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REMEDIAL ACTION PLAN BERTHING WHARF BUILDING 189 TRUMAN ANNEX NAS KEY WEST FL

8/1/1994

ABB ENVIRONMENTAL SERVICES INC

0035

REMEDIAL ACTION PLAN
BERTHING WHARF
BUILDING 189, TRUMAN ANNEX

NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA

UNIT IDENTIFICATION CODE (UIC): N00213
NAVY CLEAN - DISTRICT I
CONTRACT NO. N62467-89-D-0317

AUGUST 1994

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
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REMEDIAL ACTION PLAN

BERTHING WHARF
BUILDING 189, TRUMAN ANNEX

NAVAL AIR STATION KEY WEST
KEY WEST, FLORIDA

Unit Identification Code (UIC): N00213

Contract No. N62467-89-D-0317

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August 1994

FOREWORD

Subtitle I of the Hazardous and Solid Waste Amendments (HSWA) of 1984 to the Solid Waste Disposal Act (SWDA) of 1965 established a national regulatory program for managing underground storage tanks (USTs) containing hazardous materials, especially petroleum products. Hazardous wastes stored in USTs were already regulated under the Resource Conservation and Recovery Act (RCRA) of 1976. Subtitle I requires that the U.S. Environmental Protection Agency (USEPA) promulgate UST regulations. The program was designed to be administered by individual States, who were allowed to develop more stringent, but not less stringent standards. Local governments were permitted to establish regulatory programs and standards that are more stringent, but not less stringent than either State or Federal regulations. The USEPA UST regulations are found in the Code of Federal Regulations, Title 40, Part 280 (40 CFR 280) (*Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*) and 40 CFR 281 (*Approval of State Underground Storage Tank Programs*). 40 CFR 280 was revised and published on September 23, 1988, and became effective December 22, 1988.

The Navy's UST program policy is to comply with all Federal, State, and local regulations pertaining to USTs. This report was prepared to satisfy the requirements of Chapter 17-770, Florida Administrative Code (FAC) (*State Underground Petroleum Environmental Response*) regulations on petroleum contamination in Florida's environment as a result of spills or leaking tanks or piping.

Questions regarding this report should be addressed to the Commanding Officer, Naval Air Station, Key West, Florida, or to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Code 1849, at 803-743-0528.

EXECUTIVE SUMMARY

Groundwater contamination exceeding regulatory standards has been identified in the area near Building 189 at Naval Air Station (NAS) Key West, Florida. Free product has been observed at the site. The surficial aquifer in the vicinity of NAS Key West is classified according to the criteria specified in Chapter 17-3, Florida Administrative Code, as G-III.

This RAP presents actions necessary for remediation of petroleum contamination at the Building 189 site. The RAP presented herein is designed for implementation at the Building 189 site and, when implemented, will result in a reduction of the level of petroleum-related contamination in the soil and groundwater in accordance with the requirements of Chapter 17-770, Florida Administrative Code (FAC).

A remedial strategy of containment and source abatement is proposed to effectively address petroleum contamination at the site. Source abatement actions will include monitoring and removal of any free product that may be present. A monitoring program is proposed that will allow for measurement of the progress of the remediation and will provide feedback on contaminant plume stability. Containment of the contaminant plume consists of the natural site tidal influence and groundwater gradient reversals, which keep the plume stable, and the bulkhead separation of the turning basin waters from the site groundwater.

ACKNOWLEDGMENTS

In preparing this report, the underground storage tank personnel at ABB Environmental Services, Inc., acknowledge the support, assistance, and cooperation provided by the personnel at Naval Air Station (NAS) Key West and Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM).

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
BTEX	benzene, toluene, ethylbenzene, and xylenes
bls	below land surface
CA	contamination assessment
CAR	Contamination Assessment Report
CARA	CAR Addendum
CFR	Code of Federal Regulations
CFU	Colony Forming Units
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CNO	Chief of Naval Operations
CTO	Contract Task Order
EDB	ethyl dibromide
DFM	diesel fuel marine
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FDER	Florida Department of Environmental Regulation
ft^3	cubic feet
ft/day	feet per day
GC	gas chromatograph
GC/MS	gas chromatography/mass spectroscopy
gpm	gallons per minute
HSWA	Hazardous and Solid Waste Amendments of 1984
I	hydraulic gradient
K	hydraulic conductivity
kg	kilogram
LNAPL	light non-aqueous phase liquid
MG	Motor Generator
mg	milligrams
mg/ℓ	milligrams per liter
msl	mean sea level
µg/ℓ	micrograms per liter
mℓ	milliliter
MOP	Monitoring Only Plan
MTBE	methyl-tert-butyl-ethylene
MW	Monitoring Well
NAS	Naval Air Station
NAVSTA	Naval Station
NFA	No further action
NGVD	National Geodetic Vertical Datum of 1929

GLOSSARY (Continued)

NPDES	National Pollution Discharge Elimination System
NSC	Naval Supply Center
O&M	operation and maintenance
OVA	organic vapor analyzer
PAH	polynuclear aromatic hydrocarbon
ppb	parts per billion
ppm	parts per million
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
SOUTHNAV-FACENGCOM	Southern Division, Naval Facilities Engineering Command
SVOC	semivolatile organic compounds
SWDA	Solid Waste Disposal Act of 1965
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
UIC	uniform identification code
USEPA	U.S. Environmental Protection Agency
UST	underground storage tank
UV	ultraviolet
V	velocity
VOA	volatile organic aromatic
VOCs	volatile organic compounds

1.0 INTRODUCTION

A Contamination Assessment Report (CAR) for Building 189 at Naval Air Station (NAS) Key West, Florida, was submitted by ABB Environmental Services, Inc. (ABB-ES), in February 1992 to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM). A CAR Addendum (CARA) was submitted in November 1993. After approval of the CARA by the Florida Department of Environmental Protection (FDEP) on December 29, 1993, ABB-ES was authorized by SOUTHNAVFACENGCOM to develop a Remedial Action Plan (RAP). This work is being performed under Contract Task Order (CTO) No. 007 of the Comprehensive Long-term Environmental Action, Navy (CLEAN) contract.

1.1 PURPOSE. The purpose of this RAP is to present actions necessary for remediation of petroleum contamination at the Building 189 site. The RAP presented herein is designed for implementation at the Building 189 site and, when implemented, will result in a reduction of the level of petroleum-related contamination in the soil and groundwater in accordance with the requirements of Chapter 17-770, Florida Administrative Code (FAC).

1.2 SCOPE. This RAP presents the rationale for the remedial actions to be implemented at Building 189. Implementation of remedial actions described in this RAP will include the following tasks:

- monitoring of existing wells for free product and manually recovering product as necessary, and
- quarterly groundwater monitoring beginning at the initiation of the product monitoring and recovery program and ending 1 year after the completion of the product monitoring and recovery program.

2.0 BACKGROUND

2.1 SITE DESCRIPTION. NAS Key West is located approximately 150 miles southwest of Miami in Monroe County, Florida (Figure 2-1). NAS Key West is a complex of activities located in numerous areas of the Lower Florida Keys that encompasses approximately 5,000 acres. The majority of these activities are concentrated on Boca Chica Key and Key West. The mission of NAS Key West is to maintain and operate facilities and provide services and materials to support operations of aviation activities and units designated by the Chief of Naval Operations (CNO).

The turning basin, where ships are docked and serviced, is located within the Truman Annex in the western part of the station. Building 189 is located adjacent to the bulkhead along the eastern part of the turning basin. There are three structures at the site: Building 159, Building 189, and Motor Generator (MG) House 3 (Figure 2-2). Buildings 159 and 189 are located near the southern edge of the site. MG House 3 is located in the wharf area on the western part of the site. Much of the area east of the wharf and north of Buildings 159 and 189 is unpaved. East of the site, a fence separates a residential area from the facility. The Berthing Wharf is located along the western margin of the site. The wharf area is approximately 65 feet wide and is paved with concrete. The western edge of the site is the reinforced concrete capped, steel sheet-pile seawall, which is oriented in a north to south direction. The seawall extends to a depth of approximately 53 feet below mean sea level (msl) and forms the eastern side of the turning basin.

2.2 SITE HISTORY. The turning basin was formerly used to dock naval vessels. The present seawall at building 189 is an addition to the original turning basin seawall. A 1,200-foot section of the wharf was extended 30 feet into the turning basin in the late 1980's, at which time the present seawall was added. The seawall is constructed of a single wall of sheet piling, capped with a three-inch thick concrete encasement. The piles were driven to various depths, generally extending to 53 feet below msl. The dredge depth is approximately 33 feet below msl. The original seawall was driven to various depths, generally extending to 23 feet below msl, with a dredged depth of about 13 feet below msl.

During reconstruction of the wharf in 1989, a north to south oriented Bunker C fuel oil pipeline was discovered approximately 25 feet west of Building 189. The pipeline was broken prior to or during the wharf reconstruction activities, resulting in the release of petroleum. An east to west oriented spur of the pipeline was also discovered east of MG House 3 in an area paved with asphalt.

The sections of the pipeline discovered at the site and much of the contaminated soil were removed during wharf reconstruction activities. NAS Key West Public Works Department personnel were unable to provide information regarding where the excavated soil and pipeline materials were transported. The area where the former north to south pipeline was discovered was resurfaced with concrete. The area where the former east to west spur was found is now covered by broken asphalt.

There are existing underground utilities and ship service connections throughout the wharf area. The approximate locations and the distribution density of the known utilities are illustrated in Figure 2-3. These utilities and service connections include fuel and oily waste pipelines, electrical, stormwater, sanitary sewer, potable water, compressed air, and steam lines.

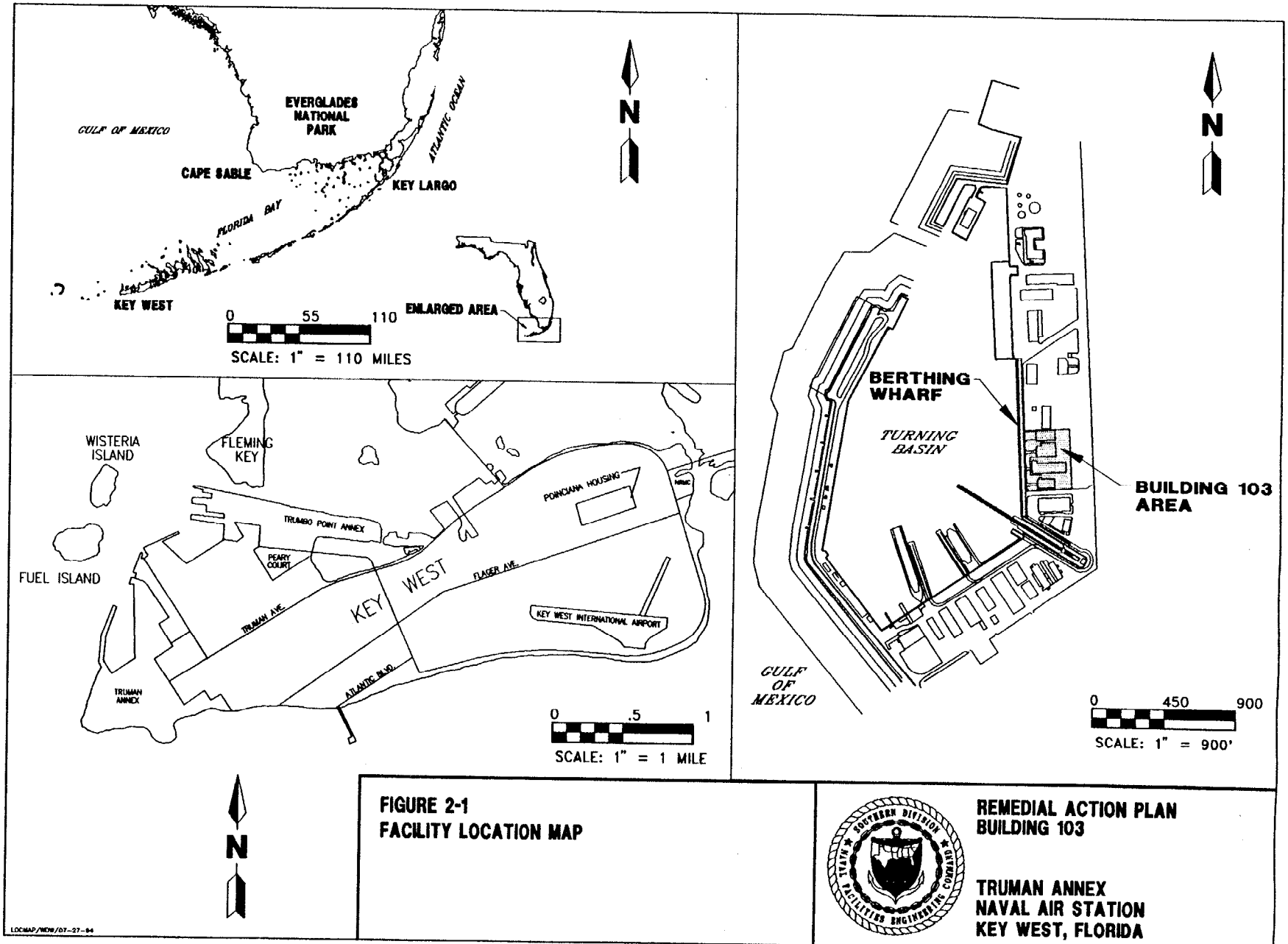


FIGURE 2-1
FACILITY LOCATION MAP

REMEDIAL ACTION PLAN
BUILDING 103

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

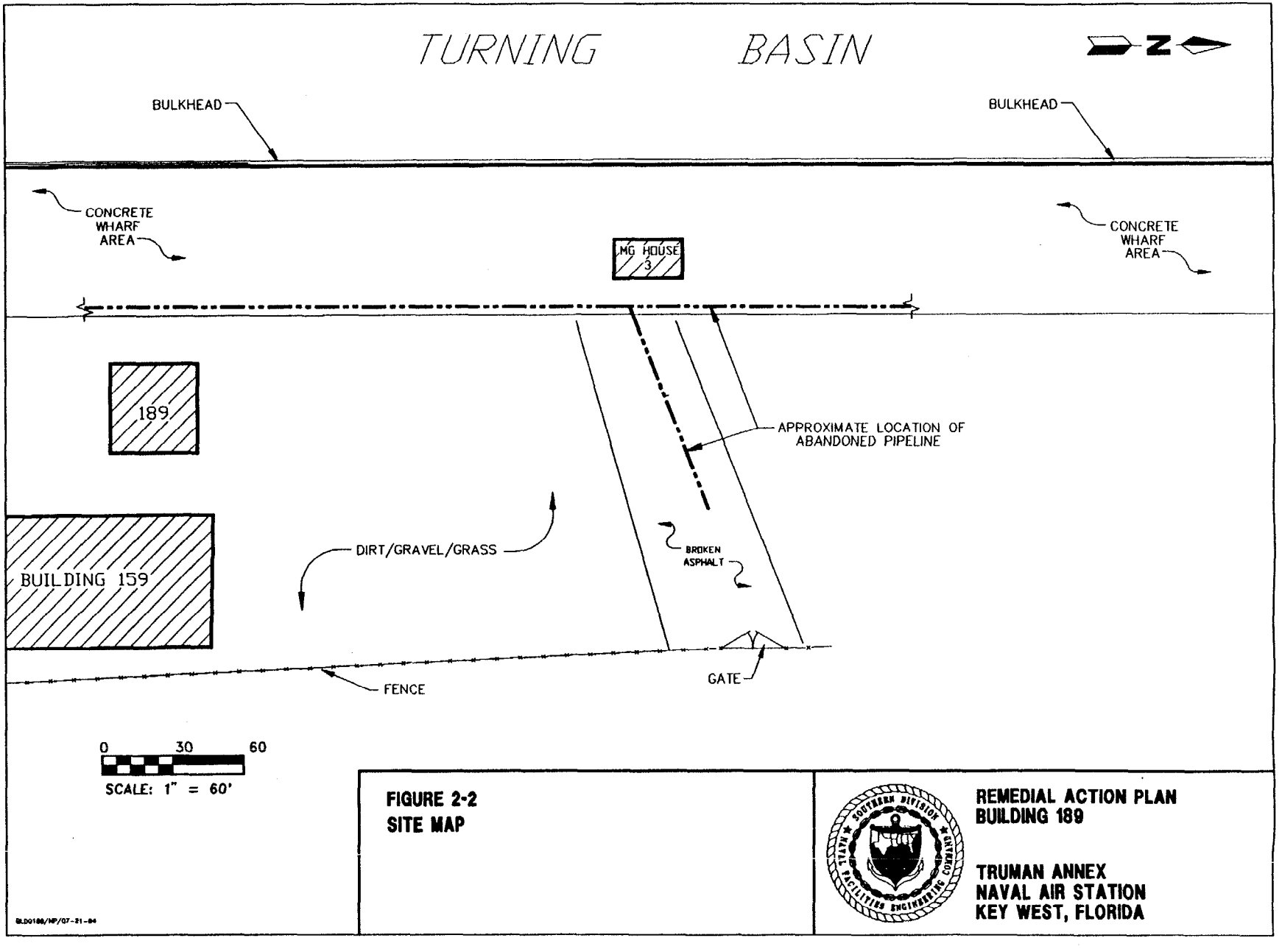


FIGURE 2-2
SITE MAP

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

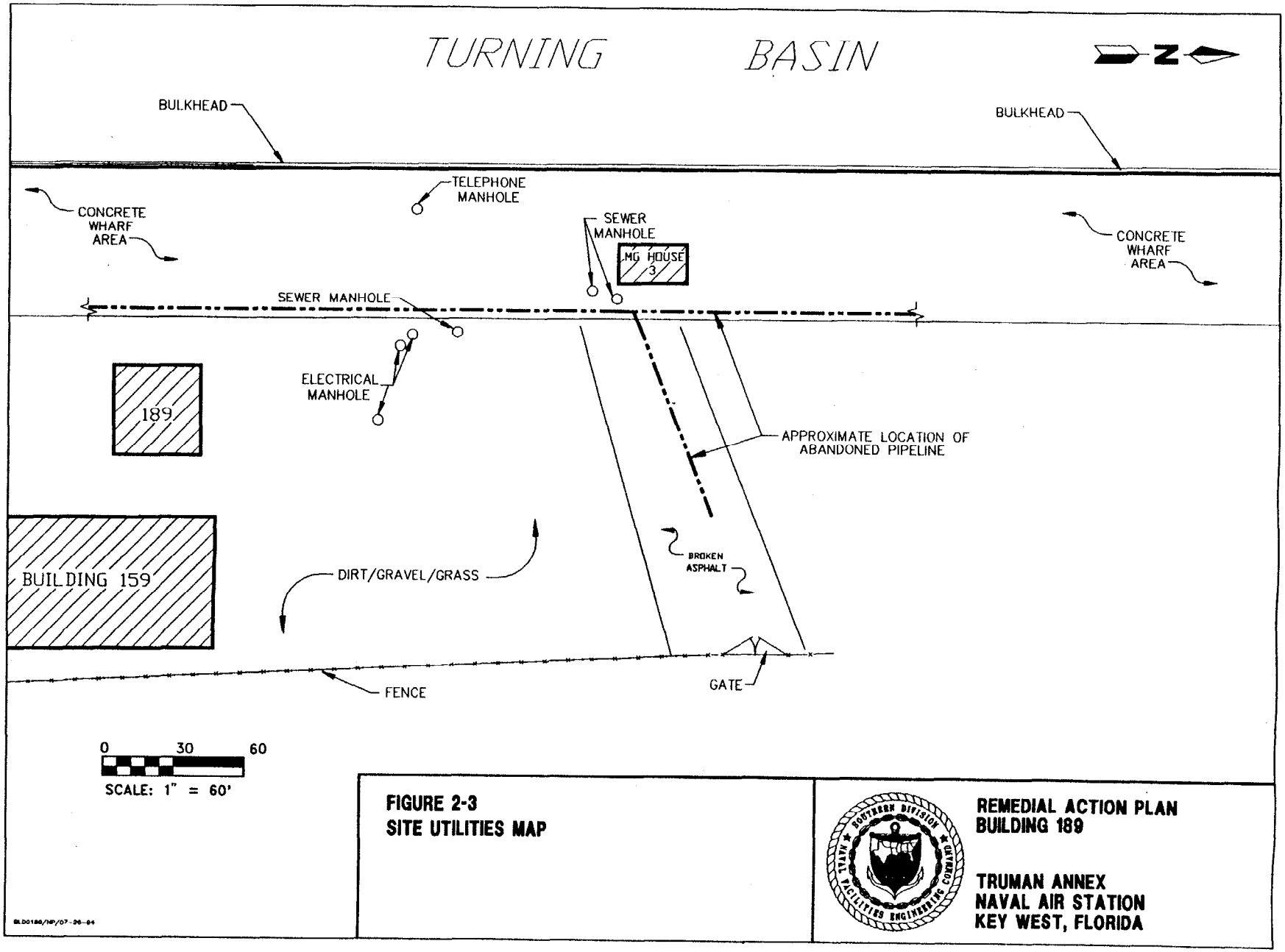


FIGURE 2-3
SITE UTILITIES MAP

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

2.3 SUMMARY OF CONTAMINATION ASSESSMENT REPORT (CAR) AND CAR ADDENDUM (CARA) FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

As a result of the observation of contamination during the wharf reconstruction in 1989, a contamination assessment (CA) was conducted in July and August 1991 and supplemented in March and June 1993. A CAR was submitted in February 1992 to the Florida Department of Environmental Regulation (FDER, currently the FDEP). The CAR recommended a monitoring only plan (MOP) be implemented. FDEP responded that a MOP could not be implemented for a site whose wells contained free product and that the product should be manually recovered. Also at the request of FDEP, supplemental field investigative activities were conducted at the site. These activities were conducted through August 1993. A CARA was submitted in November 1993. The objectives were to identify petroleum contaminants and their likely sources at the site, assess the degree and extent of petroleum contamination in the soil and groundwater, and recommend remedial actions, if necessary, to attain compliance with State regulations.

A total of 17 soil boring, 1 sediment sample, 12 shallow monitoring wells, and 1 deep monitoring well were advanced or installed at the site. Soil and groundwater quality samples were analyzed for constituents of the kerosene and mixed products analytical group as defined in Chapter 17-770, FAC. The findings, conclusions, and recommendations of the CAR and CARA are summarized below.

2.3.1 Findings

- The direction of groundwater flow is tidally influenced but is generally west toward the turning basin.
- The surficial aquifer in the Key West area does not meet State drinking water standards (McKenzie, 1990) and is generally of Class G-III quality.
- Site soils were screened using organic vapor analyzer (OVA) headspace analyses in the vicinity of monitoring well MW-2, but no excessively petroleum-contaminated soil was identified.
- Free product was observed in monitoring wells MW-1 and MW-3. Free product was observed in MW-1 only during the August 1991 sampling event at a thickness of 0.05 foot. Free product was observed in MW-3 during the March and June 1993 sampling event at a thickness of <0.01 foot. The free product is a viscous, tarry substance that resembles Bunker C fuel.
- Total recoverable petroleum hydrocarbons (TRPH) and pyrene were the only contaminants detected in groundwater samples collected in June 1993. TRPH concentrations exceed the State target level for G-III waters of 5 milligrams per liter (mg/ℓ) in samples collected from monitoring wells MW-1, MW-2, and MW-10, with the maximum concentration being 53 mg/ℓ in MW-2. Pyrene was detected only in the sample collected from monitoring well MW-2, at a concentration of 19 micrograms per liter (μg/ℓ). No regulatory target level has been established for pyrene in groundwater.
- TRPH contamination has been persistent in groundwater samples collected from monitoring wells MW-1 through MW-3.

- No contamination was detected in the sample collected from the vertical extent monitoring well MW-13D, which was screened from 30 to 35 feet below land surface (bls).

- Petroleum contamination was identified in the sediment sample collected from the floor of the turning basin adjacent to the seawall at the site. TRPH and total polynuclear aromatic hydrocarbon (PAH) concentrations were 51 mg/kg and 17.4 milligrams per kilogram (mg/kg), respectively. These concentrations exceed the State standard for clean soil (FDER, 1992). Total metals concentrations were below State target levels.

2.3.2 Conclusions

- Data indicate the source of soil and groundwater contamination is the former Bunker C pipeline.

- No excessively petroleum-contaminated soil was found on the site; however, an area of petroleum soil contamination was found in the vicinity of MW-2. Data indicate this contamination is restricted to the area around MW-2.

- Free product and TRPH in the groundwater are the primary concern at the site. Presently, the areal extent of free product contamination appears to be restricted to the vicinity of monitoring well MW-3, which is located within 10 feet of the former Bunker C pipeline location. The areal extent of TRPH groundwater contamination is roughly centered around MG House 3.

- The vertical extent of groundwater contamination is less than 30 feet bls in the vicinity of MG House 3. This indicates that groundwater contaminants are not migrating beneath the seawall into the turning basin.

- The petroleum contamination detected in the turning basin sediment sample collected along the existing seawall may be the result of former naval activities in the turning basin. Sediment sample analyses from the Electric Power Plant site (Building 103), approximately 200 feet south of Site 189, indicate TRPH concentrations in turning basin sediments vary from 9 mg/kg to 97 mg/kg (ABB-ES, 1993). The investigation at Building 103 indicated that high TRPH concentrations in the turning basin sediments do not necessarily correspond with the direction of potential groundwater contaminant migration or to areas of soil contamination.

2.3.3 Recommendations

Due to the presence of free product in monitoring well MW-3 and the persistence of TRPH contamination in groundwater samples collected from monitoring wells MW-1 and MW-2, the following actions are recommended.

- Recover free product to the extent practical in the vicinity of monitoring well MW-3, and

- remediate groundwater in the vicinity of MG House 3, in particular near monitoring wells MW-1, MW-2, and MW-3.

3.0 REMEDIAL ALTERNATIVES

3.1 CONTAMINANTS OF CONCERN. Laboratory analyses indicate the contamination is most likely from a single source. The source of contamination is believed to be the abandoned Bunker C pipeline. Based on the available data and requirements in Chapter 17-770, FAC, the constituents of the kerosene and mixed products analytical group are the basis for remedial actions. These parameters are:

- 1,2-dichloroethane (U.S. Environmental Protection Agency [USEPA] Methods 601 or 5030/8010),
- polynuclear aromatic (USEPA Methods 610, 8100, 625, 3510/8250, or 3510/8270 including PAH, the 15 listed priority pollutant PAHs plus 2-methylnaphthalene and 1-methylnaphthalene),
- benzene (USEPA Method 602 or 5030/8020),
- toluene (USEPA Method 602 or 5030/8020),
- total xylenes (USEPA Method 602 or 5030/8020),
- ethylbenzene (USEPA Method 602 or 5030/8020),
- 1,2-dibromoethane (EDB) (USEPA Methods 601 or 5030/8010 with electron capture detector substituted for Hall detector and two-column confirmation, or USEPA Method 504),
- methyl tert-butyl ether (MTBE) (USEPA Method 602 or 5030/8020),
- total volatile organic aromatics (USEPA Method 602 or 3050/8020),
- volatile organic halocarbons (listed priority pollutant compounds by USEPA Method 601 or 5030/8010),
- lead (USEPA Method 239.2 or 7421 or Standard Method 304), and
- TRPH (USEPA Method 418.1).

All the above constituents will initially be sampled for, however, based on previous results where only pyrene and TRPH were discovered, if a constituent does not appear in two consecutive sampling events, that particular constituent test will be removed from the required analyses.

3.2 APPLICABLE CLEANUP STANDARDS. The surficial aquifer at the site is saline. The surficial aquifer under the central part of Key West contains a small freshwater lens that floats on the saline groundwater. The lens, which is very thin (from less than 1 foot near the edge to an average of 5 feet near the center), is located below the center of the western half (Old Town) of the island (McKenzie, 1990). Analysis of groundwater from monitoring well MW-1 showed the total dissolved solids (TDS) concentration to be 20,000 mg/ℓ, well above the maximum for G-II aquifers of 10,000 mg/ℓ. Therefore, the surficial aquifer at the site is classified under Chapter 17-3, FAC, as G-III.

Action levels for remedial actions at this site are based on the upper limits of contaminant concentrations for monitoring only situations in a G-III aquifer. These parameters and target concentrations are as follows.

Parameter	Groundwater Target Concentration ($\mu g/\ell$)	
	Source	Perimeter
Total BTEX	1,000	200
Benzene	500	200
TRPH	100,000	5,000
Lead	1,000	50
Arsenic	1,000	50
Cadmium	200	5
Chromium	1,000	50

Note: BTEX = benzene, toluene, ethylbenzene, total xylenes.

PAHs have been identified at the site in relatively low concentrations, but are not listed as parameters for monitoring in G-III groundwater. No excessively petroleum-contaminated soil was identified by OVA headspace analysis.

3.3 **EXTENT OF CONTAMINATION**. Groundwater samples were collected from monitoring wells MW-1 and MW-4 through MW-9 on June 8, 1993, and were analyzed for TRPH only. A duplicate sample was collected from monitoring well MW-7. Groundwater samples were collected from monitoring wells MW-2, MW-10, MW-11, MW-12, and MW-13D on June 10, 1993, and analyzed for TRPH and PAHs by USEPA Methods 418.1 and 610, respectively. A duplicate sample was collected from monitoring well MW-11. Because of the presence of a small amount of free product, monitoring well MW-3 was not sampled. Free product was detected in monitoring wells MW-1 and MW-3 during the CA. In August 1991, 0.05 foot of product was detected in monitoring well MW-1 (ABB-ES, 1992b). Free product was not observed in monitoring well MW-1 during the March and June 1993 sampling events. Free product was not observed in monitoring well MW-3 during the August 1991 sampling event, but was observed in March and June 1993. The thickness of free product in monitoring well MW-3 was less than 0.01 foot.

The free product at the site is the source of groundwater contamination. TRPH levels sightly exceed the monitoring only guidelines for G-III waters. Pyrene was also discovered at the site; however, no regulatory target level has been established for pyrene in groundwater.

3.3.1 **Soil Contamination** No excessively petroleum-contaminated soil was identified by OVA headspace analysis.

3.3.2 **Free Product** The free product is a viscous, tarry substance, resembling Bunker C fuel oil. When observed in March and June 1993, the free product detected in monitoring well MW-3 did not form a continuous layer on top of the water column; rather, it occurred as small droplets approximately 0.02 to 0.1 inch in diameter at or near the top of the water column in the bailer.

Because free product was not observed in other monitoring wells during the June 1993 sampling event, the areal extent of free product contamination appears to be restricted to the vicinity of monitoring well MW-3. The presence of free product may have resulted from the release(s) of Bunker C fuel oil from the former pipeline. Monitoring well MW-3 is located 10 feet from the former pipeline location (Figure 3-1). Free product has appeared in both MW-1 and MW-3 during different sampling events. The appearance of free product is associated with the permeable fill material placed in the excavation when the Bunker C pipeline was removed.

3.3.3 Groundwater Contamination The distribution of groundwater contaminants detected in samples collected June 8 and June 10, 1993, are presented in Figure 3-1. The only contaminants identified were TRPH and pyrene. Monitoring well MW-3 was not sampled because free product was observed in this well. The product thickness in MW-3 was not measurable, but was estimated to be less than 0.01 foot.

Because there are no criteria for PAHs in G-III aquifers, TRPH is the only parameter present that exceeds the action levels described in Section 3.2. TRPH concentrations exceeded the State target level of 5 mg/ℓ for perimeter wells in the samples collected from monitoring wells MW-1, MW-2, and MW-10. The location of MW-1, MW-2, and MW-10 is close to the location of the excavated Bunker C pipeline and should be considered source wells. TRPH concentrations in samples from these monitoring wells do not exceed the State target level of 100 mg/ℓ for source wells for G-III waters. The areal extent of TRPH contamination is approximated by the bold line in Figure 3-1. This area is roughly centered around MG House 3. It is possible TRPH contamination may extend to the seawall although, due to the high density of underground utilities, there is not any data downgradient of MG House 3 to support this inference. It is assumed that the TRPH concentration in groundwater at MW-3 exceeds the G-III source area criteria of 100 mg/ℓ due to the presence of free product droplets.

No contaminants were detected in the samples collected from monitoring wells MW-4 through MW-9, MW-12, and MW-13D.

3.4 SITE-SPECIFIC LIMITATIONS TO ALTERNATIVES. The site contamination is located beneath a temporarily inactive military port facility. Because this is a relatively inactive area, remedial construction or operation and maintenance activities should be acceptable. However, the site is underlain by many active and abandoned utilities that would impact any subsurface activities such as trenching, well drilling, or excavation. Underground utilities present include potable water lines, sanitary sewers, oily waste sewers, stormwater sewers, electrical lines, telephone lines, fuel pipelines, and service lines and risers for ship connections for each of these. Additionally, structural components of the seawall and dock are present, including the original seawall, steel tie rods, concrete anchor walls, wooden structural piles, and tie rod support blocks.

3.5 REMEDIAL STRATEGY. Because excessive soil contamination was not detected a separate soil remedial system is not recommended. Free product as a source of groundwater contamination in the area or possible discharge to the surface water is the greatest concern. To mitigate this threat, a strategy of containment and source abatement is proposed. Containment should be provided that will prevent discharges of contaminated groundwater from the site into the turning basin.

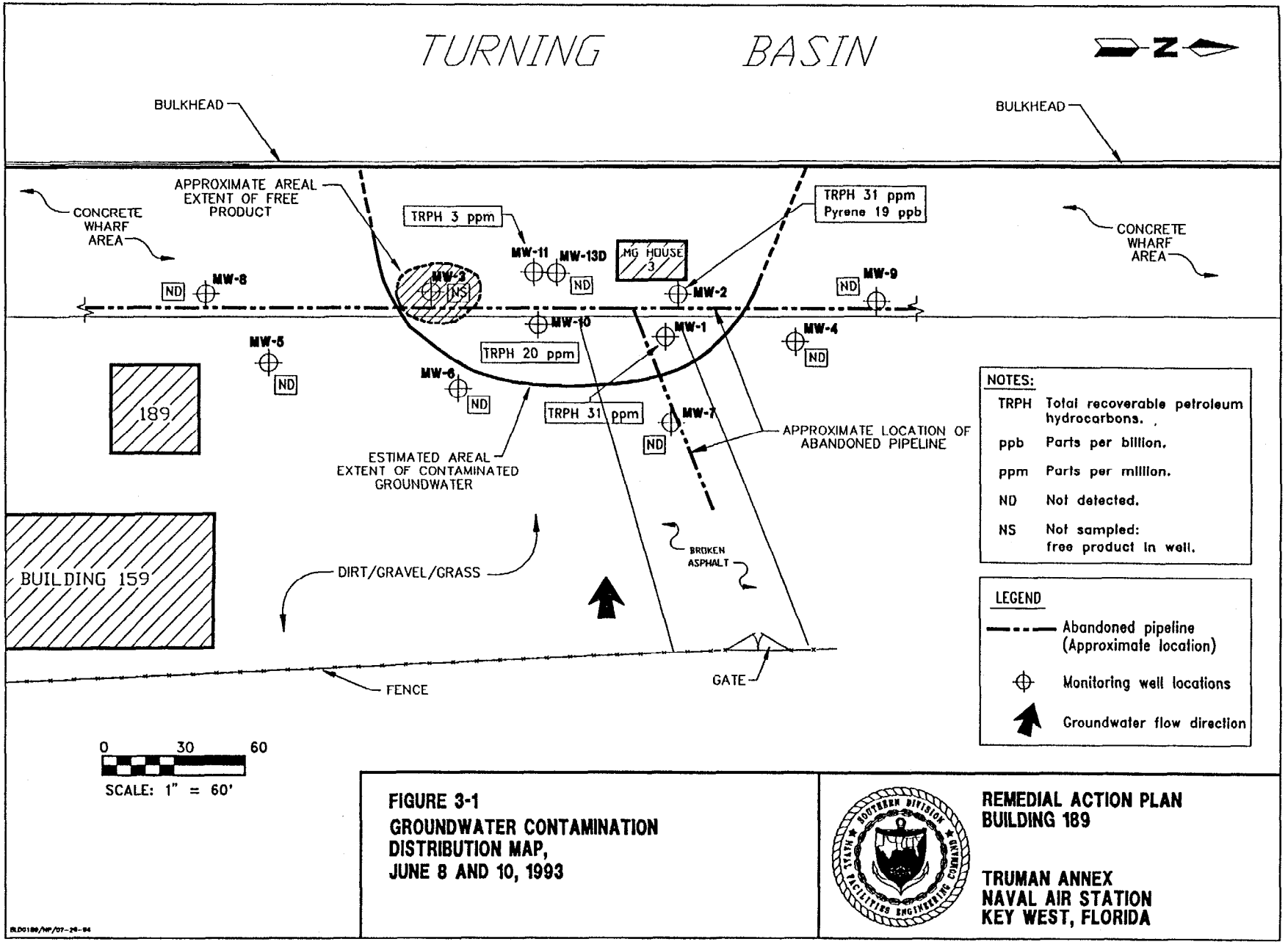


FIGURE 3-1
GROUNDWATER CONTAMINATION DISTRIBUTION MAP, JUNE 8 AND 10, 1993

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

Source abatement should include removal of any free product that may be present. A groundwater monitoring program should also be provided, that will allow for monitoring of the groundwater plume mobility and provide feedback on contamination movement. Once the groundwater monitoring program has been completed, the sampling data will be analyzed and a no further action (NFA) request will be submitted. The NFA will be based on FDEP's essential conditions for an approvable NFA found in the Technical Criteria Overview section of the *No Further Action and Monitoring Only Guidelines for Petroleum Contaminated Sites* (FDER, 1990). This document lists the following four essential criteria that must exist at the site:

- the source of the contamination has been abated,
- free product is not currently present,
- excess soil contamination is not currently present, and
- the groundwater contamination (if present) is not widespread, does not extend offsite, or is not migrating vertically.

If these conditions do not exist at the completion of the groundwater monitoring program the following two alternatives will be considered:

- the groundwater monitoring program will be extended based on the analyses of the sampling results, or
- remedial actions at the site will be reevaluated.

3.6 DISCUSSION OF ALTERNATIVES. After defining the contaminants of concern, the applicable cleanup standards, and the extent of contamination and developing a remedial strategy, it is necessary to identify and screen technologies that may be applicable to mitigate the contamination at the site. Because cleanup technologies applicable to sites contaminated with petroleum substances are continually being improved and developed, it is important to develop remedial action alternatives using the most effective technologies available.

3.6.1 Free Product Recovery Although only a small amount of free product has been detected, a free product recovery program is needed to prevent the product from acting as a continuing source of groundwater contamination. Such a system might include a product recovery well and a product only pumping system, which removes the free product without pumping any groundwater, or a total fluids system, which removes free product and groundwater together. Choosing the appropriate method would depend on the selected groundwater remedial alternative.

Another option is to continue monthly monitoring and free product recovery by manual methods when necessary. Such a program could be modified for more or less frequent product recovery as needed. This option would assure that any free product present would be dealt with, but would not be expensive to implement.

3.6.2 Groundwater Remediation In general, groundwater may be remediated *in situ* or *ex situ*. These two general scenarios are applied based on site-specific characteristics. The limited scope of the remedial strategy and the low potential risk to human health at the site, based on the lack of excessive soil contamination and G-III groundwater, do not warrant an in depth discussion of unit

processes involved in these two general treatment scenarios. Groundwater biosamples taken from MW-1 at the site indicate that 3.3×10^5 colony forming units per milliliter (CFU/ml) of hydrocarbon degrading bacteria exist in the groundwater. The large amount of hydrocarbon degrading bacteria in the groundwater suggests that natural processes are degrading the groundwater contaminant plume. A soil sample taken 2 feet to the west of MW-1 contains less than 33 CFU/ml. This soil sample suggests that there is not enough, if any, contamination in the soil above the groundwater table to support natural processes in the unsaturated soil.

Natural biodegradation processes affect the size and mobility of the contaminant plume by using the natural levels of dissolved oxygen and nutrients that appear in the groundwater and surrounding aquifer. Natural attenuation can be an effective tool in areas where a petroleum degrading microbial population presently exists. Microbes in the groundwater will adjust over time to the type of food source that is present. Microbes in the area of contamination will adjust to degrade petroleum hydrocarbon as a food source as it dissolves into the groundwater.

Natural attenuation consists of biological processes (such as biodegradation of the contaminants by the existing microbes in aerobic or anaerobic conditions), physical processes such as dispersion through the groundwater, volatilization into the soil vapor zone, and sorption of viscous constituents onto organic carbon present in the soil of the saturated zone. Indicators of the effects of natural attenuation would be the size and concentration of the contaminant plume. Soluble contaminant constituents dissolved in the groundwater expand through the groundwater to become the leading edge of the contaminant plume. Once the product has been removed from the contaminant plume and the source of contamination abated, the expansion edge of the plume will slow down and eventually recede as the petroleum degrading microbes deplete the dissolved constituents as a food source. The highly volatile constituents will transfer from the contaminated groundwater into the soil gas zone and reduce the concentration of the contamination in the groundwater. The less soluble and less volatile constituents will adsorb onto the organic carbon in the saturated soil. These constituents will become a source of food for the petroleum degrading microbes as the more soluble constituents in the contaminant plume are depleted.

3.7 ALTERNATIVE SELECTION. For free product recovery a program of scheduled free product monitoring and manual removal is recommended. Groundwater remediation is not considered necessary for this site because the groundwater gradient, along with the up and down flushing motion of the groundwater due to tidal influence, keeps the contamination from leaving the area next to the Truman Annex Bulkhead and prevents the spread of contamination. This option does not require any handling of contaminated groundwater. This option eliminates the need for extensive recovery, treatment, and disposal equipment; reduces operation and maintenance requirements; and avoids concerns associated with effluent disposal.

4.0 RECOMMENDED REMEDIAL ACTION

The recommended remedial action for the Truman Annex Site 189 groundwater contamination at NAS Key West consists of plume containment and source abatement through a free product monitoring and recovery program.

4.1 PLUME CONTAINMENT. There are two bulkheads between the contaminated groundwater and the turning basin. The bulkheads provide an effective barrier, containing the plume on its west side. The old bulkhead construction consists of interlocking steel sheet piles, driven to a depth of -23 feet msl. The new bulkhead is an extension of the original bulkhead and is of similar construction. The new bulkhead is constructed with hot rolled PZ interlocking steel sheet piles driven to depths from -53 feet msl at the water. Hot rolled steel sheet pile walls typically have a hydraulic conductivity in the range of 1.5×10^{-7} cm/sec to 5.0×10^{-7} centimeter per second (cm/sec) (Starr, 1992). A concrete cap covers the water side of the bulkhead wall to a depth of -3 feet msl. This cap increases the ability of the sheet pile bulkhead to restrict the movement of any light non-aqueous phase liquid (LNAPL) contaminants in the groundwater. The bulkheads are low permeability barriers that restrict the contaminant plume migration. The bulkhead design is shown on Figure 4-1.

The groundwater gradient in the area (Figure 4-2 and 4-3) is affected by tidal influence and is capable of a reversal where the groundwater gradient slopes to the east instead of the west. The tidal influence (Figure 4-4, 4-5, and 4-6) keeps the contaminants from moving from their present location. The up and down motion of the tidal influence along with the gradient reversals keep the contaminants moving in a circular motion within a vertical plane in the saturated zone. This circular motion along with the contaminant plume separation from the turning basin by the nearly impermeable bulkhead completes the contaminant plume containment and keeps the contaminant plume from moving offsite.

4.2 FREE PRODUCT MONITORING AND RECOVERY. Free product has been observed in samples from monitoring wells MW-1 and MW-3 (Figure 4-7). Monitoring wells MW-1 through MW-4, MW-6, MW-7, MW-10, MW-11, and MW-12 will be monitored due to their proximity to the observed free product. Monitoring wells MW-1, MW-2, MW-3, MW-10, and MW-11 will be checked using an oil and water interface probe to measure the thickness of any product that may be present. If product is discovered using the oil and water interface probe, the probe will be scrubbed with an Alconox™ and water solution, then rinsed with isopropyl alcohol and finally rinsed with deionized water before checking another well. The monitoring wells will be checked in order of least likely product appearance to most likely product appearance to prevent cross contamination. Monitoring wells MW-4, MW-6, MW-7, and MW-12 will be checked with a decontaminated bailer. Water from each location will be visually inspected and described. If free product is found, it will be manually bailed from the well. The data recorded will include the following:

- the date, time, and well number;
- the apparent thickness or absence of product using the oil-water probe;

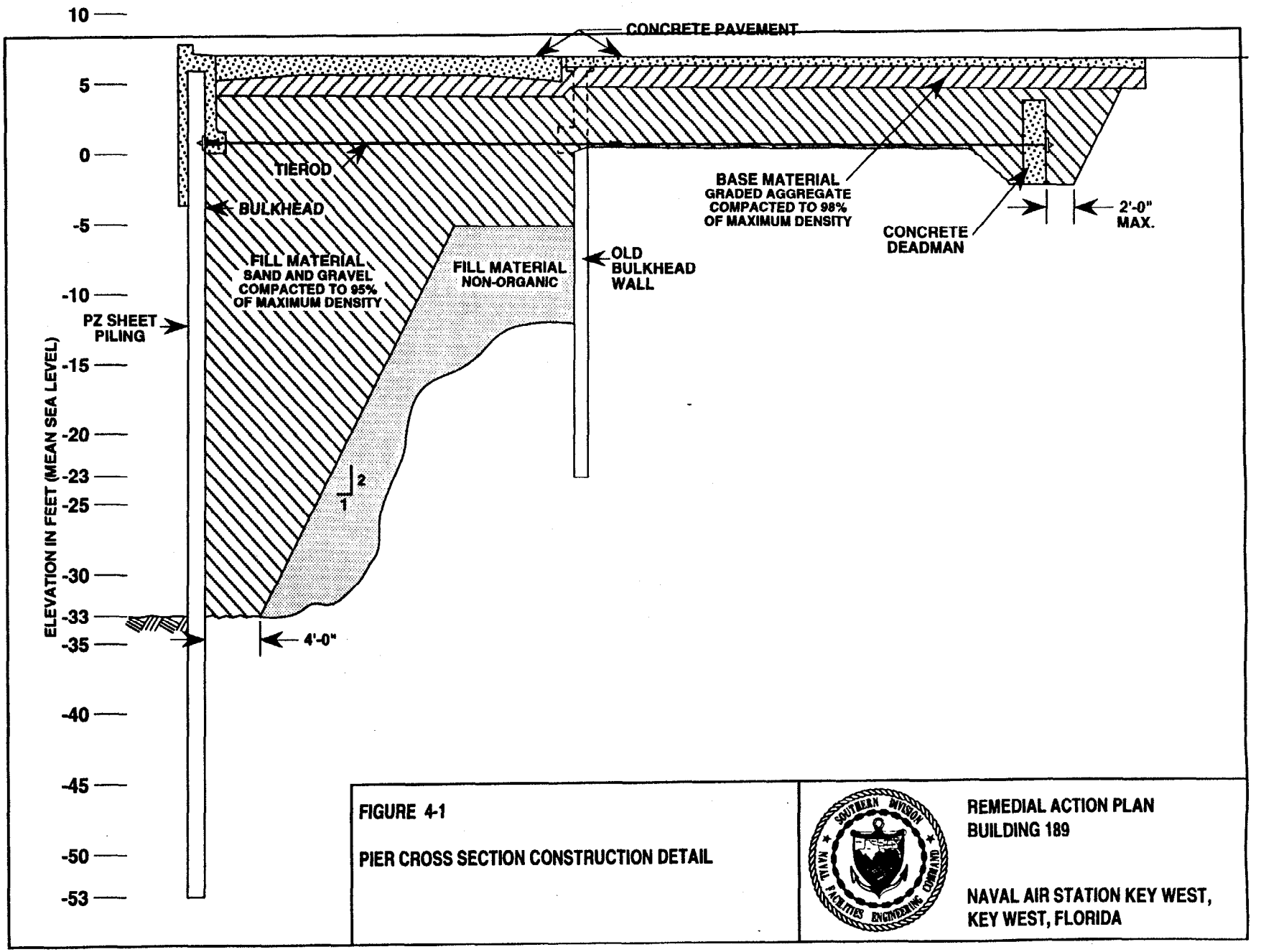


FIGURE 4-1

PIER CROSS SECTION CONSTRUCTION DETAIL

REMEDIAL ACTION PLAN
BUILDING 189

NAVAL AIR STATION KEY WEST,
KEY WEST, FLORIDA

7519-50 931228WEM

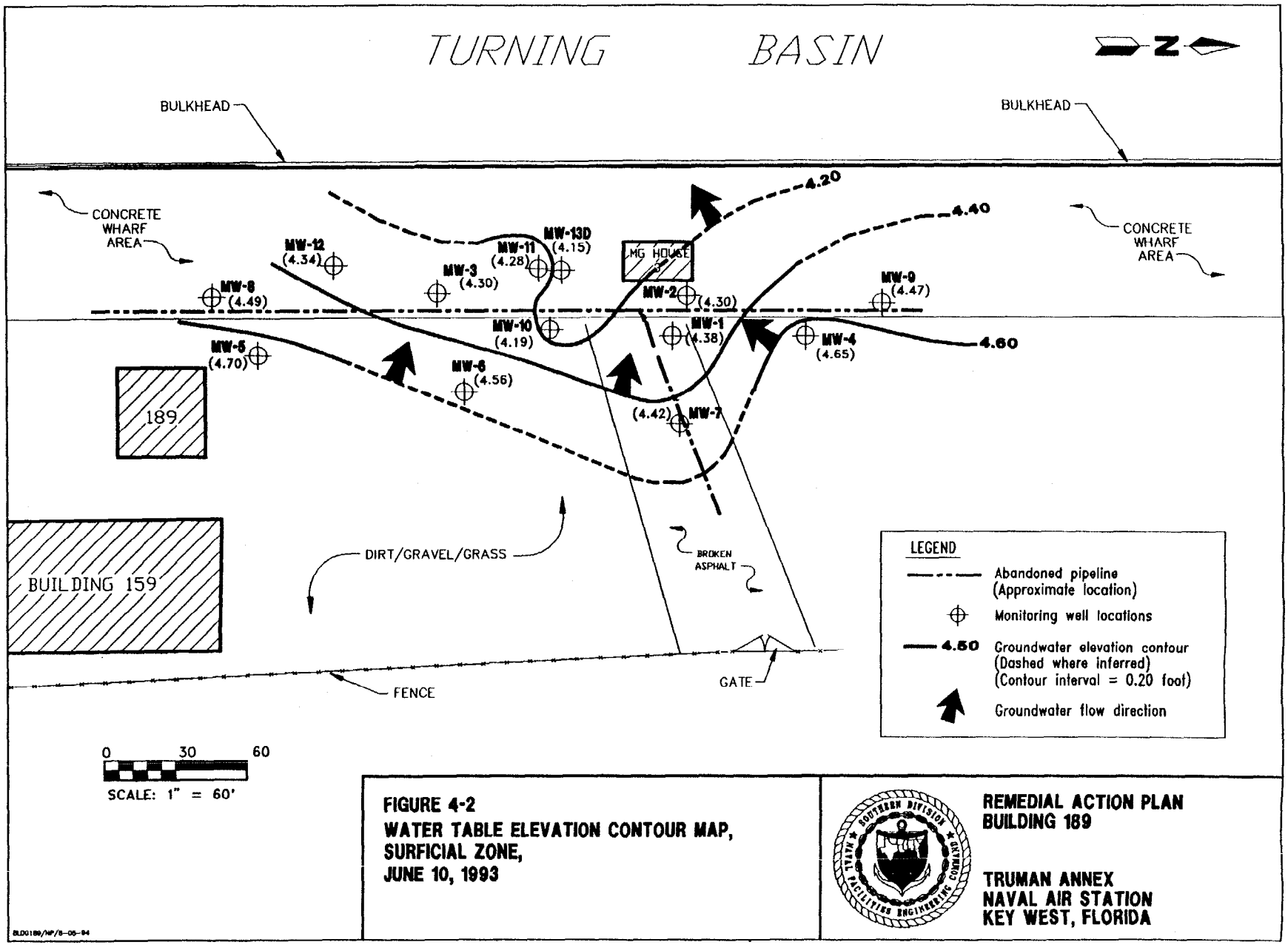


FIGURE 4-2
WATER TABLE ELEVATION CONTOUR MAP, SURFICIAL ZONE, JUNE 10, 1993

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

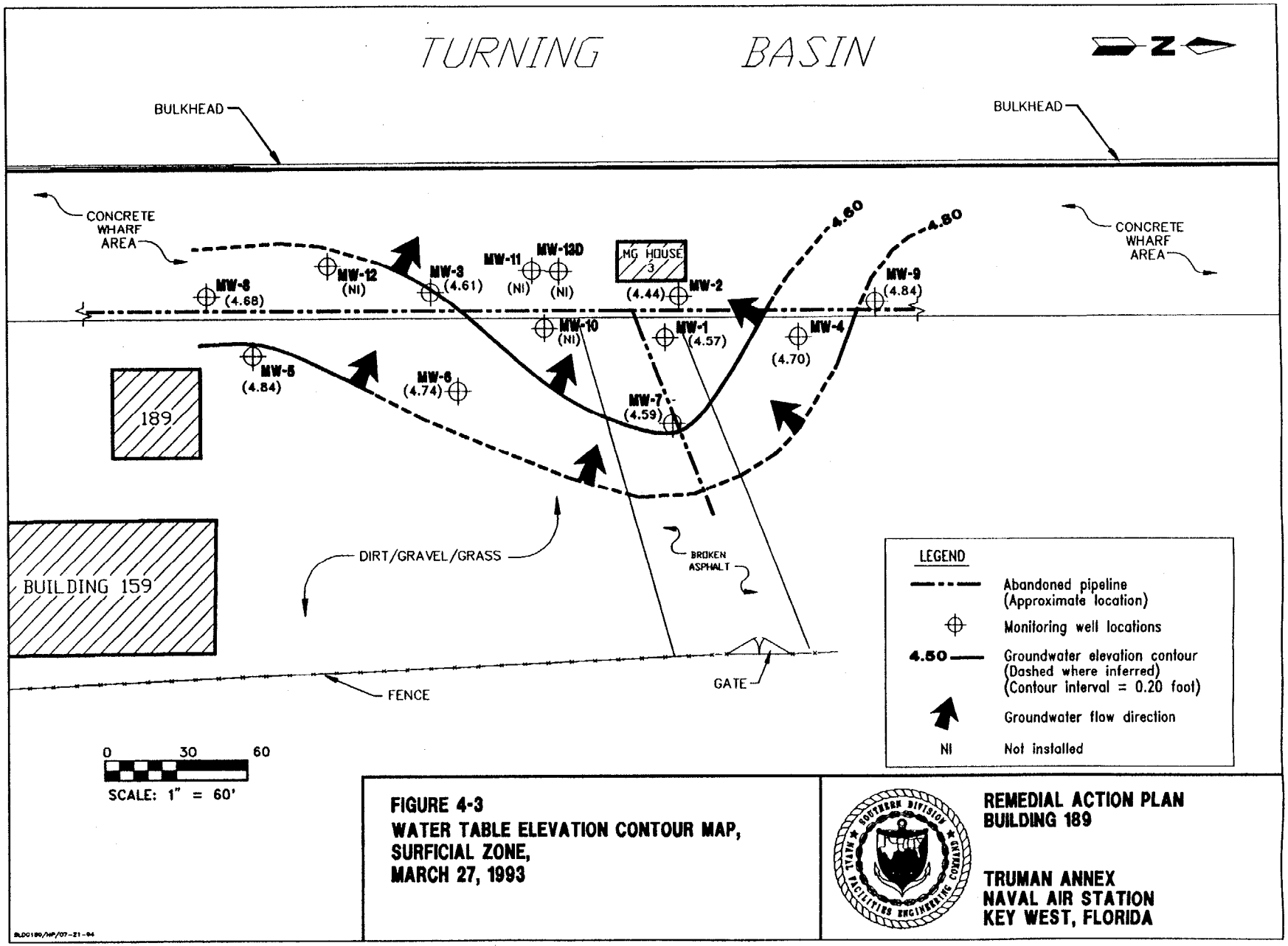


FIGURE 4-3
WATER TABLE ELEVATION CONTOUR MAP, SURFICIAL ZONE, MARCH 27, 1993

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

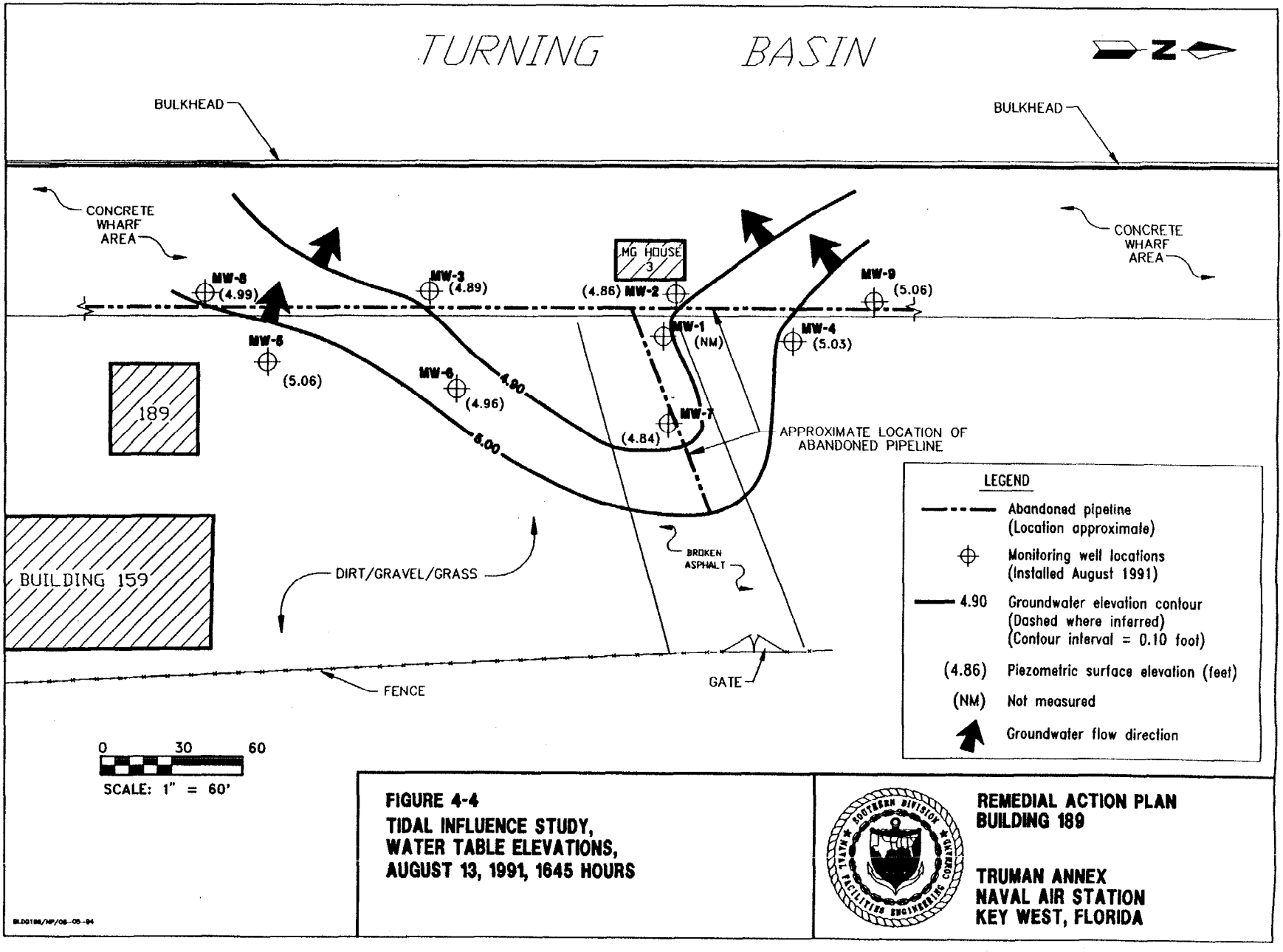


FIGURE 4-4
TIDAL INFLUENCE STUDY, WATER TABLE ELEVATIONS, AUGUST 13, 1991, 1645 HOURS

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

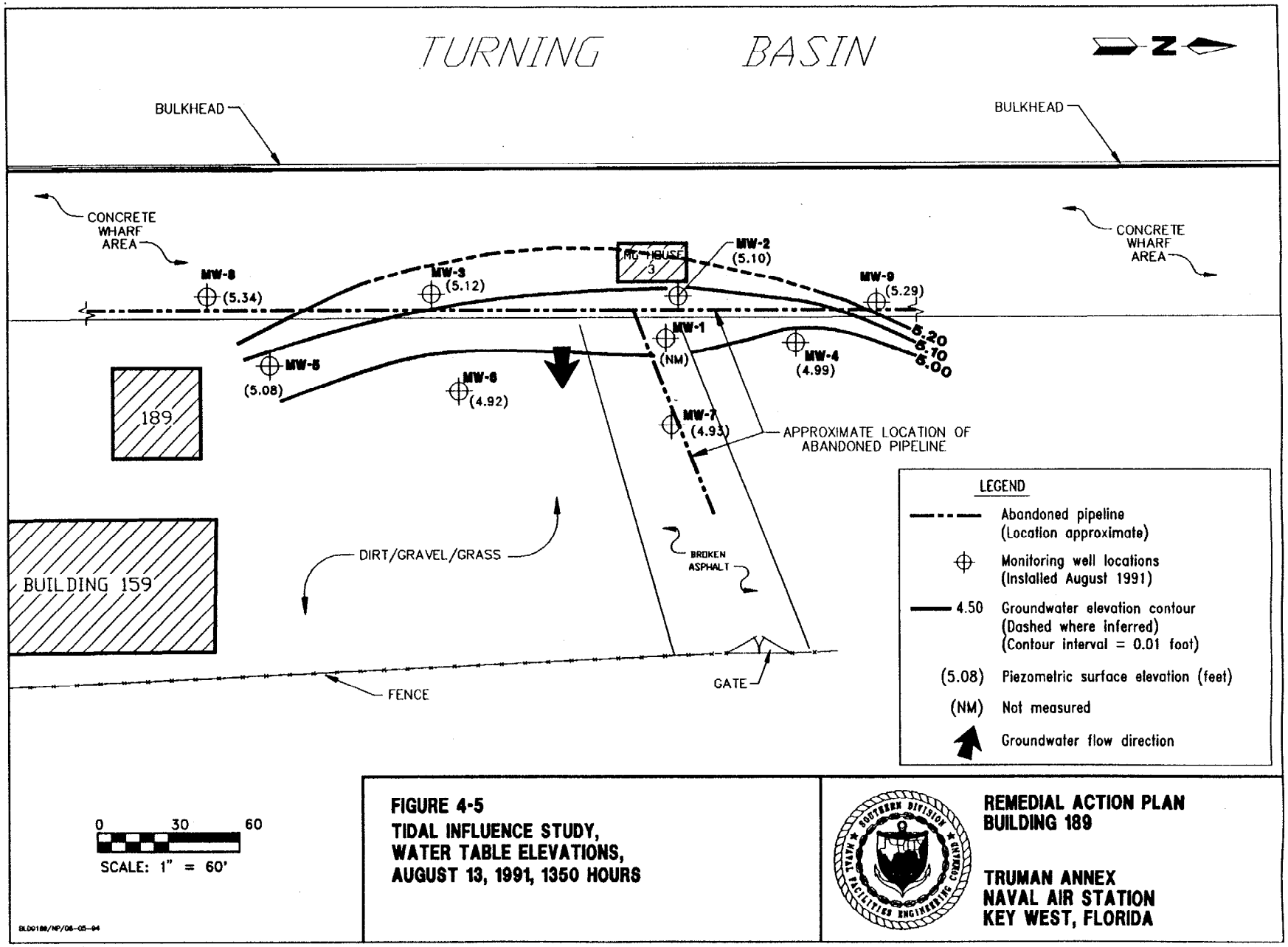


FIGURE 4-5
TIDAL INFLUENCE STUDY,
WATER TABLE ELEVATIONS,
AUGUST 13, 1991, 1350 HOURS

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

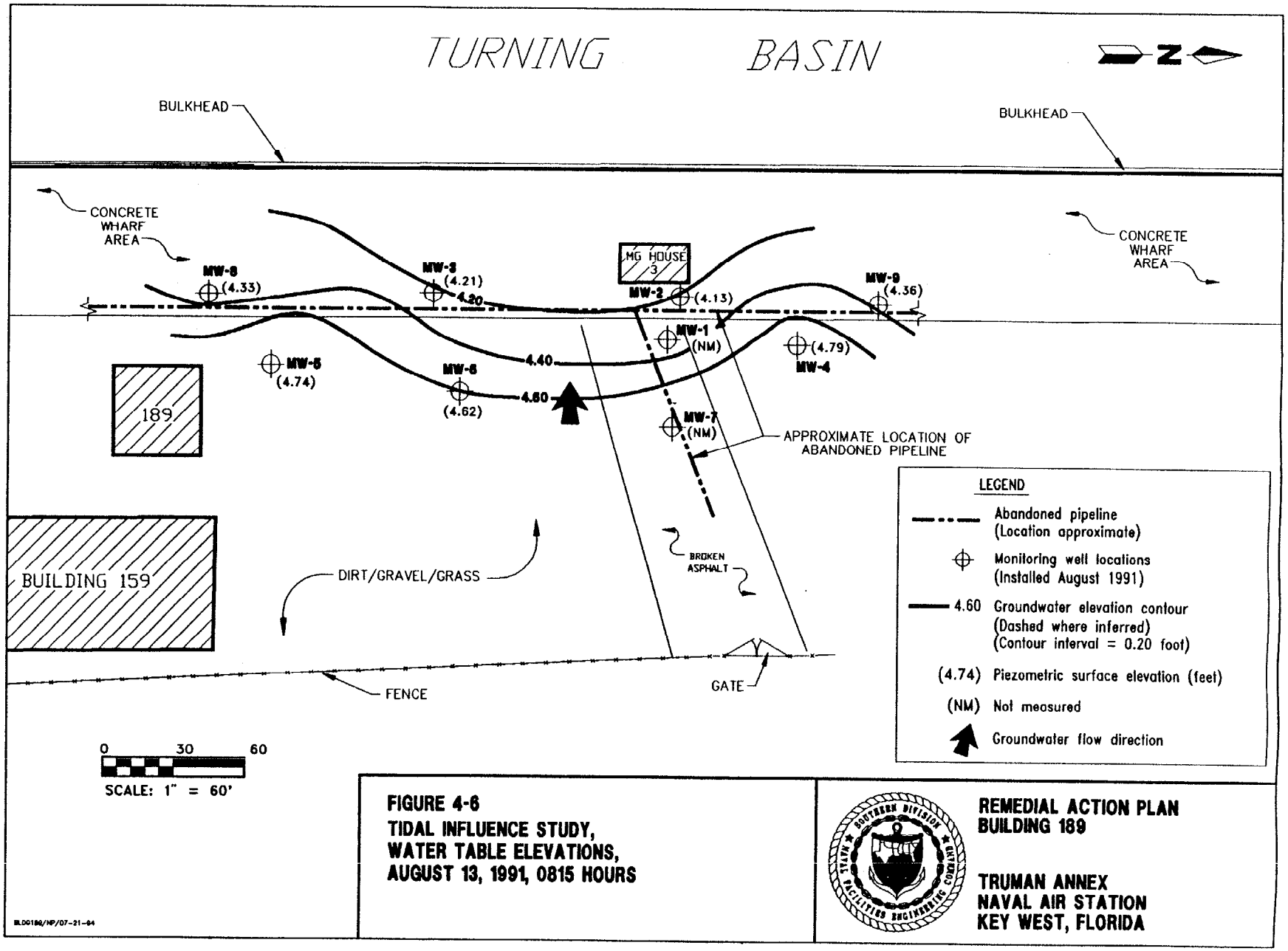


FIGURE 4-6
TIDAL INFLUENCE STUDY, WATER TABLE ELEVATIONS, AUGUST 13, 1991, 0815 HOURS

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

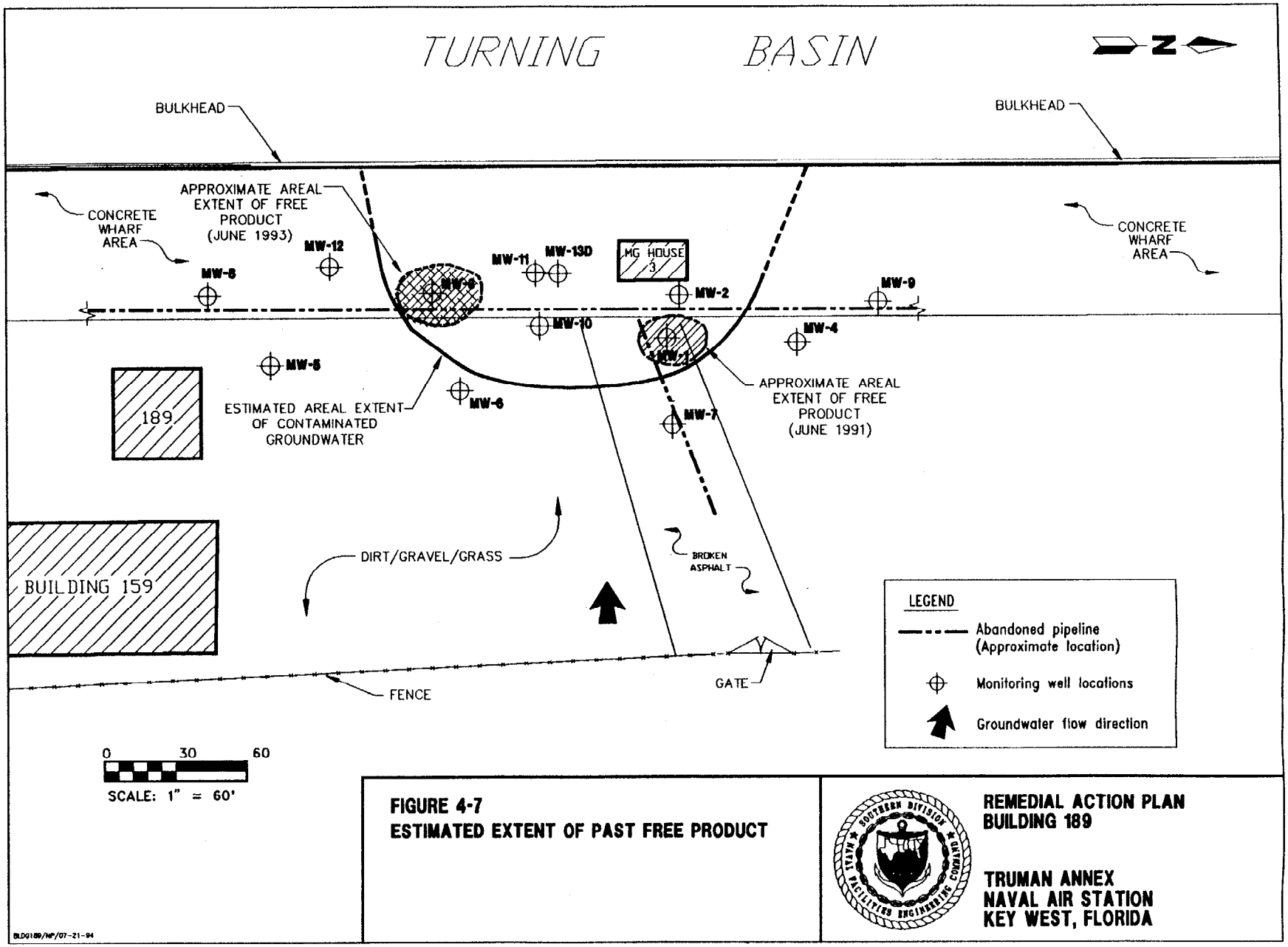


FIGURE 4-7
ESTIMATED EXTENT OF PAST FREE PRODUCT

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

- a visual description of the water and product, if present, including color, odor, and form of the product in the water (e.g. droplets, sheen, or layer);

- the number of bails taken from the well along with start and end times for removal of the product; and

- the total volumes of product and water removed.

Records of each monitoring event will be included in the reports described in Section 4.4, Groundwater Monitoring Program, of this report. Recovered free product will be placed in appropriate containers and disposed in accordance with State and Federal requirements.

The frequency of monitoring and recovery events, weekly, monthly, and quarterly, will vary according to the 3-year flow scheme displayed in Figure 4-8. The 3-year flow scheme depicts three loops of monitoring and recovery frequency and describes the circumstances that are involved in regulating transfer from one loop to another. Each loop of monitoring and recovery intensity has a maximum number of events that may be performed in that loop without stopping to reevaluate the effectiveness of the free product monitoring and recovery program. The three possible outcomes of the flow scheme are:

- reevaluate the product monitoring and recovery program if the maximum number of recovery events for one loop of intensity is exceeded, or at the end of the 3 years, which ever comes first;

- reevaluate the monitoring program if there is excessive product recovery from the weekly monitoring event loop and determine if a product recovery system is necessary; or

- stop monitoring for product if there is a completion to the quarterly monitoring event loop due to a lack of product appearance.

The product is believed to be Bunker C fuel oil, which is a viscous material. A fingerprint of the contaminant is presented in Figure 4-9.

4.3 SYSTEM STARTUP. Prior to the initiation of the free product monitoring and recovery program, groundwater from the monitoring wells designated for quarterly monitoring will be collected for laboratory analyses as a base line concentration at time zero for the monitoring program.

4.4 GROUNDWATER MONITORING PROGRAM. The quarterly groundwater monitoring program is designed to evaluate the contaminant plume stability and product monitoring and recovery program effectiveness. The source area monitoring wells, MW-2, MW-3, and MW-10 will be monitored according to the product monitoring and recovery program; however, in the absence of product, MW-1, MW-2, MW-3, and MW-10 will be sampled in accordance with the quarterly groundwater monitoring program to monitor plume mobility and to examine variations in contaminant concentrations. In addition, perimeter and background monitoring wells MW-4, MW-6, MW-7, MW-12, and MW-13D will be sampled quarterly to provide data for tracking the overall progress of the remedial program. Monitoring wells MW-4, MW-6, MW-7, and MW-12 will be

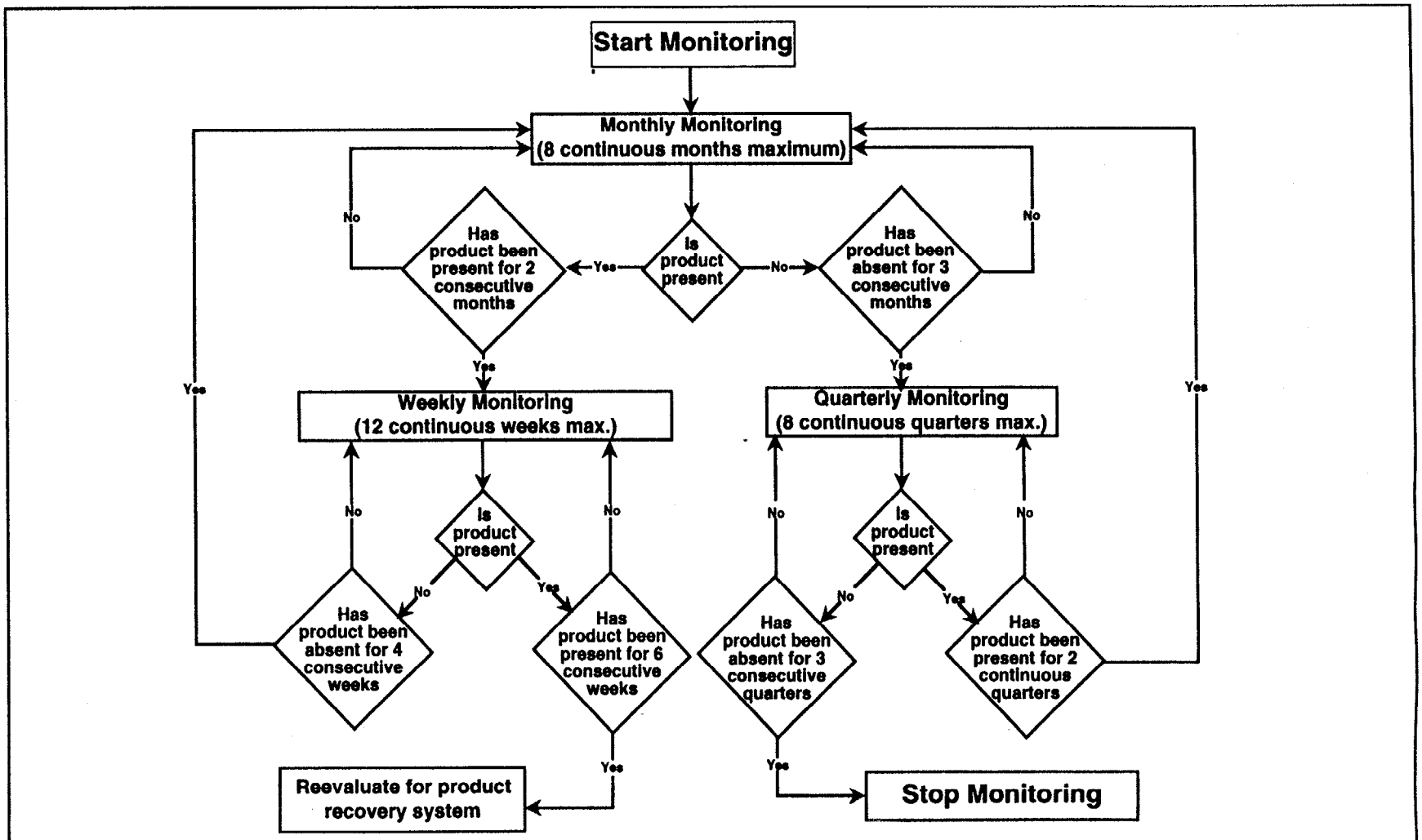


FIGURE 4-8

PRODUCT MONITORING

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

7519-50 940727WEM

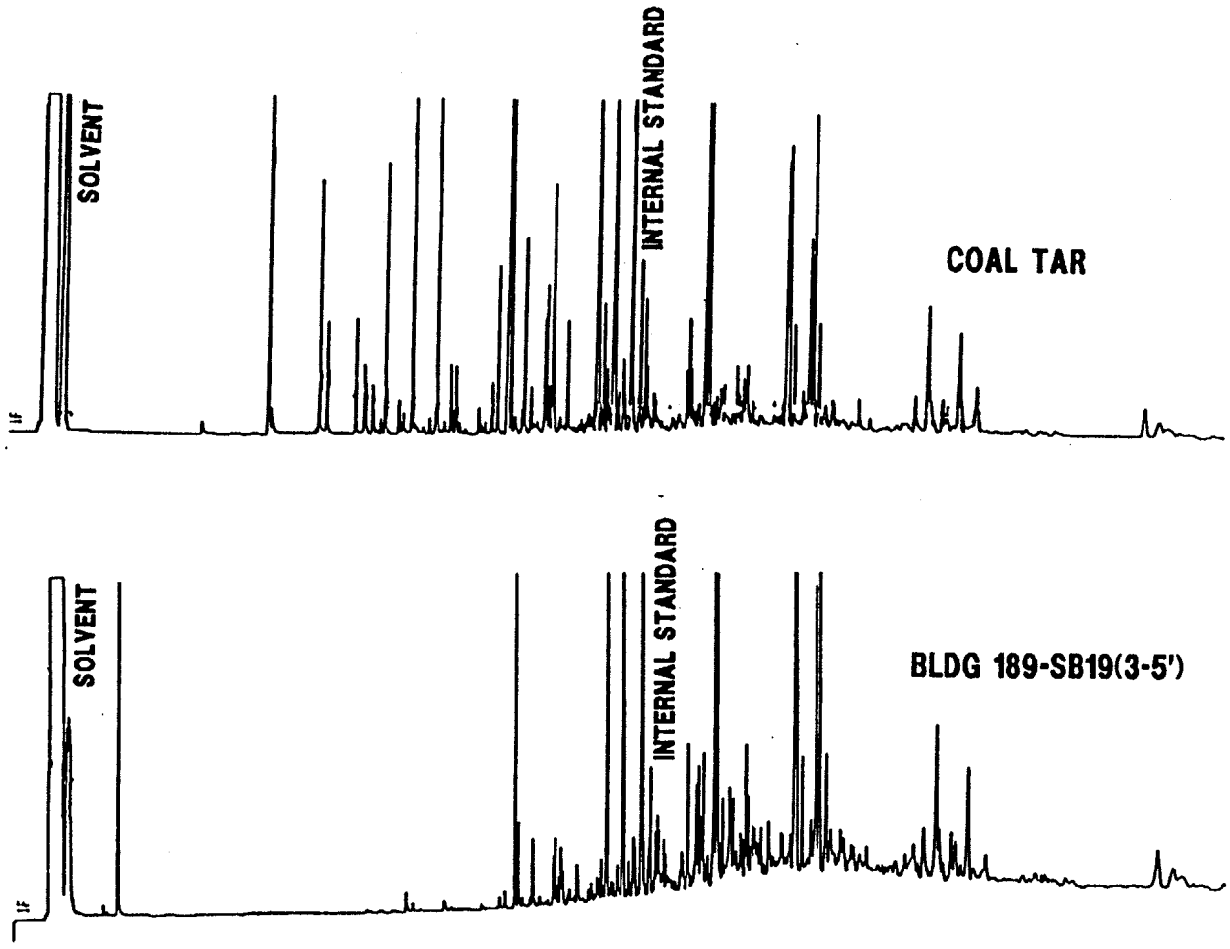


FIGURE 4-9
PETROLEUM FINGERPRINT

REMEDIAL ACTION PLAN
BUILDING 189

TRUMAN ANNEX
NAVAL AIR STATION
KEY WEST, FLORIDA

monitored to detect contaminant migration upgradient or downgradient; MW-1, MW-2, MW-3, and MW-10 will be monitored to assess the movement of contamination within the groundwater plume; and MW-13D will detect vertical contaminant migration. The quarterly groundwater monitoring program will be extended 1 year following the completion of the product monitoring and recovery program.

Once the quarterly groundwater monitoring program has stopped, the sampling data will be analyzed and an NFA request will be submitted based on FDEP's essential conditions for an approvable NFA found in the Technical Criteria Overview section of the *No Further Action and Monitoring Only Guidelines for Petroleum Contaminated Sites* document (FDER, 1990). The guidelines document lists four essential NFA criteria that must exist at the site:

- the source of the contamination has been abated,
- free product is not currently present,
- excess soil contamination is not currently present, and
- the groundwater contamination (if present) is not wide spread, not extending off-site, or not migrating vertically.

Some of the criteria have already been addressed. The possibility of soil contamination is addressed in Subsection 3.3.1 of this report. The source was a Bunker C fuel oil pipeline that was broken prior to or during wharf reconstruction activities. Subsequently the pipeline and much of the contaminated soil were removed; therefore, abating the source of contamination. The remaining two criteria concerning the presence of free product and groundwater contamination will be addressed by the product monitoring and recovery program and the quarterly groundwater monitoring program. An increase of contaminant concentration in monitoring wells MW-4, MW-6, MW-7, MW-12, or MW-13D by more than 5 mg/ℓ TRPH will result in the reevaluation of the remedial actions.

The samples will be analyzed for kerosene and mixed product analytical group constituents as described in Section 3.1. The concentrations and water level data in all wells during each quarterly sampling event will be summarized in a letter report to the Navy and FDEP following each quarterly sampling event.

Presented in Table 4-1 is a summary of the recommended groundwater sampling events for the first year.

Table 4-1
Sampling Schedule, First Year

Remedial Action Plan
Berthing Wharf, Building 189, Truman Annex
Naval Air Station Key West
Key West, Florida

Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Measure water levels			X			X			X			X
Sample perimeter and background monitoring wells[1].			X			X			X			X
Sample source area monitoring wells in the absence of product[2].			X			X			X			X

[1] Includes monitoring wells KYW-189-4, KYW-189-6, KYW-189-7, KYW-189-12, and KYW-189-13D.
[2] Includes monitoring wells KYW-189-1, KYW-189-2, KYW-189-3, and KYW-189-10.

Note: X indicates task to be performed.

5.0 COST ESTIMATE

The cost estimate is inserted following Appendix B in those report copies that require it and has been omitted in others. This was done to facilitate Navy procurement requirements.

6.0 SCHEDULE

It is estimated that the monitoring and recovery programs can begin approximately 2 weeks following the monitoring and recovery work contract agreement.

The product monitoring and recovery program has the potential to last a minimum of 1 year and a maximum of 3 years. The quarterly monitoring program will last for a minimum of 2 years and a maximum of 4 years. The quarterly monitoring program will extend 1 year past the end of the product monitoring and recovery program.

7.0 DOCUMENTATION

A product monitoring and recovery plan will be provided at the initiation of the monitoring and recovery program. The plan will provide all necessary information for the proper operation and maintenance of the product monitoring and recovery program. The plan will include, at a minimum, the following:

- Material Safety Data Sheets for materials used or being treated;
- monitoring schedule, including sampling frequency, sampling locations, required analyses, and parameters for field measurement; and
- instructions for maintaining a site activity log.

The plan will be assembled and bound in a manner suitable for use in the field.

8.0 PROFESSIONAL REVIEW CERTIFICATION

This RAP was prepared using standard engineering practices and designs. The plan for remediating this site is based on the information collected between June 1992 and August 1993 and engineering detailed in the text and appended to this report. If conditions are determined to exist that are different than those described, the undersigned professional engineer should be notified to evaluate the effects of any additional information on the design described in this report.

This RAP was developed for the Truman Annex site 189, NAS Key West, Florida, and should not be construed to apply to any other site.

Michael K. Dunaway
P.E. No. 39451
Principal Engineer

REFERENCES

ABB Environmental Services, Inc. (ABB-ES), 1992a, Comprehensive Quality Assurance Plan: Tallahassee, Florida.

ABB-ES, 1992b, Contamination Assessment Report, Truman Annex Berthing Wharf Building 189, Naval Air Station, Key West, Florida: prepared for Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), Charleston, South Carolina, February 1992.

ABB-ES, 1993, Contamination Assessment Report Addendum, Electric Power Plant, Building 103, Truman Annex, Naval Air Station Key West, Florida: prepared for SOUTHNAVFACENGCOM, Charleston, South Carolina.

Bouwer, H. 1989, The Bouwer and Rice Slug Test, an Update: Groundwater, vol. 127, p. 304-309.

Florida Department of Environmental Regulation (FDER), 1990, No Further Action and Monitoring Only Guidelines for Petroleum Contaminated Sites, Division of Waste Management Bureau of Waste Cleanup Technical Review Section, Department of Environmental Regulation, October 1990.

FDER, 1992, Division of Waste Management, Guidelines for Assessment and Remediation of Petroleum Contaminated Soils, 39 p., May 1992.

Freeze, R.A., and Cherry, J.A., 1979, Groundwater: Prentice Hall, Inc., Englewood Cliffs, New Jersey, 604 p.

Geraghty & Miller, Inc., 1989, AQTESOLV™, Aquifer Test Design and Analysis: Computer Version 1.00 or 1.01.

McKenzie, D.J., 1990, Water Resources Potential of the Freshwater Lens at Key West, Florida: U.S. Geological Survey Water-Resources Investigations Report 90-4115, 24 p.

Starr, R.C., 1992, Field Hydraulic Test of a Rectangular Enclosure Comprised of Bethlehem Steel PZ22 Sheet Piling: University of Waterloo, Waterloo, Ontario, 5 p.

Testa, S.M., and Winegardner, D.L., 1991, Restoration of Petroleum-Contaminated Aquifers: Lewis Publishers, Chelsea, Michigan, 269 p.

APPENDIX A

LABORATORY ANALYTICAL RESULTS

ENSECO-WADSWORTH/ Laboratories
Division of Corning Lab Services, Inc

5910 Breckenridge Parkway, Suite H 813-621-0784
Tampa, FL 33610 FAX 813-623-6021

ANALYTICAL REPORT

SUBCONTRACT NUMBER: SE1-08-134

TASK ORDER NO: 35

KEY WEST TRUMAN ANNEX

Presented to:

ROGER DURHAM

ABB ENVIRONMENTAL SERVICES, INC.

ENSECO-WADSWORTH/ALERT LABORATORIES

5910 BRECKENRIDGE PARKWAY, SUITE H

TAMPA, FLORIDA 33610

(813) 621-0784

Joanne Anderson
Project Manager

Randall C. Grubbs
Laboratory Director - Florida

July 8, 1993

ENSECO-WADSWORTH/
Laboratories

INVOLVEMENT

This report summarizes the analytical results of the Key West Truman Annex site submitted by ABB Environmental Services, Inc. to Enseco-Wadsworth/ALERT Laboratories who provided independent, analytical services for this project under the direction of Roger Durham. The samples were accepted into Wadsworth's Florida facility on 11 June 1993, in accordance with documented sample acceptance procedures. The Total Organic Carbon analysis was performed by our N. Canton, Ohio facility Lab #E87225. The associated analytical methods and sample results are outlined sequentially in this report.

Analytical results included in this report have been reviewed for compliance with the Laboratory QA/QC Plan as summarized in the Quality Control Section at the rear of the report. Sample custody documentation describing the number of samples and sample matrices is also included. Any qualifications and/or non-compliant items have been noted below.

ENSECO-WADSWORTH/
Laboratories

ANALYTICAL METHODS

Wadsworth/ALERT Laboratories utilizes only USEPA approved analytical methods and instrumentation. The analytical methods utilized for the analysis of these samples are listed below.

PARAMETER	METHOD
MISCELLANEOUS	
Alkalinity	** EPA Method 310.1
Biochemical Oxygen Demand	** EPA Method 405.1
Chloride	** EPA Method 325.3
Chemical Oxygen Demand	** EPA Method 410
Color	** EPA Method 110.2
Dissolved Oxygen	** EPA Method 360.1
Hardness	** EPA Method 130.2
Nitrate-Nitrite Nitrogen	** EPA Method 353.3
Ammonia Nitrogen	** EPA Method 350.2
Oil & Grease	** EPA Method 413.1
Orthophospate	** EPA Method 365.2
Sulfate	** EPA Method 376.1
Total Kjeldhal Nitrogen	** EPA Method 351.3
Total Organic Carbon	** EPA Method 415.1
Total Solids	** EPA Method 160.3
Total Suspended Solids	** EPA Method 160.2

NOTE:	** Indicates usage of this method to obtain results for this report.
(D)	Indicates draft version of this method was used
EPA Methods	Methods for Chemical Analysis of Water and Wastes, USEPA, 600/4-79-020, March, 1983. July, 1982 Drinking Waters USEPA, 600/4-88/039, December, 1988.
Std. Methods	Standard Methods for the Examination of Water and Waste-water, APHA, 16th edition, 1985.
USEPA Methods	From 40CFR Part 136, published in Federal Register on October 26, 1984.
SW846 Methods	Test Methods for Evaluating Solid Waste Physical/Chemical Methods, 3rd Edition, USEPA, 1986.
ASTM Methods	American Society for Testing and Materials.
NIOSH Method	NIOSH Manual of Analytical Methods, National Institute for Occupational Safety and Health, 2nd Edition, April 1977.

ENSECO-WADSWORTH/
Laboratories

COMPANY : ABB ENVIRONMENTAL SERVICES, INC. DATE RECEIVED: 6/11/93
LAB #: 3F1113-1
MATRIX : WATER

SAMPLE ID : BLDG 189-MW-1 KEY WEST/TRUMAN ANNEX

CERTIFICATION #: E84059
HRS84297

METALS ANALYTICAL REPORT
SELECTED LIST

Total metals analysis results - as received

ELEMENT	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Iron	6/21- 6/23/93	4,400	100	ug/l
Manganese	6/21- 6/22/93	ND	50	ug/l

NOTE: ND (None Detected)

ENSECO-WADSWORTH/
Laboratories

COMPANY : ABB ENVIRONMENTAL SERVICES, INC. DATE RECEIVED: 6/11/93
LAB #: 3F1113-1
MATRIX : WATER

SAMPLE ID : BLDG 189-MW-1 KEY WEST/TRUMAN ANNEX
CERTIFICATION #: E84059
HRS84297

ANALYTICAL REPORT

PARAMETER	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Alkalinity (CaCO3 to pH 4.5)	6/27/93	340	5	mg/L
Biochemical Oxygen Demand 5	6/11- 6/16/93	28	2.0	mg/L
Chloride	6/15/93	11,000	1,000	mg/L
Chemical Oxygen Demand	6/16/93	96	20	mg/L
Color	6/11/93	10	5	C.U.
Dissolved Oxygen	6/14/93	4.4	2.0	mg/L
Hardness (CaCO3)	6/16/93	6,400	130	mg/L
Ammonia Nitrogen	6/16/93	ND	0.5	mg/L
Nitrate-Nitrite Nitrogen	6/28/93	ND	0.05	mg/L
Oil and Grease	6/22- 6/24/93	100	5	mg/L
Phosphate Phosphorus	6/25/93	ND	0.1	mg/L
Sulfate	6/14/93	1,600	500	mg/L
Sulfide	6/18/93	32	5	mg/L
Total Dissolved Solids	6/14- 6/15/93	20,000	10	mg/L
Total Kjeldahl Nitrogen	6/16/93	6.0	0.5	mg/L
Total Organic Carbon	6/22/93	18	1	mg/L
Total Solids	6/14- 6/15/93	25,000	5	mg/L
Total Suspended Solids	6/14- 6/15/93	5,500	20	mg/L
Biochemical Oxygen Demand 20	6/11- 7/1/93	39	2.0	mg/L

NOTE: ND (None Detected)

ENSECO-WADSWORTH/
Laboratories

QUALITY CONTROL SECTION

- Quality Control Summary
- Laboratory Blanks
- Laboratory Control Sample
- Matrix Spike/Matrix Spike Duplicate Results
- Sample Custody Documentation

ENSECO-WADSWORTH/
Laboratories

QUALITY ASSURANCE / QUALITY CONTROL
PROGRAM SUMMARY

Wadsworth/ALERT Laboratories considers continuous analytical method performance evaluations to be an integral portion of the data package, and routinely includes the pertinent QA/QC data associated with various analytical result reports. Brief discussions of the various QA/QC procedures utilized to measure acceptable method and matrix performance follow.

Surrogate Spike Recovery Evaluations

Known concentrations of designated surrogate spikes, consisting of a number of similar, non-method compounds or method compound analogues, are added, as appropriate, to routine GC and GC/MS sample fractions prior to extraction and analysis. The percent recovery determinations calculated from the subsequent analysis is an indication of the overall method efficiency for the individual sample. This surrogate spike recovery data is displayed alongside acceptable analytical method performance limits at the bottom of each applicable analytical result report sheet.

NOTE: Acceptable method performance for Base/Neutral Acid extractables is indicated by two (2) of three (3) surrogates for each fraction with a minimum recovery of ten (10) percent each. For Pesticides one (1) of two (2) surrogates meeting performance criteria is acceptable.

Laboratory Analytical Method Blank Evaluations

Laboratory analytical method blanks are systematically prepared and analyzed in order to continuously evaluate the system interferences and background contamination levels associated with each analytical method. These method blanks include all aspects of actual laboratory method analysis (chemical reagents, glassware, etc.), substituting laboratory reagent water or solid for actual sample. The method blank must not contain any analytes above the reported detection limit. The following common laboratory contaminants are exceptions to this rule provided they are not present at greater than five times the detection limit.

Volatiles	Semi-volatiles	Metals
Methylene chloride	Dimethyl phthalate	Calcium
Toluene	Diethly phthalate	Magnesium
2-Butanone	Di-n-butyl phthalate	Sodium
Acetone	Butyl benzyl phthalate	
	Bis (2-ethylhexyl) phthalate	

A minimum of five percent (5%) of all laboratory analyses are laboratory analytical method blanks.

Laboratory Analytical Method Check Sample Evaluations

Known concentrations of designated matrix spikes (actual analytical method compounds) are added to a laboratory reagent blank prior to extraction and analysis. Percent recovery determinations demonstrate the performance of the analytical method. Failure of a check sample to meet established laboratory recovery criteria is cause to stop the analysis until the problem is resolved.

ENSECO-WADSWORTH/
Laboratories

QUALITY ASSURANCE / QUALITY CONTROL
PROGRAM SUMMARY
(cont'd)

At that time all associated samples must be re-analyzed. A minimum of five percent (5%) of all laboratory analyses are laboratory analytical method check samples.

Matrix Spike (MS)/Matrix Spike Duplicate (MSD) Recovery Evaluations

Known concentrations of designated matrix spikes (actual analytical method compounds) are added to two of three separate aliquots of a sequentially predetermined sample prior to extraction and analysis. Percent recovery determinations are calculated from both of the spiked samples by comparison to the actual values generated from the unspiked sample. These percent recovery determinations indicate the accuracy of the analysis at recovering actual analytical method compounds from the matrix. Relative percent difference determinations calculated from a comparison of the MS/MSD recoveries demonstrate the precision of the analytical method. Actual percent recovery and relative percent difference data is displayed alongside their respective acceptable analytical method performance limits in the QA/QC section of the report. The MS/MSD are considered in control when the precision is within established control limits and the associated check sample has been found to be acceptable. A minimum of ten percent (10%) of all analyses are MS/MSD quality control samples.

**********EXAMPLE**********

COMPOUND	SAMPLE CONC.	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS RECOVERY
4,4'-DDT	0	95	112	16	22	66-119
Benzene	10	86	93	8	20	39-150
(cmpd. name)	sample result	1st% recov.	2nd% recov.	Rel.% diff.	accep. method perform range	

Analytical Result Qualifiers

The following qualifiers, as defined below, may be appended to analytical results in order to allow proper interpretation of the results presented:

J - indicates an estimated concentration (typically used when a dilution, matrix interference or instrumental limitation prevents accurate quantitation of a particular analyte).

B - indicates the presence of a particular analyte in the laboratory blank analyzed concurrently with the samples. Results must be interpreted accordingly.

DIL - indicates that because of matrix interferences and/or high analyte concentrations, it was necessary to dilute the sample to a point where the surrogate or spike concentrations fell below a quantifiable amount and could not be reported.

ENSECO-WADSWORTH/
Laboratories

COMPANY : ABB ENVIRONMENTAL SERVICES, INC. DATE RECEIVED: 6/11/93
LAB #: 3F1113-BK
MATRIX : WATER

SAMPLE ID : LABORATORY BLANK

CERTIFICATION #: E84059
HRS84297

METALS ANALYTICAL REPORT
SELECTED LIST

Total metals analysis results - as received

ELEMENT	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Iron	6/21- 6/23/93	ND	100	ug/
Manganese	6/21- 6/22/93	ND	50	ug/

NOTE: ND (None Detected)

ENSECO-WADSWORTH/
Laboratories

COMPANY : ABB ENVIRONMENTAL SERVICES, INC. DATE RECEIVED: 6/11/93
LAB #: 3F1113-BK
MATRIX : WATER

SAMPLE ID : LABORATORY BLANK

CERTIFICATION #: E84059
HRS84297

ANALYTICAL REPORT

PARAMETER	PREPARATION - ANALYSIS DATE	RESULT	DETECTION LIMIT	
Alkalinity (CaCO3 to pH 4.5)	6/27/93	ND	5	mg/L
Biochemical Oxygen Demand 5	6/11- 6/16/93	ND	2.0	mg/L
Chloride	6/15/93	ND	5	mg/L
Chemical Oxygen Demand	6/16/93	ND	20	mg/L
Color	6/11/93	ND	5	C.U.
Dissolved Oxygen	6/14/93	2.2	2.0	
Hardness (CaCO3)	6/16/93	ND	5	mg/L
Ammonia Nitrogen	6/16/93	ND	0.5	mg/L
Nitrate-Nitrite Nitrogen	6/28/93	ND	0.05	mg/L
Oil and Grease	6/22- 6/24/93	ND	5	mg/L
Phosphate Phosphorus	6/25/93	ND	0.1	mg/L
Sulfate	6/14/93	ND	5	mg/L
Sulfide	6/18/93	ND	1.0	mg/L
Total Dissolved Solids	6/14- 6/15/93	ND	5	mg/L
Total Kjeldahl Nitrogen	6/16/93	ND	0.5	mg/L
Total Organic Carbon	6/22/93	ND	1	mg/L
Total Solids	6/14- 6/15/93	ND	5	mg/L
Total Suspended Solids	6/14- 6/15/93	ND	5	mg/L
Biochemical Oxygen Demand	6/11 - 7/1/93	ND	2.0	mg/L

NOTE: ND (None Detected)

ENSECO-WADSWORTH/
Laboratories

LAB ID : LCS MATRIX : WATER

LABORATORY CONTROL SAMPLE RESULTS
METALS

ELEMENT	DATE PREPARED	DATE ANALYZED	LCS %REC	QC LIMITS RPD	QC LIMITS %REC	
Iron	06/21/93	06/23/93	104	18	84-119	LCS
Manganese	06/21/93	06/22/93	106	15	87-117	

ENSECO-WADSWORTH/
Laboratories

LAB ID : LCS

MATRIX : WATER

LABORATORY CONTROL SAMPLE RESULTS
WET CHEMISTRY

PARAMETER	DATE PREPARED	DATE ANALYZED	LCS %REC	QC LIMITS RPD	QC LIMITS %REC
Total Suspended Solids	06/14/93	06/15/93	105	32	68-132
Total Dissolved Solids	06/14/93	06/15/93	92	15	80-112
Hardness	06/16/93	06/16/93	102	10	90-112
Chloride	06/15/93	06/15/93	107	15	86-117
Sulfate	06/14/93	06/14/93	91	11	82-105
Total Solids	06/14/93	06/15/93	97	20	80-120
Total Kjeldahl Nitrogen	06/16/93	06/16/93	108	10	92-109
Oil & Grease (grav)	06/22/93	06/24/93	111	20	85-125
Phosphate Phosphorus	06/25/93	06/25/93	120	30	66-126
Total Alkalinity as CaCO3	06/27/93	06/27/93	96	17	85-110
Nitrate Nitrogen	06/28/93	06/28/93	100	21	76-119
Ammonia Nitrogen	06/16/93	06/16/93	100	16	86-119

ENSECO-WADSWORTH/
Laboratories

LAB ID: LCS
MATRIX: WATER

DATE PREPARED: 06/22/93
DATE ANALYZED: 06/22/93

LABORATORY CONTROL SAMPLE RESULTS
WET CHEMISTRY

PARAMETER	LCS % REC	QC LIMITS % REC
Total Organic Carbon	113	80-119

ENSECO-WADSWORTH/
Laboratories

LAB ID : LCS

MATRIX : WATER

LABORATORY CONTROL SAMPLE RESULTS
WET CHEMISTRY

PARAMETER	DATE PREPARED	DATE ANALYZED	LCS %REC	QC LIMITS RPD	QC LIMITS %REC	
Chemical Oxygen Demand	06/16/93	06/16/93	96	19	85-123	LCS
Biochemical Oxygen Demand	06/11/93	06/16/93	92	46	54-147	
Sulfide	06/18/93	06/18/93	76	15	66-95	

ENSECO-WADSWORTH/
Laboratories

LAB ID : 3F1113-1 DATE RECEIVED : 06/11/93
MATRIX : WATER

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY
INORGANIC PARAMETERS - METALS

ELEMENT	DATE PREPARED	DATE ANALYZED	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS %REC	LAB ID
Iron	06/21/93	06/23/93	*	*		19	82-121	3F1113-1
Manganese	06/21/93	06/22/93	92	88	4	18	83-119	

* = Diluted out

ENSECO-WADSWORTH/
Laboratories

LAB ID : 3F1113-2
MATRIX : WATER

DATE RECEIVED : 06/11/93

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY
INORGANIC PARAMETERS - METALS

ELEMENT	DATE PREPARED	DATE ANALYZED	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS %REC	LAB ID
Iron	06/21/93	06/23/93	104	108	4	19	82-121	3F1113-2
Manganese	06/21/93	06/22/93	90	92	2	18	83-119	

* = Diluted out

ENSECO-WADSWORTH/
Laboratories

LAB ID: 3F1113-1
MATRIX: WATER

DATE RECEIVED: 06/11/93
DATE PREP'D: 06/11/93 - 06/16/93
DATE ANALYZED: 06/11/93 - 06/16/93

DUPLICATE

COMPOUND	SAMPLE	DUPLICATE	RPD
Dissolved Oxygen	4.4	4.4	0
Dissolved Oxygen	3.3	3.3	0
Total Suspended Solids	5,500	5,400	2
Total Suspended Solids	1,300	1,200	8
Total Solids	25,000	25,000	0
Total Solids	11,000	1,0000	0
Total Dissolved Solids	20,000	21,000	5
Total Dissolved Solids	10,000	9,900	1
Biochemical Oxygen Demand	28	27	4
Biochemical oxygen Demand	35	34	3

ENSECO-WADSWORTH/
Laboratories

LAB ID : 3F1113-1
MATRIX : WATER

DATE RECEIVED : 06/11/93

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY
INORGANIC PARAMETERS - WET CHEMISTRY

PARAMETER	DATE PREPARED	DATE ANALYZED	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS %REC	LAB ID
Sulfate	06/14/93	06/14/93	94	92	2	10	87-104	3F1113-1
Sulfate	06/14/93	06/14/93	100	98	2	10	87-104	
Ammonia Nitrogen	06/16/93	06/16/93	101	100	1	20	77-127	
Ammonia Nitrogen	06/16/93	06/16/93	100	98	2	20	77-127	
Hardness	06/16/93	06/16/93	99	99	0	22	78-122	
Hardness	06/16/93	06/16/93	100	102	2	22	78-122	
Chloride	06/15/93	06/15/93	64	66	3	12	90-114	
Chloride	06/15/93	06/15/93	130	130	0	12	90-114	
Phosphate Phosphorus	06/25/93	06/25/93	136	107	24	33	50-141	
Phosphate Phosphorus	06/25/93	06/25/93	101	91	10	33	50-141	
Total Alkalinity as CaCO3	06/27/93	06/27/93	90	77	16	17	85-110	
Total Alkalinity as CaCO3	06/27/93	06/27/93	62	70	12	17	85-110	

* = Diluted out

ENSECO-WADSWORTH/
Laboratories

LAB ID : 3F1113-1 DATE RECEIVED : 06/11/93
MATRIX : WATER

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY
INORGANIC PARAMETERS - WET CHEMISTRY

PARAMETER	DATE PREPARED	DATE ANALYZED	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS %REC	LAB ID
Nitrate Nitrogen	06/28/93	06/28/93	106	109	3	14	67-118	3F1113-1
Nitrate Nitrogen	06/28/93	06/28/93	95	101	6	14	67-118	

* = Diluted out

ENSECO-WADSWORTH/
Laboratories

LAB ID : 3F1113-1
MATRIX : WATER

DATE RECEIVED : 06/11/93

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY
INORGANIC PARAMETERS - WET CHEMISTRY

PARAMETER	DATE PREPARED	DATE ANALYZED	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS %REC	LAB ID
Sulfide	06/18/93	06/18/93	72	70	3	14	46-117	3F1
Sulfide	06/18/93	06/18/93	66	66	0	14	46-117	

* = Diluted out

ENSECO-WADSWORTH/
Laboratories

LAB #: 3F1113-4
MATRIX: WATER

DATE EXTRACTED: 06/22/93
DATE ANALYZED: 06/22/93

MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

COMPOUND	MS %REC	MSD %REC	RPD	QC LIMITS RPD	QC LIMITS RECOVERY
Total Organic Carbon	86	92	7	19	56-131

ENSECO-WADSWORTH/ALERT LABORATORIES
SAMPLE SHIPPER EVALUATION AND RECEIPT FORM

Client: ABB Project Name/Number: Bldg 103 & 189

Samples Received By: [signature] (Signature) Date Received: 6-11-93

Sample Evaluation Form By: [signature] (Signature) LAB No: 3F1113 / 7137

Type of shipping container samples received in? WAL Cooler ✓

Client Cooler ____ WAL Shipper ____ Box ____ Other ____

Any "NO" responses or discrepancies should be explained in comments section.

		YES	NO
1.	Were custody seals on shipping container(s) intact?	✓	
2.	Were custody papers properly included with samples?	✓	
3.	Were custody papers properly filled out (ink, signed, match labels)?	✓	
4.	Did all bottles arrive in good condition (unbroken)?	✓	
5.	Were all bottle labels complete (Sample No., date, signed, analysis preservatives)?	✓	
6.	Were correct bottles used for the tests indicated?	✓	
7.	Were proper sample preservation techniques indicated?	✓	
8.	Were samples received within adequate holding time?	✓	
9.	Were all VOA bottles checked for the presence of air bubbles? (If air bubbles were found indicate in comment section)	✓	
10.	Were samples in direct contact with wet ice? (NOTE TEMPERATURE BELOW)	✓	
11.	Were samples accepted into the laboratory? (If no see comments)	✓	

Cooler # B91 Temp 8 °C Cooler # B500 Temp 5°C °C

Cooler # 230 Temp 5 °C Cooler # ~~R102~~ Temp ~~3°C~~ °C

Comments: COLOR, DO received out of hold time. B527 3°C Bottles have Fe & Mn on labels while COC only states MN is wanted. Lab will assume Fe wanted also.

WADSWORTH/ALERT LABORATORIES
Sampling, testing, mobile labs

5910 Breckenridge Pkwy.
Suite H
Tampa, FL 33610

(813) 621-0784
Fax (813) 623-6021

Chain of Custody Record

Record ____ of ____

08140

Client:

Project Name / Location

Sampler(s)

Project #:

Item #	Date	Time	MATRIX	Sample Location	No. Of CON-TAINERS	VOC	BNA	METALS	TRPH	EDB									Remarks
1			GW		15	1	1	1	1	1	1	2	1	1	1	1	1	1	1
2					5	1	1	1	1	1	1	2	1	1	1	1	1	1	1
3					5	1	1	1	1	1	1	2	1	1	1	1	1	1	1
4					5	1	1	1	1	1	1	2	1	1	1	1	1	1	1
5																			
6																			
7																			
8																			
9																			
10																			
11																			

Parameter

Total Containers (4)

Number of Coolers in Shipment 1

Bailers

Report To:

Additional Comments:

Transfer Number	Item Number(s)	Relinquished By / Company	Accepted By / Company	Date	Time
1	1-4				
2					
3					
4					
5					
6					

Original Accompanies Shipment

ABB

ABB ENVIRONEMTNAL SERVICES, INC.
TREATABILITY LABORATORY
ANALYSIS REPORT

Project: NAS-Key West

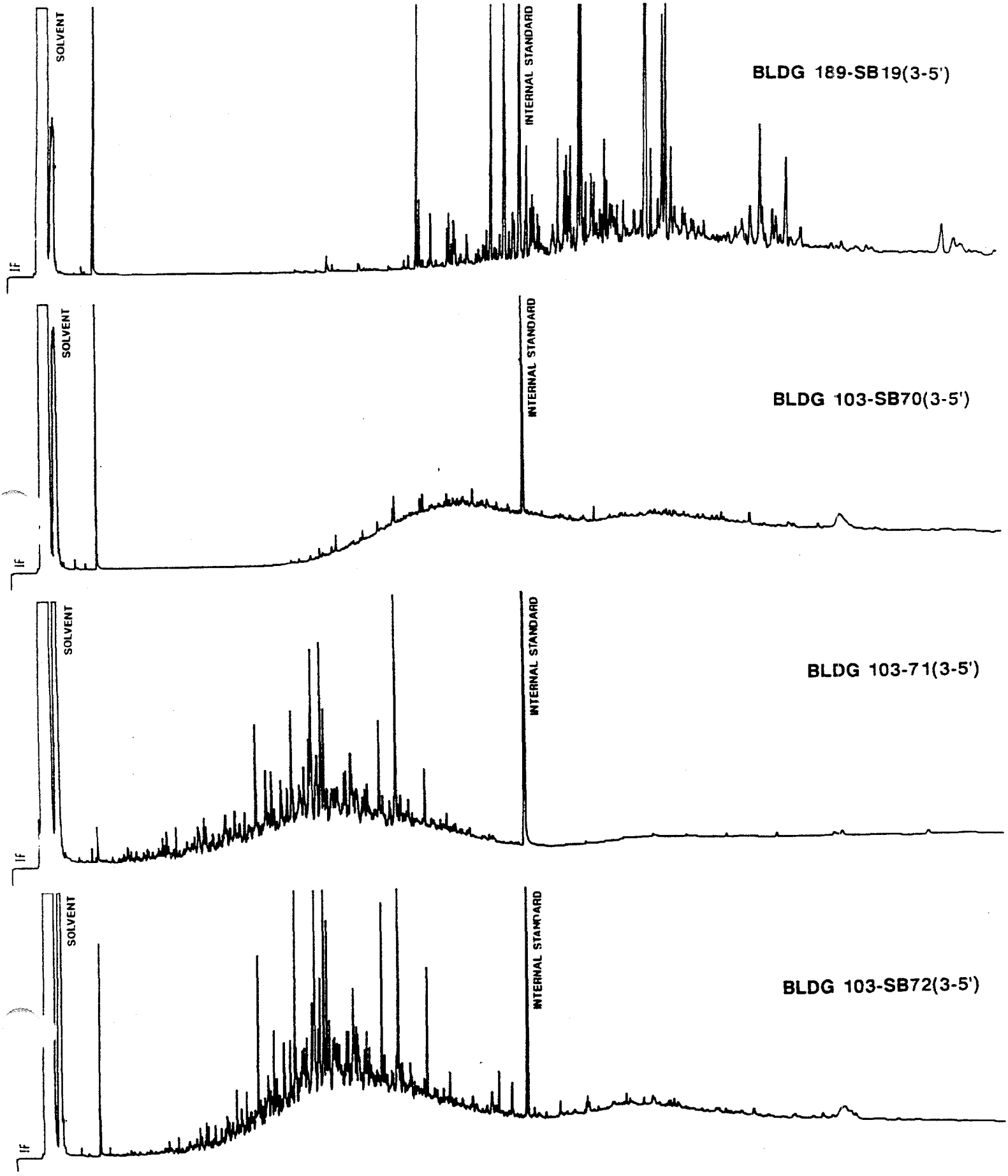
Sample ID	Date Sampled	Total Bacteria (CFU/mL)	Hydrocarbon Bacteria (CFU/mL)	pH
BLDG 189-MW1	6/9/93	6.3×10^5	3.3×10^5	6.8
BLDG 103-MW3	6/9/93	3.8×10^5	1.7×10^5	6.8
BLDG 103-MW12	6/9/93	<333	<33	6.8
BLDG 103-MW14	6/9/93	1.2×10^5	9.5×10^5	6.8
Sample ID	Date Sampled	Total Bacteria (CFU/mL)	Hydrocarbon Bacteria (CFU/mL)	pH
BLDG 189-SB19 (3-5')	6/10/93	<333	<33	9.5
BLDG 103-SB70 (3-5')	6/10/93	2.7×10^6	6.7×10^5	8.0
BLDG 103-SB71 (3-5')	6/10/93	3.6×10^5	1.7×10^5	8.0
BLDG 103-SB72 (3-5')	6/10/93	7.0×10^7	6.7×10^6	8.0

CFU ; Colony Forming Units

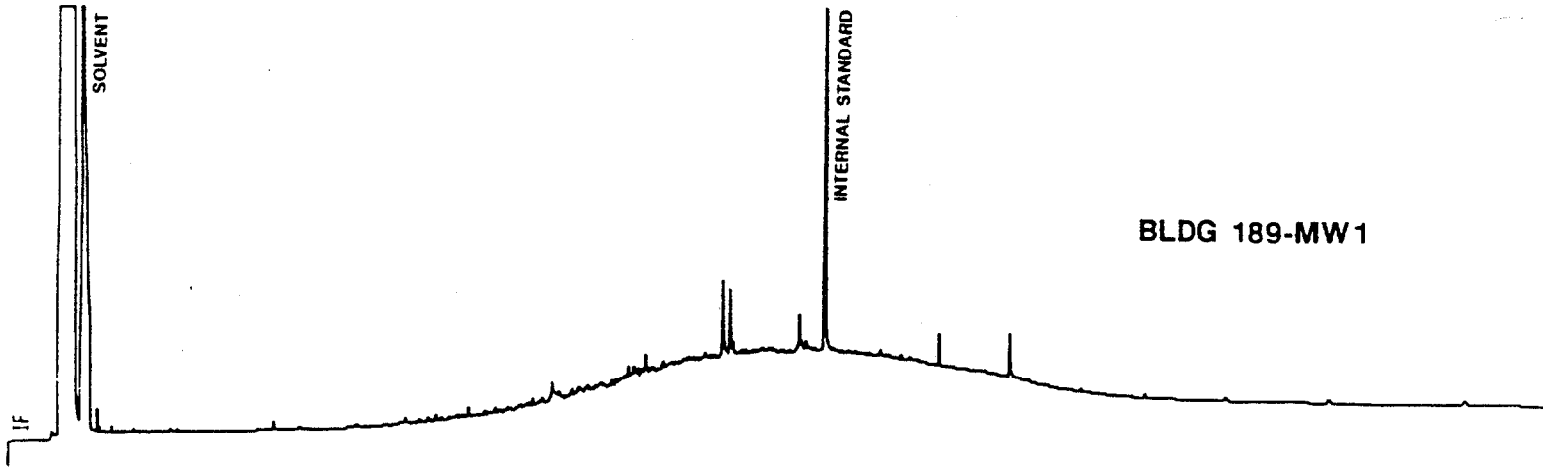
ABB Environmental Services, Inc.

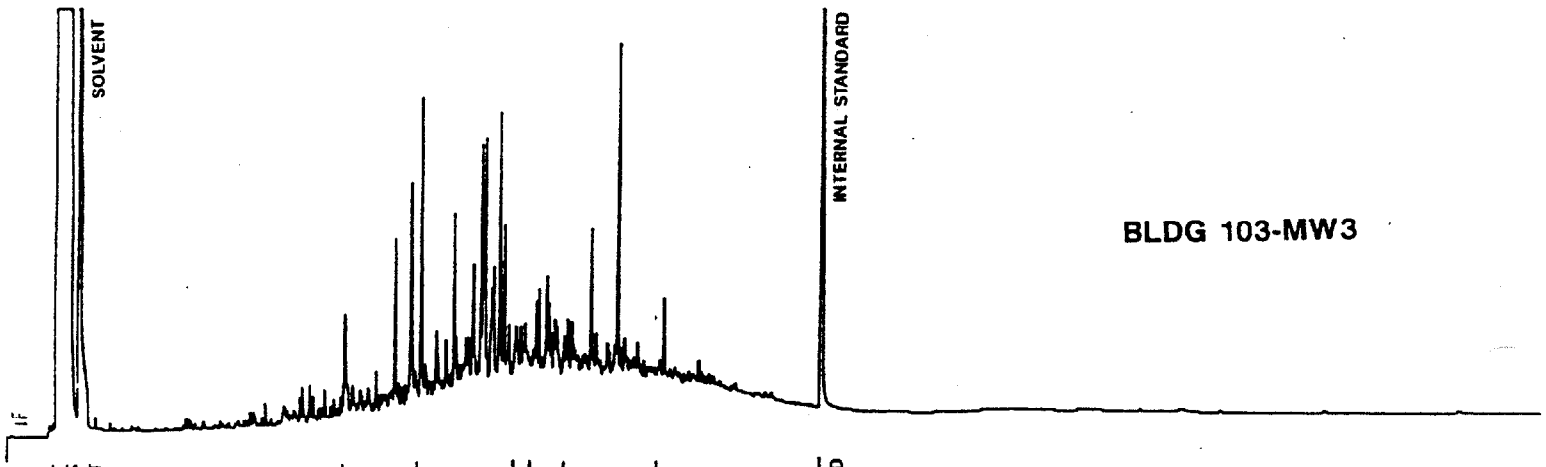
Northeast Region
Corporate Place 128
107 Audubon Road
Wakefield, MA 01880
Tel. (617) 245-6606
Fax (617) 246-5060

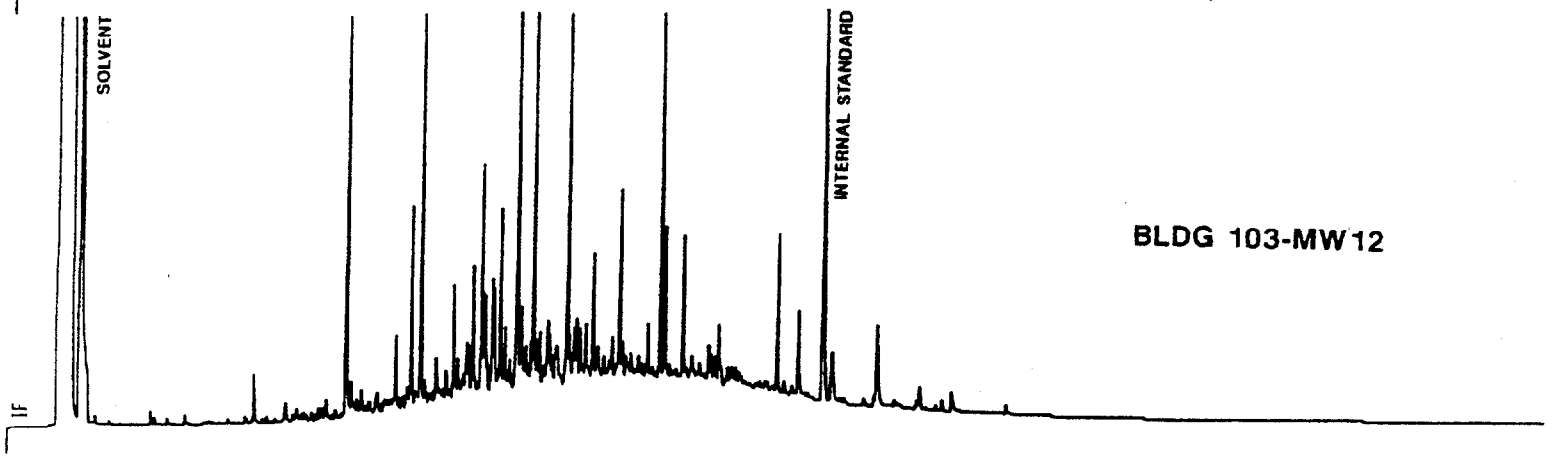
PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West

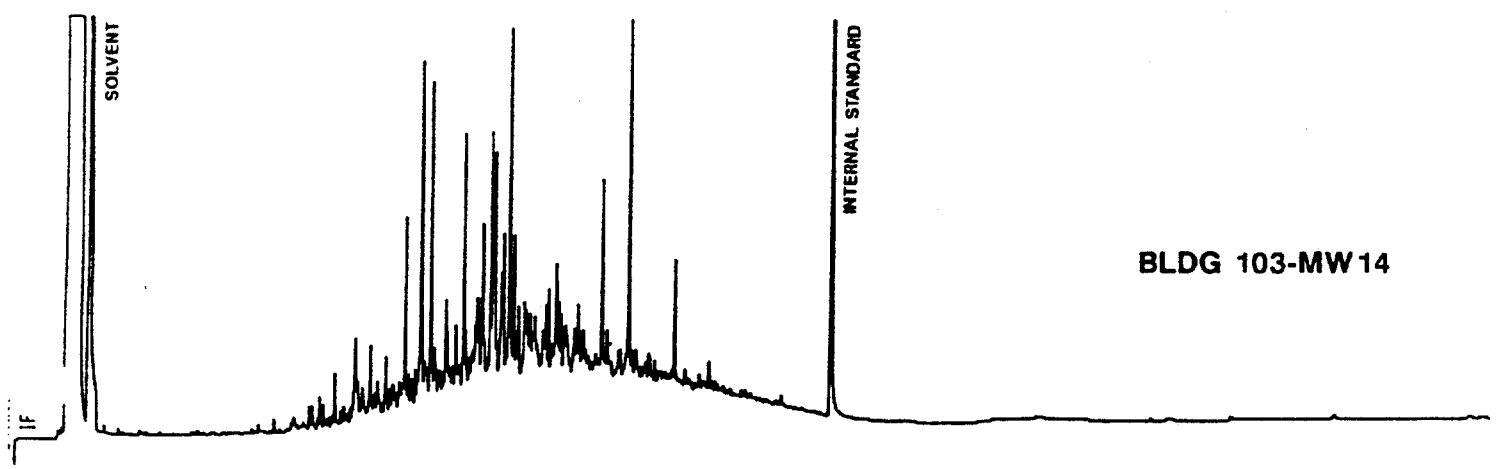


PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West

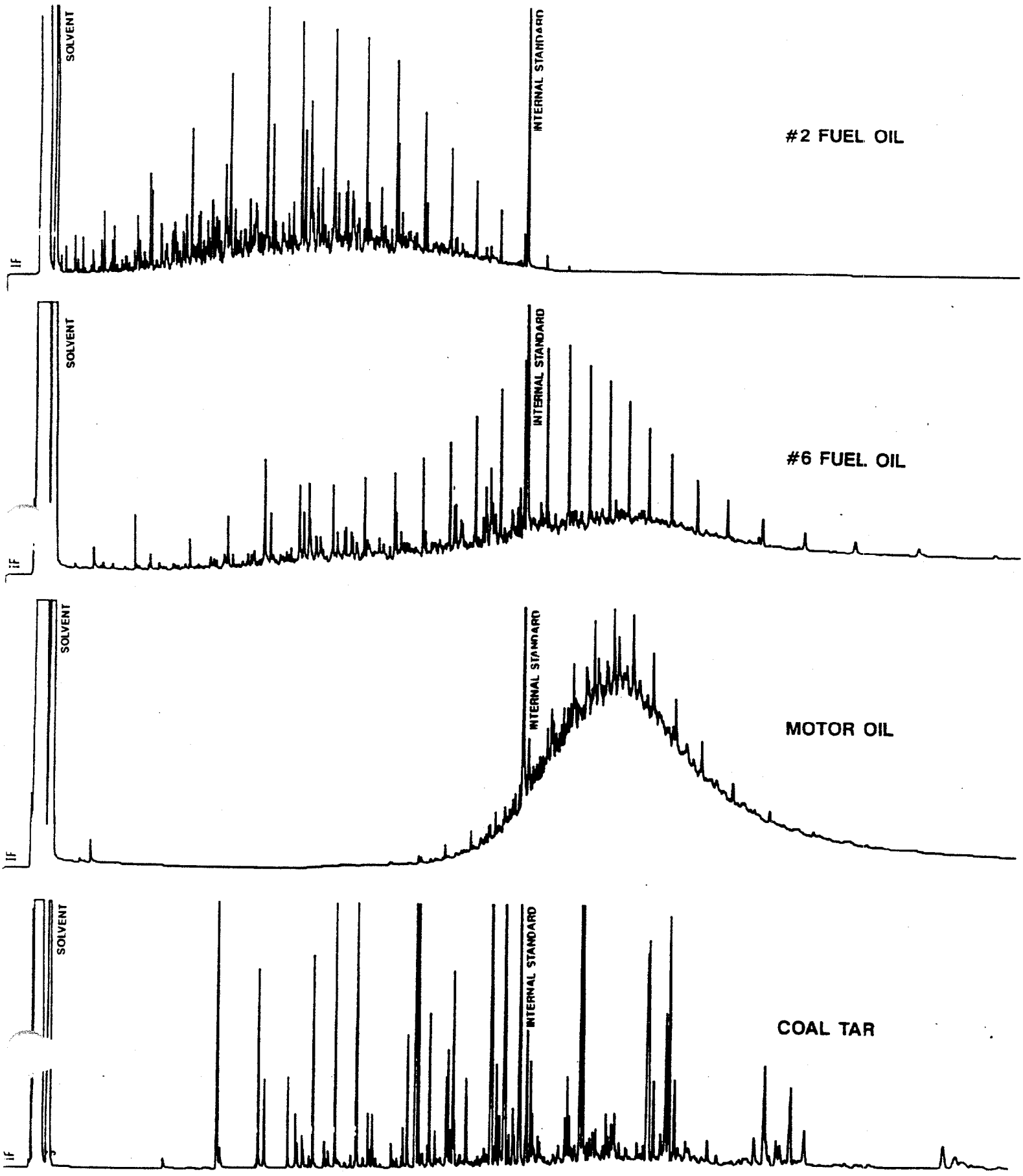




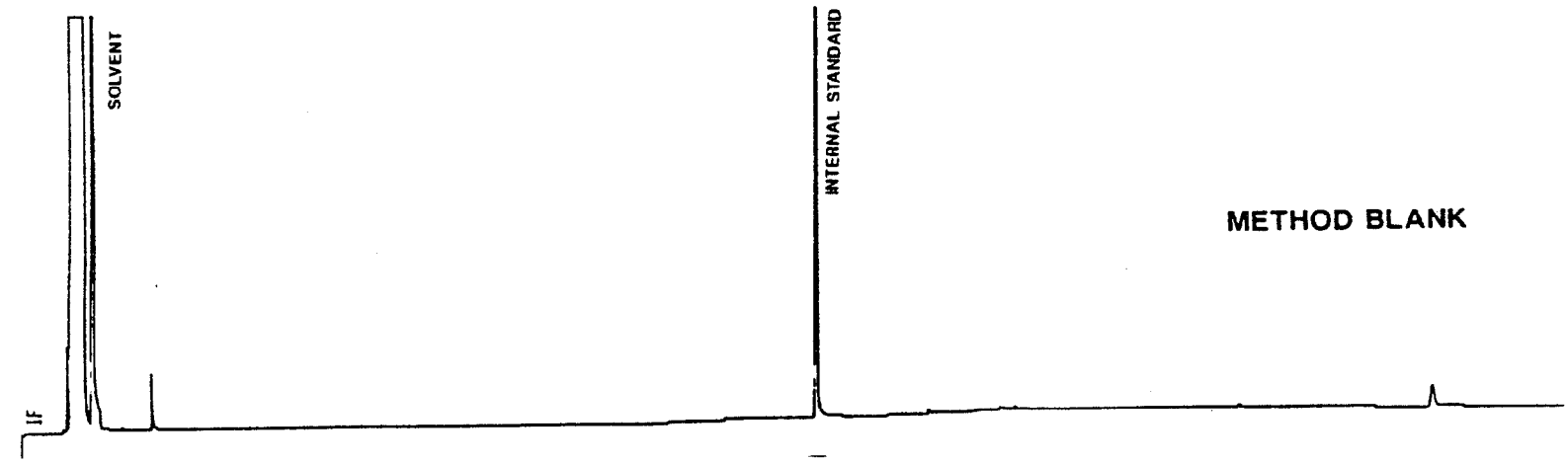


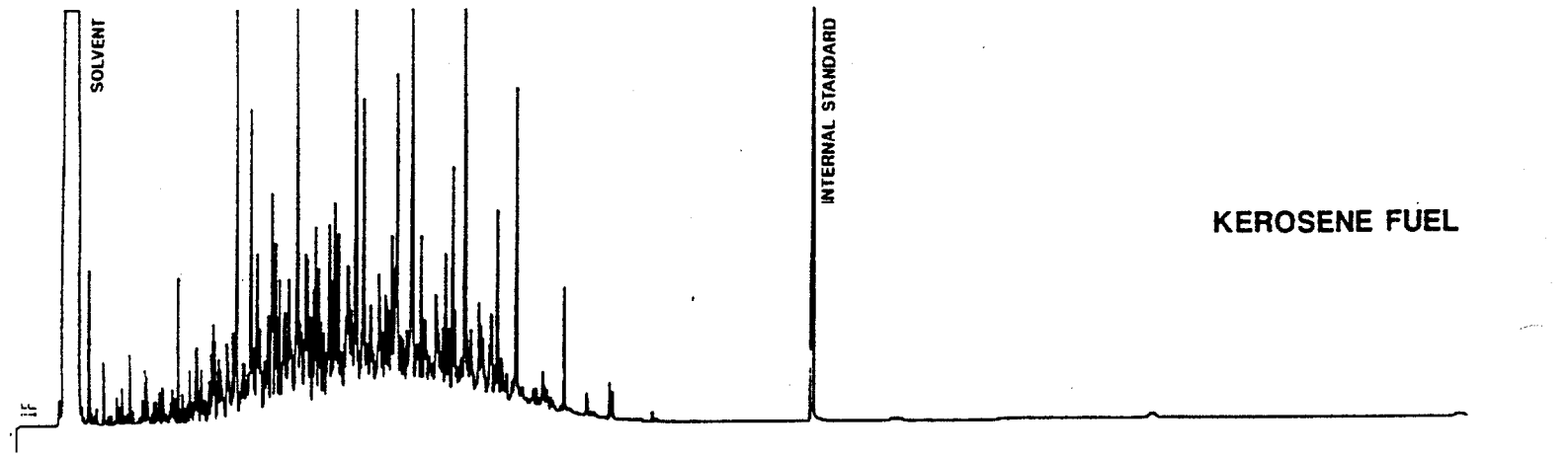


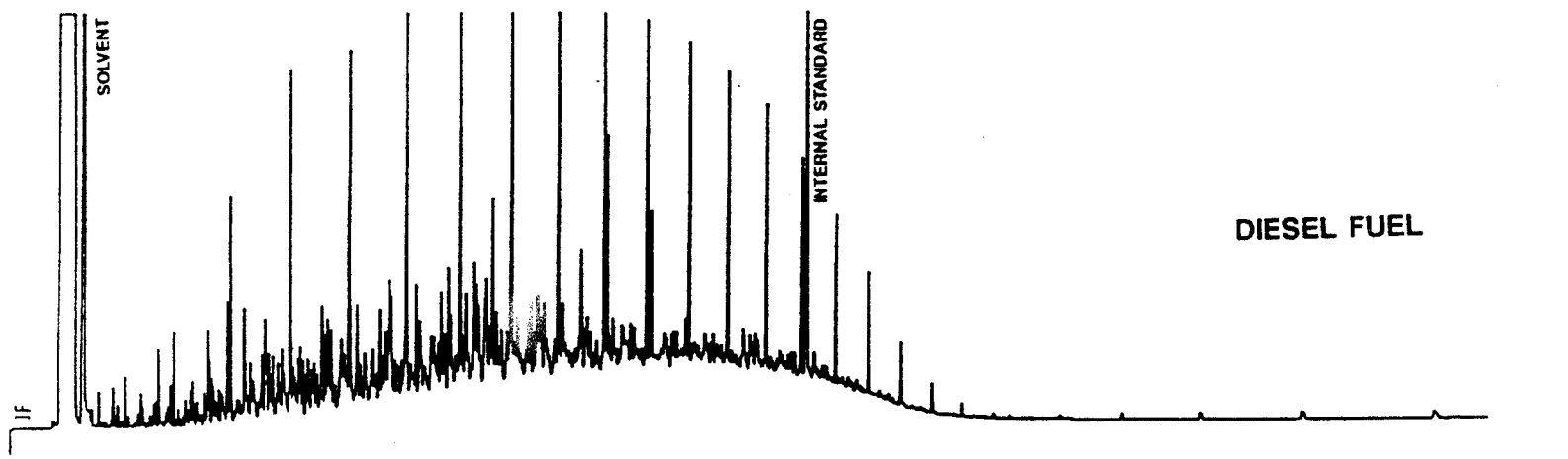
PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West

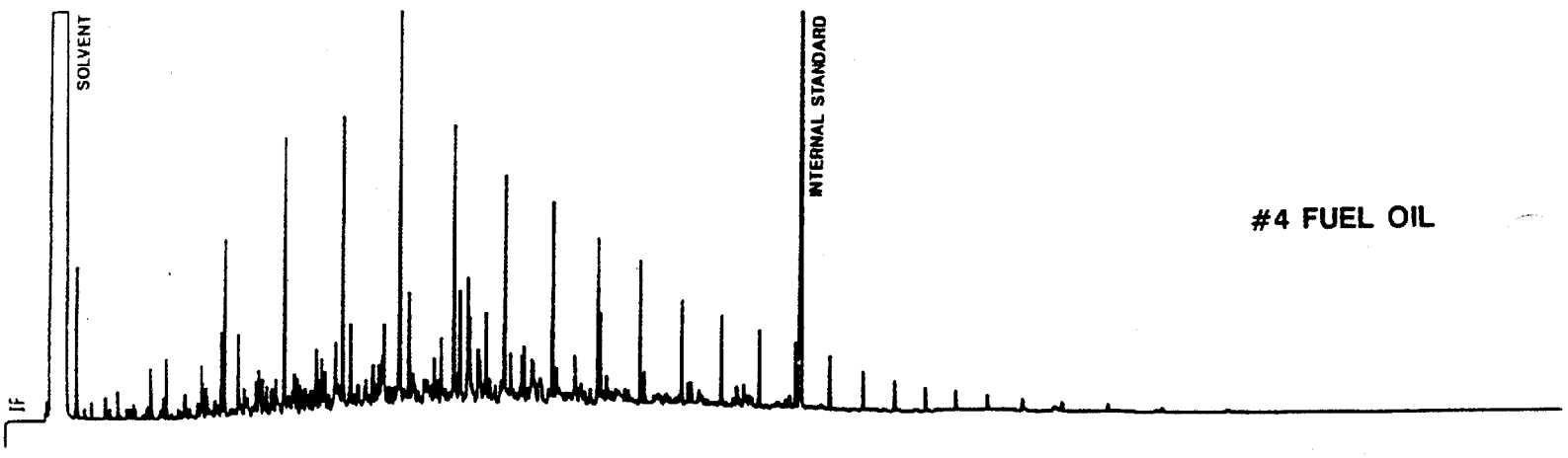


PETROLEUM FINGERPRINT
MODIFIED METHOD 3550/8100
Project: NAS-Key West









APPENDIX B

BASIS OF DESIGN

BASIS OF DESIGN

The purpose of this Remedial Action Plan (RAP) is to present a plan for remediation of petroleum contamination at the Truman Annex, adjacent to Building 189, in accordance with the requirements of Chapter 17-770, Florida Administrative Code (FAC). Implementation of the RAP will include the following tasks:

- program that monitors and recovers free product and that can adjust monitoring frequency based on the frequency of product discovery, and
- quarterly monitoring of the site for up to 1 year following the completion of a product monitoring and recovery program.

Based on field data and laboratory analytical results, as presented in the Contamination Assessment Report (CAR) and CAR Addendum, site conditions are as follows. Groundwater depths range approximately from 5 to 7 feet below land surface (bls). Groundwater flow direction near the site is generally to the west toward the bulkhead with some gradient reversals due to tidal influence. Ground elevations at the site are approximately 10 feet above msl. The calculated hydraulic conductivity in the surficial aquifer varies from 2.9 ft/day to 8.1×10^{1} ft/day. The average high and low tide hydraulic gradient is approximately 8.5×10^{-3}. The surficial aquifer in the Key West area is unconfined. The surficial aquifer is contained within the Miami Limestone, the underlying Key Largo Limestone, and surficial fill materials. The surficial aquifer contains a small freshwater lens that floats on the saline groundwater. The lens, which is very thin (from less than 1 foot near the edge to an average of 5 feet near the center), is located below the center of the western half (Old Town) of the island. Water quality data indicate that the lens is an unlikely source of potable water (McKenzie, 1990).

Excessive soil contamination was not detected at the site; therefore, a soil remedial system is not recommended.

Total recoverable petroleum hydrocarbon (TRPH) and pyrene were the only contaminants detected in groundwater samples collected in June 1993. TRPH concentrations did not exceed the State target level of 100 milligrams per liter (mg/ℓ) for source wells for G-III waters in samples collected from monitoring wells MW-1, MW-2, and MW-10. Pyrene was detected only in the sample collected from monitoring well MW-2, at a concentration of 19 ppb.

Free product as a source of groundwater contamination in the area is the greatest threat. Free product droplets have been observed in MW-3 with an estimated maximum *in situ* thickness of 0.01 foot. The product covers a small area and represents a residual amount of hydrocarbon to be extracted from the groundwater. Due to the viscous nature of the product, believed to be Bunker C fuel oil, groundwater recovery was not considered likely to be effective.

These site characteristics along with the small amount of free product in a contained environment, with the TRPH concentrations qualifying for monitoring only status for source wells for G-III waters, did not warrant development of a costly treatment system scenario.

COST ESTIMATE

for

Remedial Action Plan

at

Naval Air Station Key West, Florida

```
** BASIC INFORMATION **
 00 1  1   8
 01 PRELIMINARY
 02
 03 BUILDING 189, TRUMAN ANNEX
 04
 05 KEY WEST, FLORIDA
 06 N2
 07   /  /
 08 BLAKE G. SVENDSEN
 09    100000.00
 10       1.00
 11 EA
 12 01/21/92
 13 02
** PRIME CONTRACTOR MARKUP **
 14 A XXXXX  0.0 35.5  0.0  2 17  2 10 10 10 1.50  0.0  0.00   0.0  0.00  0.00  0.00
** SUBCONTRACTOR MARKUP **
 15 A XXXXX  0.0 35.5  0.0  2 17  2 10 10 10  5  5  5  5  5  5  1.50  0.0  0.00  0.0  0.00  0.00  0.00
** END ITEMS **
```

WBS	ITEM	QTY	UM	R	SPEC	SSPEC	GRP	MATL	LABR	EQP	DESC
3301	AAAAAA	1.00	LS					0.00	0.00	0.00	MOBILIZATION AND PREPARA TORY WORK
330101	AAAAAA	1.00	LS					0.00	0.00	0.00	MOBILIZATION OF CONSTRUC TION EQP AND FA CILITIES
.0101	AAAAAA	1.00	HR					0.00	0.00	0.00	TRANSPORT VEHICLES OWNER SHIP/OPERATION
33010101	ABB002	4.00	EA		13900	13900	SA	0.00	2202.00	0.00	MOB TO SITE FOR SAMPLING AND LABOR YEAR 1
33010101	ABB002	4.00	EA		13900	13900	SA	0.00	2202.00	0.00	MOB TO SITE FOR SAMPLING AND LABOR SUBS EQUENT YE AR
33010101	SYSDC	0.00						0.00	0.00	0.00	EQUIPMENT MOBILIZATION
330103	AAAAAA	4.00	EA					0.00	0.00	0.00	SAMPLING REPORTS
330103	ABB001	8.00	EA		13900	13900	SA	0.00	1545.00	198.00	QUARTERLY SAMPLING REPOR TS
330103	SYSDC	0.00						0.00	0.00	0.00	SAMPLING REPORTS
3302	AAAAAA	1.00	LS					0.00	0.00	0.00	MONITORING, SAMPLING, TE STING, AND ANAL YSIS
330204	AAAAAA	1.00	EA					0.00	0.00	0.00	MONITORING WELLS
33020419	AAAAAA	1.00	LS					0.00	0.00	0.00	OPERATION AND MAINTENANC E
33020419	ABB001	4.00	EA		13900	13900	SA	1060.00	0.00	0.00	O & M OTHER EXPENDABLES YEAR 1
33020419	ABB002	4.00	EA		13900	13900	SA	1060.00	0.00	0.00	O & M OTHER EXPENDABLES SUBSEQUENT YEAR
33020419	SYSDC	0.00						0.00	0.00	0.00	OPERATION AND MAINTENANC E
330205	AAAAAA	1.00	EA					0.00	0.00	0.00	SAMPLING SURFACE WATER/G ROUND WATER/LIQ UID WASTE
330205	AAAAAA	1.00	YR					0.00	0.00	0.00	PRODUCT MONITORING AND R ECOVERY

** END ITEMS **

WBS	ITEM	QTY	UM	R SPEC	SSPEC	GRP	MATL	LABR	EQP	DESC
33020501	AAAAAA	1.00	YR				0.00	0.00	0.00	MANUAL PRODUCT RECOVERY
33020501	CON001	6.00	EA	13900	13900	PR	230.00	300.00	85.00	PRODUCT RECOVERY YEAR 1
33020501	CON002	1.00	YR	13900	13900	PR	400.00	300.00	240.00	CONTAINMENT AND DISPOSAL FOR 1 DISPOSAL FOR 1 YE AR
33020501	SYSDC	0.00					0.00	0.00	0.00	PRODUCT MONITORING AND R ECOVERY
33020502	AAAAAA	1.00	EA				0.00	0.00	0.00	GROUND WATER
33020502	ABB001	4.00	EA	13900	13900	SA	8757.50	0.00	0.00	GROUNDWATER SAMPLING YEAR 1
33020502	ABB002	4.00	EA	13900	13900	SA	8757.50	0.00	0.00	GROUNDWATER SAMPLING SUBSEQUENT YEAR
33020502	SYSDC	0.00					0.00	0.00	0.00	GROUND WATER

UMMARY REPORT
ORK BREAKDOWN
MINARY

PRINTING DATE : 07/29/94 8
DATABASE USED : 01/21/92 02
PAGE NUMBER : 1
ESTIMATE NAME : KEYWEST

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
LOCATION: KEY WEST, FLORIDA
ESTIMATORS: BLAKE G. SVENDSEN
PROJECT SIZE: 1.00 EA
AUTHORIZED CONSTRUCTION FUNDS: 100,000.00

CAT CODE:
UIC: N2
P-NO.:
DATE OF ESTIMATE: 07/29/94
BID DATE: / /

	COST/ WBS BASED ON 1.00	WBS UNITS	U/M	COST/WBS UNIT	TOTAL MU MATL COST	TOTAL MU LABOR COST	TOTAL MU EQUIP COST	TOTAL CONTRACT COST
ENVIRONMENTAL								
01 MOBILIZATION AND PREPARA								
30101 MOBILIZATION OF CONSTRUC		1.00	LS	31,180.32	0	31,180	0	31,180
330103 SAMPLING REPORTS		4.00	EA	5,920.35	0	21,877	1,804	23,681
3302 MONITORING, SAMPLING, TE								
30204 MONITORING WELLS		1.00	EA	9,658.72	9,659	0	0	9,659
330205 SAMPLING SURFACE WATER/G		1.00	EA	86,397.01	81,826	3,717	854	86,397
SUBTOTAL ENVIRONMENTAL					91,484	56,775	2,658	150,917
TAL ESTIMATE CONTRACT					91,484	56,775	2,658	150,917
TOTAL ESTIMATE CONTRACT (ROUNDED)								151,000

INPUT REPORT
MARK-UP
MINARY

PRINTING DATE : 07/29/94 8
DATABASE USED : 01/21/92 02
PAGE NUMBER : 1
ESTIMATE NAME : KEYWEST

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
LOCATION: KEY WEST, FLORIDA
ESTIMATORS: BLAKE G. SVENDSEN
PROJECT SIZE: 1.00 EA
AUTHORIZED CONSTRUCTION FUNDS: 100,000.00

CAT CODE:
UIC: N2
P-NO.:
DATE OF ESTIMATE: 07/29/94
BID DATE: / /

PRIME MARK-UP

DESIGN CONTINGENCIES	0.00%		
TAX ON MATERIAL	0.0%		
TAX & INSURANCE ON LABOR	35.5%		
TAX ON EQUIPMENT	0.0%		
PRIME OVERHEAD	MAT'L	LABOR	EQUIP
	2%	17%	2%
PRIME PROFIT	MAT'L	LABOR	EQUIP
	10%	10%	10%
BOND	1.50%		
MISC. TAXES	0.0%		
CQC	0.00%		
ESCALATION	0.0%		
PCAS	0.00%		
CONT	0.00%		
SIOH	0.00%		
MATERIAL COMPOSITE MARK-UP	1.139		
LABOR COMPOSITE MARK-UP	1.770		
EQUIPMENT COMPOSITE MARK-UP	1.139		

SPECIFICATION SECTIONS
MARKED UP FOR PRIME

XXXXX

SUB MARK-UP A

DESIGN CONTINGENCIES	0.00%		
TAX ON MATERIAL	0.0%		
TAX & INSURANCE ON LABOR	35.5%		
TAX ON EQUIPMENT	0.0%		
SUB OVERHEAD	MAT'L	LABOR	EQUIP
	2%	17%	2%
SUB PROFIT	MAT'L	LABOR	EQUIP
	10%	10%	10%
PRIME OVERHEAD	MAT'L	LABOR	EQUIP
	5%	5%	5%
PRIME PROFIT	MAT'L	LABOR	EQUIP
	5%	5%	5%
BOND	1.50%		
MISC. TAXES	0.0%		
CQC	0.00%		
ESCALATION	0.0%		
PCAS	0.00%		
CONT	0.00%		
OH	0.00%		
MATERIAL COMPOSITE MARK-UP	1.256		
LABOR COMPOSITE MARK-UP	1.951		
EQUIPMENT COMPOSITE MARK-UP	1.256		

SPECIFICATION SECTIONS
MARKED UP FOR SUB

XXXXX

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
LOCATION: KEY WEST, FLORIDA
ESTIMATORS: BLAKE G. SVENDSEN
PROJECT SIZE: 1.00 EA
AUTHORIZED CONSTRUCTION FUNDS: 100,000.00

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SPEC	ACT	WBS	MATL	LABOR	EQUIP

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
LOCATION: KEY WEST, FLORIDA
ESTIMATORS: BLAKE G. SVENDSEN
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AUTHORIZED CONSTRUCTION FUNDS: 100,000.00

CAT CODE:
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	QUAN	U/M	MUP/ EXT	LUP/ EXT	EUP/ EXT	TOTAL
33010101 HTRW REMEDIAL ACTION						
MOBILIZATION AND PREPARATORY WORK						
MOBILIZATION OF CONSTRUCTION EQP AND FACILITIES						
TRANSPORT VEHICLES OWNERSHIP/OPERATION						
SYSDC EQUIPMENT MOBILIZATION						
13900 MISCELLANEOUS SPECIAL CONSTRUCTION						
13900 MISCELLANEOUS SPECIAL CONSTRUCTION						
ABB002 MOB TO SITE FOR SAMPLING			0.00*	3,897.54*	0.00*	3,897.54
AND LABOR YEAR 1	4.00	EA	0	15,590	0	15,590
ABB002 MOB TO SITE FOR SAMPLING						
AND LABOR SUBSEQUENT YE			0.00*	3,897.54*	0.00*	3,897.54
AR	4.00	EA	0	15,590	0	15,590
SUBTOTAL-SUBSPEC SECTION 13900			0	31,180	0	31,180
TOTAL FOR SPEC SECTION 13900			0	31,180	0	31,180
SUBTOTAL-WORK BREAKDOWN 33010101			0	31,180	0	31,180
TOTAL FOR WORK BREAKDOWN 33010101			0	31,180	0	31,180
COST/WBS UNIT 33010101						31,180.32

33010 HTRW REMEDIAL ACTION
MOBILIZATION AND PREPARATORY WORK
SAMPLING REPORTS

SYSDC SAMPLING REPORTS

13900 MISCELLANEOUS SPECIAL CONSTRUCTION

13900 MISCELLANEOUS SPECIAL CONSTRUCTION						
ABB001 QUARTERLY SAMPLING REPOR			0.00*	2,734.65*	225.52*	2,960.17
TS	8.00	EA	0	21,877	1,804	23,681

	QUAN	U/M	MUP/ EXT	LUP/ EXT	EUP/ EXT	TOTAL
SUBTOTAL-SUBSPEC SECTION 13900			0	21,877	1,804	23,681
TOTAL FOR SPEC SECTION 13900			0	21,877	1,804	23,681
SUBTOTAL-WORK BREAKDOWN 330103			0	21,877	1,804	23,681
TOTAL FOR WORK BREAKDOWN 330103			0	21,877	1,804	23,681
COST/WBS UNIT 330103						23,681.38

33020419 HTRW REMEDIAL ACTION
MONITORING, SAMPLING, TESTING, AND ANALYSIS
MONITORING WELLS
OPERATION AND MAINTENANC E

SYSDC OPERATION AND MAINTENANCE

13900 MISCELLANEOUS SPECIAL CONSTRUCTION

13900 MISCELLANEOUS SPECIAL CONSTRUCTION						
ABB001 O & M OTHER EXPENDABLES			1,207.34*	0.00*	0.00*	1,207.34
YEAR 1	4.00	EA	4,829	0	0	4,829
ABB002 O & M OTHER EXPENDABLES			1,207.34*	0.00*	0.00*	1,207.34
SUBSEQUENT YEAR	4.00	EA	4,829	0	0	4,829
SUBTOTAL-SUBSPEC SECTION 13900			9,659	0	0	9,659
TOTAL FOR SPEC SECTION 13900			9,659	0	0	9,659
SUBTOTAL-WORK BREAKDOWN 33020419			9,659	0	0	9,659
TOTAL FOR WORK BREAKDOWN 33020419			9,659	0	0	9,659
COST/WBS UNIT 33020419						9,658.72

33020501 HTRW REMEDIAL ACTION
MONITORING, SAMPLING, TESTING, AND ANALYSIS
SAMPLING SURFACE WATER/GROUND WATER/LIQUID WASTE
MANUAL PRODUCT RECOVERY

SYSDC PRODUCT MONITORING AND RECOVERY

13900 MISCELLANEOUS SPECIAL CONSTRUCTION

13900 MISCELLANEOUS SPECIAL CONSTRUCTION						
CON001			261.97*	531.00*	96.82*	889.79
PRODUCT RECOVERY YEAR 1	6.00	EA	1,572	3,186	581	5,339
CON002 CONTAINMENT AND DISPOSAL						
FOR 1 DISPOSAL FOR 1 YE			455.60*	531.00*	273.36*	1,259.96
AR	1.00	YR	456	531	273	1,260

		QUAN	U/M	MUP/ EXT	LUP/ EXT	EUP/ EXT	TOTAL
SUBTOTAL-SUBSPEC SECTION	13900			2,027	3,717	854	6,599
TOTAL FOR SPEC SECTION	13900			2,027	3,717	854	6,599
SUBTOTAL-WORK BREAKDOWN	33020501			2,027	3,717	854	6,599
TOTAL FOR WORK BREAKDOWN	33020501			2,027	3,717	854	6,599
COST/WBS UNIT	33020501						6,598.67

33020502 HTRW REMEDIAL ACTION
MONITORING, SAMPLING, TESTING, AND ANALYSIS
SAMPLING SURFACE WATER/GROUND WATER/LIQUID WASTE
GROUND WATER

SYSDC GROUND WATER

13900 MISCELLANEOUS SPECIAL CONSTRUCTION

		QUAN	U/M	MUP/ EXT	LUP/ EXT	EUP/ EXT	TOTAL
13900 MISCELLANEOUS SPECIAL CONSTRUCTION							
ABB001 GROUNDWATER SAMPLING				9,974.79*	0.00*	0.00*	9,974.79
YEAR 1		4.00	EA	39,899	0	0	39,899
ABB002 GROUNDWATER SAMPLING				9,974.79*	0.00*	0.00*	9,974.79
SUBSEQUENT YEAR		4.00	EA	39,899	0	0	39,899
SUBTOTAL-SUBSPEC SECTION	13900			79,798	0	0	79,798
TOTAL FOR SPEC SECTION	13900			79,798	0	0	79,798
SUBTOTAL-WORK BREAKDOWN	33020502			79,798	0	0	79,798
TOTAL FOR WORK BREAKDOWN	33020502			79,798	0	0	79,798
COST/WBS UNIT	33020502						79,798.34

SUMMARY REPORT:
SPEC SECTION
MINARY

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PAGE NUMBER : 1
ESTIMATE NAME : KEYWEST

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
LOCATION: KEY WEST, FLORIDA
ESTIMATORS: BLAKE G. SVENDSEN
PROJECT SIZE: 1.00 EA
AUTHORIZED CONSTRUCTION FUNDS: 100,000.00

CAT CODE:
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	MATERIAL		LABOR		EQUIPMENT		
	SUB SPEC SECT	SPEC SECT	SUB SPEC SECT	SPEC SECT	SUB SPEC SECT	SPEC SECT	SPEC SECT
13900 MISCELLANEOUS SPECIAL CONSTRUCTION							
13900 MISCELLANEOUS SPECIAL CONSTRUCTION	91,484		56,775		2,658		
SUBTOTAL SPEC SECTION 13900		91,484		56,775		2,658	150,917
SUBTOTAL SPEC DIVISION 13		91,484		56,775		2,658	150,917
TOTAL		91,484		56,775		2,658	150,917

ENGINEERING ESTIMATE

PROJECT: BUILDING 189, TRUMAN ANNEX
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		QUAN	U/M	MUP/ EXT	LUP/ EXT	EUP/ EXT	TOTAL
PR							
CON001				230.00*	300.00*	85.00*	615.00
	PRODUCT RECOVERY YEAR 1	6.00	EA	1,380	1,800	510	3,690
CON002	CONTAINMENT AND DISPOSAL FOR 1 DISPOSAL FOR 1 YEAR	1.00	YR	400.00* 400	300.00* 300	240.00* 240	940.00 940
	SUBTOTAL-GROUP PR			1,780	2,100	750	4,630
	TOTAL FOR GROUP PR			2,027	3,717	854	6,599
	TOTAL INCL OVERHEAD PR			2,027	3,717	854	6,599
SA							
ABB001	QUARTERLY SAMPLING REPORTS	8.00	EA	0.00* 0	1,545.00* 12,360	198.00* 1,584	1,743.00 13,944
ABB001	O & M OTHER EXPENDABLES YEAR 1	4.00	EA	1,060.00* 4,240	0.00* 0	0.00* 0	1,060.00 4,240
ABB001	GROUNDWATER SAMPLING YEAR 1	4.00	EA	8,757.50* 35,030	0.00* 0	0.00* 0	8,757.50 35,030
ABB002	MOB TO SITE FOR SAMPLING AND LABOR YEAR 1	4.00	EA	0.00* 0	2,202.00* 8,808	0.00* 0	2,202.00 8,808
ABB002	MOB TO SITE FOR SAMPLING AND LABOR SUBSEQUENT YEAR	4.00	EA	0.00* 0	2,202.00* 8,808	0.00* 0	2,202.00 8,808
ABB002	O & M OTHER EXPENDABLES SUBSEQUENT YEAR	4.00	EA	1,060.00* 4,240	0.00* 0	0.00* 0	1,060.00 4,240
ABB002	GROUNDWATER SAMPLING SUBSEQUENT YEAR	4.00	EA	8,757.50* 35,030	0.00* 0	0.00* 0	8,757.50 35,030
	SUBTOTAL-GROUP SA			78,540	29,976	1,584	110,100
	TOTAL FOR GROUP SA			89,457	53,058	1,804	144,319
	TOTAL INCL OVERHEAD SA			89,457	53,058	1,804	144,319