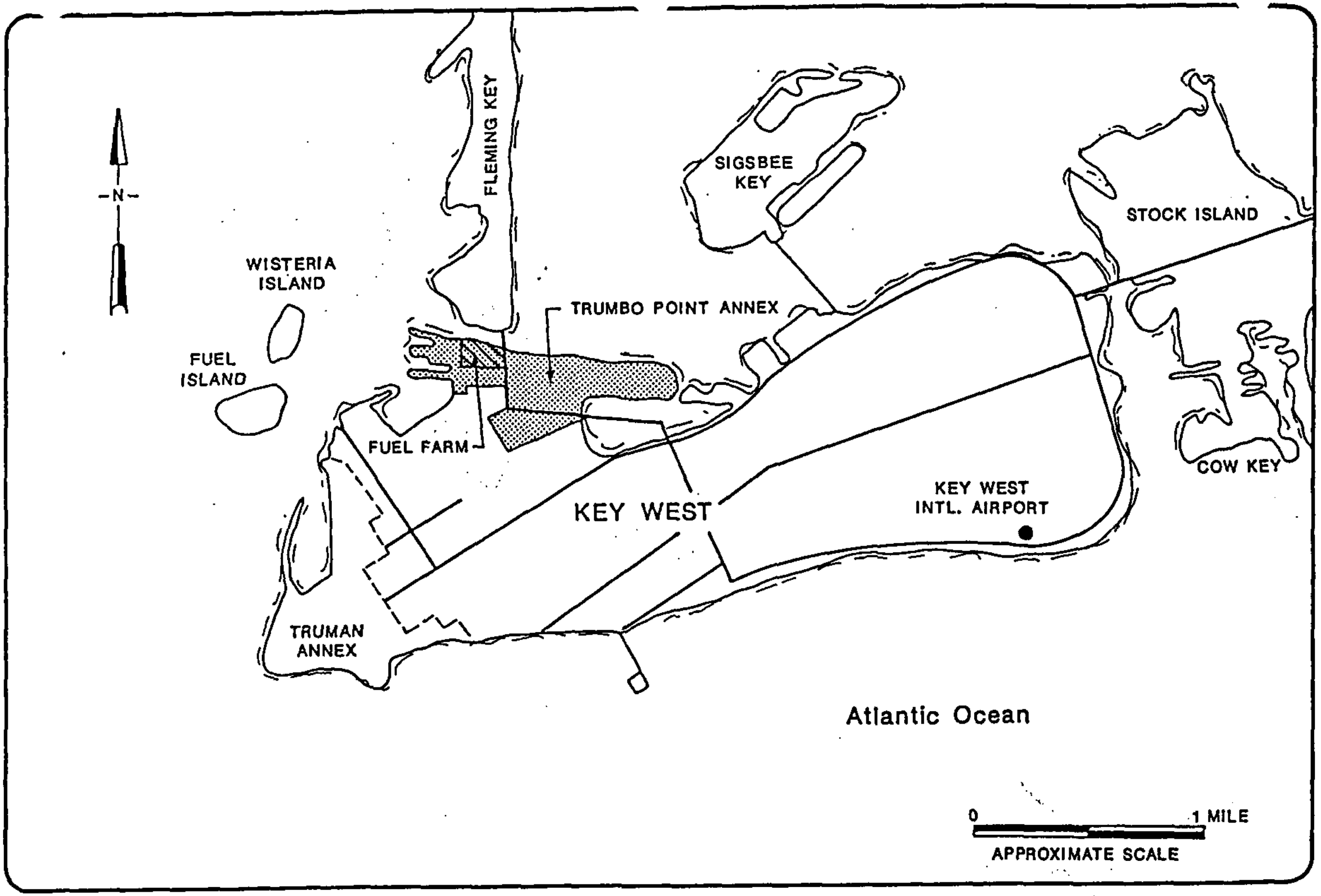


Figure 2.

Location of Tank D-4 and Recovery System at Trumbo Point Fuel Farm.

CLIENT NAME:

Department of the Navy
Naval Air Station
Key West, Florida



Geraghty & Miller, Inc.

Figure 1.

Location of Trumbo Point Fuel Farm, Naval Air Station, Key West, Florida.

CLIENT NAME:

Department of the Navy
Naval Air Station
Key West, Florida

BACKGROUND

The Trumbo Point Annex is located on the north side of Key West. According to Navy personnel, in 1918 the Annex was originally constructed of dredged materials for use as a seaplane base. The fuel farm, located on the north side of the Annex (Figure 1), has been used as a distribution and storage facility for various types of fuels since 1942. Until about 1985, the fuel farm consisted of 28 tanks; however, at present, 15 tanks are still intact. Four of the tanks, including tank D-4 are not presently in use (Figure 2).

G&M has previously performed three hydrogeologic investigations at the fuel farm. The results of the first investigation were presented in a report entitled "Subsurface Hydrocarbon Investigation at Trumbo Point Annex, NAS-Key West, Florida, June 1985." This report indicated that in 1981 a loss of diesel fuel occurred from a corroded pipe between tank D-4 and the D-26 pumphouse (Figure 2). As part of the overall investigation of this area, a monitor well (MW-4) was installed between these two structures. Daily water-level measurements collected in this well between April 23 and 26, 1985 (see Table 1), showed that liquid-phase hydrocarbon thicknesses ranged from 0.03 to 1.39 feet (ft).

The second investigation conducted at the NAS that included this area was the "Verification Study, Assessment of Potential Ground-Water Pollution at the Naval Air Station, Key West, Florida, March 1987." As part of this investigation, additional wells, KWM23 and KWM25, were installed at the locations shown in Figure 2. The results of data collected during this study indicated that no liquid-phase hydrocarbons were present in well KWM25. On July 9, July 10, and August 4, 1986, thicknesses of liquid-phase hydrocarbon in KWM23 were 2.66, 2.96, and 5.80 ft, respectively. In well

Table 1. Thickness of Liquid-Phase Hydrocarbon in Monitor Wells MW-4, KWM23, and KWM25

	Liquid-Phase Hydrocarbon Thickness (ft)[1/]		
Date	MW-4	KWM23	KWM25
4-23-85	0.03		
4-24-85	0.75		
4-25-85	1.39		
4-26-85	0.66		
7-9-86	--[2/]	2.66	0[3/]
7-10-86	0.16	2.96	0
8-4-86	0.48	5.80	0
4-15-88	0	7.71	0

1/ ft = feet

2/ -- = no measurement taken

3/ no liquid-phase hydrocarbon present

Note: KWM23 and KWM25 were installed in 1986.

675/20

MW-4, 0.16 and 0.48 ft of liquid-phase hydrocarbon was measured on July 10, and August 4, 1986, respectively. No measurements were made in well MW-4 on July 9, 1986 (Table 1).

In March 1988, the Navy contracted G&M to perform an investigation entitled "Draft Preliminary Site Investigation Report and Expanded Site Investigation/Remedial Field Investigation Work Plan, Trumbo Point Fuel Farm and Piers D-1 and D-3, Naval Air Station, Key West, Florida." As requested by the Navy, this study did not include the area around tank D-4. However, when the field portion of this study was performed on April 13, 1988, water-level and liquid-phase hydrocarbon measurements were collected from well MW-4, KWM23, and KWM25 so that a complete data base could be obtained. These data (Table 1) indicated that liquid-phase hydrocarbon was not present in wells MW-4 and KWM25. However, 7.71 ft of liquid-phase hydrocarbon was detected in well KWM23 and between 0.01 and 0.25 ft of liquid-phase hydrocarbon was found in two sumps adjacent to building D-26 (see Figure 2). Additionally, a strong fuel odor was noted when the inside of this building (D-26) was inspected, and the floor had been stained by what appeared to be fuel.

The information acquired during these previous investigations indicates that liquid-phase hydrocarbon has been detected in monitor wells in the vicinity of tank D-4 since April of 1985. This information also suggests that the hydrocarbon plume has changed in either location, extent or thickness, and presently the areal extent of the plume is not certain. However, in April 1988, to begin remediation of this plume, the Navy requested G&M to prepare the following work plan that describes a pilot study to evaluate recovery of dissolved and liquid-phase hydrocarbon contamination. The work plan also includes a discussion of the preliminary selection of the remedial technology to be evaluated during the pilot study.

PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

Prior to preparing the Pilot Study work plan, G&M screened several remedial alternatives for ground water and liquid-phase hydrocarbon recovery for site-specific conditions in order to select the preferred method to be evaluated during the pilot study. Given the site-specific information available, it was necessary to make assumptions about the local hydrogeology based on information acquired during the previously discussed investigations. These assumptions, which were considered during the preliminary evaluation of a remedial alternative, are listed below.

- Lithologic data collected during installation of wells MW-4 (G&M, 1985), KWM23, and KWM25 (G&M, 1987) were compared to published literature (Davis and DeWeist, 1966) to acquire an estimate of the hydraulic conductivity of soils in the study area. This comparison indicates that these soils probably have a relatively low hydraulic conductivity (10^{-6} to 10^{-3} cm/sec). No in-situ aquifer testing to determine actual hydraulic conductivity values of the soils at the site has been performed. LARGE RANGE

- Water-table elevations are affected by tidal fluctuations in the surrounding marine surface-water bodies (G&M, 1987). As a result, the predominant direction of ground-water flow has not been ascertained because continuous water-level monitoring has not yet been performed to evaluate the effects of tides on the water table.

Considering these assumptions, an appropriate remedial alternative was selected for evaluation during the Pilot Study. The first step in selection was to compile a list of collection systems that would be appropriate to the known hydrogeologic conditions at the site, and then to choose a complementary fluid-handling system. After the remedial alternative was selected, a pilot study work plan was developed for the preferred alternative.

Collection Systems

The use of recovery wells, infiltration galleries, or a combination of both was considered for collection of liquid-phase hydrocarbon and ground water (see Table 2). Because of the low hydraulic conductivity of the soils comprising the shallow aquifer, the anticipated yields from these types of collection systems will be relatively low. However, if properly located, these collection systems should be able to recover ground water and liquid-phase hydrocarbon.

Recovery wells could be utilized to capture ground water and/or liquid-phase hydrocarbon and are generally easily installed at a relatively low cost. However, the areal influence of one recovery well would be limited due to the low transmissivity of the aquifer at the site, thereby requiring a multiple well system.

An infiltration gallery would consist of a trench backfilled with pea gravel. The gallery would convey ground water and/or liquid-phase hydrocarbon to a common collection point (sump) creating a continuous hydraulic zone of influence, similar to a line of closely spaced recovery wells. Although infiltration galleries are generally more expensive to install, experience has shown that periodic redevelopment of recovery wells is usually required to maintain efficient yields, thereby resulting in higher long-term O&M costs. Therefore, because of the shallow depth of and tidal influence on the water-table surface, and low hydraulic conductivity of the aquifer, infiltration galleries would be generally more cost effective to operate and

Table 2. Comparison of Collection Systems

Collection System	Effectiveness	Implementability	Cost
Recovery Wells	o Due to low permeability of soils, zone of influence of each well might be small. o Large number of wells would be required to effectively capture floating layer.	o Easily Installed.	o Low Capital o Moderate O&M
Infiltration Gallery	o Creates a continuous zone of influence. o Requires minimal maintenance.	o Underground piping may pose location and/or construction difficulties.	o Moderate to High Capital o Low O&M
Infiltration Gallery/ Recovery Wells	o Would utilize infiltration gallery in large areas requiring remediation.	o Site characteristics will dictate which system gets implemented in various areas.	o Moderate to High Capital o Low O&M

maintain than recovery wells. As in the case with any infiltration gallery, a collection sump is needed to pump the liquid-phase hydrocarbon and/or dissolved hydrocarbon from the subsurface. For the above-stated reasons, the use of an infiltration gallery to intercept and collect ground water and/or liquid-phase hydrocarbon appears to be the most favorable alternative.

Fluid Handling Systems

Four fluid handling systems for hydrocarbon recovery were evaluated (see Table 3) including: (1) Auto Skimmer(s)™ for removing liquid-phase hydrocarbon, (2) Scavenger® pump for removing liquid-phase hydrocarbon, (3) a two-pump system consisting of a liquid-phase hydrocarbon recovery pump (Probe-Scavenger®) and a water-table depression pump, and (4) a total-fluid system which collects both liquid-phase hydrocarbon and ground water.

The Auto Skimmer™ is capable of recovering liquid-phase hydrocarbon from wells as small as two inches in diameter using a bailer-type mechanism and can work without, or in conjunction with, a water-table depression pump. The skimmer can be set to recover small liquid-phase hydrocarbon thicknesses from the top of the water table and can be installed below grade, if desired. A fluid handling system utilizing the Auto Skimmer™ without the use of a water table depression pump would require a large number of recovery wells to be effective. Auto Skimmers™ can be difficult to install, generally need frequent maintenance to be effective, and G&M's previous on-site applications with similar devices have not been always successful. For these reasons, the Auto Skimmer™ is not considered appropriate for conditions at the site.

Table 3. Fluid Handling Systems

Fluid Handling System	Effectiveness	Implementability
Auto Skimmer(s)™	o Can skim small product thicknesses. o Generally requires frequent operator attention.	o Easily implemented in wells as small as 2 inches.
Scavenger®	o Generaly requires minimal operator attention. o Can skim small product thicknesses. o Effectively recovers up to 5 gallons per minute.	o Requires large-diameter (24 inches) recovery well.
Probe-Scavenger®	o Generally requires frequent attention. o Requires approximately 1 inch of product before it initiates recovery. o Effectively recovers up to 35 gallons per minute.	o Requires 8 to 12-inch-diameter recovery wells.
Pneumatic	o Generally requires frequent operator attention. o Effectively recovers ground water and/or product from low yielding wells.	o Requires an oil-water separator. o Requires an air compressor.

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The Scavenger^R pump is used for recovering liquid-phase hydrocarbon and operates by floating on top of the liquid-phase hydrocarbon layer. It is essentially an in-situ oil/water separator which collects liquid-phase hydrocarbon by utilizing a membrane which repels water while allowing liquid-phase hydrocarbon to pass through for discharge to an above-ground storage tank. Unlike other pumps, the Scavenger^R floats on the liquid-phase hydrocarbon layer so that no adjustments in pump level would be necessary as the water table fluctuates in response to tidal action or rainfall events. The Scavenger^R system requires a large-diameter recovery well (at least 24 inches in diameter) to act as a collection sump and is capable of removing liquid-phase hydrocarbon thicknesses as small as 0.01 feet (ft) from the water table. It is designed to recover liquid-phase hydrocarbon at a rate of up to 5 gallons per minute (gpm). Since this type of pump eliminates the need for an above-ground oil/water separator and can be used only to recover liquid-phase hydrocarbon or in conjunction with a water-table depression pump to recover ground water, it will be considered for use at the site.

The Probe-Scavenger^R system also utilizes a membrane to separate liquid-phase hydrocarbon and water. However, the unit utilizes a submersible rather than floating pump to recover the liquid-phase hydrocarbon for discharge to an above-ground storage tank. This system is capable of recovering liquid-phase hydrocarbon at up to 35 gallons per minute (gpm) and can be installed in wells as small as 8 inches in diameter although, generally 12-inch-diameter wells are utilized. This system is less sensitive to liquid-phase hydrocarbon thicknesses than the Scavenger^R pump, and it requires about 0.08 ft (one inch) of liquid-phase hydrocarbon thickness before it initiates recovery. If it is assumed that the soils at the site have a low hydraulic conductivity, then it would seem unlikely that liquid-phase hydrocarbon could be recovered from the soils at yields high enough to operate a Probe-Scavenger[R] system. Therefore, a Probe-Scavenger[R] system is not considered appropriate for conditions at the site.

Total fluid handling systems are pneumatic systems designed to collect both liquid-phase hydrocarbon and ground water from a recovery well for discharge to an oil/water separator. This system utilizes compressed air to convey the fluids and can be installed in a recovery well as small as two inches in diameter (four-inch-diameter wells are recommended). Remote control panels, up to 200 feet away from the well, can be used to operate a multiple well system, if required. The system can be modified to use a ballasted float to pump only liquid-phase hydrocarbon from the well. Total fluid handling systems may be desirable if the yields from a well are small; however, they generaly require more operator attention than the other pump systems.

Each of the four liquid-phase hydrocarbon recovery systems discussed above are capable of operating in conjunction with a water-table depression pump. This pump withdraws ground water from beneath the liquid-phase hydrocarbon/ground-water interface so that a cone of depression is formed in the water table causing floating liquid-phase hydrocarbon to move towards the recovery well and/or infiltration gallery. Generally, the water-table depression pump is designed to maintain a predetermined drawdown in the recovery well and probes are commercially available which will automatically shut the pump off if liquid-phase hydrocarbon approach the pump intake.

SELECTION OF REMEDIAL ALTERNATIVES

Due to the assumed hydraulic conductivity of the soils and tidal influence on the water table at the site, an infiltration gallery with a Scavenger[R] pump and water-table depression pump installed at the collection point (recovery well) is recommended for evaluation during the pilot study. Because of the unknown stability of the soils, it is recommended that an inert material be placed in the trench to serve as a filter and stabilizer material.

Upon conducting a pilot test using this system, the findings will be used to design a full-scale liquid-phase and dissolved hydrocarbon collection system. The engineering plans and construction specifications will be prepared during Phase III and implemented during Phase IV.

PILOT SCALE STUDY

To assist in the design of a full-scale system, a pilot study is needed to provide design parameters including the zone of influence of an infiltration gallery and its anticipated liquid-phase hydrocarbon recovery rate. This information is critical to evaluate a liquid-phase hydrocarbon and/or ground-water recovery system. Also, because tidal influences might cause the thickness and elevation of the liquid-phase hydrocarbon layer and the direction of ground-water flow to fluctuate, the effect on the depth and location of the liquid-phase hydrocarbon layer should be better defined.

It is proposed that an infiltration gallery connected to a collection/recovery well will be installed for recovery of liquid-phase hydrocarbon and/or ground water at the site. A trench will be excavated laterally from the collection/recovery well to form the infiltration gallery. The trench will be excavated to a depth of approximately eight to ten feet, a width of about five feet and extend ten feet on either side from the collection/recovery well. The infiltration gallery will be constructed similar to that shown in Figures 3 and 4 and at the location proposed in Figure 2. The length has been selected so that the hydraulic zone of influence of the gallery can be evaluated separately from the zone of influence of the collection/recovery well. The width and depth of the infiltration gallery has been selected as the minimum that will effectively recover liquid-phase hydrocarbon and ground water using G&M's previous experience with these systems. The exact dimensions of the trench will be dictated by field conditions during construction. The angle of repose (the maximum slope or angle at which a soil remains stable) may require that a trench box or sheet pile is required to construct the gallery. The inner core (three feet) of the infiltration gallery will be constructed of pea

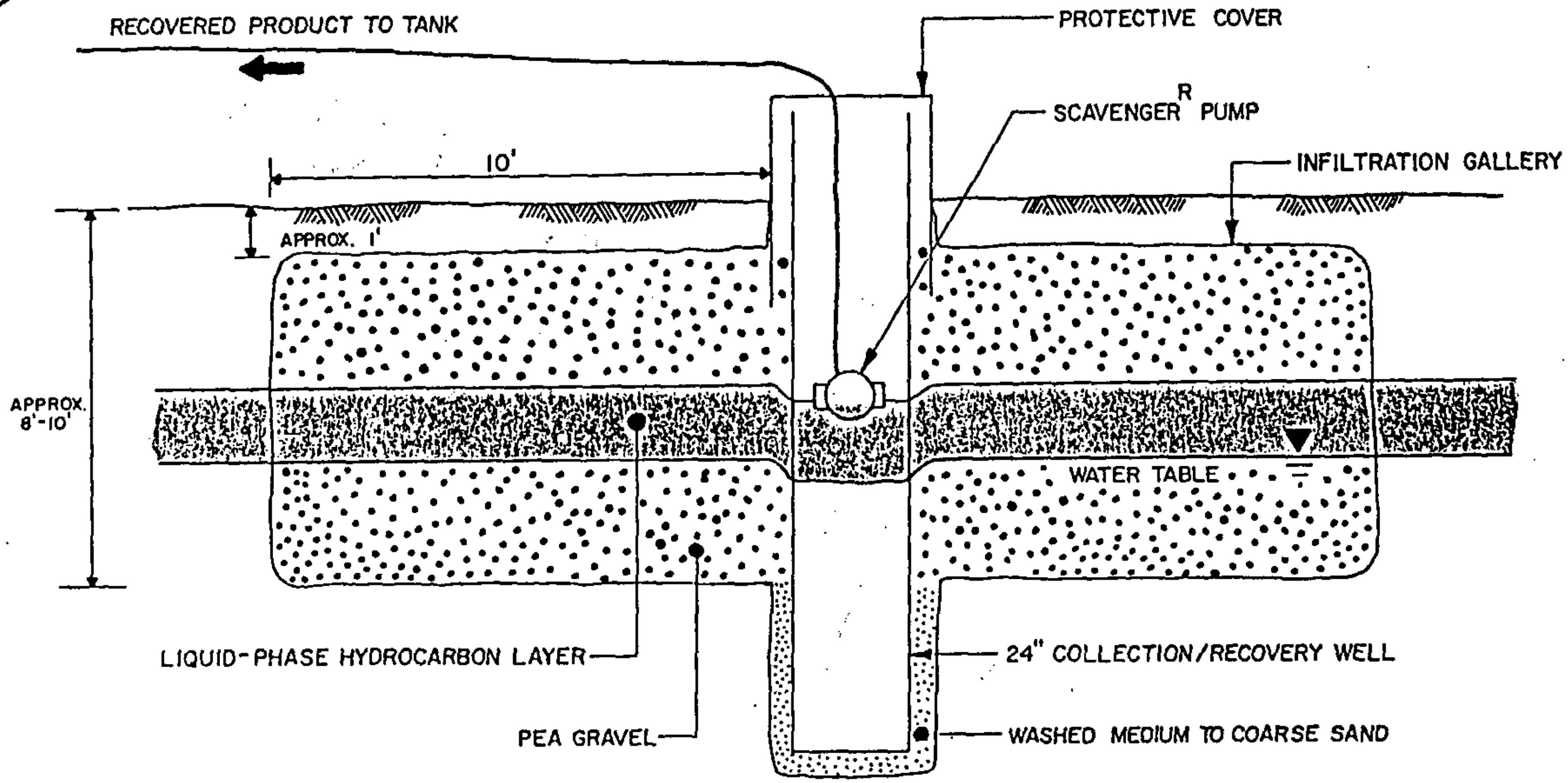

FIGURE 3

CONCEPTUAL DESIGN OF INFILTRATION GALLERY

DEPARTMENT OF THE NAVY

NAVAL AIR STATION

KEY WEST, FLORIDA

GMCE

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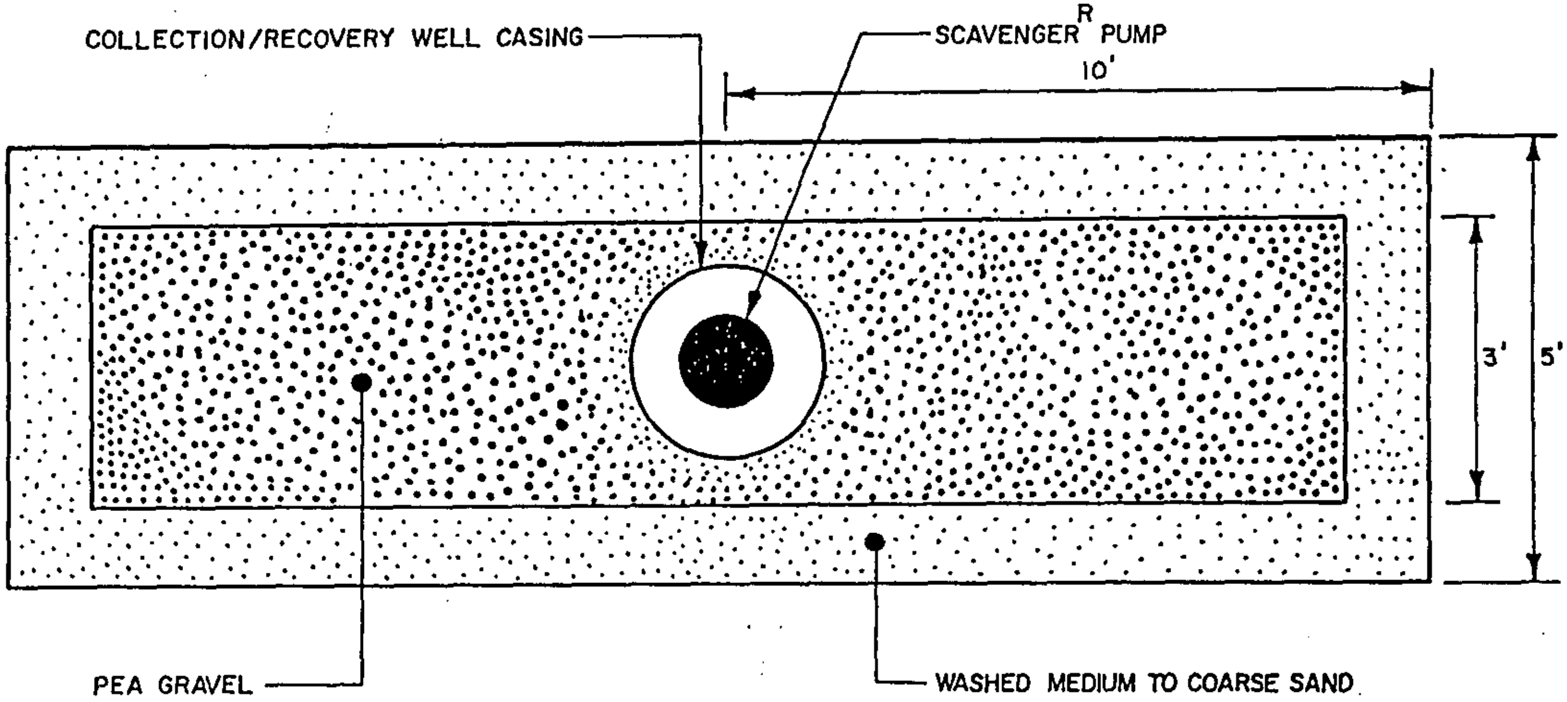
DRAWN BY: Ken Carey	DATE: 8-8-88
CHECKED: GJR	DATE: 8/8/88
APPROVED: [illegible]	DATE: 8/29/88



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DRAWN BY: Ken Carroll	DATE: 8-8-88
CHECKED: GJR	DATE: 8/8/88
APPROVED: GJG	DATE: 8/29/88

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FIGURE 4

PLAN VIEW OF CONCEPTUAL INFILTRATION GALLERY

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
KEY WEST, FLORIDA

gravel (approximately 18 cubic yards) while the outer edges (12 inches on each side) will be composed of washed medium to coarse-grained sand (approximately 12 cubic yards). The sand will minimize the infiltration of fine soil, which may clog the system, but will allow the liquid-phase hydrocarbon and contaminated ground water to flow freely into the gallery and recovery well. If dewatering is necessary for construction of the infiltration gallery, the ground water will be pumped into a tanker truck, tested for EP Toxicity metals and volatile organics (U.S. Environmental Protection Agency [EPA] Methods 601, 602, and 625), and properly disposed. Soil produced during construction will be placed in 55-gallon drums, analyzed for EP Toxicity metals and volatiles (EPA Methods 8010, 8020, and 8250), then properly disposed of by Navy personnel.

The collection/recovery well will serve as a sump for liquid-phase hydrocarbon that accumulates in the infiltration gallery. The well will be constructed of 24-inch-diameter, 12-ft long perforated galvanized steel culvert pipe capped at the bottom. The diameter of the well was chosen to facilitate the installation and operation of a Scavenger[R] pump. The well will be installed to a depth of approximately 12 feet by the mud-rotary method of drilling. Initially, the collection/recovery well will be utilized to recover liquid-phase hydrocarbon. Eventually, it will be utilized to perform a pumping test and will be incorporated into the full-scale system to recover contaminated ground water.

After the system has been constructed, the collection/recovery well will be outfitted with the Scavenger[R] pump. The recovered liquid-phase hydrocarbon will be pumped into an above-ground tank. At this time, it is anticipated that a 5,000-gallon tank will be necessary to store the recovered liquid-phase hydrocarbon. The exact location of the tank will be determined during the preparation of plans and specifications. The recovery system will be provided with an automatic shut-off mechanism to prevent tank overflows. Disposal of the recovered liquid-phase hydrocarbons will be performed by the Navy.

About four 2-inch-diameter PVC observation wells (2 feet of blank casing with 10-feet of 0.01-inch slot screen) will be installed using the hollow-stem auger method to a depth of about 12 feet in the vicinity of the infiltration gallery. The thickness of liquid-phase hydrocarbon in the observation wells will be monitored to determine if it could be effectively recovered without water-table depression achieved by concurrent pumping of the ground water. Additionally, these wells will be monitored to evaluate recovery of the liquid-phase hydrocarbon and to determine the zone of influence from recovery operations.

SYSTEM OPERATION AND MAINTENANCE

After initial recovery system start-up and operation, G&M or an independent contractor will check the system once per week to evaluate and monitor the performance of the system. During each visit, ground-water level and liquid-phase hydrocarbon thickness measurements will be obtained from the observation wells and from the collection/ recovery well. This information will be used to evaluate the effectiveness of the recovery system. In addition, the operation of the recovery system will be monitored and any problems or equipment failures will be corrected. The amount of liquid-phase hydrocarbon that has been recovered in the storage tank will be monitored and, if requested by the Navy, arrangements for disposal will be coordinated.

After most of the liquid-phase hydrocarbon has been recovered or after a period of three months (which ever occurs first), a submersible ground-water pump will be installed in the recovery well and a pumping test will be performed to determine the zone of influence (drawdown) due to pumping. At this point, a method for long-term disposal of the contaminated ground water will be proposed. In some instances, this water must be treated to reduce contaminant concentrations in order to receive permission to discharge. In addition, available points for sewage hook-up or other treatment and disposal options will be evaluated and discussed with the Navy. Prior to designing this treatment system or choosing a ground-water recovery pump, additional hydrogeologic data will be necessary. The hydraulic conductivity of the aquifer, ground-water quality, plume size, and plume location will need to be determined for effective final design of the ground-water pumping and treatment system.

SAFETY CONSIDERATIONS

Because of the flammable nature of liquid-phase hydrocarbon, extreme care will be taken when installing the recovery system to minimize the chance of fire or explosion. Underground pipes and electrical lines will be located so that they are not encountered during construction activities. In addition, personnel working in the area during construction will be made aware of these risks and will work in accordance with the Safety Plan and Training Plan prepared for this project by G&M at the request of the Navy.

The equipment used for recovery will be explosion-proof and appropriate for recovering hydrocarbon products. All parts and equipment, including pumps, wiring, and hoses, will be explosion proof and resistant to the effects of hydrocarbons. To further reduce the risk of spark or fire, care will be taken to ensure that wiring is not frayed or damaged during installation or routine maintenance.

SUMMARY

In summary, the following tasks will be performed to ensure the proper execution of this project:

1. Obtain approval of this plan from the State of Florida Department of Environmental Regulation;

2. Prepare construction plans and specifications of the infiltration gallery/pumping system;

3. Solicit contractor bids for plans and specifications;

4. Select a contractor for construction of the recovery system;

5. Commence start-up operations and conduct pilot test;

6. Monitor Pilot Program; and

7. Evaluate test data.

Prior to preparing plans and specifications of this work plan, underground utilities and piping should be located. It would also be helpful if a preliminary assessment of liquid-phase hydrocarbon thickness was performed to identify the areas with the largest amount of liquid-phase hydrocarbons. To minimize cost, this could be performed by digging holes with a post-hole digger in various areas of the site. This way not only will the pilot study be used to obtain data for design of a full scale system, but would also remediate the most contaminated area.

CLOSING COMMENTS

When the draft Pilot Study work plan has been approved by the Navy, it will be finalized and G&M and G&M Consulting Engineers, Inc. (GMCE) staff members will meet with Navy representatives to present the work plan to the Florida Department of Environmental Regulation and/or other appropriate regulatory personnel. Subsequently, a final work plan will be prepared addressing any comments or questions raised at this meeting. During Phase II, construction plans and specifications will be prepared by GMCE outlining the construction of the pilot system prior to the initiation of activities. All documents will be submitted according to Section III - Submittal and Schedules of the Request of Proposal for Amendment Number 2.

REFERENCE

Davis, S.N., and R.J.M. DeWiest, 1966. Hydrogeology. John Wiley and Sons, Inc., New York, NY. 463 pg.

APPENDIX B

SUMMARY OUTLINE
IMPLEMENTATION OF PILOT STUDY WORK PLAN

APPENDIX B
SUMMARY OUTLINE
IMPLEMENTATION OF PILOT STUDY WORK PLAN

I. Logistics

- A. Obtain approval from FDER of work
- B. Site Requirements
    1. Pinpoint a construction staging area
    2. Establish a secure storage area
    3. Locate treatment plant site
    4. Locate 5,000 gallon storage tank
    5. Locate drum soil storage site
    6. Locate field trailer site

II. Design and Specifications

- A. Equipment - IT to supply the following items:
    1. Treatment System
        - a. Air Stripper and accessories (skid mounted)
        - b. Two units - carbon adsorption column (skid mounted)
        - c. Concrete for skid
        - d. Dual pump system (Petropurge and Hydropurge)
        - e. Electrical
            - (1) Transformer(s)
            - (2) Power Cable
            - (3) Meter
            - (4) Main Switch Box
            - (5) PVC conduit
    2. Storage Units
        - a. Product tank 5,000 gallons
        - b. PVC liner
        - c. Vacuum tanker truck for dewatering
    3. Piping
        - a. PVC piping from sump to treatment plant and treatment plant to ditch
            - (1) Piping
            - (2) Valves
            - (3) Miscellaneous items, i.e., elbows, glue, etc.

4. Field site trailer - for: office, first aid, and storage

   a. Miscellaneous site tools and supplies

      (1) Hand tools

         (a) Screw Drivers
         (b) Pliers
         (c) Sockets
         (d) Drills and bits
         (e) Extensions cords
         (f) Tool box
         (g) Miscellaneous

      (2) Backup supplies

         (a) PVC pipe
         (b) Pump parts
         (c) Electrical

            i) Wire
            ii) Tape

III. Mobilization Phase - to NAS Key West Site

A. Equipment/materials

1. Treatment system
2. Product tank
3. PVC piping
4. Field site trailer
5. Electrical materials
6. Vacuum tanker truck
7. PVC liner
8. Miscellaneous site tools and supplies

B. Personnel

1. Excavation contractor
2. IT personnel

IV. Construction Phase

A. Site trailer - for: office, first aid room, lunch room, and change house

1. Move trailer onto site
2. Hookup power to trailer
3. Hookup telephone to trailer
4. Hookup water supply to trailer

5. Install air conditioning unit to trailer

B. Treatment unit

1. Concrete pad

    a. Install carbon adsorption unit

2. Hookup electrical

    a. Power meter
    b. Transformer to commercial power source
    c. Main switch box
    d. From transformer to treatment plant and treatment plant to ditch

        (1) Piping
        (2) Valves
        (3) Miscellaneous items

C. Infiltration gallery

1. Construct trench

    a. Begin excavation
    b. Install trench box
    c. Install collection sump
    d. Install sand pack
    e. Install pea gravel to one foot below grade
    f. Install dewatering wells (if necessary)

        (1) Hookup to power
        (2) Hookup PVC line to vacuum tanker truck

D. Install observation wells

1. Move drill rig over well site
2. Auger to required 12' depth
3. Install 2" diameter PVC casing and 0.01 inch slotted well screen
4. Install sand pack
5. Install bentonite plug
6. Grout hole to surface

E. Locate Product Tank

1. Dig out and form tank foundation
2. Compact tank foundation
3. Install tank

V. Operation

A. Sampling and Analysis

1. Treated effluent
2. Soil
3. Vacuum tanker water

B. Performance Criteria

1. Check system once per week

   a. Ground water level measurements
   b. Hydrocarbon thickness measurements

2. Reporting progress
3. Perform pumping test and treat test water
4. Disposal options for soils

   a. Evaluate
   b. Discuss options with the Navy

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This work plan describes procedures to implement the pilot study work plan developed previously. The work plan when implemented will provide data for sizing full scale remediation treatment system.

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