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REMEDIAL ACTION PLAN JET ENGINE TEST CELL NAS CECIL FIELD FL
11/1/1996
ABB ENVIRONMENTAL SERVICES

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5-1

REMEDIAL ACTION PLAN

JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

UNIT IDENTIFICATION CODE: N60200
CONTRACT NO.: N62467-89-D-0317/124 7

NOVEMBER 1996

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

ABB

8570-0002

November 22, 1996

Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blairstone Road
Tallahassee, Florida 32399-2400
Attention: Mr. Eric Nuzie

Subject: **Remedial Action Plan**
Jet Engine Test Cell
NAS Cecil Field, Jacksonville, Florida
Contract No. N62467-89-D-0317/127

Dear Eric:

On behalf of Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), ABB Environmental Services, Inc. is pleased to forward two copies of the subject document for your review and approval.

Comments or questions you may have concerning this document should be directed to Mr. Bryan Kizer at SOUTHNAVFACENGCOM (803-820-5896) within 45 calendar days from the receipt of this document.

Very truly yours,

ABB ENVIRONMENTAL SERVICES, INC.

Rao Angara
Installation Manager

cc: B. Kizer, SDIV (2 copies)
S. Wilson, SDIV
D. Kruzicki, NASCF (2 copies)
H. Bauer, BEI
L. Routhier, ABB-ES
D. Vaughn-Wright, USEPA
file

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REMEDIAL ACTION PLAN

JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Unit Identification Code: N60200

Contract No.: N62467-89-D-0317/127

Prepared by:

ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, Florida 32301

Prepared for:

Department of the Navy, Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29418

Bryan Kizer, Code 1842, Engineering-in-Charge

November 1996

CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/127 are complete and accurate and comply with all requirements of this contract.

DATE: November 22, 1996

NAME AND TITLE OF CERTIFYING OFFICIAL: Rao Angara
Task Order Manager

NAME AND TITLE OF CERTIFYING OFFICIAL: Mike Dunaway, P.G., P.E.
Project Technical Lead

(DFAR 252.227-7036)

FOREWORD

Subtitle I of the Hazardous and Solid Waste Amendments 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, primarily petroleum products. Hazardous wastes stored in USTs were already regulated under the Resource Conservation and Recovery Act of 1976, which was also an amendment of SWDA. Subtitle I requires that the U.S. Environmental Protection Agency (USEPA) promulgate UST regulations. The program was designed to be administered by the individual States, who were allowed to develop more stringent standards, 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 (CFR), Title 40, Part 280 (Title 40 CFR 280), *Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks*. Title 40 CFR 280 was revised and published on September 23, 1988, and become 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 62-770, Florida Administrative Code, *State Underground Petroleum Environmental Response*, regulations pertaining to petroleum contamination.

Questions regarding this report should be addressed to the Commanding Officer, Naval Air Station Cecil Field, Jacksonville, Florida, or to Bryan Kizer at Southern Division, Naval Facilities Engineering Command, Code 1842 at 803-820-5896.

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Naval Air Station Cecil Field
Jacksonville, Florida

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Jacksonville, Florida

1.0 INTRODUCTION

This report was prepared by ABB Environmental Services, Inc. (ABB-ES), and presents the remedial action plan recommended for contaminated soil and groundwater at the Jet Engine Test Cell site, Naval Air Station (NAS) Cecil Field, Florida.

1.1 BACKGROUND. The Jet Engine Test Cell site is located at NAS Cecil Field, Jacksonville, Florida. NAS Cecil Field is situated in southwestern Duval County at the junction of Highway 228 (Normandy Boulevard) and 103rd Street (Figure 1-1). The Jet Engine Test Cell facility is located on the main base northeast of the Jet Road and Ninth Street intersection (Figure 1-2). The facility consists of four buildings, each facing Jet Road. Building 811, which was originally constructed as a temporary test cell, is northernmost; Buildings 339 and 334 are central; and Building 328 is southernmost (Figure 1-3).

Building 811 houses maintenance facilities for the test cell, which include repair and maintenance of electrical systems and painting operations. Engine testing operations are no longer conducted in Building 811. Building 328 is an office and locker room area with a small garage attached for automotive repair and maintenance. The cells in which the jet engines are tested are Buildings 334 and 339.

The area between Jet Road and the buildings is paved with asphalt or concrete. The remaining area is generally unpaved. Between Buildings 811 and 339 is a fuel tanks yard, approximately 3,200 square feet in area. In the western part of the yard are two 20,000-gallon, asphalt-coated steel, underground storage tanks numbered 339-TC1 and 339-TC2 (Figure 1-3). These tanks, installed in 1953, contain jet propellent (JP)-5 jet fuel and have corrosion resistant coated metal pipes with cathodic protection.

In October 1989, precision fitness tests were attempted on Tanks 339-TC1 and 339-TC2. Due to inadequate seals between the manway covers and the tank walls, leaks occurred, and the tests were terminated. Several spills have also occurred as a result of overfilling. As an outcome of the release detection program findings, contamination assessment (CA) began at the Jet Engine Test Cell site.

In the eastern part of the yard is a vacant tank pad on which the third storage tank, Tank 339-TC3, was located. Tank 339-TC3 was a 5,000-gallon aboveground storage tank (AST) constructed of stainless steel. Tank 339-TC3, installed in 1970 to serve temporary operations in Building 811, rested on a concrete base and was surrounded by a 3-foot high concrete block wall. This tank was removed in June 1996; following the removal, free product leaking from the product distribution line from Tank 339-TC3, which served Building 811, was observed by members of the NAS Cecil Field Public Works Center. This distribution line has been disconnected and left in place. The quantity of fuel released is unknown. A listing of environmental actions performed at the Jet Engine Test Cell from 1990 through August 1996 is given in Section 1.2.

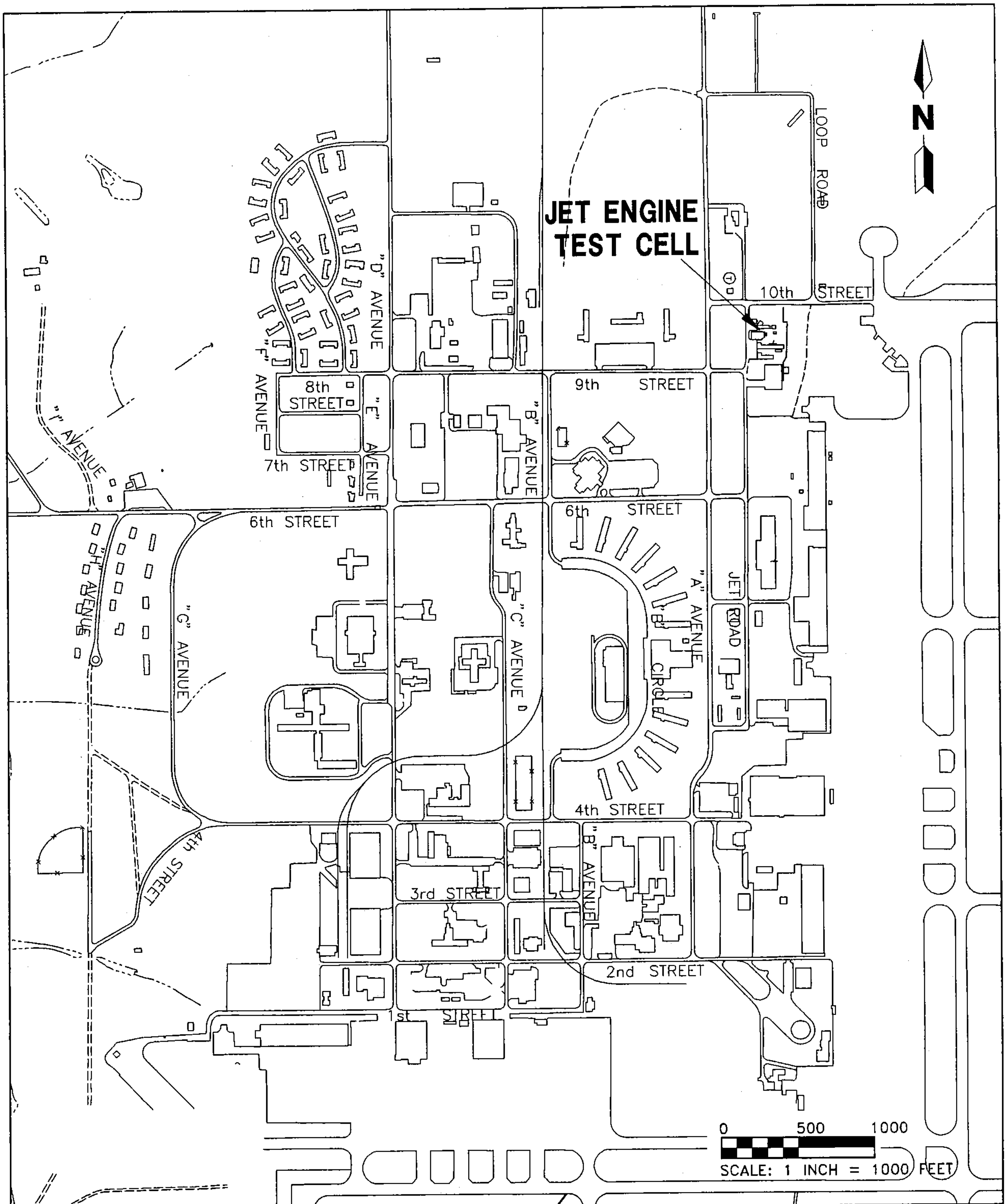

FIGURE 1-2
SITE LOCATION MAP

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

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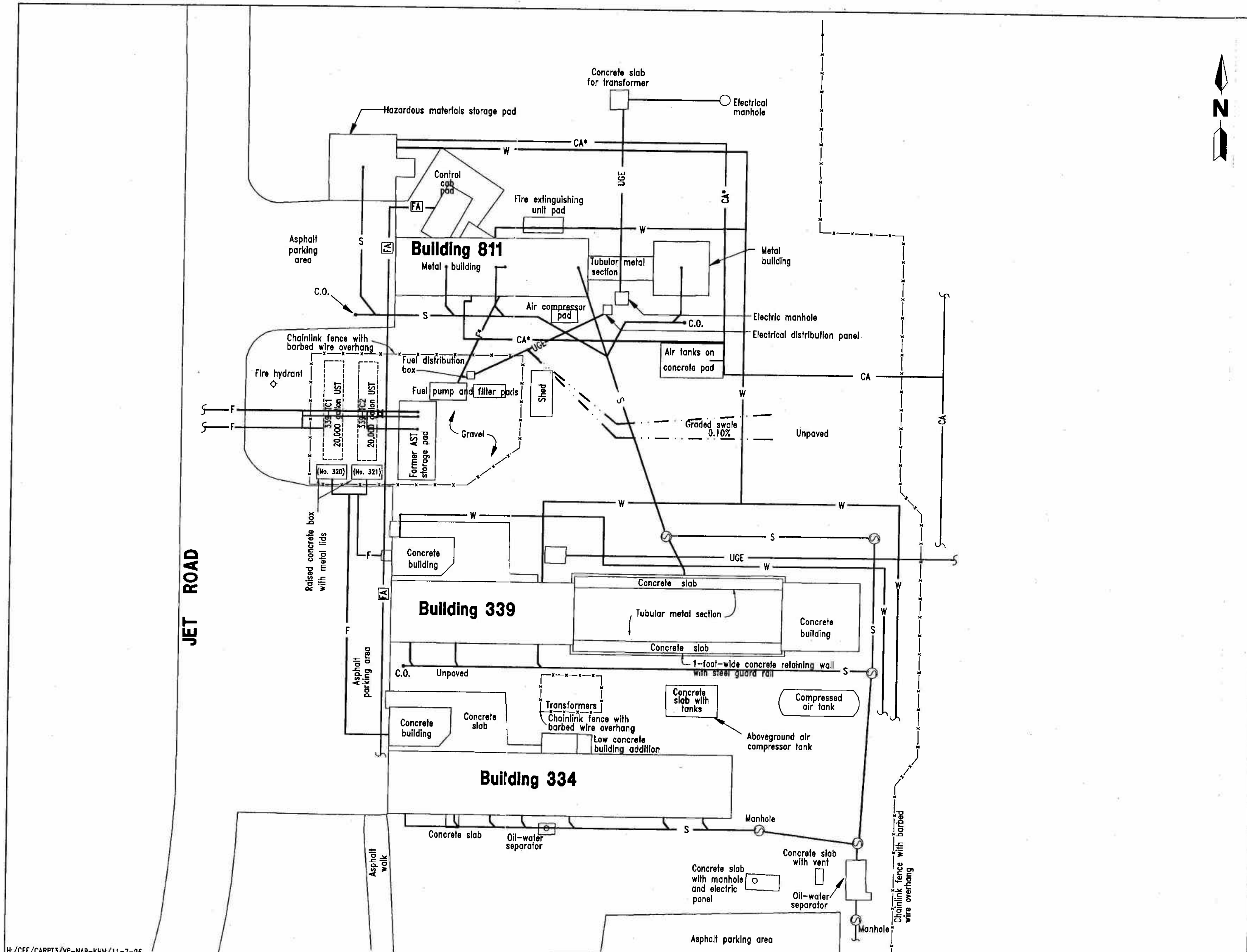


NOTES:

1. Utility locations should be field verified.
2. Building 811 is scheduled to be removed in 1997.

LEGEND

—F—	Fuel distribution
—F*—	Fuel inactive
—W—	Water line
—CA—	Compressed air
—CA*—	Compressed air inactive
—S—	Sanitary sewer line
—UGE—	Underground electric
—FA—	Fire alarm
C.O.	Clean out
⊘	Sanitary sewer manhole
AST	Aboveground storage tank
UST	Underground storage tank

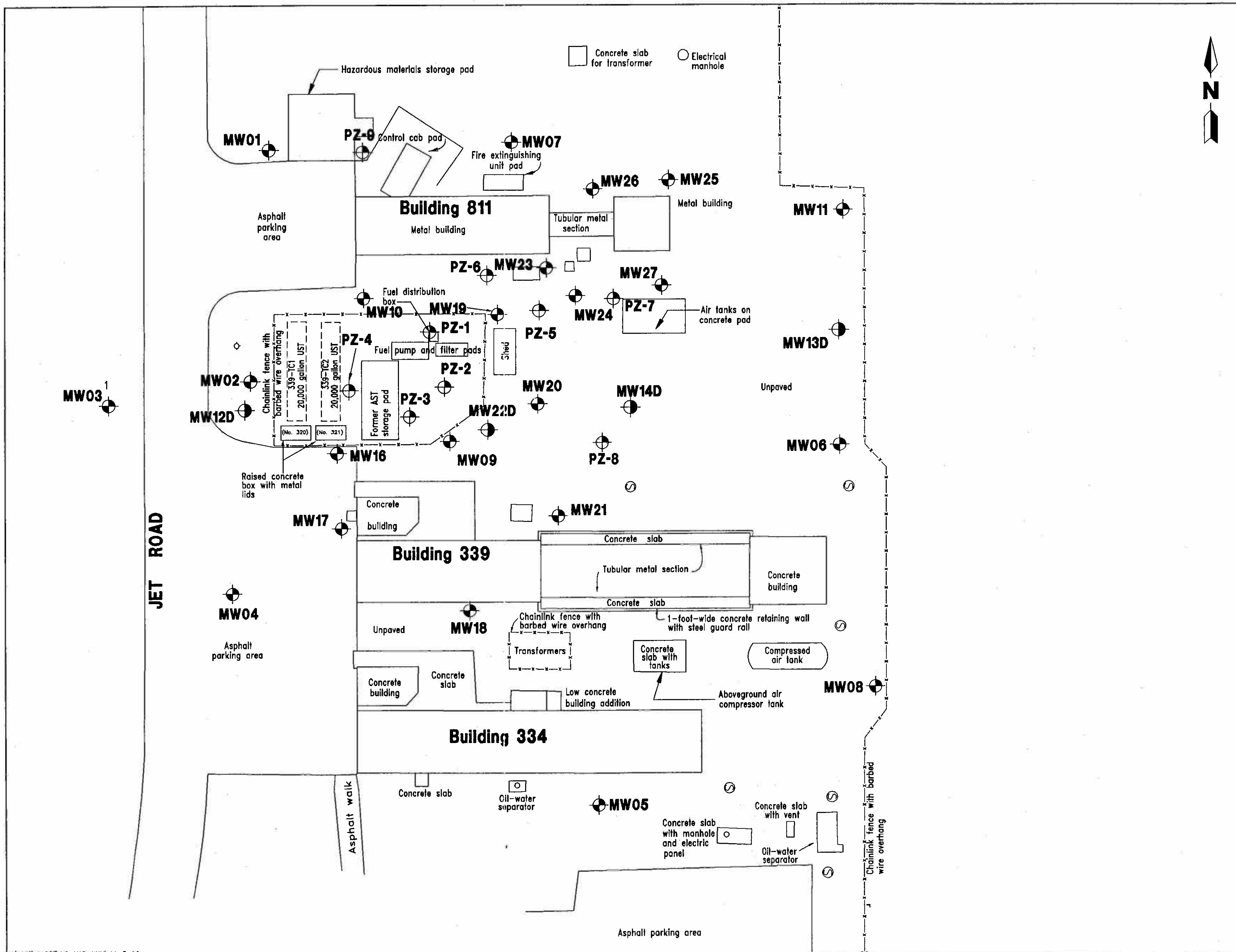
0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 1-3
SITE MAP INCLUDING APPROXIMATE LOCATION OF SITE UTILITIES

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Building 811 is scheduled to be removed in 1997.

LEGEND

Symbol	Description
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
AST	Aboveground storage tank
UST	Underground storage tank
⊘	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 2-1
MONITORING WELL AND PIEZOMETER LOCATIONS

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

1.2 PREVIOUS DOCUMENTATION. This section consists of a listing of documents that have been prepared during the study and assessment of the Jet Engine Test Cell site. Important actions and decisions are also included. Years listed are followed by the months and actions performed.

1990 December: ABB-ES initiates a preliminary CA.

1991 March: The U.S. Army Corps of Engineers (USACE) submits a Preliminary Contamination Report (USACE, 1991) to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM).
June: ABB-ES begins CA.
December: NAS Cecil Field began demolition and reconstruction of Building 339, interrupting the CA activities.

1993 September: ABB-ES resumes CA.

1994 March: ABB-ES submits a Contamination Assessment Report (CAR) (ABB-ES, 1994a) to the Florida Department of Environmental Protection (FDEP) and SOUTHNAVFACENGCOM.
May: FDEP comments are received by ABB-ES.
November: ABB-ES submits a CAR Addendum (CARA) (ABB-ES, 1994b) following additional fieldwork in response to FDEP comments.
December: FDEP approves the CARA and requests a remedial action plan (RAP).

1995 Emphasis shifts toward an Initial Remedial Action initiative with an Alternate Procedures Request (APR) to address free-product contamination.
August: ABB-ES submits an APR for a vapor enhanced free-product extraction system (ABB-ES, 1995).
October: FDEP grants APR approval.

1996 January: ABB-ES explores the option of using a mobile vacuum truck to perform vacuum enhanced free-product extraction.
May: ABB-ES installs four piezometers in the tank containment area for further free-product delineation.
June: Tank 399-TC3 is removed (see closure report Appendix A).
July: Free product with a measured thickness of 3.66 feet was measured for the first time in MW24 downgradient of the known product plume.
Mr. Lloyd Crews (NAS Cecil Field) reports release to FDEP in a letter dated July 22, 1996 (Appendix B).
Two 8-hour pilot tests are conducted using a vacuum truck to perform vacuum enhanced recovery of free product from existing wells and piezometers.
August: SOUTHNAVFACENGCOM informs the Base Realignment and Closure (BRAC) Cleanup team (BCT) that upon base closure, operations will cease at the Test Cell and all tanks will likely be removed.
ABB-ES is directed, by the BCT, to submit an RAP to the FDEP addressing petroleum contamination at the site.

1.3 SCOPE AND PURPOSE. The scope of work for this project involved the following tasks:

- reviewing existing hydrogeologic and soil and groundwater quality data for the site;

- collecting supplemental data to fill data gaps, including resampling of selected monitoring wells and hand-installed piezometers;
- collecting geochemical data to support the intrinsic remediation alternative;
- developing a conceptual model of the contamination in the subsurface, possible preferential pathways, and receptors;
- evaluating remedial alternatives based on the results of the BIOSCREEN model;
- providing a conceptual design for the selected remedial alternative based on site-specific effectiveness;
- providing a long-term monitoring plan including a sampling and analysis plan; and
- developing a cost estimate for the proposed remedial actions.

1.4 REPORT SUMMARY. This report is divided into two sections. The first section consists of Chapters 1.0 through 4.0 and describes the essential supplemental assessment and contamination assessment findings. The second section begins with Chapter 5.0 where remedial action plan objectives are defined and continues with Chapters 6.0 through 9.0 with the description of the recommended remedial alternative. Chapters 10.0 through 12.0 consist of schedule and cost information, with professional certification in Chapter 12.0. Analytical results in Appendix A and letters of correspondence are provided in Appendix B. All engineering calculations are included in Appendix C. The Basis of Design for remedial actions recommended in the report is summarized in Appendix D. An RAP checklist is provided in Appendix E.

The invert elevation of the sanitary manhole, which serves the aforementioned drainage system, was field-surveyed in relation to existing monitoring wells by ABB-ES field personnel using a surveyor's level and stadia rod. The invert elevation of the sanitary manhole is 76.23 feet National Geodetic Vertical Datum. Based on this elevation and groundwater monitoring since December 1995, ABB-ES noted at least one instance where the groundwater elevation was at a higher elevation than the invert elevation, making the storm drain and the soil in the immediate vicinity of the drain possible contaminant pathways during extremely wet conditions.

2.2.2 Potential Receptors Potential receptors of contaminants from the Jet Engine Test Cell could be individuals who consume contaminated groundwater from drinking water wells completed in the surficial aquifer. At this time, there are no drinking water wells completed in the surficial aquifer within a 0.25-mile radius of the site.

There are five public water supply wells serving NAS Cecil Field. These wells are screened in the Floridan aquifer system. Only one of these wells, PS-5, is within a 0.25-mile radius of the site (Figure 2-2). At the time of the CAR, March 1994, it was reported that groundwater samples were collected from this well and tested for petroleum constituents on a regular basis with results indicating no groundwater contamination. It is also not likely that contaminants from the Jet Engine Test Cell could reach the Floridan aquifer based on the groundwater flow patterns and the large continuing unit separating the Floridan aquifer from the overlying aquifers.

Surface water in the area is not used as a potable water source (Envirodyne Engineers, 1985), and there are no private potable wells within 1 mile of this site (Geraghty & Miller, 1983). The nearest surface water body is Sal Taylor Creek, which is greater than 5 years downgradient of the contaminant plume based on groundwater pore velocity. It is not anticipated that contaminants in groundwater would reach this water body.

2.3 GROUNDWATER ELEVATION SURVEY. Prior to groundwater sampling, groundwater elevations in monitoring wells were measured to the nearest 0.01 foot using an electronic water-level indicator. Free product thicknesses were also recorded to the nearest 0.01 foot using an electronic oil-water interface probe. Groundwater elevations in wells with product were adjusted based on the difference in fluid densities in order to reflect actual groundwater elevations at each isopotential using the following equation.

$$DTW_{actual} = TOC_{elev} - DTW_{measured} + (0.8 \times (DTW_{measured} - DTP_{measured}))$$

where:

- $TOC_{elev.}$ represents the TOC elevation of the piezometer or well measured from the north side of the casing,
- $DTW_{measured}$ represents the depth to water in feet measured from the top of casing with the oil-water interface probe,
- 0.8 is the specific weight of JP-5, and
- $DTP_{measured}$ represents the depth to product in feet measured from the top of casing with the oil-water interface probe.

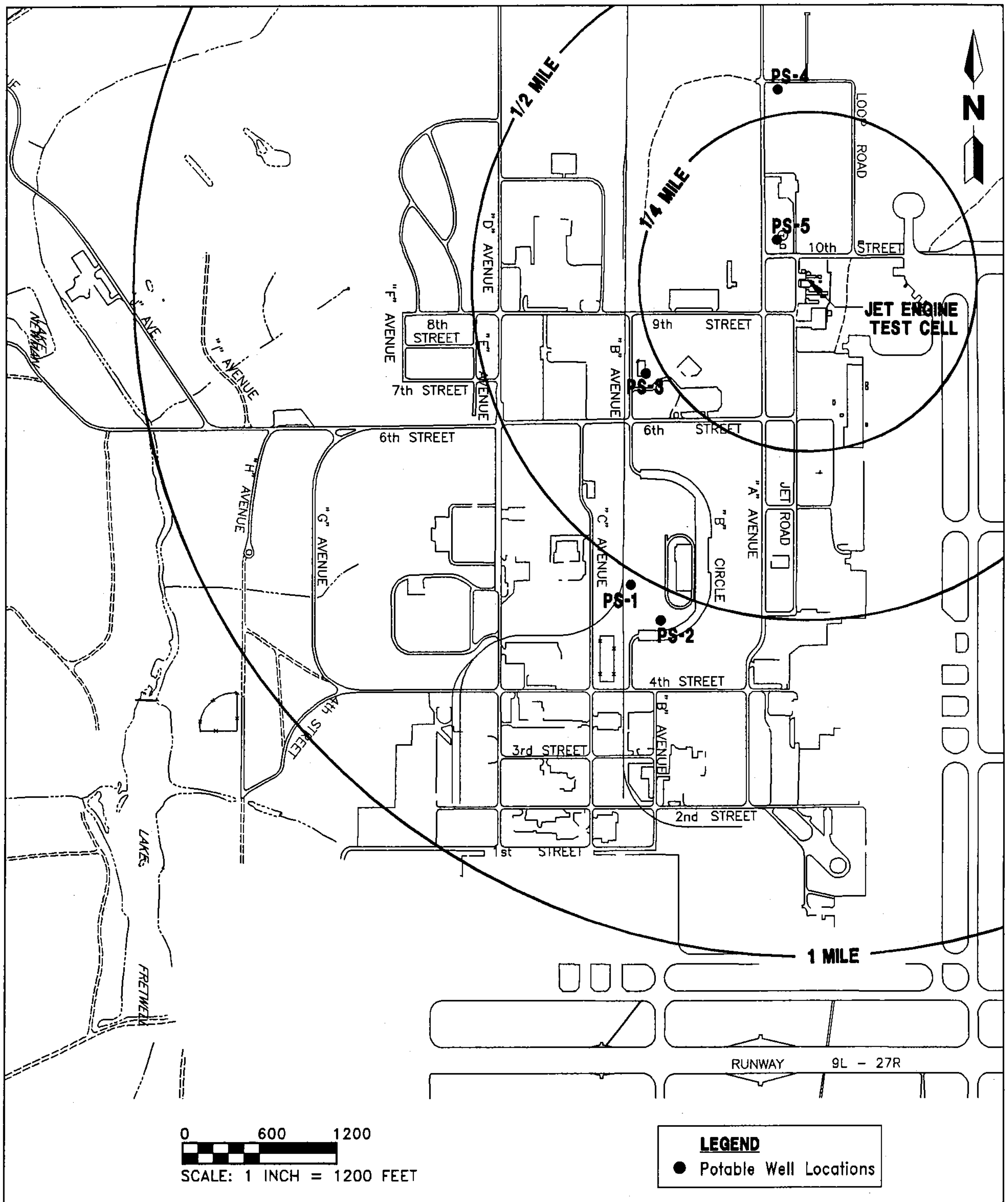


FIGURE 2-2
LOCATION OF POTABLE WELLS

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REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

2.4 SOIL SAMPLING. A total of 14 soil borings, PZ-5 through PZ-8 and 96SB-1 through 96SB-10 were conducted. Soil samples were collected at 2-foot sample intervals starting at 1 foot bls and analyzed using an organic vapor analyzer (OVA) equipped with a flame ionization detector (FID). Soil borings were advanced to the top of the groundwater table (5 feet bls in most areas).

All soil sampling tools, hand augers, jars, etc. were cleaned onsite prior to use and between each sampling event with phosphate-free laboratory detergent and a clean water rinse.

2.5 GROUNDWATER SAMPLING. This section documents field procedures implemented during the sampling, handling, and shipment of groundwater samples. Data quality levels will also be discussed.

2.5.1 Sample Collection and Analysis Samples were collected in accordance with a Level E data quality requirements (Naval Energy and Environmental Support Activity, 1988). Low-flow purging was conducted using a peristaltic pump operating at a flow rate of approximately 1 liter per minute. Approximately 3 well volumes were purged from each well; temperature, specific conductance, and pH were measured periodically during purging with a Horiba U-10 water quality checker. Once the physical parameter readings had stabilized, a groundwater sample to be analyzed using HACH field test kits was collected in a 1-liter glass jar. HACH field test kits use colorimetric methods and were used for the detection of natural attenuation parameters nitrate, sulfate, carbon dioxide, iron, and chloride. These and other physical parameters collected in order to demonstrate natural attenuation are listed in Table 2-1.

The contaminants of concern at the Jet Engine Test Cell site are primarily total volatile organic aromatics (VOAs) and polynuclear aromatic hydrocarbons (PAHs), specifically total naphthalenes. Groundwater analyzed for PAHs by U.S. Environmental Protection Agency (USEPA) Method 610 was collected directly from the peristaltic pump. Groundwater analyzed for total VOAs by USEPA Method 602 were collected using a Teflon™ disposable bailer.

2.5.2 Onsite Measurements Onsite measurements of dissolved oxygen, temperature, pH, turbidity, and electric conductivity were taken using a Horiba U-10 water quality checker. Dissolved oxygen measurements made with the Horiba were collected using methods adapted from the *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater* (Wiedemeier, et al., 1995). In all cases, the lowest dissolved oxygen measurement was recorded. Once stabilized, measured values were recorded in the field log book.

Table 2-1
Natural Attenuation Sampling

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Analyses	Method	Data Use
Temperature	Direct-reading thermometer, Horiba U-10 Water Quality Checker	Low-flow well purging; biological processes are temperature dependent.
pH	Direct-reading meter, Horiba U-10 Water Quality Checker	Biological processes are pH sensitive.
Conductivity	Direct-reading meter, Horiba U-10 Water Quality Checker	General water quality parameter used to verify that site samples are obtained from the same groundwater system.
Carbon dioxide	HACH Carbon Dioxide Test Kit	Elevated CO_2 could indicate an aerobic mechanism for bacterial degradation of petroleum.
Dissolved oxygen	Dissolved oxygen meter, Horiba U-10 Water Quality Checker	The oxygen concentration is a data input to the BIOSCREEN model; concentrations less than 1 mg/ℓ generally indicate an anaerobic pathway.
Sulfate	HACH Sulfate Test Kit	Sulfate acts as an electron acceptor in the anaerobic process of Sulfanogenesis.
Nitrate	HACH Nitrate Test Kit	Nitrate acts as an electron acceptor if oxygen is depleted.

Notes: "HACH" refers to the HACH Company catalog, 1990.
CO_2 = carbon dioxide.
mg/ℓ = milligrams per liter.

3.0 CA AND SUPPLEMENTAL SUBSURFACE INVESTIGATION FINDINGS

Pertinent results of the CA and the supplemental assessment, which support the selection of remedial action alternatives, are included in this chapter. The extent of soil and groundwater contamination are presented as well as the apparent extent of free product.

3.1 SOIL BORINGS. To verify the extent of soil contamination at the Jet Engine Test Cell site, 14 soil borings were advanced, and soil samples were collected and analyzed with an OVA equipped with an FID. Four of 14 borings were located south of the tank containment area near soil borings advanced in 1993 to confirm 1993 results and check any possible contaminant attenuation. Additional soil borings were advanced north of Building 811 near the Hazardous Materials Storage area and at 20-foot intervals along the storm drainage line east of the tank containment area (Figure 3-1). Soil samples analyzed during the piezometer installation are designated as 96SBPZ on Figure 3-1 and in Table 3-1 and have sample numbers corresponding to the piezometer that was installed at that location. Soil sample OVA results are presented in Table 3-1, and the approximate extent of soil contamination is shown on Figure 3-1.

During the advancement of soil boring 96SB-4, an obstruction was encountered approximately 2.5 feet below grade. This boring was offset 2 feet south of the former boring location, advanced, and sampled. The results of this sample indicated excessively contaminated soils present in this area.

After further review of site maps, a 1989 Plan for the Retrofitting of Building 339 showed an oil-water separator and a 280-gallon UST (both scheduled for removal) in the same location as soil boring 96SB-4.

3.2 GROUNDWATER ELEVATION SURVEY. Water table elevations were calculated by correlating the TOC elevations for each monitoring well to a common datum. For a more detailed description of the benchmark selection, please see the CARA, Section 3.3 (ABB-ES, 1994b). The relationship (outlined in Section 2.1) between the groundwater and free-product levels measured on September 6, 1996, was used to update the water table elevations. These measurements and adjusted groundwater elevations are listed in Table 3-2. Revised piezometric surface maps indicate the general groundwater flow direction in the shallow zone of the surficial aquifer is to the east (Figure 3-2).

3.3 APPARENT EXTENT OF FREE PRODUCT. Free-product measurements indicate two source areas of product at the Jet Engine Test Cell (Figure 3-3). The first area, centered near PZ-2, is located in the immediate vicinity of the tank containment area. Free product in this area is likely the result of leaks in fittings and lines and over-filling of the tanks in the tank area. The second area, centered near MW24, is likely the result of leaks from the AST fuel line connection to Building 811 and the nearby drainage lines, which served as a pathway for product flow.

Table 3-1
Soil Sample Organic Vapor Analysis Results, September 4, 5, and 6, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Boring Number	Concentration			
	Depth (feet)	Unfiltered	Filtered	Actual
96SBPZ-5	1.0	0	0	0
	3.0	1,000	15	985
	5.0	2,100	0	2,100
96SBPZ-6	1.0	0	0	0
	3.0	0	0	0
	5.0	500	0	500
96SBPZ-7	1.0	0	0	0
	3.0	0	0	0
	5.0	2,100	0	2,100
96SBPZ-8	1.0	0	0	0
	3.0	0	0	0
	5.0	10	0	10
	8.0 (wet)	320	0	320
96SB-1	1.0	0	0	0
	3.0	0	0	0
	5.0	45	0	45
96SB-2	1.0	0	0	0
	3.0	0	0	0
	5.0	900	0	900
96SB-3	1.0	0	0	0
	3.0	0	0	0
	5.0	3	0	3
96SB-4	1.0	5	0	5
	3.0	130	0	130
	5.0	1,100	0	1,100
96SB-5	1.0	0	0	0
	3.0	0	0	0
	5.0	90	0	90

See notes at end of table.

Table 3-1 (Continued)
Soil Sample Organic Vapor Analysis Results,
September 4, 5, and 6, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Boring Number	Concentration			
	Depth (feet)	Unfiltered	Filtered	Actual
96SB-6	1.0	80	0	80
	3.0	10	0	10
	5.0	6	0	6
96SB-7	1.0	280	0	280
	3.0	180	0	180
	5.0	900	0	900
96SB-8	1.0	2	0	2
	3.0	3	0	3
	5.0	2	0	2
96SB-9	1.0	0	0	0
	3.0	0	0	0
	5.0	0	0	0
96SB-10	1.0	0	0	0
	3.0	0	0	0
	5.0	0	0	0

Notes: Concentrations are reported in parts per million.
Soil borings designated 96SBPZ correspond to piezometer locations.

Table 3-2
Well Construction and Water Table Elevation Data

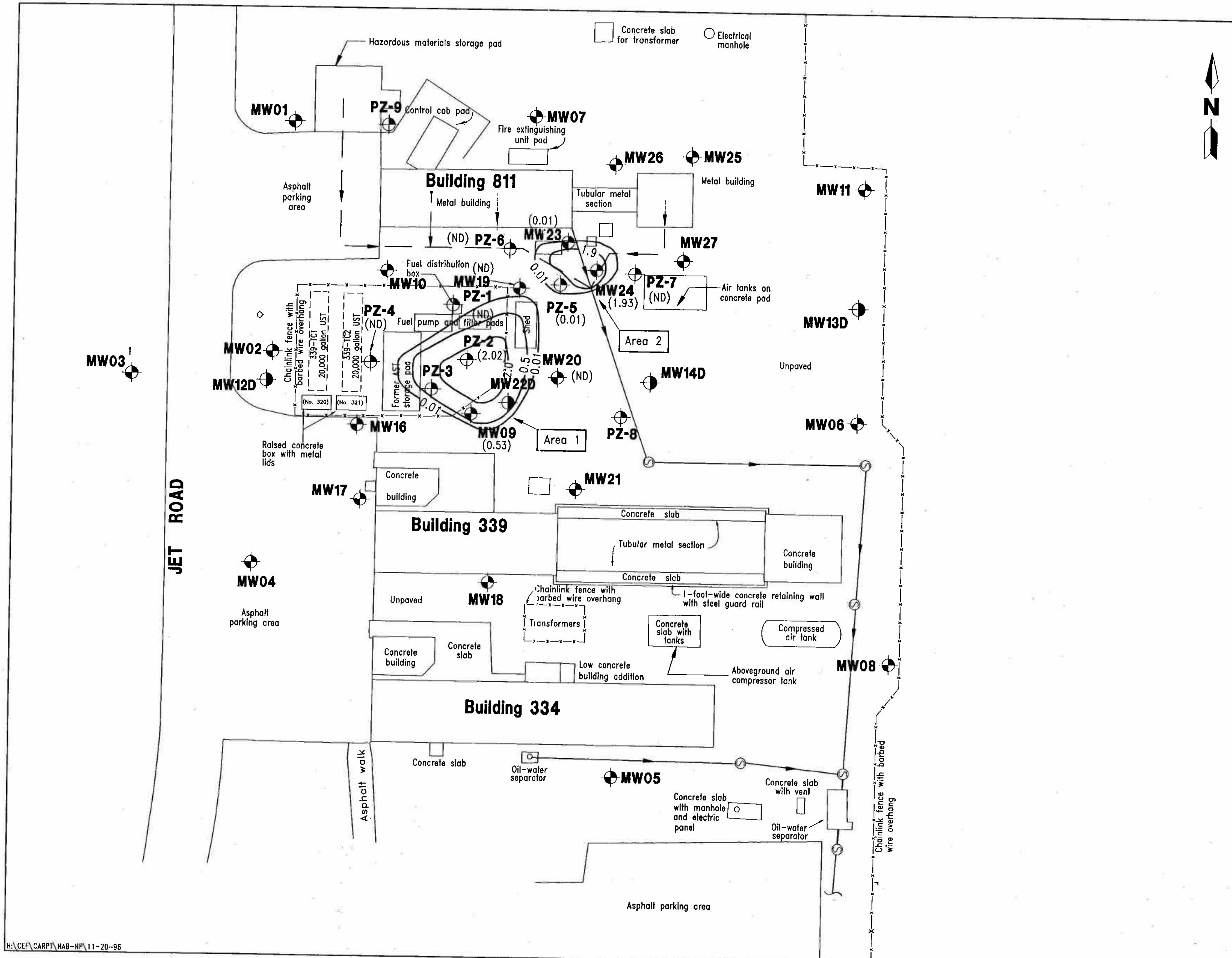
Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Monitoring Well No.	Total Well Depth (feet bls)	Screened Interval (feet bls)	TOC Elevation[1] (feet NGVD)	September 9, 1996			
				Depth to Water (feet BTOC)	Depth to Product (feet BTOC)	Apparent Water-Level Elevation (feet NGVD)	Water-Level Elevation[1] (feet NGVD)
MW02	14.83	4.83 to 14.83	79.47	5.55	NA	73.92	73.92
MW06	12.92	2.92 to 12.92	79.39	6.23	NA	73.16	73.16
MW09	14.08	4.00 to 14.00	79.20	6.16	5.63	73.11	73.53
MW10	14.11	4.11 to 14.11	79.27	5.49	NA	73.78	73.78
MW16	15.22	5.22 to 15.22	79.29	5.57	NA	73.72	73.72
MW17	14.70	4.70 to 14.70	79.25	5.59	NA	73.66	73.66
MW18	14.92	4.92 to 14.92	79.42	5.93	NA	73.49	73.49
MW19	15.00	5.00 to 15.00	78.94	5.46	NA	73.48	73.48
MW20	14.98	4.98 to 14.98	78.91	5.55	NA	73.36	73.36
MW21	15.00	5.00 to 15.00	79.06	5.67	NA	73.39	73.39
MW23	15.00	5.00 to 15.00	79.89	6.50	6.49	73.39	73.40
MW24	15.00	5.00 to 15.00	79.12	7.42	5.47	71.70	73.26
MW26	14.00	4.00 to 14.00	79.70	6.41	NA	73.29	73.29
MW27	14.00	4.00 to 14.00	79.63	6.42	NA	73.21	73.21
PZ-1	12.00	7.00 to 12.00	80.46	6.90	NA	73.50	73.50
PZ-2	12.00	7.00 to 12.00	80.65	8.72	6.70	71.93	73.55
PZ-3	12.00	7.00 to 12.00	80.69	7.06	7.05	73.63	73.64
PZ-4	12.00	7.00 to 12.00	80.51	6.84	NA	73.67	73.67
PZ-5	12.00	7.00 to 12.00	79.57	6.16	6.15	73.41	73.42
PZ-6	12.00	7.00 to 12.00	80.21	6.71	NA	73.50	73.50
PZ-7	12.00	7.00 to 12.00	80.21	6.88	NA	73.33	73.33
PZ-8	12.00	7.00 to 12.00	80.42	7.04	NA	73.38	73.38
PZ-9	12.00	7.00 to 12.00	80.57	6.83	NA	73.74	73.74

[1] Benchmark elevation of 79.48 taken from concrete wall at the intersection of "A" Avenue and Loop Road, at the North Fuel Farm site. Elevations for wells containing free product have been corrected to account for density differentials between the product and the water column.

Notes: Groundwater elevations taken only for those points sampled in September 1996.

bls = below land surface.
TOC = top of casing.
NGVD = National Geodetic Vertical Datum.
BTOC = below top of casing.
NA = not applicable.



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Free-product measurements taken from monitoring points with known groundwater contamination
3. Area 1: 1,793 square feet.
4. Area 2: 516 square feet.

LEGEND

PZ-5	Piezometer location and designation
MW20	Monitoring well location and designation
MW14D	Deep monitoring well location and designation
(0.53)	Apparent free-product thickness in feet
UST	Underground storage tank
AST	Aboveground storage tank
ND	Not detected
0.5	Apparent free-product thickness contour in feet
→ →	Sanitary sewer line and flow direction (Approximate location)
⊘	Sanitary sewer manhole

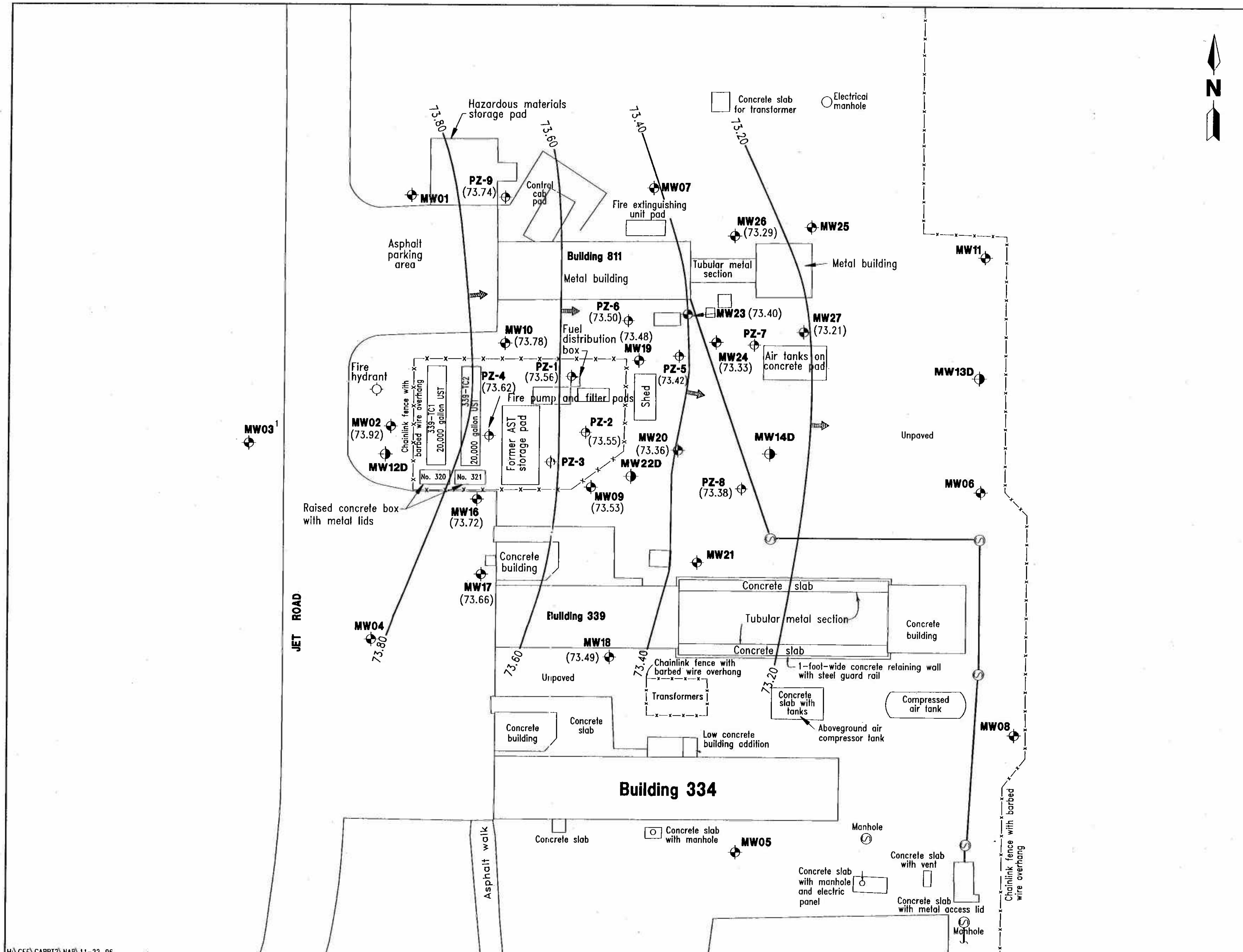
0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 3-3
APPARENT THICKNESS AND EXTENT OF FREE PRODUCT, SEPTEMBER 6, 1996

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Water-level measurements taken from selected points which were sampled in September 1996.

LEGEND

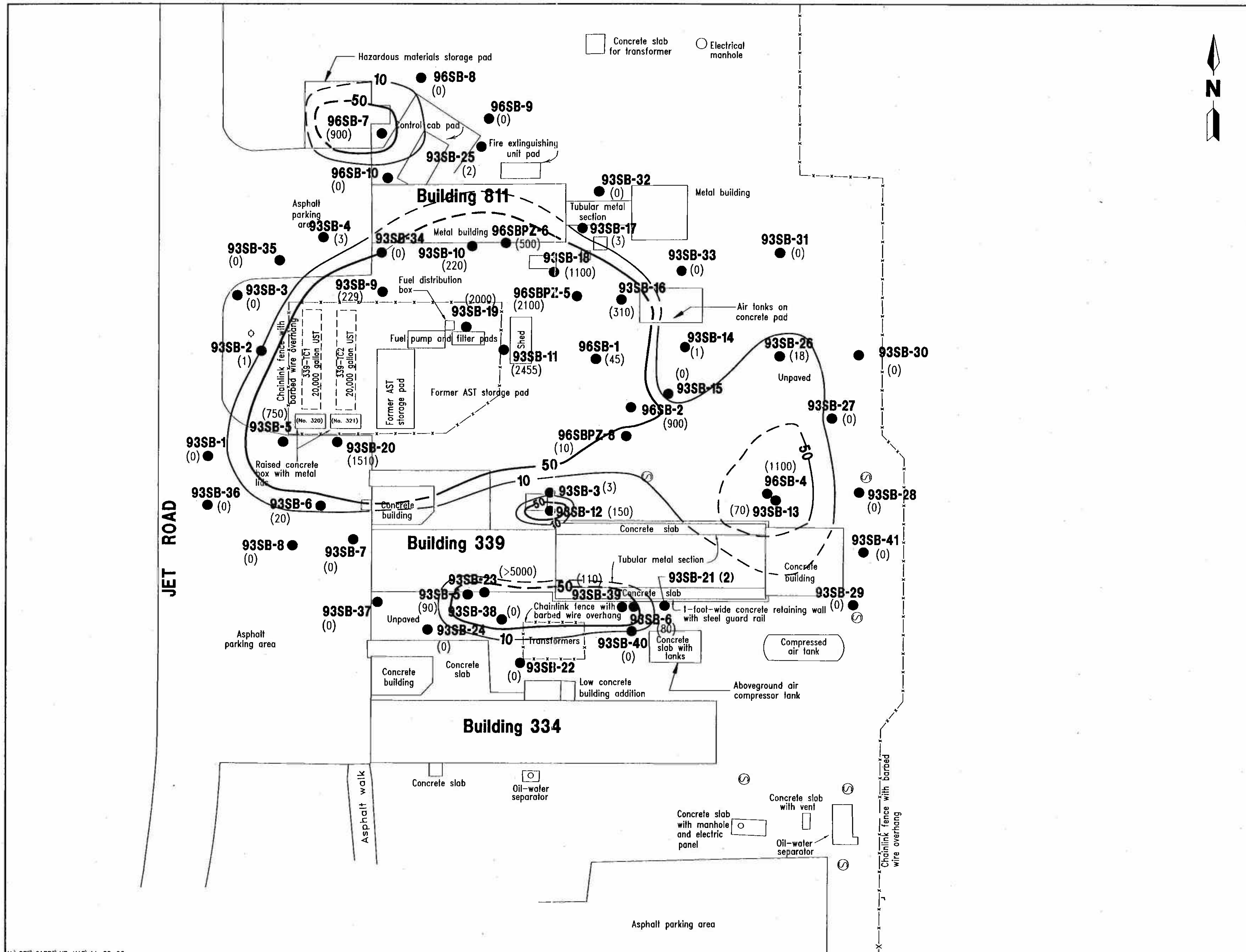
- PZ-5 — Piezometer location and designation
- MW20 — Monitoring well location and designation
- MW12D — Deep monitoring well location and designation
- Sanitary sewer manhole
- (73.78) — Water-level elevation (NGVD)
- —73.80— — Groundwater contour of equal elevation referenced to National Geodetic Vertical Datum (NGVD)
- Groundwater contour interval = 0.20 feet
- Groundwater flow direction
- UST — Underground storage tank
- AST — Aboveground storage tank

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 3-2
REVISED WATER TABLE ELEVATION MAP, SEPTEMBER 6, 1996

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



N

NOTES:

1. Soil borings 93SB-1 through 93SB-31 advanced in October 1993. Soil borings 93SB-32 through 93SB-41 advanced in June 1994.
2. Excessively contaminated soil (>50 ppm) shown in this figure represents Zone 1 in engineering calculations.
3. Total area of excessively contaminated soil is 15,080 square feet.
4. 96SB-1 was contoured within the 50 ppm contour line due to suspicion of contamination which could be associated with the nearby drainage line.

LEGEND

93SB-1	Soil boring location
(20)	Maximum organic vapor analyzer reading in parts per million (ppm)
——	Isoconcentration line (ppm)
━━	Isoconcentration line (ppm)
96SB-1	Soil boring location analyzed in September 1996.
96SBPZ-5	Soil boring location corresponding to piezometer locations.
AST	Aboveground storage tank
UST	Underground storage tank
Ø	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 3-1
SOIL CONTAMINATION DISTRIBUTION MAP, OCTOBER 1993, JUNE 1994, AND SEPTEMBER 1996

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

3.4 GROUNDWATER SAMPLING AND ANALYTICAL RESULTS. Some uncertainty as to the extent of the groundwater contaminant plume had resulted from a newly discovered (July 1, 1996) release of JP-5 from the AST that was removed June 12, 1996. To update groundwater contamination data, groundwater samples were collected from selected monitoring wells and piezometers and analyzed to assess the extent of groundwater contamination. ABB-ES also collected four groundwater samples beneath free product in monitoring wells MW409, MW24, and piezometers PZ-2 and PZ-6. All groundwater samples were collected and analyzed as described in Section 2.6. Groundwater analytical results are summarized in Table 3-3. Groundwater analytical data are reported in Appendix B. Figures 3-4, 3-5, and 3-6 show the extent of groundwater contamination based on the September 1996 groundwater analytical data.

3.5 EXTENT OF GROUNDWATER CONTAMINATION. The configuration of the petroleum hydrocarbon groundwater plume at the site is generally oriented in an east to northeast direction. The maximum length of the plume is 140 feet, and the maximum plume width is 110 feet. The horizontal extent of contamination is larger than previously shown in the CARA (ABB-ES, 1994b). Total VOA, benzene, and total naphthalene contamination has spread to MW10 and MW16. Data from PZ-6 indicate that the plume may have migrated northward beneath Building 811; however, this may be a result of the latest release in that immediate area. No petroleum hydrocarbon compounds in excess of regulatory standards were detected in monitoring well MW14D (screened 40 to 45 feet bls); therefore, vertical plume migration is less than 40 feet bls.

Table 3-3
Summary of Groundwater Analytical Results, September 10, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Contaminant	Monitoring Well or Piezometer Location								
	MW2	MW9[1]	MW10	MW14D	MW16	MW19[1]	MW20	Monitoring Only Guidance Concentration for G-II Groundwater Source/Perimeter	Regulatory Standards Class G-II Groundwater No Further Action[2]
Volatile Organic Compounds (USEPA Method 601/602) (μg/ℓ)									
Benzene	ND	13	1.7	ND	9.9	2	9.2	250/1	1
Ethylbenzene	ND	72	36	1.1	32	38	75		
Toluene	ND	ND	ND	ND	ND	11	5.7		
Xylenes, total	ND	61	23	ND	ND	180	71		
Total VOAs	ND	146	60.7	1.1	41.9	231	160.9	500/50	50
Polynuclear Aromatic Hydrocarbons (USEPA Method 625) (μg/ℓ)									
1-Methylnaphthalene	ND	150	43	ND	55	180	210		
2-Methylnaphthalene	ND	140	35	ND	43	130	150		
Naphthalene	ND	200	46	ND	49	210	270		
Total naphthalenes	ND	490	124	ND	147	520	630	1000/100	100

See notes at end of table.

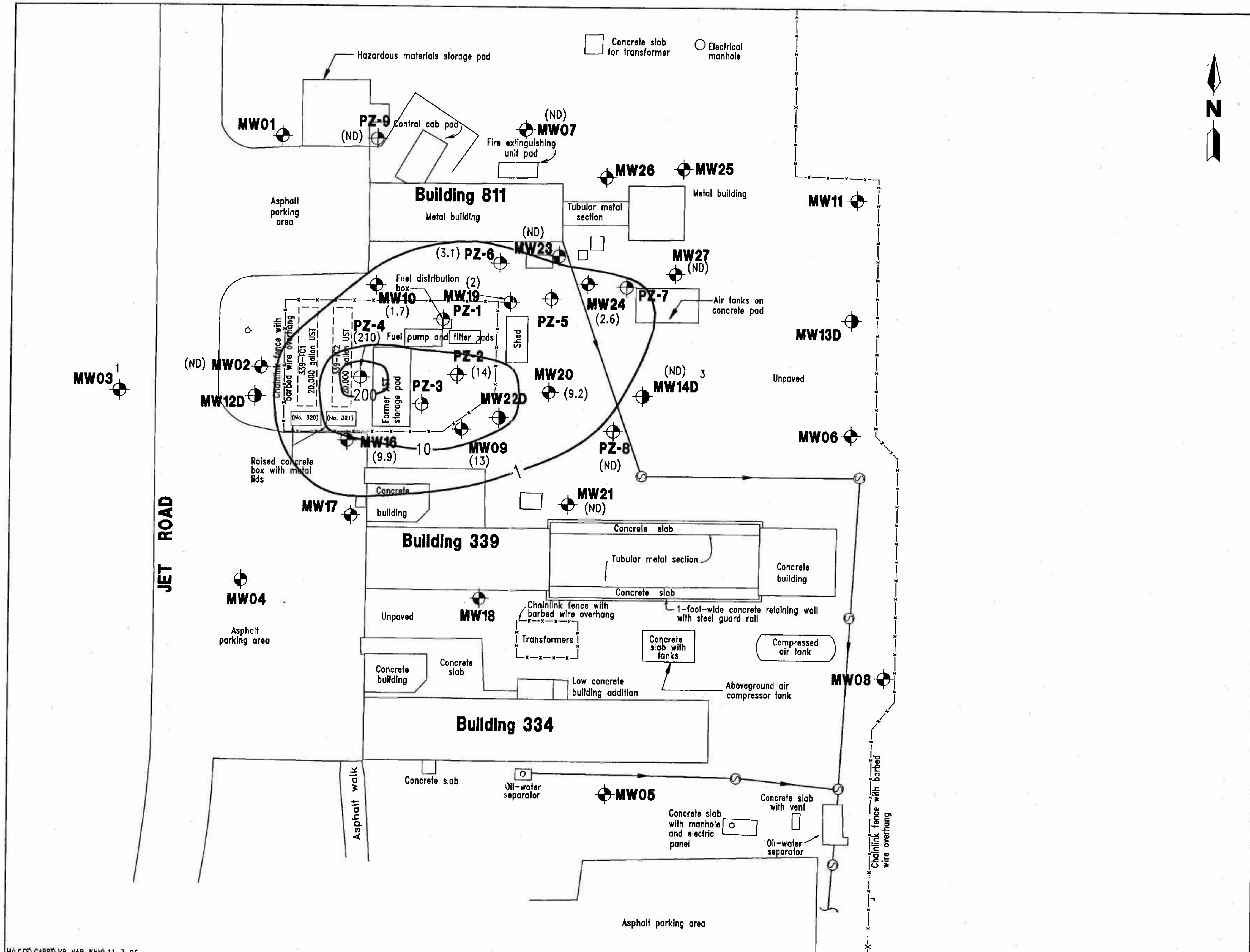
Table 3-3 (Continued)
Summary of Groundwater Analytical Results, September 10, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Contaminant	Monitoring Well or Piezometer Location										
	MW21	MW23[1]	MW24[2]	MW27	PZ-1[1]	PZ-4	PZ-6	PZ-8	PZ-9	Monitoring Only Guidance Concentration for G-II Groundwater Source/Perimeter	Regulatory Standards Class G-II Groundwater No Further Action[2]
Volatile Organic Compounds (USEPA Method 601/602) (μg/ℓ)											
Benzene	ND	ND	2.6	ND	14	210	3.1	ND	ND		
Ethylbenzene	ND	21	90	ND	58	470	56	2.1	ND		
Toluene	ND	ND	23	ND	ND	ND	ND	ND	ND		
Xylenes, total	ND	41	380	ND	170	1400	150	ND	ND		
Total VOAs	ND	62	495.6	ND	242	2080	209.1	2.1	ND		
Polynuclear Aromatic Hydrocarbons (USEPA Method 625) (μg/ℓ)											
1-Methylnaphthalene	ND	150	160	56	210	98	120	110	2.8		
2-Methylnaphthalene	ND	93	110	39	160	61	180	77	1.7		
Naphthalene	ND	77	180	ND	280	180	160	24	ND		
Total naphthalenes	ND	310	450	95	650	339	460	211	4.5	1000/100	100

[1] Contaminant concentration in groundwater sample obtained below free product.
[2] Chapter 62-770.730 (5a), Florida Administrative Code.

Notes: D = deep well.
USEPA = U.S. Environmental Protection Agency.
μg/ℓ = micrograms per liter.
ND = not detected.
Total VOAs = total volatile organic aromatics.



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Groundwater samples collected and analyzed from selected monitoring points.
3. Monitoring well MW14D not included in contour.

LEGEND

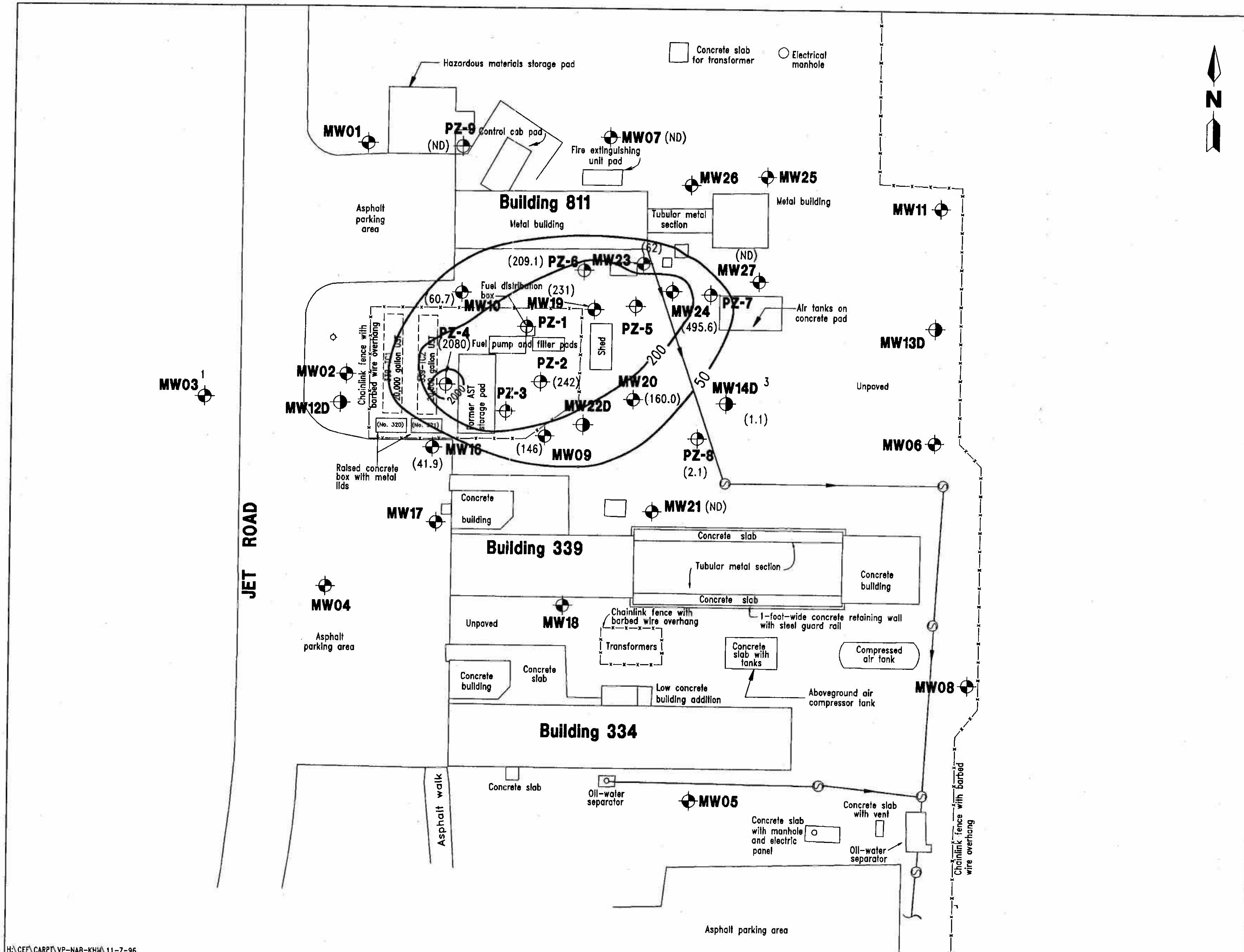
PZ-5	Piezometer location and designation
MW20	Monitoring well location and designation
MW14D	Deep monitoring well location and designation
(14)	Benzene concentration ($\mu g/l$)
—10—	Total benzene isoconcentration line ($\mu g/l$)
AST	Aboveground storage tank
UST	Underground storage tank
ND	Not detected
	Sanitary sewer line and flow direction (Complete line not shown)
($\mu g/l$)	Micrograms per liter
	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 3-4
BENZENE GROUNDWATER CONTAMINATION DISTRIBUTION MAP, SEPTEMBER 1996

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Groundwater samples collected and analyzed from selected monitoring points.
3. Monitoring well MW14D not included in contour.

LEGEND

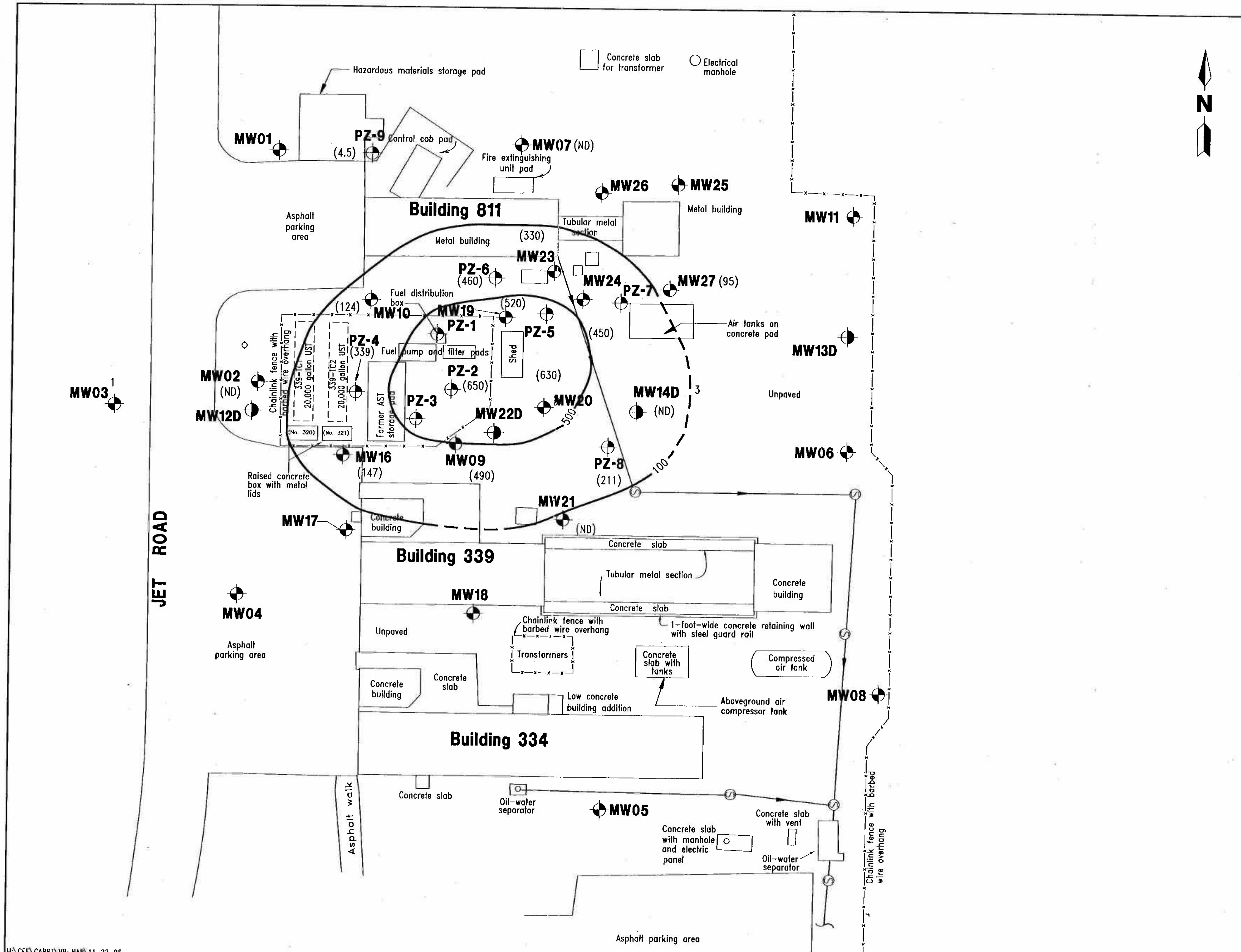
PZ-5	Piezometer location and designation
MW20	Monitoring well location and designation
MW14D	Deep monitoring well location and designation
(41.9)	Total VOA concentration ($\mu g/l$)
—50—	Total VOA isoconcentration line ($\mu g/l$)
ND	Not detected
AST	Aboveground storage tank
UST	Underground storage tank
⊘→ →	Sanitary sewer line and flow direction (Complete line not shown)
($\mu g/l$)	Micrograms per liter
⊘	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 3-5
TOTAL VOLATILE ORGANIC AROMATICS (VOA) CONTAMINATION DISTRIBUTION MAP, GROUNDWATER

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Groundwater samples collected and analyzed from selected monitoring points.
3. Monitoring well MW14D not included in contour.
4. Concentrations and contours based on selected monitoring points from September 1996.

LEGEND

PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
—100—	Total naphthalene isoconcentration (μg/l), dashed where inferred
(490)	Total naphthalenes concentration (μg/l)
AST	Aboveground storage tank
UST	Underground storage tank
⊘→ →	Sanitary sewer line and flow direction (Complete line not shown)
(μg/l)	Micrograms per liter
⊘	Sanitary sewer manhole

0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 3-6
TOTAL NAPHTHALENE CONTAMINATION DISTRIBUTION MAP, GROUNDWATER

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

4.0 ASSESSMENT CONCLUSIONS

The following findings for the Jet Engine Test Cell site at NAS Cecil Field are based on the data gathered during the field investigation conducted from June 1994 to September 1996 and the associated laboratory analytical results of soil and groundwater samples collected during the supplemental assessment in September 1996.

- Depth to groundwater in the surficial aquifer ranges from approximately 4.0 to 7.5 feet bls. The general groundwater flow direction at the site is toward the east, but may be influenced by seasonal fluctuations.

- The site is underlain by fine- to very fine-grained sand with some silt and clay stringers. A clay layer, approximately 1 foot in thickness, is located between 30 and 40 feet bls (ABB-ES, 1994b).

- Excessively contaminated soil was detected throughout the site and appears to be concentrated near the tank containment area leading southeastward following the drainage structure and surface swale. Isolated areas of soil contamination near soil borings 96SB-7, 96SB-12, and areas south of Building 339 may be associated with other surface spills and do not appear to have adversely affected groundwater in those areas.

- Soil contamination detected in samples collected from soil borings 96SB-4 and 93SB-13 appears to be associated with the oil-water separator, the UST, and their appurtenances. The proper closure and removal of these structures should be verified or further investigation may be required. This area is considered a separate source and will not be addressed in this RAP.

- The extent of free product is associated with the tank containment area and a smaller area to the northeast associated with fuel line building connection and the Building 811 drainage structure.

- Contaminants detected in groundwater samples include benzene, toluene, ethylbenzene, and xylenes (BTEX) (total VOAs), naphthalenes, 1-methylnaphthalene, and 2-methylnaphthalene (total naphthalenes).

- Class G-II groundwater regulatory standards of 1 part per billion (ppb), 50 ppb, and 100 ppb for benzene, total VOA, and total naphthalenes, respectively, were exceeded and are considered the applicable cleanup goals.

- The vertical extent of groundwater contamination does not exceed 40 feet bls.

- Groundwater from the surficial aquifer is not being used as a potable source within a 0.25-mile radius of the site.

5.0 REMEDIAL ACTION PLAN OBJECTIVES

Petroleum contamination at the Jet Engine Test Cell site is found in three phases: (1) adsorbed to the subsurface soils from approximately 1 foot bls to the groundwater table; (2) dissolved in the groundwater; and (3) in free phase, in the capillary fringe below the tank containment area and near monitoring well MW24.

5.1 FREE-PRODUCT REMOVAL. The FDEP requires containment and physical removal of free product. Based on site observations, free product at the Jet Engine Test Cell does not appear to be very mobile and is entrained in the soil. However, it is considered the primary source of groundwater contamination, and, therefore, product removal shall be completed prior to the initiation of the preferred remedial alternative.

5.2 SOIL REMEDIAL OBJECTIVES. Soil contamination at the site exceeds standards presented in Chapter 62-770.200(2), Florida Administrative Code (FAC). For the Kerosene analytical group, soil with an OVA reading greater than 50 part per million (ppm) is considered excessively contaminated. The target cleanup concentration for soil contamination is 10 ppm, which is the lower limit whereby soil may or may not require treatment.

The potential of contaminated soil to contaminate groundwater is also an issue to be considered. Contaminated soil at this site is located in areas of no known groundwater contamination. The remedial approach shall consider these areas as well to determine a practical and economic alternative to address contaminated soil.

5.3 GROUNDWATER REMEDIAL OBJECTIVES. Action levels for groundwater remediation are based on the target levels for Class G-II groundwater and the Kerosene analytical group under Chapter 62-770, FAC. Parameters that exceeded State regulatory criteria and target cleanup concentrations are shown below.

Parameter	Groundwater Target Concentration (micrograms per liter)
benzene	1
total BTEX	50
total naphthalenes	100

Trace concentrations of fluoranthene and pyrene were detected in samples collected from piezometer PZ-4. These concentrations were well below the Florida groundwater guidance concentrations for these compounds. Therefore, these two compounds are not considered site contaminants of concern.

6.0 REMEDIAL ALTERNATIVES SELECTION

When considering remedial options, exposure pathways and receptors should be identified. Once this is accomplished, the most cost-effective remedy can be selected and implemented to provide the necessary protection of human health and the environment while meeting the remedial action objectives. This phase of remedial planning becomes especially critical if natural attenuation is to be considered applicable.

6.1 TECHNOLOGY SCREENING. The screening of technologies for free-product recovery, soil treatment, and groundwater treatment are provided in Tables 6-1, 6-2, and 6-3, respectively.

Many of these technologies were discussed during a BCT meeting in June 1995. Since that time, ongoing remedial investigations at the North Fuel Farm site, South Fuel Farm site, Day Tank 1 site, Truck Stand site, and this Jet Engine Test Cell site have yielded information that aided in this revised alternatives screening. Some of the proven technologies, which were field tested or implemented, are discussed in the following subsections. Their application at the Jet Engine Test Cell is also considered.

6.1.1 Feasibility of Bioslurping At the North Fuel Farm site, operation and optimization of a bioslurping system, which began operation in May 1996, is ongoing to recover product in the tank mound area. Data collected through September 1996 shows the technology to be effective; however, extensive operation and monitoring costs have been incurred to date.

Eight-hour bioslurping tests have been performed at the Day Tank 1 site and Jet Engine Test Cell site. These tests indicate limited effectiveness for bioslurping at the Jet Engine Test Cell site.

6.1.2 Feasibility of Bioventing or Soil Vapor Extraction The intrinsic permeability has been estimated with an 8-hour permeability test at the Day Tank 1 site, which is one-half mile south of the Jet Engine Test Cell. The test data indicate that a radius of influence for vapor with an application pressure of 50 inches of water could approach 28 feet.

These test results are considered applicable for the Jet Engine Test Cell as each site has similar soil types. Results of this test are included in the APR for the Jet Engine Test Cell (ABB-ES, 1995).

6.1.3 Feasibility of Biosparging Air sparge and biosparge tests have been performed at both the North Fuel Farm and the South Fuel Farm sites. Results and test data from the South Fuel Farm are included in the RAP for the South Fuel Farm Site (ABB-ES, 1996). Each test indicates that biosparging would be an effective remedial alternative for the groundwater at the Jet Engine Test Cell site.

6.1.4 Feasibility of Natural Attenuation Although not designed as a natural attenuation site, natural attenuation appears to be occurring at the Truck Stand site. At this time, groundwater concentrations have reached monitoring only levels following source zone removal and a monitoring only plan is being implemented.

Table 6-1
Screening of Free-Product Recovery Technologies

Remedial Action Plan, Jet Engine Test Cell Site
Naval Air Station Cecil Field
Jacksonville, Florida

Collection				
Technology/ Process	Advantages	Disadvantages	Screening Status	Comments
Interceptor trenches	• Requires a minimum of power input and maintenance by consolidating recovery pumps and appurtenances.	• The majority of the free-product contaminated area is within the underground storage tank area. • Passive recovery techniques typically take place over a long time frame. • Excavated soil and groundwater must be managed appropriately.	Eliminated	A longer free-product recovery time will be required for a passive recovery system.
Extraction wells with skimmer pumps	• Has been successfully implemented at other sites. • Groundwater recovered would require minimal treatment before going to the wastewater treatment facility.	• Requires multiple recovery pumps and associated appurtenances. • Effectiveness decreases in fine-grained soil. • Large power maintenance requirements are necessary for extraction of LNAPL.	Eliminated	Water table depressions may smear free product to greater depths.
Extraction wells with vacuum-enhanced recovery (Bioslurping)	• Groundwater recovered would require minimal treatment before going to the wastewater treatment facility. • Added benefit of bioventing in the vadose zone and increased dissolved oxygen in the shallow groundwater may be experienced. • Groundwater recovery can be minimized with appropriate operation. • No "smear zone" which is normally associated with free-product recovery wells.	• Operation and maintenance may be extensive to handle extreme groundwater fluctuations.	Eliminated	Similar systems operating at other sites onbase not operating efficiently. Technology is site specific and requires extensive operation and maintenance.
Large-diameter sumps	• Product recovery sumps allow the use of product skimmers without groundwater recovery. • Operation and maintenance of an extensive well system is not necessary.	• A passive approach, complete product recovery may not be achieved within a desirable time frame.	Eliminated	A longer free-product recovery time will be required for a passive recovery system.

See notes at end of table.

Table 6-1 (Continued)
Screening of Free-Product Recovery Technologies

Remedial Action Plan, Jet Engine Test Cell Site
Naval Air Station Cecil Field
Jacksonville, Florida

Collection

Technology/ Process	Advantages	Disadvantages	Screening Status	Comments
Horizontal extraction wells	• Can be positioned around the perimeter of the tank area. • Total number of pumps can be minimized with the aid of gravity flow. • Minimal site disturbance would be experienced.	• Large quantities of groundwater may be recovered during product recovery. • Installation below the capillary fringe is necessary to maintain gravity flow into the trench. • Excavated soil and groundwater must be managed appropriately.	Eliminated	Groundwater recovery will be maximized in an effort to draw in free product.
Manual Recovery	• Equipment requirements are minimal. • Capital costs are low compared to other technologies. • Uses existing wells.	• Costs for frequent mobilization of personnel and equipment are high • Low number and large spacing of existing monitoring wells results in low removal rate over a long time frame.	Eliminated	Presently in use. Product recovers quickly (next day) indicating limited effectiveness.
Direct Excavation	• Provides complete removal of all free product and excessively contaminated soil. • Soil at the Test Cell site is amenable to excavation beneath the groundwater table without immediate infiltration of contaminated groundwater. • Has been used successfully at other sites on base. • Fixed-price free-product removal alternative.	• Difficult to determine the extent of free product while excavating. • Free product infiltrating into the excavation must be collected. • Controls and safety measures are required during excavation. • Pipelines in the area may make excavation difficult.	Retained	Technology offers a set time period for completion. Complete recovery of free product is almost assured. The most excessively contaminated soil is removed for treatment as well.

Notes: ░ = indicates technology was eliminated.
LNAPL = light nonaqueous-phase liquid.

Table 6-2
Soil Remedial Technology Review

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Remedial Technology	Advantages	Disadvantages	Screening Status	Comments
No action	• No cost would be incurred other than for monitoring. • Some contaminated soil is not contributing to groundwater contamination.	• Does not reduce exposure potential for human or environmental receptors. • Would not reduce mobility, toxicity, or volume of contaminants.	Retained	Potential threat to human health is low and contaminant migration is sufficiently delayed.
Soil cover	• Reduces exposure potential for human receptors. • Easily implemented.	• Would not reduce toxicity or volume of contaminants. • Long-term liability associated with waste.	Eliminated	Sufficient threat is not apparent to warrant extensive actions.
Offsite landfill	• Widely used and easily implemented technology. • No wastes or treatment residuals remaining onsite. • Contaminants may be relocated to a more stable, contained, lower exposure potential environment. • Relatively little mobilization effort and cost. • Experienced excavation contractors available.	• Subsurface utilities make excavation difficult. • Would not reduce toxicity or volume of contaminants. • Limited landfill capacity nationwide. • Transportation and landfilling costs may be expensive. • Long-term liability associated with landfilled waste.	Retained	Choice will be dependent upon cost analysis.
Onsite biotreatment (Site 5 Biocell)	• No secondary wastes produced. • Contaminants may be relocated to a more stable, contained, lower exposure potential environment. • No transportation of waste over public roads.	• Subsurface utilities in the area make excavation difficult. • Would not reduce toxicity or volume of contaminants. • Long-term monitoring and maintenance would be required. • Long-term liability associated with landfilled waste.	Retained	Availability of the biocell is in question as CERCLA regulated hazardous waste is currently being stockpiled in the cell. Excavation of contaminated soil associated with free product could occur prior to site closure.
Onsite incineration	• Destruction and removal efficiencies are greater than 99.99 percent, thus reducing volume of contaminants. • Technology is reliable and has been demonstrated for treating organics at full scale. • Widely used for treatment of organic wastes. • Mobile units are available.	• Subsurface utilities make excavation difficult.	Retained	Excavation of contaminated soil associated with free product could occur prior to site closure. Choice will be dependent upon cost analysis and base wide plan.

See notes at end of table.

Table 6-2 (Continued)
Screening of Soil Remedial Technologies

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Remedial Technology	Advantages	Disadvantages	Screening Status	Comments
Offsite incineration	• Destruction and removal efficiencies are greater than 99.99 percent, thus reducing volume of contaminants. • Technology is reliable and has been demonstrated for treating organics at full scale. • Widely used for treatment of organics wastes. • Experienced vendors are available.	• Subsurface utilities make excavation difficult.	Retained	Excavation of contaminated soil associated with free product could occur prior to site closure. Choice will be dependent upon cost analysis.
Thermal soil aeration	• Technology has been demonstrated full scale for treating organics. • May not require an incinerator permit to operate. • Mobile units are available.	• Would not reduce toxicity, mobility, and volume of contaminants. • Secondary waste stream requires further treatment.	Eliminated	Does not offer benefits over other screened technologies.
Soil washing	• Wide application to varied waste groups. • Mobile units are available.	• Difficulty in treating complex waste mixtures. • Potentially hazardous chemicals may be brought onsite to be used in process. • Potential difficulty in removing washing solution from treated soil. • Limited effectiveness for treating soil with high humic content and high fine-grained clay fraction.	Eliminated	Does not offer benefits over other screened technologies.
Soil vapor extraction	• Reduces mobility, toxicity, and volume of contaminants if vapors are collected and treated. • Effective for extraction of VOCs from unsaturated zone. • Demonstrated capability for extracting up to 2,000 pounds of VOCs per day. • Not subject to RCRA land disposal restrictions. • Extraction equipment is off-the-shelf and experienced vendors are readily available.	• Dispersion of vapors could result in localized concentrations of contaminants near well heads. • Extensive soil, air, and groundwater monitoring required, including soil borings. • Not effective for treating soil with a high moisture content.	Eliminated as primary treatment, may be necessary in coordination with Biosparging for groundwater.	Capable of treating organic compounds. May be used with air sparging or bioventing. Large vapor contaminant concentrations from the product saturated zone would require treatment.

See notes at end of table.

Table 6-2 (Continued)
Screening of Soil Remedial Technologies

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Remedial Technology	Advantages	Disadvantages	Screening Status	Comments
Soil flushing	• Can be used in conjunction with groundwater treatment. • Effective for removal of organics from permeable soil. • Full-scale units are available.	• Difficulty in treating complex waste mixtures. • Limited effectiveness for treating soil with high humic content and high fine-grained clay fraction. • Transferring contaminant to groundwater will create more problems in contaminant recovery.	Eliminated	The number of pore volumes necessary would be excessive and an even distribution is difficult.
Bioventing	• Demonstrated at pilot-scale for treating hydrocarbons in soil. • Reduces toxicity and volume of organics. • No secondary waste streams. • Data from North Fuel Farm indicates that indigenous hydrocarbon degrading bacteria are present.	• Injected air may mobilize VOCs in the vadose zone. • Strict operating controls are required to maintain optimal biodegradation environment.	Eliminated	Capable of treating organics. May be used with soil vapor extraction. Free product present will continue to recontaminate any cleaned soil.

Notes: ░ = indicates technology was eliminated.
RCRA = Resource Conservation and Recovery Act.
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act.
VOCs = volatile organic compounds.

Table 6-3
Screening of Groundwater Remedial Technologies

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Remedial Technology	Advantages	Disadvantages	Screening Status	Comments
Natural Attenuation	• Disturbance to existing site operations is minimal. • The technology can be used in locations that are difficult to treat due to obstructions (i.e., under buildings, etc.)	• The technology is not suitable at sites where free product or impacted groundwater is present. • Natural attenuation may not be suitable if receptors could be affected by migration of contaminants. • Treatment times are normally longer than for active remedial measures.	Retained	Extended cleanup times are acceptable for the sites at Naval Air Station Cecil Field. Free product must be removed to implement this option.
Groundwater monitoring	• Monitors short- and long-term effectiveness of remedial technologies when used during and after remediation.	• Would not reduce mobility, toxicity, or volume of contaminants when used alone.	Retained	Required component of any groundwater remediation.
Slurry wall	• May reduce the mobility of contaminants present in groundwater. • Current construction methods are capable of going to a depth of 200 feet below ground surface.	• Containment would not reduce the toxicity or volume of contaminants in groundwater. • Would not reduce mobility of contaminants without capping the site. • Contaminants may well degrade slurry wall material.	Eliminated	Plume containment is not an issue as pore velocity indicates migration is sufficiently retarded. There are no downgradient receptors.
Groundwater extraction wells	• Some existing wells may be used.	• Wells must be strategically located so that cones of depression intersect and capture all contaminated groundwater.	Eliminated	More effective technologies have been proven.
Air sparging	• Injected air may volatilize hydrocarbons. • Effective for VOCs when used in conjunction with soil vapor extraction. • Soil vapor extraction may not be necessary if low sparge rates are used.	• Extensive monitoring and operational adjustments may be required during start-up to attain proper dispersion rates. • Extensive soil, air, structural stability and groundwater monitoring are required.	Eliminated	Biosparging is preferred as vapor recovery or vapor concentrations would be minimized.

See notes at end of table.

Table 6-3 (Continued)
Screening of Groundwater Remedial Technologies

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Remedial Technology	Advantages	Disadvantages	Screening Status	Comments
Biosparging	• Injected air stimulates biological degradation of contaminants *in situ*.	• Soil vapor extraction system may be required to recover vapors. • Extensive monitoring and operational adjustments may be required during start-up to attain proper dispersion rates. • Extensive soil, air, structural stability and groundwater monitoring required.	Retained May be applicable if natural attenuation is unsuccessful.	Low air flow rates may caused less structural instability in the subsurface soils than flow rates associated with air sparging.
Wastewater treatment facility disposal	• May involve only pumping groundwater to treatment facility. • May only require the use of an oil-water separator.	• Treatability studies would be required to determine effect on treatment processes. • Approval required by operating agency.	Eliminated	Could be a viable disposal option for treated effluent. Groundwater recovery is not preferred.
Groundwater reinjection	• Treated groundwater is reinjected for further treatment. • Accelerates groundwater cleanup.	• Infiltration of treated groundwater could affect the migration of contaminants. • Reinjection of water into the plume's path may have an adverse effect on the collection system. • Requires permitting.	Eliminated	Could be a viable disposal option for treated effluent. Groundwater recovery is not preferred.
Discharge to surface water	• Existing pipes and NPDES permit.	• Effluent must meet discharge permit requirements.	Eliminated	No surface water body nearby.

Notes: ░ = indicates technology was eliminated.
VOCs = volatile organic compounds.
NPDES = National Pollution Discharge Elimination System.

This site is located in an industrial setting and is likely to remain as such during reuse. There are no known potential receptors at the Jet Engine Test Cell site; however, effort should be made to limit contaminant migration.

The drainage system associated with building 811 and the hazardous materials storage area may be acting as a preferential pathway for contaminants during wet conditions (high water table). Building 811 was a temporary facility and is no longer used for the purpose of testing jet engines. This building is scheduled for removal in 1997 and the use of this drainage line will no longer be required. Removal of the drainage system is recommended at that time.

<u>6.2 ALTERNATIVES SELECTION</u>. The remedial alternative selection process should be performed considering all three contaminant zones (groundwater, soil, and free product) as one unit. The interaction of contaminants in one phase with contaminants in other phases should be considered. Removal of contaminants in the form of soil vapor, groundwater, or free-phase product will have a positive effect on the other matrices not directly targeted. The remainder of this chapter will cover the selected alternative for free-product recovery and source zone reduction. The recommended groundwater alternative will follow.

<u>6.2.1 Free-Product Removal and Source Zone Reduction</u> Free-product removal will help expedite any soil and groundwater remedial alternatives. Residual product (product trapped in the interstitial pores of the soil) and free product make up a large portion of the total mass of contaminant. Whether residual or free phase, the product acts as a continuing source to groundwater and soil contamination as fluctuations in groundwater occur.

Due to the nature of the soil at the Jet Engine Test Cell, a greater percentage of product is found in the residual phase than in the free phase. This hinders the active recovery options listed in Table 6-1; however, residual product does offer advantages. Free-product migration offsite is retarded, and removal of free product by direct excavation beneath the groundwater table is effective. This method of free-product recovery has been used successfully at other sites with similar soil characteristics and free and residual phase JP-5 fuel contamination.

Direct excavation and treatment of contaminated soil and free product is recommended. The depth to groundwater at the Jet Engine Test Cell at mean low water table is between 6.5 and 7.5 feet bls. Excavation to a depth of approximately 8 feet in the areas of known product contamination can effectively remove close to 90 percent of the source material. Remaining source material will consist of contaminated soil outside of the tank area, portions of which do not appear to be contributing to groundwater contamination as shown by groundwater concentrations in these areas. These soils will be addressed during site modeling that is included in Chapter 8.0.

Offsite thermal treatment is considered to be the most economical option when considering the soil volume to be removed and treated. This alternative is, therefore, recommended as the soil treatment alternative.

6.2.2 Groundwater Treatment Based on encouraging results from the Truck Stand site at NAS Cecil Field, the nature of the contaminants, and the natural attenuation data collected in September 1996, evidence exists supporting the feasibility of natural attenuation as a remedial alternative at the Jet Engine Test Cell site. With the data collected to support natural attenuation and site-specific hydrogeologic parameters, the USEPA's BIOSCREEN Natural Attenuation Decision Support System (BIOSCREEN) was used to model contaminant fate and transport before and following source reduction. These results are presented in Chapter 8.0.

Natural attenuation is the preferred remedy for this site; however, biosparging has been demonstrated as an effective technology at other similar sites at NAS Cecil Field. Biosparging may be an effective option if natural attenuation does not proceed in an expedient fashion.

7.0 SOIL EXCAVATION AND PRODUCT RECOVERY

The recommended remedial action for the Jet Engine Test Cell site consists of source abatement through excavation of excessively contaminated soils in the area of known free-product contamination. Provisions should be taken for the proper handling and disposal of infiltrating groundwater and free product during the excavation. Following source removal, groundwater contaminant concentrations will remain above necessary action levels specified in Chapter 5.0 of this document, and remediation will be required.

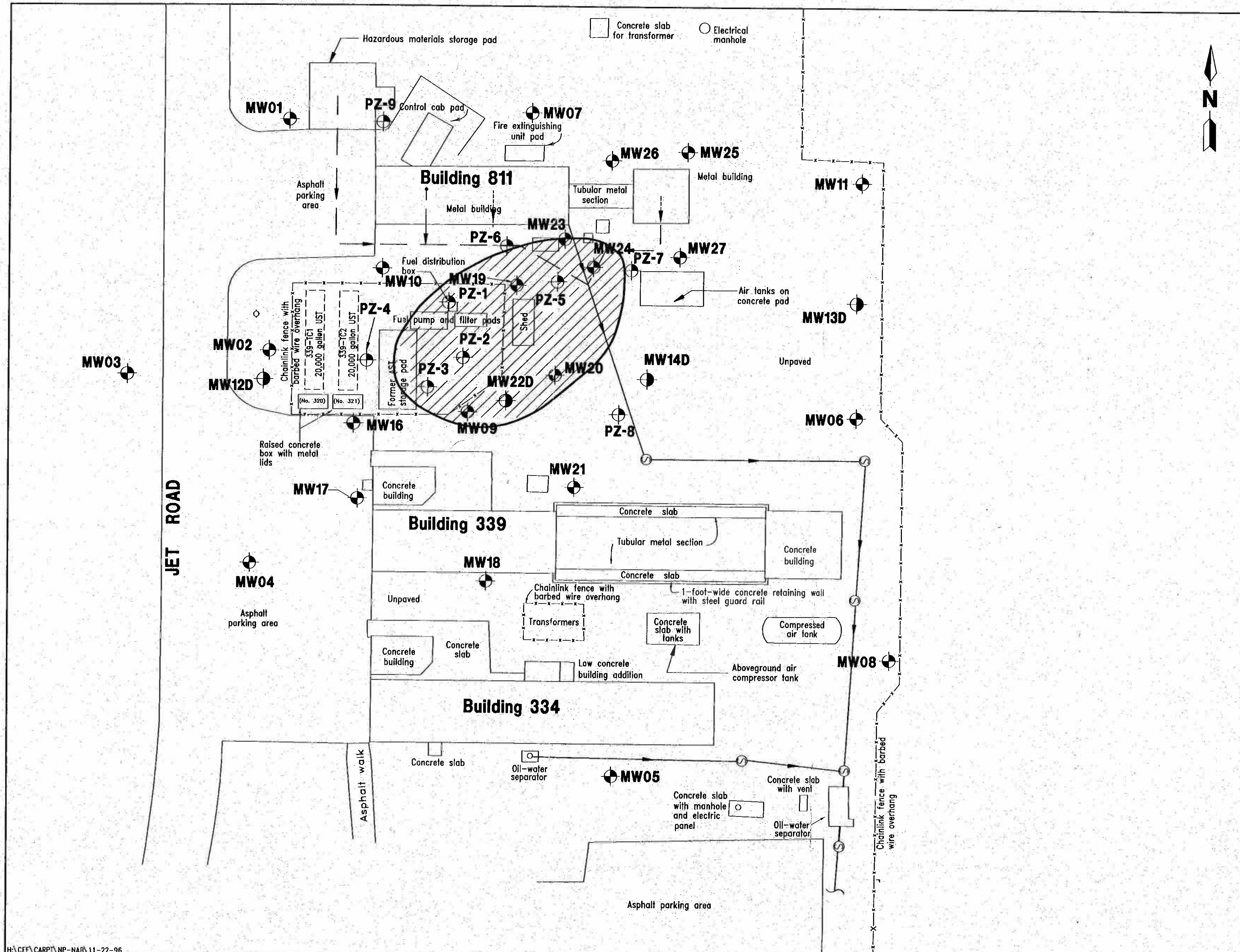
The USEPA's BIOSCREEN was used to model natural attenuation processes at this site and to predict the natural reduction of contaminant concentrations. The assumptions and input values used for BIOSCREEN as well as an explanation of the BIOSCREEN scenarios screened are included in Chapter 8.0.

7.1 SOIL EXCAVATION AND TREATMENT. The area of excavation shown on Figure 7-1 is approximately 4,700 square feet. This area includes both areas where free product has been measured. The soil is classified as a silty sand based on the Unified Soil Classification System.

Excavation and thermal treatment processes should be performed as outlined in Chapter 62-775, FAC. Excavation to a depth of 8 feet bls is proposed for the area shown. The total volume of soil to be excavated is 1,568 cubic yards (approximately 2,200 tons). Soil volume calculations, including a swell factor of 12 percent, are presented in Appendix C, Engineering Calculations. The excavation will include vacuum cleaning and capping or removal of abandoned JP-5 fuel distribution lines when encountered.

7.1.1 Pretreatment Sampling The area of soil contamination corresponds with the suspected area of free-product contamination. Based on the volume of contaminated soil expected, six composite pretreatment samples must be analyzed, as described in Table 7-1, for VOAs, total recoverable petroleum hydrocarbons, and volatile organic halocarbons in accordance with Chapter 62-775.410, FAC. A total metals analysis must also be performed. Each composite soil sample must be collected from at least four locations in the contaminated area and can be taken while performing the excavation.

7.1.2 Excavation Excavation will be conducted using standard earthmoving equipment. All operators will be certified by the Occupational Safety and Health Administration. OVA headspace analyses will be performed at set intervals during the excavation to monitor soil contaminant levels, however, visual inspection and knowledge of the apparent extent of free-product will be used to delineate the area to be removed and treated. Excavation to a depth approximately 1 foot below the mean low groundwater table is necessary to implement free-product removal. Excavated soil should be loaded directly into trucks to facilitate immediate site removal and delivery to a permitted soil thermal treatment facility and to prevent spreading of the contaminated soil at the site. An updated listing of permitted thermal treatment facilities can be obtained from the FDEP.



NOTES:

1. Excavation area is approximately 4,721 square feet.
2. Excavation to be approximately 8 feet deep.
3. Proper shoring and site access control required.
4. Field verify location of all subsurface utilities.
5. Excavation area referred to as Zone 3 in engineering calculations.

LEGEND

PZ-5	Piezometer location and designation
MW20	Monitoring well location and designation
MW14D	Deep monitoring well location and designation
	Excavation area
UST	Underground storage tank
AST	Aboveground storage tank
ND	Not detected
	Sanitary sewer line and flow direction (Complete line not shown)
	Sanitary sewer manhole

0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 7-1
AREA OF PROPOSED EXCAVATION

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Table 7-1
Soil Sampling and Analyses

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Contaminant	Test Method
Total volatile organic aromatics	USEPA Methods 5030/8020
Total recoverable petroleum hydrocarbons	Method FL8100
Polynuclear aromatic hydrocarbons	USEPA Methods 3540/8100, 3550/8100, 3540/8250, 3540/8270, 3550/8250, 3550/8270, 3540/8310, or 3550/8320
Volatile organic halocarbons	USEPA Method 5030/8010
Metals	
Arsenic	USEPA Methods 7060, 7061, or 6010
Barium	USEPA Method 7080 or 6010
Cadmium	USEPA Method 7130, 7131, or 6010
Chromium	USEPA Method 7190, 7191, or 6010
Lead	USEPA Method 7420, 7421, or 6010
Mercury	USEPA Method 7471
Selenium	USEPA Method 7040, 7041, or 6010
Silver	USEPA Method 7760 or 6010

Source: Chapter 62-775.400(4) through 62-775-410(1)(e), Florida Administrative Code.

Note: USEPA = U.S. Environmental Protection Agency.

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The excavation should have sides sloped or shored in accordance with applicable standards to prevent unstable conditions during excavation that could pose hazards to personnel or surrounding structures and pavements. Stormwater runon and runoff controls should be implemented to prevent offsite migration of sediment or contaminated stormwater during site activities. Dust control should also be implemented to prevent fugitive emissions during excavation and soil handling. Benchmarks, existing structures, fences, sidewalks, utilities, and other cultural features shall be protected from excavation equipment. A professional survey to verify locations of site utilities was not conducted for this report; however, active or inactive subsurface obstructions are present. Obstructions may include pipelines for sanitary sewerage, compressed air, underground electric lines, and JP-5 distribution lines. Subsurface features shown on Figure 1-3 should be field verified prior to excavating.

<u>7.2 FREE-PRODUCT REMOVAL</u>. The approximate volume of product associated with the area to be excavated is 1,495 gallons. This product exists in both free and residual forms. Excavation below the depth of the mean low water table will be required to capture product that is entrained in the capillary fringe. Excavations of this nature performed previously at NAS Cecil Field show the mobility of product to be minimal.

<u>7.2.1 Infiltration into the Excavation</u> Excavation to a depth below the groundwater table may cause infiltration of the surrounding groundwater into the open area. Past experience indicates that this is not a major concern, however, if free product is detected in recharging groundwater, recovery will be necessary. The volume of any infiltrating free product is unknown; however, because it would be originating from outside the expected area of free-product, small quantities, if any, are expected. The groundwater and free product recovery method will be chosen by the Response Action Contractor and to allow for some flexibility in this selection, only general requirements are specified here. Other options may be used with prior approval from FDEP.

Product sorbing materials will be used to recover small quantities of product that filtrate into the excavation. This material will be removed when saturated and drummed onsite. These containers will be removed from the site by a licensed petroleum-recycling agent.

A tanker truck with vacuum connections will be used to capture large quantities of free product if necessary. A licensed petroleum recycling agent will remove the free product and any incidentally captured groundwater. Collected groundwater and free product will be disposed of in the base oil-water separators prior to final treatment at the NAS Cecil Field Waste Water Treatment Plant.

<u>7.2.2 Abandonment of Monitoring Wells</u> The free-product areas are delineated by existing piezometers and monitoring wells MW09 and MW24. Monitoring wells within the area to be excavated should be abandoned (grouted and sealed) in accordance with Chapter 40C-3.517, FAC, prior to excavation. Well abandonment should be performed a minimum of 12 hours prior to the excavation. Proper permits will also be required.

7.3 SITE RESTORATION AND DEMOBILIZATION. Backfilling activities should commence and be completed at the end of each working day to minimize groundwater infiltration into the open area. An impermeable high density polyethylene liner or equivalent, should be placed immediately to the east, downgradient of the two active USTs to avoid possible recontamination of the clean fill. The liner should span the entire eastern edge of the excavation. This liner shall be placed on a vertical wall of the excavation and extend from the ground surface to 1 foot below the mean low water table (approximately 8 feet bls).

Backfill should be field compacted in place to surrounding conditions with earthmoving equipment tracks to a minimum of 85 percent Proctor (American Society for Testing and Materials D1557) or approved equivalent. Backfill material will be compacted in lifts of approximately 1 foot. Compactive effort will be no less than four passes of the earthmoving equipment. Approximately 1,600 yd^3 of backfill material will be needed.

The backfilled area will be raised grade to above surrounding elevations and the grade will be sloped from the center outward to a minimum slope of 50 horizontal to 1 vertical so that runoff will flow away from the backfilled area. The slope will be blended into level areas and the grade changes will be gradual. Certification that the backfill is free of petroleum hydrocarbon contamination is required from the backfill source prior to delivery.

During backfill operations, utility services will be disconnected in coordination with base personnel. After completion, benchmarks, existing structures, fences, sidewalks, utilities, and other cultural features to remain that were damaged during remedial activities will be repaired. All lines and grades will be verified after all equipment and materials have been removed from the site and work is complete. Final review of project documentation as well as a site walkover will be conducted to assure satisfactory completion of the project prior to leaving the site.

7.4 FUTURE SITE ACTIVITIES. The Jet Engine Test Cell site will remain active following source removal with operations serving Buildings 334 and 339 until base closure, which is scheduled for 2000.

Soils in the immediate vicinity of the tanks are excessively contaminated and the presence of free and entrained product in the tank beds is likely. Final decommissioning of the Jet Engine Test Cell will consist of tank removal as well as fuel line capping or removal. At that time excavation should continue to a depth of approximately 8 feet (1 foot below the mean low water table), if the presence of product or tank leakage is evident.

Proper monitoring and documentation of future JP-5 releases is essential to the success of this RAP. By operating the Jet Engine Test Cell with best management practices any future releases can be minimized.

8.0 GROUNDWATER GEOCHEMISTRY AND GROUNDWATER MODEL

The most important assumption when modeling natural attenuation is that biodegradation is occurring at the site. A strong indication of biodegradation is the presence of electron acceptors relative to the contamination at each sample location. At the Jet Engine Test Cell site, electron acceptor concentrations and other physical parameters such as pH, temperature, and turbidity were measured to evaluate if natural degradation is occurring. These data are provided in Table 8-1. An analysis of the data, as it pertains to each electron acceptor and microbial processes, is provided in this section. The groundwater model is then discussed with results and recommendations.

8.1 ELECTRON ACCEPTORS AND OTHER INDICATORS OF BIODEGRADATION. Evidence exists for biodegradation when concentrations of electron acceptors, such as dissolved oxygen, nitrate, and sulfate, are depleted in the area of contamination. Other indicators of biodegradation are increased by-product concentrations, such as carbon dioxide (CO_2) and iron (II), in known areas of groundwater contamination. These indicators as well as alkalinity and other parameters are now described.

8.1.1 Dissolved Oxygen A depleted concentration of dissolved oxygen in the source area is a strong indication of aerobic biodegradation (Figure 8-1). Field measurements indicate that dissolved oxygen at the Jet Engine Test Cell is relatively low, in the 0.5 to 2 milligrams per liter (mg/ℓ) range, in both the source and background area. The average background concentration for dissolved oxygen, based on measurements taken from wells outside of the contaminated zone was 1.4 mg/ℓ with a high concentration of 2.0 mg/ℓ. Inside the source zone an average concentration of 1.1 mg/ℓ with a low concentration of 0.56 mg/ℓ associated with monitoring well MW19 was measured.

8.1.2 Nitrate Concentrations of nitrate were measured in the field using a HACH test kit. The lower detection limit using this method was 5 mg/ℓ and was too high for the low concentrations experienced at the Jet Engine Test Cell site. The use of nitrate in the denitrification process is not likely to occur at the Jet Engine Test Cell due to the presence of dissolved oxygen. Nitrate cannot be used as an electron acceptor until the concentration of dissolved oxygen falls below about 0.5 mg/ℓ (Wiedemeier, 1995). At the Jet Engine Test Cell site the lowest dissolved oxygen concentration within the plume was 0.56 mg/ℓ. A second reason denitrification is not likely is due to the average pH of 5.67, which is lower than the favored pH conditions of 6.2 to 10.2 standard units (Wiedemeier, 1995).

8.1.3 Iron II Under anaerobic conditions, iron III may be used as an electron acceptor. Although iron III available to microorganisms cannot be measured without knowing the degree of crystallinity, iron II, an end-product in the reaction can be used as an indicator. Elevated levels of iron II corresponding to elevated levels of BTEX indicate that biodegradation via iron III reduction is likely occurring. This is the case at the Jet Engine Test Cell site where three of the four highest iron II concentrations correspond with the three most highly contaminated monitoring points (Figure 8-2). The average concentration of iron II in these monitoring points is 9.2 mg/ℓ, compared to a background concentration of 1.52 mg/ℓ. The third area of elevated iron II concentrations is centered in monitoring well MW18, near the location of a removed oil-water separator, a known area of soil contamination.

Table 8-1
Natural Attenuation Monitoring
September 10-12, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Monitoring Parameters	Monitoring Wells CEF-811-									
	02	07	09	10	14D	16	17	18	19	20
Iron (mg/ℓ)	0.4	0	0.6	3.2	0.8	3.4	5.0	10.0	1.3	7.2
Chloride (mg/ℓ)	10	10	15	15	15	15	15	20	15	15
Alkalinity (mg/ℓ)	102.0	20.4	108.8	13.6	13.6	129.2	95.2	163.2	40.8	108.8
Nitrate (mg/ℓ)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Sulfate (mg/ℓ)	<50	<50	50.0	<50	<50	<50	<50	<50	<50	<50
Dissolved Oxygen* (mg/ℓ)	1.96	1.80	0.62	0.66	1.51	0.61	0.61	0.80	0.56	1.17
Carbon Dioxide (mg/ℓ)	60	70	130	150	50	120	90	140	90	250
pH	6.14	5.12	5.83	4.89	4.33	6.02	5.72	5.97	5.42	5.48
Temperature (°C)	26.5	25.3	25.3	26.5	26.6	26.5	26.3	24.6	26.0	25.2
Conductivity (ms/cm)	0.175	0.059	0.278	0.053	0.074	0.228	0.182	0.256	0.068	0.189
Turbidity (NTU)	7	4	20	4	0	21	8	N/A	7	2

See notes at end of table.

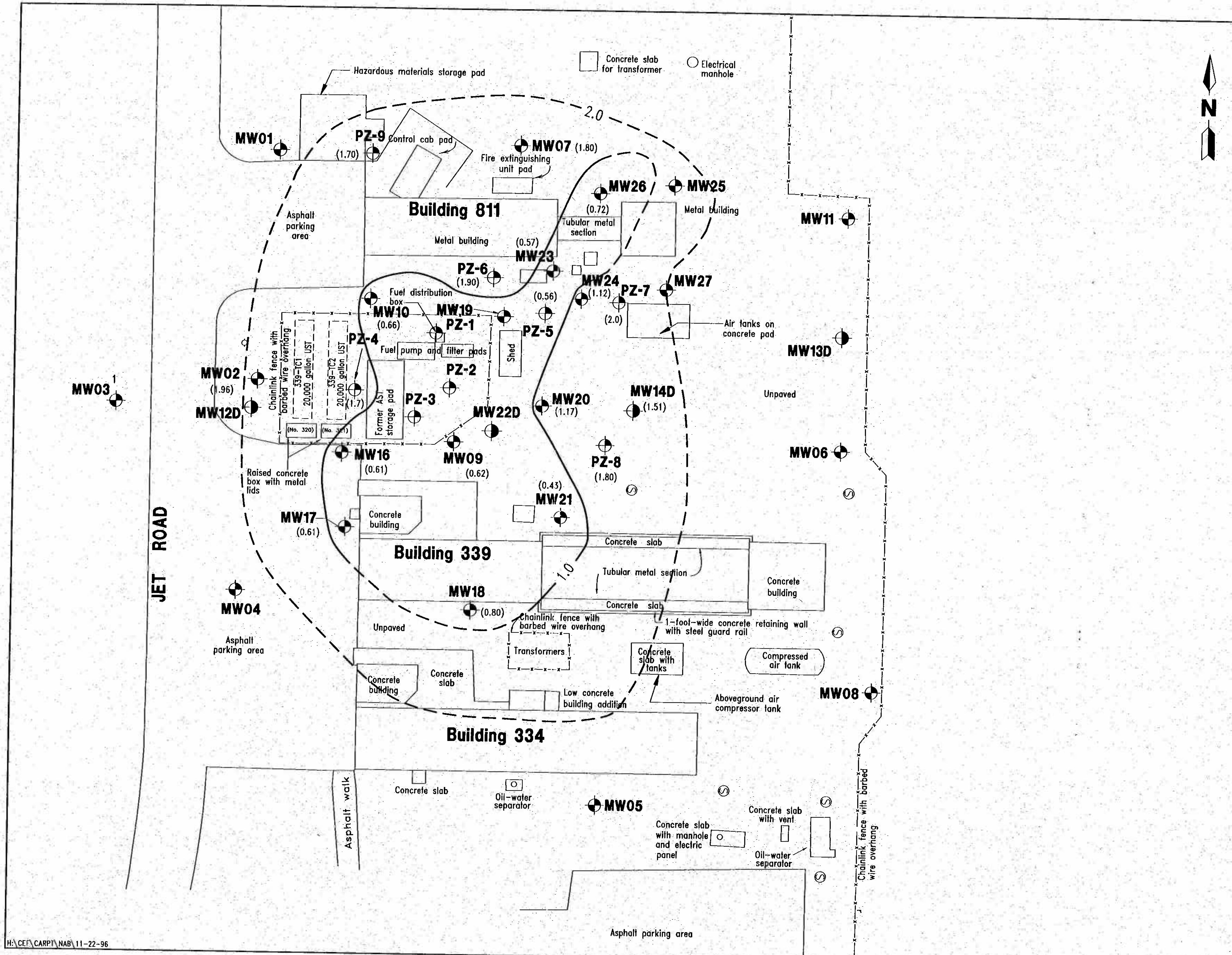
Table 8-1 (Continued)
Natural Attenuation Monitoring
September 10-12, 1996

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Monitoring Parameters	Monitoring Wells CEF-811-									
	21	23	24	26	27	PZ-2	PZ-4	PZ-6	PZ-8	PZ-9
Iron (mg/ℓ)	0.6	0.7	10.0	0	2.5	10.0	9.6	3.4	2.0	1.4
Chloride (mg/ℓ)	10	10	10	15	10	15	15	10	25	15
Alkalinity (mg/ℓ)	258.4	34.0	81.6	27.2	81.6	54.4	183.6	54.4	54.4	156.4
Nitrate (mg/ℓ)	<5	<5	<5	<5	<5	<5	5.0	<5	5.0	<5
Sulfate (mg/ℓ)	<50	<50	<50	<50	<50	<50	90.0	<50	50.0	<50
Dissolved Oxygen* (mg/ℓ)	0.43	0.57	1.12	0.72	2.00	N/A	1.70	1.90	1.80	1.70
Carbon Dioxide (mg/ℓ)	50	24	120	35	160	200	160	180	140	170
pH	6.63	5.83	5.57	5.56	5.79	N/A	6.07	5.56	5.52	6.35
Temperature (°C)	24.7	25.8	26.0	24.2	25.2	N/A	28.3	26.1	26.9	28.8
Conductivity (ms/cm)	0.393	0.162	0.106	0.068	0.077	N/A	0.298	0.105	0.106	0.305
Turbidity (NTU)	0	90	7	17	10	N/A	525	42	28	89

Notes: Iron, chloride, alkalinity, nitrate, sulfate and carbon dioxide results from HACH field kits.
Temperature, conductivity, pH and turbidity results from field meters.

D = deep well.
mg/ℓ = milligrams per liter.
< = less than.
* = field measurement of dissolved oxygen.
NM = no measurement taken at this location.
°C = degrees Celsius.
mS/cm = millisiemens per centimeters.
NTU = nephelometric turbidity units.
N/A = data not available.



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. D.O. measurements taken from selected points in September 1996.

LEGEND

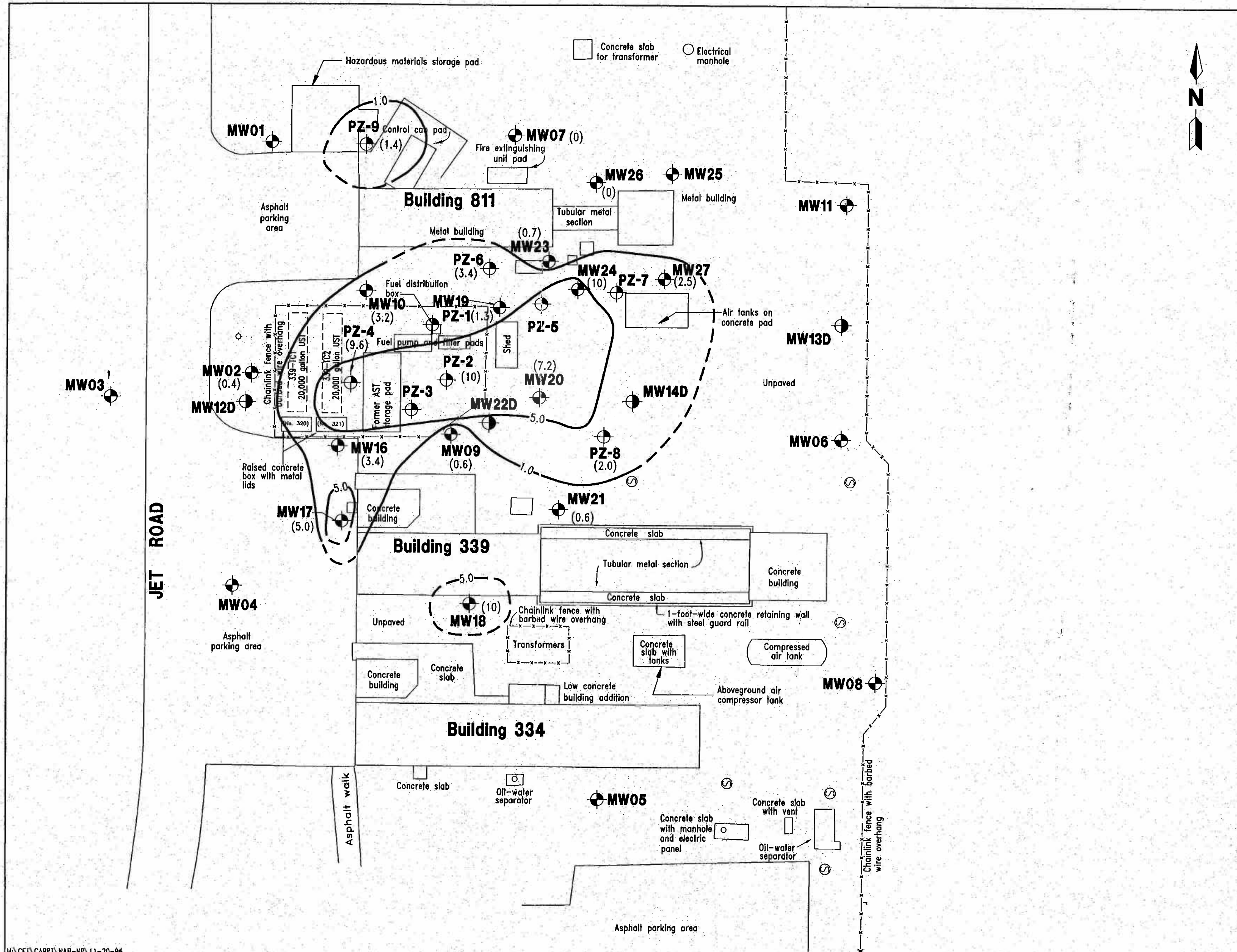
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
—1.0—	Dissolved oxygen isoconcentration line (mg/l), dashed where inferred
(mg/l)	milligrams per liter
AST	Aboveground storage tank
UST	Underground storage tank
D.O.	Dissolved oxygen
⊘	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 8-1
DISSOLVED OXYGEN IN GROUNDWATER ISOPLETH MAP

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Iron II measurements taken from selected monitoring points in September 1996.

LEGEND

Symbol	Description
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
—5.0—	Iron (II) isoconcentration line in milligrams per liter
AST	Aboveground storage tank
UST	Underground storage tank
⊘	Sanitary sewer manhole

0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 8-2
DISSOLVED IRON (II) IN GROUNDWATER ISOPLETH MAP

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

8.1.4 Sulfate Sulfate concentrations were measured using a HACH test kit. As with nitrate, the lower detection limit was too high to yield useful information. Conservative estimates were made for the presence of sulfate in the modeling effort based on background concentrations from Site 16 (Chapelle, 1996) 0.5 mile south of the site.

8.1.5 Dissolved Methane Dissolved methane measurements were not taken at this site. Conservative estimates were made for the presence of methane in the modeling effort based on dissolved methane concentrations observed from Site 8, a firefighting training area on the base and data from other petroleum contaminated sites nationwide.

8.1.6 CO_2 One of the end-products of both aerobic and anaerobic biodegradation is CO_2. When compared to background concentrations, elevated levels of CO_2 in groundwater were found downgradient of the free product zone and throughout the area of known BTEX contamination. Isolated areas of elevated CO_2 readings corresponded to areas of known soil contamination near piezometer PZ-9 and monitoring well MW18 (Figure 8-3). These elevated CO_2 readings indicate that biodegradation is occurring in these areas.

8.1.7 Alkalinity Increased alkalinity, like CO_2, in areas of known contamination can be an indicator of biodegradation. Alkalinity measurements match fairly well with results from CO_2 measurements, but the highest levels are centered southeast of the source area (Figure 8-4).

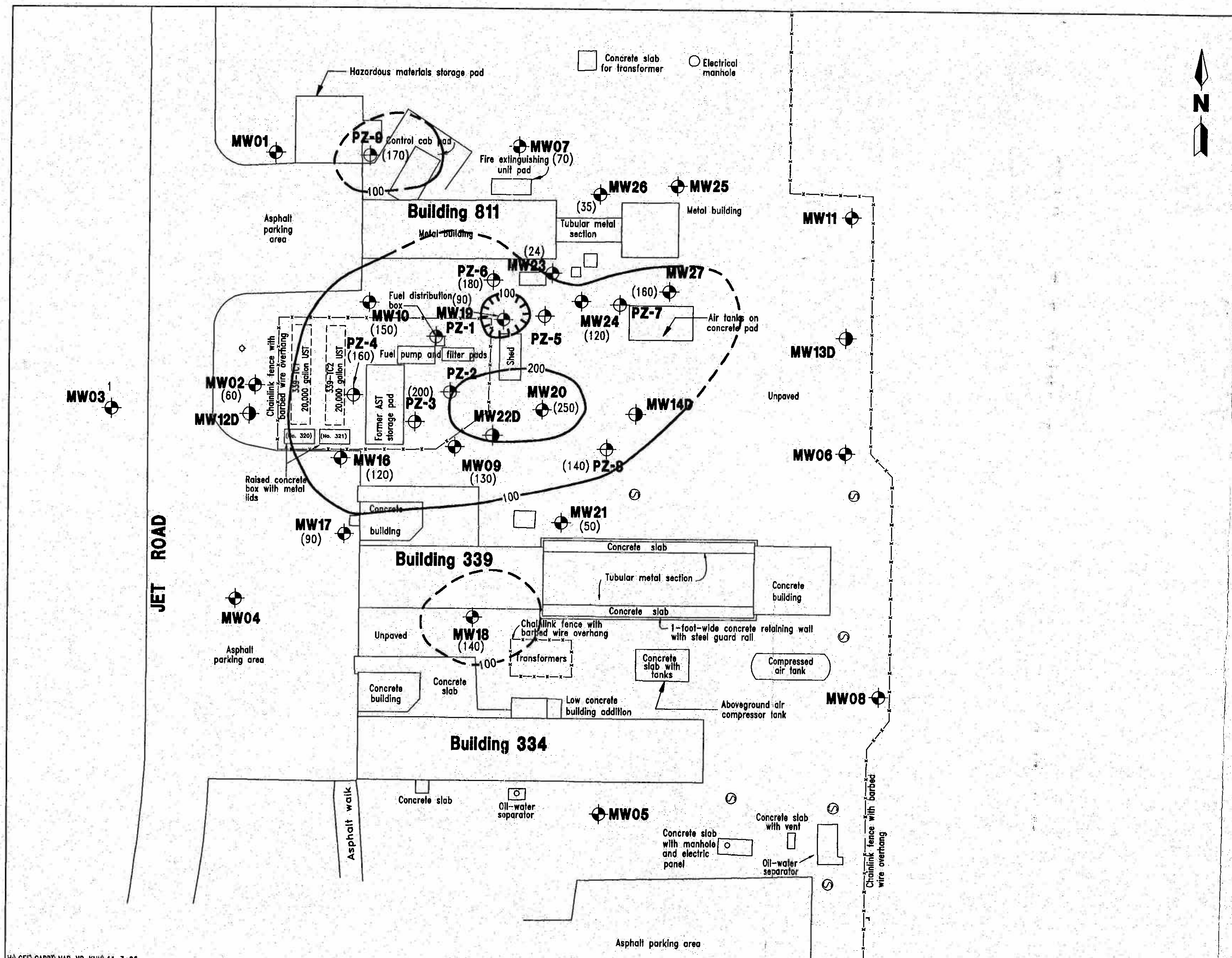
8.1.8 pH, Temperature, Conductivity, and Turbidity The average pH at the Jet Engine Test Cell, as mentioned earlier, is 5.67. Although this pH appears low, it appears that microorganisms have adapted to site conditions. The temperature at the Jet Engine Test Cell is not subject to large fluctuations due to the mild climate in Florida and is not a limiting factor. Conductivity and turbidity measurements were recorded during sampling to ensure that representative samples were obtained.

8.2 GROUNDWATER MODEL OVERVIEW AND DESCRIPTION. The BIOSCREEN computer model was used to model transport and degradation of hydrocarbons at the Jet Engine Test Cell site. The BIOSCREEN model was developed by the U.S. Air Force in August 1996 as a user friendly model set in a Microsoft Excel spreadsheet environment. It is based on the Domenico analytical solute transport model.

The BIOSCREEN model used in this demonstration assumes that the limiting factors of biodegradation are the presence of indigenous hydrocarbon degrading bacteria and the presence of sufficient background electron acceptor concentrations. A soil sample obtained from the Jet Engine Test Cell during the installation of monitoring well MW20 indicates a hydrocarbon bacteria count of 1×10^4 $cf\mu/g$ (ABB-ES, 1994b). As shown in the preceding sections, evidence exists that both aerobic and anaerobic degradation is occurring at the Jet Engine Test Cell site.

BIOSCREEN simulates advection, adsorption, dispersion, aerobic, and dominant anaerobic reactions through three model types. These three model types are

- solute transport without decay,



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. CO_2 measurements taken from selected monitoring points in September 1996.

LEGEND

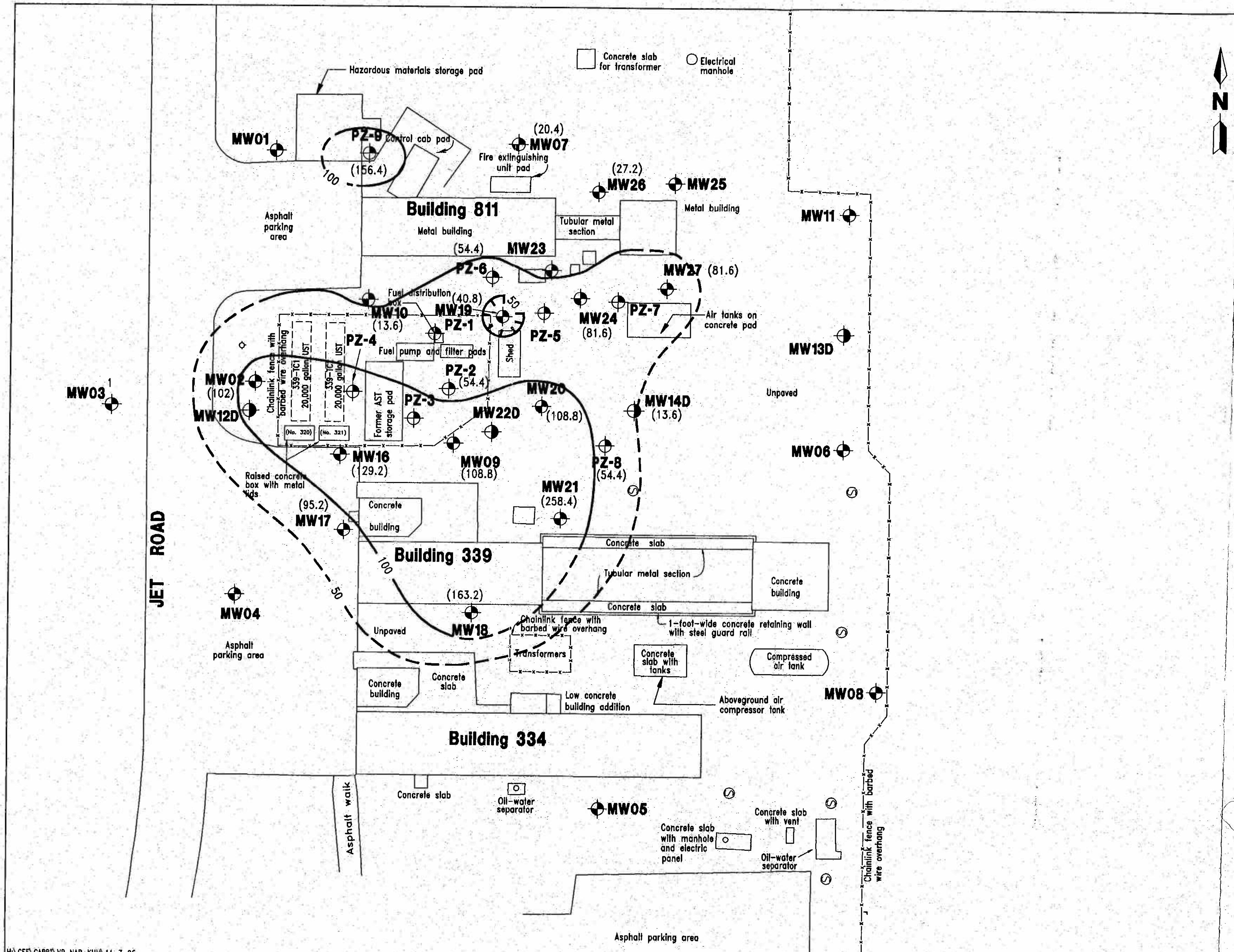
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
	Contour depression
—100—	CO_2 isoconcentration line (mg/l), dashed where inferred
(mg/l)	milligrams per liter
AST	Aboveground storage tank
UST	Underground storage tank
Ø	Sanitary sewer manhole

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 8-3
DISSOLVED CARBON DIOXIDE (CO_2) IN GROUNDWATER ISOPLETH MAP

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA



NOTES:

1. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
2. Alkalinity measurements taken from selected monitoring points in September 1996.

LEGEND

Symbol	Description
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
AST	Aboveground storage tank
UST	Underground storage tank
⊘	Sanitary sewer manhole
— 100 —	Alkalinity isoconcentration line (mg/l) Dashed where inferred.
(13.6)	Alkalinity concentration (mg/l)
mg/l	Milligrams per liter

0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 8-4
ALKALINITY IN GROUNDWATER ISOPLETH MAP

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

- solute transport with first-order decay, and
- solute transport with biodegradation assuming an instantaneous biodegradation reaction.

For the Jet Engine Test Cell site, benzene and total VOA contamination can be modeled with all three model types. Naphthalene degradation may also be estimated with the use of the first order decay model.

<u>8.3 MODEL LIMITATIONS</u>. The BIOSCREEN model is effective for assessing the present contaminant conditions at the Jet Engine Test Cell site, however, limitations do exist. Modelers should consider these limitations when evaluating results.

A modeling limitation for this site is the inability to specify an areal distribution of the source material. Following the excavation of free-product saturated soils, other contaminated soil downgradient of the source will remain. This remaining soil contamination is associated with groundwater contamination or is the result of surface spills and surface runoff. Contaminated soil downgradient does not appear to be percolating contaminants to the groundwater or is contributing hydrocarbon contamination at a rate that is less than the aquifer contaminant mass loading capacity (i.e., hydrocarbons are degraded sufficiently as they percolate through or are entrained in the unsaturated zone).

This remaining soil contamination cannot be accurately depicted directly by the BIOSCREEN model. BIOSCREEN considers the source area to be a total mass of contamination corresponding to the highest level of groundwater contamination distributed over a line source. This will not be the case following excavation; therefore, engineering judgement and field observations will be necessary to completely predict the effectiveness of the remedial action.

Once the excavation is performed and the source area is removed, groundwater contaminant concentrations downgradient will remain above action limits. Modeling a plume in this configuration is not possible with BIOSCREEN. For this reason the time to attenuate may be underestimated by the BIOSCREEN model following source removal. This situation may be counteracted by any volatilization of contaminants in the source zone and increased oxygenation of the source zone groundwater during the excavation.

The latest documented fuel release at the Jet Engine Test Cell occurred in June 1996. The quantity of JP-5 released is not known. The June release created a second free-product source zone and elevated groundwater contaminant concentrations in the northeast portion of the existing plume. Modeling of a commingled plume is not feasible with BIOSCREEN, and emphasis will be placed on the stabilized portions of the original plume.

A final limitation of the BIOSCREEN model is its inability to directly model the biological decay of naphthalene, however, naphthalene may be modeled effectively using the First-Order Decay model.

8.4 GROUNDWATER MODEL DESIGN AND ASSUMPTIONS. In order to use the BIOSCREEN model to predict future contaminant transport and degradation, the model must be calibrated to match present site conditions. To do this an assumed plume origination date of 1971 is considered appropriate for model calibration. Operations began at the Jet Engine Test Cell in 1953. Numerous spills have occurred since that time, and the use of the temporary Test Cell, Building 811, beginning in the early 1970s led to other releases. For these reasons, pinpointing an exact release date is not possible. Despite these factors, the assumed plume lifetime of 25 years, starting in 1971, corresponds well with the observed plume travel distance (centerline length), which can also be calculated using the known pore velocity, contaminant retardation factor, and the assumed 25-year time period.

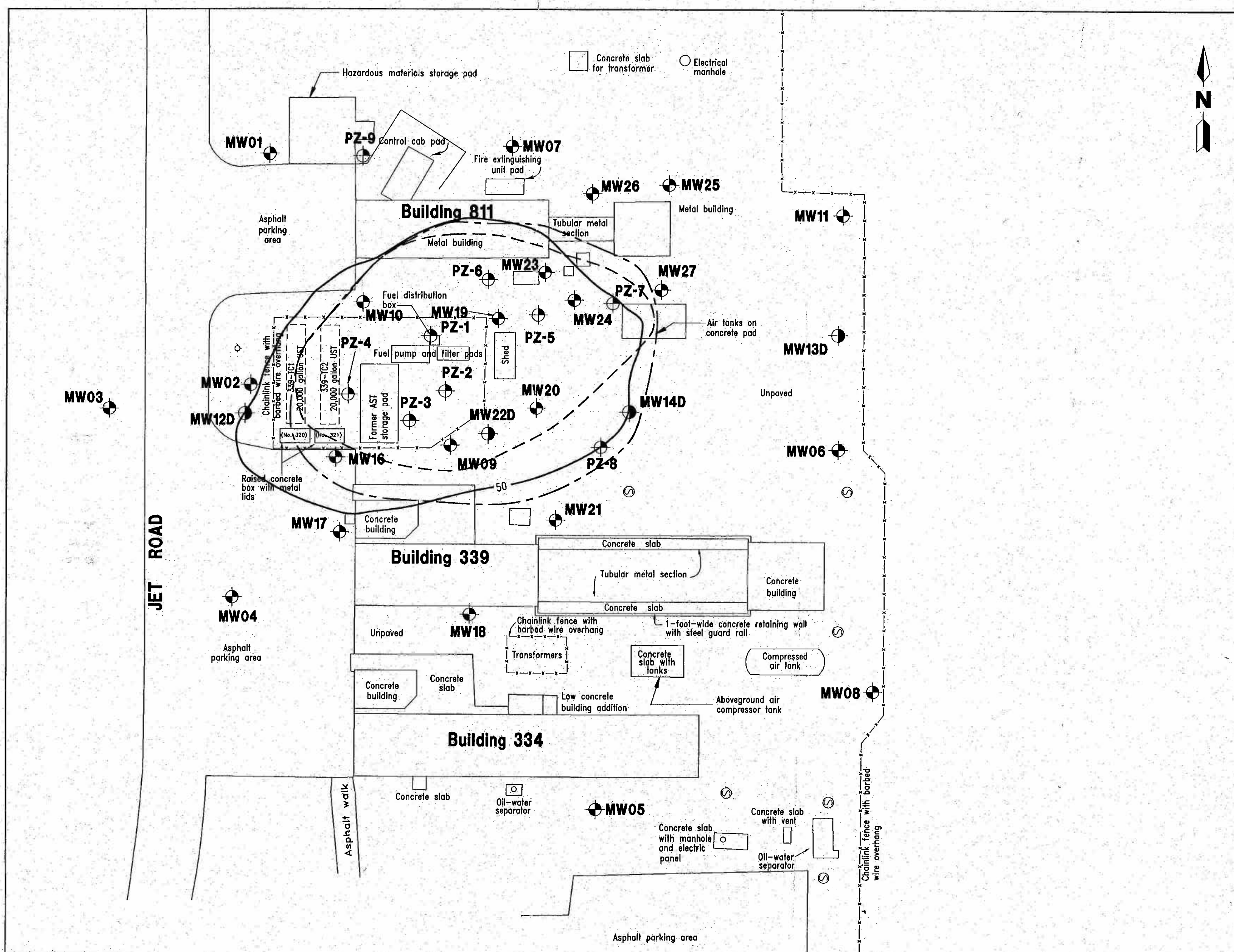
Based on the existing data, groundwater contamination is restricted to the upper zone of the surficial aquifer (i.e., the first 35 feet of the surficial aquifer). The lithology of the upper zone consists of silty, fine-grained sand, with clay lenses occurring locally. A conservative effective porosity of 0.25 is estimated. The use of BIOSCREEN, which is a two-dimensional model, is appropriate as the saturated interval is relatively homogeneous, and evidence of significant vertical migration of the groundwater contamination is not present.

The extent of petroleum contaminated soil, which appears to be acting as a continuing source to groundwater contamination, is shown on Figure 8-5. This area was used in calculating the soluble contaminant mass contributing to the groundwater plume in the model calibration. Contributions from soils outside this region are assumed to be relatively minor and the main process of interest is the length of the plume from the high concentration source zone.

The free-product-saturated soil contains approximately 90 percent of the contaminants in the source area but is only 37 percent of the contaminated soil volume. Free product acts as a continuing source to groundwater and soil contamination, as contaminants are most mobile in this zone. Because of this, and to accommodate model limitations, a negligible soluble contaminant mass load was presumed for modeling efforts following the removal of the free-product-saturated soil.

Empirical data from the Truck Stand site just north of the Jet Engine Test Cell show marked decreases in groundwater concentrations 3 months following the excavation of free-product contaminated soil. Similar concentration reductions are expected at the Jet Engine Test Cell. These reductions will be due to some volatilization and oxygenation of contaminants during excavation, and increased biological activity following site restoration. Recalibration of the BIOSCREEN model and verification of this and other assumptions will be performed following the excavation of the free-product-saturated soils. An evaluation of the effectiveness of the BIOSCREEN model will also be made.

8.4.1 Model Setup and Model Input Calibration of the BIOSCREEN model involved adjusting model inputs, which impacted contaminant transport and degradation rates. Assuming a 25-year plume lifetime starting in 1971, this procedure was continued until the present plume configuration matched model results. A hydraulic conductivity of 3.0 feet per day, as determined by the U.S. Geological Survey Basewide Groundwater Model (U.S. Geological Survey, 1996), was found to best replicate field conditions.



NOTES:

1. Area of excessively contaminated soil (> 50 ppm) is referred to as Zone 2 in engineering calculations.
2. Total area of soil contamination in Zone 2 is 12,610 square feet.

LEGEND

Symbol	Description
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
—50—	Approximate extent of soil contamination associated with the groundwater plume (50 ppm OVA)
— — —	Approximate extent of total VOA contamination in groundwater
—-—-—	Approximate extent of naphthalene contamination in groundwater
VOA	Volatile organic aromatics
OVA	Organic vapor analyzer
ppm	parts per million
AST	Aboveground storage tank
UST	Underground storage tank
⊘	Sanitary sewer manhole

0 20 40

SCALE: 1 INCH = 40 FEET

FIGURE 8-5
APPROXIMATE EXTENT OF SOIL CONTAMINATION ASSOCIATED WITH GROUNDWATER CONTAMINATION

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Following this calibration, two scenarios were modeled. The first scenario considered a no action alternative to determine the maximum extent of contaminant transport and its effects. The second scenario considered source removal and natural attenuation. Model inputs for scenarios that modeled total BTEX are provided in Table 8-2.

8.5 MODEL RESULTS. Model results indicate that natural attenuation is feasible for the Jet Engine Test Cell site following source removal. A synopsis of each individual modeling effort is given in Appendix C-2. This section includes a brief summary of the results and their relevance to remedial actions at this site.

8.5.1 Calibration Model (Total BTEX Contamination) The calibration model indicates that first order decay is occurring at the Jet Engine Test Cell site. Incorporating biodegradation using the Instantaneous Reaction model shows a more accurate representation of the plume extent. This may be due to increased aerobic biological activity downgradient from the source zone. The first order decay is considered applicable for modeling general plume configurations in other modeling scenarios; however, the Instantaneous Reaction model appears valuable for more accurately determining the ultimate extent of the contaminant plume.

8.5.2 Fate and Transport: 25 and 50 Years Modeling a no action alternative, the plume source area was allowed to remain in place for 25 and 50 years from today. In both time frames considered, complete source reduction is not achieved no matter which model type is used. A positive result of this model, which supports this natural attenuation alternative, is that the plume has apparently reached equilibrium and is not expected to extend beyond its present location.

8.5.3 Groundwater BTEX Concentrations Following Source Removal Source removal is the key to the success of the natural attenuation process. This modeling scenario supports this. Assuming a negligible source material results in an immediate reduction of groundwater BTEX concentrations in the source zone using the Instantaneous Reaction model. A parallel reduction is expected downgradient of the plume. The plume redistributes following source removal in the First-Order Decay model but reaches no further action levels within 11 years.

8.5.4 Calibration and Attenuation of Naphthalene The calibration of naphthalene contamination in groundwater did not yield a direct relation to either the First-Order Decay or the Instantaneous Reaction model at first glance. However, monitoring results indicate that the naphthalene source area extends beyond the BTEX source area, with naphthalene concentrations of 630 micrograms per liter ($\mu g/\ell$) greater than 40 feet downgradient of the source area (the source area concentration is 650 $\mu g/\ell$). This may be due in part to multiple releases and release points. Assuming the actual source area to begin at this point downgradient, a favorable relation is seen with both the First-Order decay and Instantaneous Reaction models.

Following source removal, BIOSCREEN predicts that naphthalene concentrations will be below target levels in a maximum of 8 years. The maximum estimate of 8 years is based on the First-Order Decay model. If the Instantaneous Reaction model results are indicative of the fate of naphthalene, an immediate reduction would be experienced and target levels would be achieved in less than 0.25 year.

Table 8.2 (Continued)
BIOSCREEN Model Input Parameters

Remedial Action Plan, Jet Engine Test Cell
Naval Air Station Cecil Field
Jacksonville, Florida

Data Type	Parameter	Calibration Model Value	Fate and Transport Model Value	Source Removal and Natural Attenuation Value	Source of Data
Source Data	· Source Thickness: · Source Concentration:	35 (ft) See Figure 3-5	35 (ft) See Figure 3-5	35 (ft) See Figure 3-5	
Actual Data	· Distance from Source (ft): · BTEX Concentration in groundwater (mg/ℓ):	0 / 2.08 40 / 0.242	60 / 0.161	100 / 0.002 140 / 0.0	· Based on Groundwater Concentrations, September 1996.

Notes: Use of data displayed above is shown in Appendix C-2.
Units selected in the table above were based on units input into the BIOSCREEN model.

cm/sec = centimeters per second.
ft = feet.
BTEX = benzene, toluene, ethylbenzene,and xylenes.
ft/ft = feet per foot.
USGS = U.S. Geological Survey.
kg/ℓ = kilograms per liter.
O_2 = oxygen.
NO_3 = nitrate.
SO_4 = sulfate.
Fe = iron.
CH_4 = methane.

9.0 LONG-TERM MONITORING PLAN

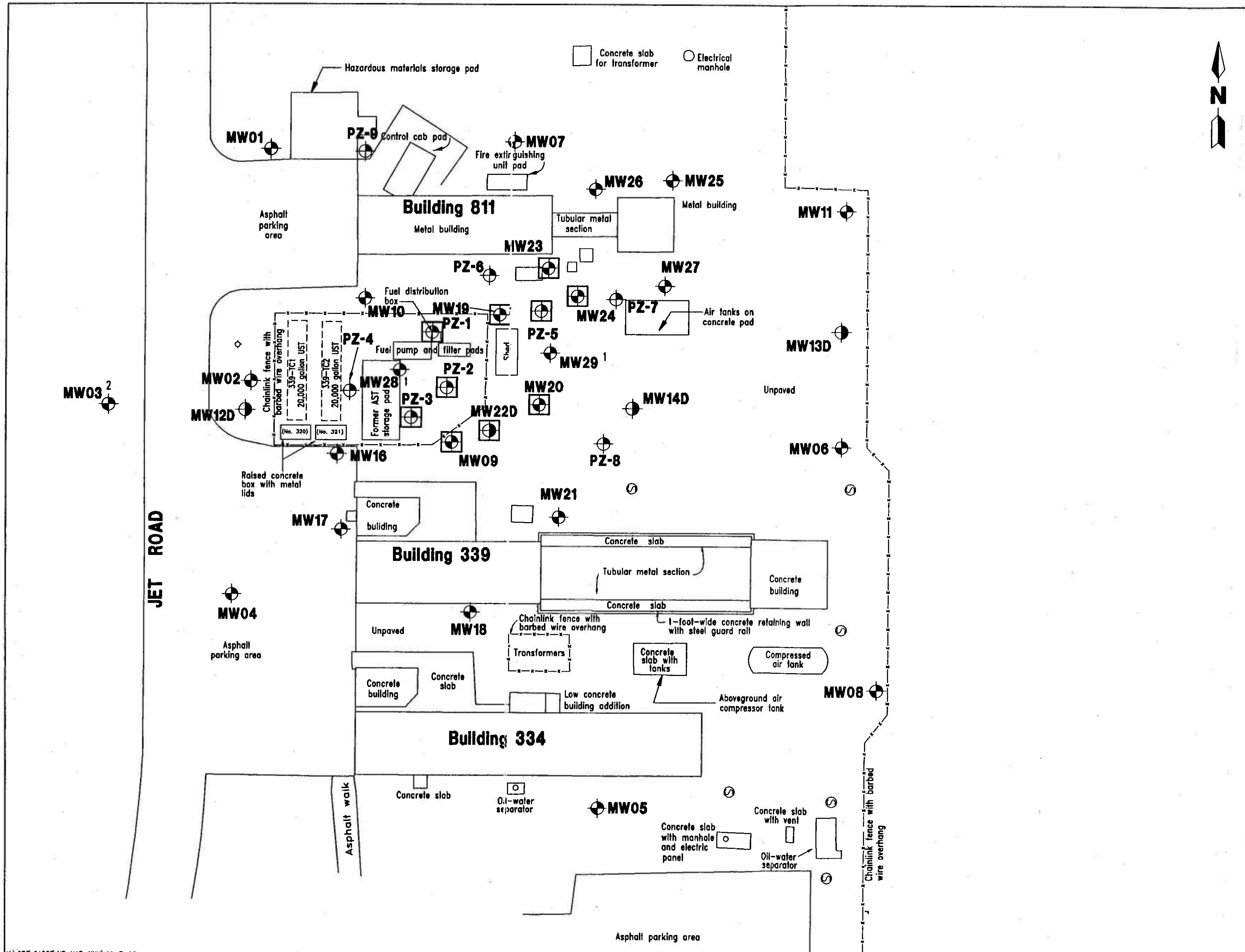
9.1 OVERVIEW. The monitoring program is designed to evaluate the performance, progress, and effectiveness of natural attenuation to reduce contaminants and retard their migration. The monitoring plan described in this chapter is designed to monitor plume migration over time, while verifying that intrinsic remediation is occurring. In the event that data collected under this long-term monitoring plan indicate that intrinsic remediation is insufficient to protect human health and the environment or that contaminant reduction rates indicate more costly monitoring than anticipated, a contingency plan will be developed to augment or replace the intrinsic remediation alternative.

9.2 MONITORING WELL LOCATIONS. Long-term monitoring wells will be installed or are already in place upgradient, within, and immediately downgradient of the groundwater plume. Existing monitoring wells will be incorporated into this monitoring plan, when possible, to minimize well installation costs, however, it should be noted that four shallow wells and possibly one deep well will be abandoned to complete phase one of this RAP.

Five monitoring wells will be used as long-term monitoring wells to observe the degradation of the contaminants and plume retardation. The location of these wells is shown on Figure 9-1. Monitoring well MW02 will be used to monitor upgradient site conditions. A shallow monitoring well, MW28, will be installed within the area of highest contaminant concentrations, just downgradient of the location of piezometer PZ-4. Monitoring well MW10 will be used as a long term monitoring well to monitor contaminant migration around the liner system and for transverse flow. A second shallow long-term monitoring well, designated MW29, will be used for plume character monitoring and will be installed south of the free-product area associated with monitoring well MW24. Monitoring well MW27 will be used to monitor downgradient conditions and detect future plume migration.

Groundwater samples will also be collected using methods described in Table 9-1 from monitoring wells MW06 and MW18 to verify that soil contamination in those areas is not leaching and dissolving into the groundwater. Sampling of these wells may be discontinued if groundwater contaminants are found below the target levels after the first year of monitoring.

9.3 MONITORING WELL INSTALLATION. All long-term monitoring wells will be screened in the shallow aquifer approximately 5 to 15 feet bls. Monitoring well installation and well development will comply with SOUTHNAVFACENGCOM's "Guidelines for Groundwater Monitoring Well Installation" and with USEPA's "Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells", EPA/600/4-89/034, April 1989. In addition, monitoring well installation will comply with Florida Administrative Code, FAC, Chapter 62-532.



NOTES:

1. Monitoring wells MW28 and MW29 to be installed following excavation.
2. Monitoring well MW03 was found to be inundated with pine straw and dirt during the supplemental assessment.
3. MW03 to be restored during replacement monitoring well installation.

LEGEND

Symbol	Description
PZ-1	Piezometer location and designation
MW01	Monitoring well location and designation
MW12D	Deep monitoring well location and designation
AST	Aboveground storage tank
UST	Underground storage tank
Ø	Sanitary sewer manhole
MW20	Monitoring well to be abandoned or piezometer to be removed during excavation

0 20 40
SCALE: 1 INCH = 40 FEET

FIGURE 9-1
PROPOSED LONG-TERM MONITORING WELL LOCATIONS

REMEDIAL ACTION PLAN
JET ENGINE TEST CELL

NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

Table 9-1
Groundwater Sampling and Analysis

Jet Engine Test Cell
Remedial Action Plan
NAS Cecil Field, Jacksonville, Florida

Analyte	Method[1]/ Reference	Data Use	Sample volume, sample container, and sample preservation	Field or Fixed-Base Laboratory
Aromatic hydrocarbons	602; GC/MS	Method of analysis for BTEX.	Collect water samples in a 40 mℓ VOA vial; cool to 4°C; add hydrochloric acid to pH 2	Fixed-base
Semivolatile aromatics	625; semivolatile extractables	Method of analysis for semivolatiles such as total naphthalenes.	Collect water samples in a 1 liter amber-tinted glass bottle; cool to 4°C.	Fixed-base

Notes: Method refers to USEPA test methods.

GC/MS = gas chromatography and mass spectroscopy.
BTEX = benzene, toluene, ethylbenzene, and xylenes.
mℓ = milliliter.
VOA = volatile organic aromatic.
°C - degrees Celsius.
USEPA = U.S. Environmental Protection Agency.

9.4 GROUNDWATER SAMPLING. Sampling will be conducted quarterly for the first year and semi-annually for additional years to verify that the contaminant mass and mobility are being effectively reduced. Water-level measurements will be collected during each sampling event. Biological parameters listed in Table 9-2 will be collected from all remaining shallow monitoring wells and analyzed on a yearly basis. This data will be used for continuing calibration of the groundwater model. Contaminants of concern listed in Table 9-1 will be sampled from wells designated for long-term monitoring only and analyzed using the test methods shown. If the data collected during this time period supports the anticipated effectiveness of the remedial alternative at this site, monitoring frequency may be reduced to once per year subject to FDEP approval. If the data collected at any time during the monitoring period indicate plume migration or a risk to human health, the sampling frequency will be adjusted accordingly and/or a contingency plan will be developed, approved by FDEP, and implemented.

9.5 REPORTING. Following each sampling event, groundwater models will be calibrated for improved forecasting. Within 60 days of each event, a report will be prepared and submitted to SOUTHNAVFACENGCOM. The report will include sampling and model results and recommendations for future actions.

Table 9-2
Groundwater Sampling and Analysis[1]

Jet Engine Test Cell, Remedial Action Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Analysis	Method[2]/ Reference	Data Use	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Temperature	170.1, Direct reading thermometer	Well development; biological processes are temperature dependent	Conduct *in situ*	Field
Oxygen	Dissolved oxygen meter	The oxygen concentration is a data input to most biological models; concentrations less than 1 mg/ℓ generally indicate an anaerobic pathway	Collect 300 mℓ of water in biochemical demand bottles; analyze immediately; alternately measure dissolved oxygen *in situ*	Field
pH	150.1, Direct reading meter	Biological processes are pH sensitive	Collect 100 - 250 mℓ of water in a glass or plastic container; analyze immediately	Field
Conductivity	120.1, Direct reading meter	General water quality parameter used to verify that site samples are obtained from the same groundwater system	Collect 100 - 250 mℓ of water in a glass or plastic container; analyze immediately	Field
Alkalinity	310.1, Manual titrimetric	General water quality parameter used to verify that site samples are obtained from the same groundwater system and to measure the buffering capacity of groundwater	Collect 250 mℓ of water in a glass or plastic container; analyze within 6 hours	Field
Ferrous (Fe^{+2})	HACH Method 8146	May indicate an anaerobic degradation process due to depletion of oxygen, nitrate, and manganese	Collect 100 mℓ of water in a glass container, acidify with hydrochloric acid per method	Field
Nitrate (NO_3^{-1})	353.2, Automated Cadmium Reduction	Substrate for microbial respiration if oxygen is depleted	Collect up to 40 mℓ of water in a glass or plastic container; cool to 4°C; analyze within 48 hours	Fixed-base
Sulfate (SO_4^{-2})	IC Method E300 or method SW9056	Substrate for anaerobic microbial respiration	Collect up to 40 mℓ of water in a glass container; cool to 4°C	Fixed-base

See notes at end of table.

Table 9-2[1] (Continued)
Groundwater Sampling and Analysis

Jet Engine Test Cell, Remedial Action Plan
Naval Air Station Cecil Field
Jacksonville, Florida

Analysis	Method[2]/ Reference	Data Use	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Redox potential	Standard Methods A2580 B	The redox potential of groundwater provides information on environmental conditions and is used to interpret the nature and state of chemical compounds and biological conditions; the redox potential may range from 200 mV to less than -400 mV	Collect 100 - 250 mℓ of water in a glass container, filling container from bottom; analyze immediately	Field
Dissolved sulfide (S^{-2})	HACH[3] Model HS-C test kit	Product of sulfate-based anaerobic degradation; analyze in conjunction with sulfate analysis	Collect 100 mℓ of water in a glass container; analyze immediately	Field
Dissolved organic carbon (DOC)	Standard Methods; A5310 C	An indirect index of microbial activity	Collect 100 mℓ of water in an amber glass container with Teflon®-lined cap; preserve with sulfuric acid to pH less than 2; cool to 4°C	Fixed-base
Carbon Dioxide	HACH[3] CO_2 titrimetric kit	Elevated levels of free carbon dioxide dissolved in groundwater above background concentrations could indicate an aerobic mechanism for bacterial degradation.	Collect 100 mℓ of water in a glass container; analyze immediately	Field
Methane	8015 modified; Headspace analysis with GC/FID or TCD	The presence of methane indicates biological degradation via an anaerobic pathway utilizing CO_2 as the electron acceptor.	Collect water samples in 40 mℓ volatile organic analysis (VOA) vials with butyl gray/Teflon®-lined caps; cool to 4°C	Fixed-base

[1] Table adapted from the Technical Protocol for Implementing the Intrinsic Remediation with Long-Term Monitoring Option for Natural Attenuation of Dissolved-Phase Fuel Contamination in Ground Water (Wiedemeier, Todd H., 1995).
[2] Method refers to United States Environmental Protection Agency (USEPA) test methods.
[3] HACH refers to the HACH Company catalog.

Notes: mg/ℓ = milligrams per liter.
mℓ = milliliters.
°C = degrees Celsius.
mV = milliVolts.
GC/FID = gas chromatograph/flame ionization detector.
TCD = thermal conductivity defecter.

10.0 COST ESTIMATE

A cost estimate for the excavation and treatment of contaminated soil and ongoing monitoring of the Jet Engine Test Cell has been prepared. To facilitate the Navy's procurement procedures, the cost estimate is being submitted under a separate cover.

11.0 SCHEDULE

Excavation of up to 1,500 cubic yards of contaminated soil, included as phase one source removal of this RAP, can begin as soon as possible without FDEP RAP approval. It is estimated that approximately 2 weeks would be necessary for site mobilization and site staging for phase one. Preparation of any permit applications should begin immediately upon notice to proceed from the Navy. The location of all underground utilities should also be determined and marked during this time period.

The remedial subcontractor should be an approved contractor for the thermal treatment of petroleum contaminated soils and should meet all permit requirements. Well permits from the St. Johns River Water Management District for the abandonment and installation of shallow monitoring wells (to be installed in phase two) will be required prior to and following excavation and site restoration. This permitting process is expected to take approximately 1 week.

Mobilization and well installation for two shallow monitoring wells is expected to be completed within 1 week following site restoration.

Following notice to proceed, including 1 month of procurement, approximately 2 months should be budgeted for implementation of remedial activities at the Jet Engine Test Cell.

12.0 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 December 1990 and September 1996 and engineering detailed in the text and appended to this report. If conditions are determined to exist differently 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 Jet Engine Test Cell site, NAS Cecil Field, Jacksonville, Florida, and should not be construed to apply to any other site.

Michael K. Dunaway
Professional Engineer 11/22/96
P.E. No. 39451

Date

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APPENDIX A

ANALYTICAL RESULTS

NAS CECIL FIELD -- JET ENGINE TEST CELL
BETX AND PAHs -- REPORT REQUEST NO. 8217

Lab Sample Number:	A6I1101530				A6I1101530				A6I1101530				A6I1101530			
Site	JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST			
Locator	CEF8112				CEF8117				CEF81110				CEF81114D			
Collect Date:	10-SEP-96				10-SEP-96				10-SEP-96				10-SEP-96			
	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL
BETX																
Benzene	1	U	ug/l	1	1	U	ug/l	1	1.7		ug/l	1	1	U	ug/l	1
Ethylbenzene	1	U	ug/l	1	1	U	ug/l	1	36		ug/l	2.5	1.1		ug/l	1
Toluene	1	U	ug/l	1	1	U	ug/l	1	2.5	U	ug/l	2.5	1	U	ug/l	1
Xylenes (total)	1	U	ug/l	1	1	U	ug/l	1	23		ug/l	2.5	1	U	ug/l	1
UST PAHs																
Acenaphthene	1	U	ug/l	1	1	U	ug/l	1	10	U	ug/l	10	1.1	U	ug/l	1.1
Acenaphthylene	1	U	ug/l	1	1	U	ug/l	1	10	U	ug/l	10	1.1	V U	ug/l	1.1
Anthracene	1	U	ug/l	1	1	U	ug/l	1	10	U	ug/l	10	1.1	V U	ug/l	1.1
Benzo (a) anthracene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Benzo (b) fluoranthene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Benzo (k) fluoranthene	.2	U	ug/l	.2	.2	U	ug/l	.2	.52	U	ug/l	.52	.2	U	ug/l	.2
Benzo (a) pyrene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Chrysene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Dibenzo (a,h) anthracene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Fluoranthene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
Fluorene	1	U	ug/l	1	1	U	ug/l	1	10	U	ug/l	10	1.1	U	ug/l	1.1
Indeno (1,2,3-cd) pyrene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2
1-Methylnaphthalene	1	U	ug/l	1	1	U	ug/l	1	43		ug/l	10	1.1	U	ug/l	1.1
2-Methylnaphthalene	1	U	ug/l	1	1	U	ug/l	1	35		ug/l	10	1.1	U	ug/l	1.1
Naphthalene	1	U	ug/l	1	1	U	ug/l	1	46		ug/l	10	1.1	U	ug/l	1.1
Phenanthrene	1	U	ug/l	1	1	U	ug/l	1	10	U	ug/l	10	1.1	U	ug/l	1.1
Pyrene	.2	U	ug/l	.2	.2	U	ug/l	.2	1	U	ug/l	1	.2	U	ug/l	.2

U = NOT DETECTED J = ESTIMATED VALUE
UJ = REPORTED QUANTITATION LIMIT IS QUALIFIED AS ESTIMATED
R = RESULT IS REJECTED AND UNUSABLE

NAS CECIL FIELD -- JET ENGINE TEST CELL
BETX AND PAHs -- REPORT REQUEST NO. 8217

Lab Sample Number:	A6I1101530				A6I1101530				A6I1101530				A6I1101530			
Site	JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST			
Locator	CEF81116				CEF81119				CEF81120				CEF81121			
Collect Date:	10-SEP-96				10-SEP-96				10-SEP-96				10-SEP-96			
	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL
BETX																
Benzene	9.9		ug/l	5	2		ug/l	1	9.2		ug/l	5	1	U	ug/l	1
Ethylbenzene	32		ug/l	5	38		ug/l	5	75		ug/l	5	1	U	ug/l	1
Toluene	5	U	ug/l	5	11		ug/l	5	5.7		ug/l	5	1	U	ug/l	1
Xylenes (total)	5	U	ug/l	5	180		ug/l	5	71		ug/l	5	1	U	ug/l	1
UST PAHs																
Acenaphthene	5.2	U	ug/l	5.2	20	U	ug/l	20	50	U	ug/l	50	1.1	U	ug/l	1.1
Acenaphthylene	5.2	U	ug/l	5.2	20	U	ug/l	20	50	U	ug/l	50	1.1	U	ug/l	1.1
Anthracene	5.2	U	ug/l	5.2	20	U	ug/l	20	50	U	ug/l	50	1.1	U	ug/l	1.1
Benzo (a) anthracene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Benzo (b) fluoranthene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Benzo (k) fluoranthene	.26	U	ug/l	.26	1	U	ug/l	1	2.5	U	ug/l	2.5	.2	U	ug/l	.2
Benzo (a) pyrene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Chrysene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Dibenzo (a,h) anthracene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Fluoranthene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
Fluorene	5.2	U	ug/l	5.2	20	U	ug/l	20	50	U	ug/l	50	1.1	U	ug/l	1.1
Indeno (1,2,3-cd) pyrene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2
1-Methylnaphthalene	55		ug/l	5.2	180		ug/l	20	210		ug/l	50	1.1	U	ug/l	1.1
2-Methylnaphthalene	43		ug/l	5.2	130		ug/l	20	150		ug/l	50	1.1	U	ug/l	1.1
Naphthalene	49		ug/l	5.2	210		ug/l	20	270		ug/l	50	1.1	U	ug/l	1.1
Phenanthrene	5.2	U	ug/l	5.2	20	U	ug/l	20	50	U	ug/l	50	1.1	U	ug/l	1.1
Pyrene	.52	U	ug/l	.52	2	U	ug/l	2	5	U	ug/l	5	.2	U	ug/l	.2

U = NOT DETECTED J = ESTIMATED VALUE
UJ = REPORTED QUANTITATION LIMIT IS QUALIFIED AS ESTIMATED
R = RESULT IS REJECTED AND UNUSABLE

NAS CECIL FIELD -- JET ENGINE TEST CELL
BETX AND PAHs -- REPORT REQUEST NO. 8217

Lab Sample Number:	A6I1101530				A6I1101530				A6I1101530				A6I1101530			
Site	JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST			
Locator	CEF81123				CEF81124				CEF81127				CEF811PZ2			
Collect Date:	10-SEP-96				10-SEP-96				10-SEP-96				10-SEP-96			
	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL
BETX																
Benzene	1	U	ug/l	1	2.6		ug/l	1	1	U	ug/l	1	14		ug/l	10
Ethylbenzene	21		ug/l	1	90		ug/l	10	1	U	ug/l	1	58		ug/l	10
Toluene	1	U	ug/l	1	23		ug/l	10	1	U	ug/l	1	10	U	ug/l	10
Xylenes (total)	41		ug/l	1	380		ug/l	10	1	U	ug/l	1	170		ug/l	10
UST PAHs																
Acenaphthene	11	U	ug/l	11	11	U	ug/l	11	10	U	ug/l	10	54	U	ug/l	54
Acenaphthylene	11	U	ug/l	11	11	U	ug/l	11	10	U	ug/l	10	54	U	ug/l	54
Anthracene	11	U	ug/l	11	11	U	ug/l	11	10	U	ug/l	10	54	U	ug/l	54
Benzo (a) anthracene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Benzo (b) fluoranthene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Benzo (k) fluoranthene	.55	U	ug/l	.55	.54	U	ug/l	.54	.5	U	ug/l	.5	2.7	U	ug/l	2.7
Benzo (a) pyrene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Chrysene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Dibenzo (a,h) anthracene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Fluoranthene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
Fluorene	11	U	ug/l	11	11	U	ug/l	11	10	U	ug/l	10	54	U	ug/l	54
Indeno (1,2,3-cd) pyrene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4
1-Methylnaphthalene	150		ug/l	11	160		ug/l	11	56		ug/l	10	210		ug/l	54
2-Methylnaphthalene	93		ug/l	11	110		ug/l	11	39		ug/l	10	160		ug/l	54
Naphthalene	77		ug/l	11	180		ug/l	11	10	U	ug/l	10	280		ug/l	54
Phenanthrene	11	U	ug/l	11	11	U	ug/l	11	10	U	ug/l	10	54	U	ug/l	54
Pyrene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1	U	ug/l	1	5.4	U	ug/l	5.4

U = NOT DETECTED J = ESTIMATED VALUE
UJ = REPORTED QUANTITATION LIMIT IS QUALIFIED AS ESTIMATED
R = RESULT IS REJECTED AND UNUSABLE

NAS CECIL FIELD -- JET ENGINE TEST CELL
BETX AND PAHs -- REPORT REQUEST NO. 8217

Lab Sample Number:	A6I1101530				A6I1101530				A6I1101530				A6I1101530			
Site	JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST				JET ENGINE TEST			
Locator	CEF811PZ4				CEF811PZ6				CEF811PZ8				CEF811PZ9			
Collect Date:	10-SEP-96				10-SEP-96				10-SEP-96				10-SEP-96			
	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL	VALUE	QUAL	UNITS	DL
BETX																
Benzene	210		ug/l	50	3.1		ug/l	1	1	U	ug/l	1	1	U	ug/l	1
Ethylbenzene	470		ug/l	50	56		ug/l	20	2.1		ug/l	1	1	U	ug/l	1
Toluene	50	U	ug/l	50	20	U	ug/l	20	1	U	ug/l	1	1	U	ug/l	1
Xylenes (total)	1400		ug/l	50	150		ug/l	20	1	U	ug/l	1	1	U	ug/l	1
UST PAHs																
Acenaphthene	11	U	ug/l	11	11	U	ug/l	11	11	U	ug/l	11	1	U	ug/l	1
Acenaphthylene	11	U	ug/l	11	11	U	ug/l	11	11	U	ug/l	11	1	U	ug/l	1
Anthracene	11	U	ug/l	11	11	U	ug/l	11	11	U	ug/l	11	1	U	ug/l	1
Benzo (a) anthracene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Benzo (b) fluoranthene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Benzo (k) fluoranthene	.53	U	ug/l	.53	.56	U	ug/l	.56	.54	U	ug/l	.54	.2	U	ug/l	.2
Benzo (a) pyrene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Chrysene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Dibenzo (a,h) anthracene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Fluoranthene	1.8		ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
Fluorene	11	U	ug/l	11	11	U	ug/l	11	11	U	ug/l	11	1	U	ug/l	1
Indeno (1,2,3-cd) pyrene	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2
1-Methylnaphthalene	98		ug/l	11	180		ug/l	11	110		ug/l	11	2.8		ug/l	1
2-Methylnaphthalene	61		ug/l	11	120		ug/l	11	77		ug/l	11	1.7		ug/l	1
Naphthalene	180		ug/l	11	160		ug/l	11	24		ug/l	11	1	U	ug/l	1
Phenanthrene	11	U	ug/l	11	11	U	ug/l	11	11	U	ug/l	11	1	U	ug/l	1
Pyrene	2	P	ug/l	1.1	1.1	U	ug/l	1.1	1.1	U	ug/l	1.1	.2	U	ug/l	.2

U = NOT DETECTED J = ESTIMATED VALUE
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APPENDIX B

CORRESPONDENCE

8514-001

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
2155 EAGLE DR. P O BOX 190010
NORTH CHARLESTON, S C 29419-9010

PLEASE ADDRESS REPLY TO THE COMMANDING OFFICER, NOT TO THE SIGNER OF THIS LETTER
REFER TO:
5090
Code 1842
17 Jan 95

ABB Environmental Services, Inc.
2590 Executive Center Circle, East
Tallahassee, FL 32301
Attention: Mr. John Kaiser

Subj: APPROVAL OF THE CONTAMINATION ASSESSMENT REPORT (CAR) FOR THE JET ENGINE TEST CELL, NAS CECIL FIELD, JACKSONVILLE, FLORIDA

Dear John:

The following is forwarded to you for your information. Please start work on the Remedial Action Plan as requested by FDEP. If there are any questions please contact Mr. Bryan Kizer at (803) 743-0896.

Sincerely,

Bryan Kizer, E.I.T.
Petroleum Branch

Encl:
EPA ltr dated 19 December 1994

Department of Environmental Protection

Lawton Chiles
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

December 19, 1994

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding Officer
Mr. Bryan Kizer, Code 1842
SOUTHNAVFACENGCOM
Post Office Box 190010
North Charleston, SC 29419-0068

RE: Contamination Assessment Report Addendum, Jet Engine Test Cell, Naval Air Station Cecil Field Florida.

Dear Mr. Kizer:

I have reviewed the Contamination Assessment Report (CAR) Addendum dated November, 1994 (received November 9, 1994), submitted for this site. I found all the documents submitted to date to be adequate to meet the contamination assessment requirements of Rules 62-770.600 and 62-770.630, Florida Administrative Code (F.A.C.). Therefore, you must now submit a Remedial Action Plan (RAP) in accordance with Rule 62-770.700, F.A.C.

Please submit the RAP addressed to Mr. Eric S. Nuzie, Technical Review Section, Bureau of Waste Cleanup, within the time frame established in the approved Site Management Plan for the Petroleum Agreement between the Navy and FDEP. If you should have any questions concerning this review, please contact me at (904) 921-9991.

Sincerely,

Michael J. Deliz

Michael J. Deliz, P.G.
Remedial Project Manager

cc: John Mitchell, FDEP Natural Resource Trustee
Brian Cheary, FDEP Northeast District
Bart Reedy, USEPA - Atlanta
Jerry Young, City of Jacksonville
Steve Wilson, SOUTHNAVFACENGCOM

TJB JJC ESN

Department of Environmental Protection

FLORIDA

Lawton Chiles
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Virginia B. Wetherell
Secretary

October 3, 1995

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Commanding Officer
Mr. Bryan Kizer, Code 1842
SOUTHNAVFACENGCOM
Post Office Box 190010
North Charleston, SC 29419-0068

RE: Alternate Procedure and Requirements
Jet Engine Test Cell, Naval Air Station Cecil Field, Florida
File No. AP-PC0078

Dear Mr. Kizer:

The Department has reviewed the request for an alternate procedure to Chapter 62-770, Florida Administrative Code (F.A.C.), for the planned bioslurping project thr Jet Engine Test Cell dated August 1995 (received August 20, 1995). The specific exception is to Rule 62-770.300(2), F.A.C., that prohibits free product recovery which requires dewatering or groundwater extraction that causes groundwater table depression without Department approval. The Department concurs with this request and an executed copy of the Approval of Alternate Procedures is enclosed.

If you have any concerns regarding this letter, please contact me at (904) 921-9991.

Sincerely,

Michael J. Deliz

Michael J. Deliz, P.G.
Remedial Project Manager

cc: Greg M. Brown, FDEP
Pat Kincaid, FDEP Natural Resource Trustee
Brian Cheary, FDEP Northeast District
Bart Reedy, USEPA - Atlanta
Jerry Young, City of Jacksonville

Steve Wilson, SOUTHNAVFACENGCOM
[redacted] ABB-ES
Lynn Sims, Bechtel Environmental Inc.
Ursula Klimas, NAS Cecil Field

TJB TB JJC JJC ESN ESN

Enclosures (2)

c:\data_m\nascf\y\stalt.doc

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
CECIL FIELD, FLORIDA 32215-5000

5090
184UK
June 17, 1996

Certified Mail - Return Receipt Requested

Mr. Marshall Mott-Smith
Florida Department of
Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Dear Mr. Mott-Smith:

Enclosure (1) contains the Closure Assessment and Storage Tank Registration Form. This 5000 gallon JP-5 above ground storage tank was in support of a jet engine test cell bldg 810. The test cell was dismantled and is being transferred, to Portsmouth, VA along with the tank.

Mr. A. C. Carroll from the City of Jacksonville was on site for the removal. No soil OVA readings or water samples were performed. This tank was located in a contaminated area which is being assessed by the Base Closure Team at the test cells.

If you have any questions concerning this matter, please contact Ms. Ursula Klimas (904) 778-6040.

Sincerely,

J. LLOYD CREWS
Environmental Director
By direction of the
Commanding Officer

Encl:
(1) Closure and Storage Tank Registration Forms

Copy to:
City of Jacksonville, Regulatory
and Environmental Service Department

Florida Department of
Environmental Protection
Northeast District

Florida Department of
Environmental Protection
Bureau of Waste Management
Attn: Mike Deliz

DER Form #	17-761.900(6)
Form Title	Closure Assessment Form
Effective Date	December 10, 1990
DER Application No.	(Filled in by DER)

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Closure Assessment Form

Owners of storage tank systems that are replacing, removing or closing in place storage tanks shall use this form to demonstrate that a storage system closure assesment was performed in accordance with Rule 17-761 or 17-762, Florida Administrative Code. Eligible Early Detection Incentive (EDI) and Reimbursement Program sites do not have to perform a closure assessment.

Please Print or Type
Complete All Applicable Blanks

1. Date: June 12, 1996
2. DER Facility ID Number: 168507293
3. County: Duval
4. Facility Name: Naval Air Station Cecil Field
5. Facility Owner: U.S. Navy
6. Facility Address: NAS Cecil Field
7. Mailing Address: Staff Civil Engineer, Environmental Division, Jacksonville, FL 32215
8. Telephone Number: (904) 778-5620
9. Facility Operator: U.S. Navy
10. Are the Storage Tank(s): **(Circle one or both)** A. Aboveground or B. Underground

    Type of Product(s) Stored: JP-5
12. Were the Tank(s): **(Circle one)** A. Replaced B. Removed C. Closed in Place D. Upgraded (aboveground tanks only)
13. Number of Tanks Closed: 1
14. Age of Tanks: Installed in 1989

Facility Assessment Information

Yes	No	Not Applicable	
[ ]	[x]		1. Is the facility participating in the Florida Petroleum Liability Insurance and Restoration Program (FPLIRP)?
[ ]	[x]		2. Was a Discharge Reporting Form submitted to the Department? If yes, When: ______ Where: ______
[x]	[ ]		3. Is the depth to ground water less than 20 feet?
[x]	[ ]	[ ]	4. Are monitoring wells present around the storage system? If yes, specify type: [ ] Water monitoring [ ] Vapor monitoring
[ ]	[ ]	[x]	5. Is there free product present in the monitoring wells or within the excavation?
[ ]	[ ]	[x]	6. Were the petroleum hydrocarbon vapor levels in the soils greater than 500 parts per million for gasoline? Specify sample type: [ ] Vapor Monitoring wells [ ] Soil sample(s)
[ ]	[ ]	[x]	7. Were the petroleum hydrocarbon vapor levels in the soils greater than 50 parts per million for diesel/kerosene? Specify sample type: [ ] Vapor Monitoring wells [ ] Soil sample(s)
[ ]	[ ]	[x]	8. Were the analytical laboratory results of the ground water sample(s) greater than the allowable state target levels? (See target levels on reverse side of this form and supply laboratory data sheets)
[ ]	[ ]	[x]	9. If a used oil storage system, did a visual inspection detect any discolored soil indicating a release?
[x]	[ ]		10. Are any potable wells located within ¼ of a mile radius of the facility?
[ ]	[x]		11. Is there a surface water body within ¼ mile radius of the site? If yes, indicate distance: ______

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form # 17-761.900(2)
Form Title Storage Tank Registration Form
Effective Date December 10, 1990
DER Application No. ______ (Filled in by DER)

Storage Tank Registration Form

Please Print or Type - Review Instructions Before Completing Form

1. DER Facility ID Number: 168507293
2. Facility Type: ______
3. New Registration ☐ New Owner Data ☐ Facility Revision ☐ Tank(s) Revision ☒
4. County and Code of tank(s) location: Duval County / ______

5. Facility Name: Naval Air Station Cecil Field
Tank(s) Address: ______
City/State/Zip: Jacksonville, FL 32215
Contact Person: Ms. Ursula Klimas Telephone: (904) 778-6040
6. Financial Responsibility Type: Self-Insurance

7a. Tank(s) Owner: U. S. Navy
Owner Mailing Address: NAS Cecil Field
City/State/Zip: Jacksonville, FL 32215
Contact Person: Ms. Ursula Klimas Telephone: (904) 778-6040

7b. New Owner Signature/Change Date: N/A / __/__/__

8. Location (optional) Latitude: 30° 14' 22" Longitude: 81° 58' 46" Section 15 Township 35 Range 24E

Complete One Line For Each Tank At This Facility (Use Codes - See Instructions)

Complete 9 - 16 for tanks in use; 9 - 19 for tanks out of use

9	10	11	12	13	14	15	16	17	18	19
810	5000	F	1989	A	CA I	B	FL	B	Ø	6/12/96

20. N/A
Certified Contractor*

DPR# ______
Department of Professional Regulation License Number*

*For new tank installation or tank removal

To the best of my knowledge and belief all information submitted on this form is true, accurate and complete.

J. LLOYD CREWS
Print name & title of owner or authorized person

[signature]
Signature

6/17/96
Date

DEPARTMENT OF THE NAVY
NAVAL AIR STATION
CECIL FIELD, FLORIDA 32215-5000

5090
18413
July 22, 1996

City of Jacksonville
Bio-Environmental Division
Attn: Mr. Lewis Shields
Towncentre-Suite 412
421 West Church Street
Jacksonville, Fl 32202-4111

Dear Mr. Shields:

This letter is to provide additional information concerning the telephone report made by Ms. Ursula Klimas on July 17, 1996 regarding a release from an underground fuel line at the Jet Engine Test, Building 811.

This release was discovered when free product, appeared in a monitoring well. It was determined the release was due to a bad seal at a joint in the piping from the fuel filter to the cell. This cell was taken out of service and the tank and filter associated with the cell were removed in June 1996.

Mr. Mike Deliz, FDEP, agreed no Initial Remedial Action is required, this area presently has an approved Contamination Assessment Report. The newly discovered area of contamination will be addressed in the Remedial Action Plan for the Test Cell site.

A report was not made to the National Response Center, U.S. Environmental Protection Agency as no water ways were threatened.

If you have any questions regarding this matter, please contact Ms. Ursula Klimas at (904) 778-6040.

Sincerely,

J. LLOYD CREWS
By direction of
the Commanding Officer

Copy to:
Florida Department of
Environmental Protection
Northeast District
Attn: Mr. Kenton Brown

Attn: Mr. Kenton Brown

Florida Department of
Environmental Protection
Attn: Mr. Mike Deliz

COMNAVBASE (Code N3)

APPENDIX C

ENGINEERING CALCULATIONS

C-1 Mass and Concentration of Contaminants
C-2 Groundwater Model and Description

APPENDIX C-1

MASS AND CONCENTRATION OF CONTAMINANTS

FREE PRODUCT VOLUME CALCULATION
NAS Cecil Field, Jet Engine Test Cell

PROJECT: NAS CECIL FIELD: JET ENGINE TEST CELL
DATE: 28 OCTOBER 1996 ENGINEER: FJU

Volume of Free Product:	193.2 ft ^ 3	or	1445.004 gal.
Mass of Free Product:	9884.757 lb.	or	4483.726 kg

The estimated thickness and extent of apparent product at the Jet Engine Test Cell is illustrated in Figure 3−3. These free product measurements were taken in September 1996 but variation is not uncommon. These apparent thicknesses have been corrected using an estimation method presented in Testa and Winegardner (1991). The volume of actual free product saturated soil has been estimated in the table below using the average end area method.

JET ENGINE TEST CELL

Area 1:

Apparent Thickness (ft)	Actual Thickness (ft)	Incremental Thickness (ft)	Area (ft ^ 2)	Average Area (ft ^ 2)	Incremental Volume (ft ^ 3)	Cumulative Volume (ft ^ 3)
0.01	0.0025		515.5			
		0.4725		393.8	186.0	186.0
1.90	0.4750		272.0			
		0.0075		136.0	1.0	187.1
1.93	0.4825		0.0			

Area 2:

Apparent Thickness (ft)	Actual Thickness (ft)	Incremental Thickness (ft)	Area (ft ^ 2)	Average Area (ft ^ 2)	Incremental Volume (ft ^ 3)	Cumulative Volume (ft ^ 3)
0.01	0.0025		1793.4			
		0.1225		1608.7	197.1	197.1
0.50	0.1250		1424.0			
		0.375		1032.0	387.0	584.1
2.00	0.5000		640.0			
		0.005		320.0	1.6	585.7
2.02	0.5050		0.0			

Volume of Soil Saturated with Product: ***772.7 ft ^ 3***

Free Product Volume*: ***193.2 ft ^ 3***

*Total Volume multiplied by the porosity which is estimated to be 0.25.

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL	J. ULLO	8570.06
	CHK. BY	DATE
	B. Svenkson	10/23/96

RAP

CONTAMINATED SOIL VOLUME CALCULATIONS:

ZONE #

(1.) Volume of Contaminated Soil, Water, and Air. (total)

Take the gross area from Figure 3-1 assuming 8' total thickness.

Total Volume = 120,640 ft^3 or 4468 yd^3

(2.) Volume of Contaminated Soil, Water, and Air associated with the groundwater plume. (Figure 7-2) assuming 8' total thickness.

Total Volume = 100,878 ft^3 or 3736 yd^3

(3.) Volume of Soil, Water, and Air associated with the free product soil area (Figure 7-1) assuming 8' total thickness.

Total Volume = 37767 ft^3 or 1398.8 yd^3

Average OVA for ZONE (2.) excluding ZONE (3.)

BORING #	OVA (ppm)	BORING #	OVA (ppm)
93SB-5	750	96SB1	45
93SB-20	1510	96SB2	900
93SB9	229	93SB10	220
96PZSB6	500		
93SB16	310	Avg:	558 ppm

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL RAP	J. Ullo	8570.06
	CHK. BY	DATE
	[signature]	10/23/96

CONTAMINATE SOIL VOLUME CALCULATIONS (cont.)

Average OVA for ZONE (3)

BORING #	OVA (ppm)
93 SB19	2000
93 SB11	2455
96SBPZ5	2100
93SB18	1100

Avg: 1914 ppm

VOLUME OF CONTAMINATED SOIL TO BE EXCAVATED -- MASS OF CONTAMINANT
NAS Cecil Field, Jet Engine Test Cell

Engineer: FJU
Checked by: B. Svendsen

The volume of contaminated soil to be excavated was estimated as shown below.

Using, Zone 3, the area associated with the approximate extent of free product shown in Figure 7-1, the volume of excavation is estimated.

Approximate area of excavation	=	4721 ft^2
Depth of excavation	=	8 feet

The volume of contaminated soil =

$$4721\ ft^2 \times 8\ feet = 37{,}767\ ft^3 = 1{,}399\ yd^3 \approx 1{,}400\ yd^3$$

Using a swell factor of 1.12 for wet sand from the table attached the corrected volume of contaminated soil once excavated would be

$$1{,}400\ yd^3 \times 1.12 = 1{,}568\ yd^3$$

Using the conversion factor, 1 cubic yard of compacted soil weighs approximately 1.4 tons, the mass of contaminated soil is calculated:

$$1{,}568\ yd^3 \times 1.4\ \frac{tons}{yd^3} = 2{,}195\ tons$$

Rounding to the nearest hundred, approximately 2,200 tons of soil is to be excavated.

Percentage Swell and Load Factors of Materials

MATERIAL	SWELL, %	LOAD FACTOR
Cinders	45	0.69
Clay, dry	40	0.72
Clay, wet	40	0.72
Clay and Gravel, dry	40	0.72
Clay and Gravel, wet	40	0.72
Coal, anthracite	35	0.74
Coal, bituminous	35	0.74
Earth, dry loam	25	0.80
Earth, wet loam	25	0.80
Gravel, wet	12	0.89
Gravel, dry	12	0.89
Gypsum	74	0.57
Hardpan	50	0.67
Limestone	67	0.60
Rock, well blasted	65	0.60
Sand, dry	12	0.89
Sand, wet	12	0.89
Sandstone	54	0.65
Shale and soft rock	65	0.60
Slag, bank	23	0.81
Slate	65	0.60
Traprock	65	0.61

Reference:

Florida Department of Environmental Protection, Guidelines for Assessment and Remediation of Petroleum Contaminated Soil, May, 1992.

Merritt, Frederick S., Ed., 1983, Standard Handbook for Civil Engineers, Third Edition: McGraw-Hill Book Co., New York, ch. 13 p. 17.

Once the volume of contaminated soil is known the mass of contaminant is determined. The first step to this was the estimation of the average OVA concentrations in contaminated soil Zones 2 and 3. OVA concentrations from 1993 through 1996 were used to determine these average concentrations. The average OVA concentration for Zone 2 excluding Zone 3 is 558 ppm. For Zone 3 the average OVA concentration is 1,914 ppm.

Although there is no direct relation between OVA and analytical data, an estimate of the mass of BTEX associated with these two soil zones was necessary. The following analytical results have been reported by ABB-ES in the March 1994 CAR but are summarized here.

In December 1990 five soil samples were analyzed by Savannah Laboratories by USEPA method 8020. One soil sample was collected at a depth of approximately 3.5 feet below land surface (bls) in the tank containment area in the location of soil boring 90SB-3. A total BTEX concentration of 28,900 μg/kg was reported for this sample. The OVA reading associated with soil boring 90SB-3 at a depth of 13.5 feet bls was 504 ppm. Other OVA readings obtained from a similar depth interval as the laboratory sample collected (between 3 and 5 feet bls) in the containment area show an average OVA concentration of 2,025 ppm (based on OVA readings from soil borings 93SB-19 and 93SB-11.

For the purposes of estimating the mass of contaminant, a relation of 28,900 μg/kg to 504 ppm was used. This leads to an average BTEX concentration of 57.34 μg/kg per ppm OVA. Using this conservative relationship and the average OVA concentrations in each zone the mass of soluble BTEX was estimated. The following spreadsheets include these calculations.

MASS OF HYDROCARBON

ASSOCIATED WITH THE FREE PRODUCT AREA (ZONE 3)

PROJECT NAME:	NAS Cecil Field, Jet Engine Test Cell Site			
MASS OF CONTAMINANT				
DATE: 11/7/96	ENGINEER: FJU CHECKED BY: B. Svendsen			
Symbol	Description	Quantity	Units	Source
Vol Total	TOTAL VOLUME OF CONTAMINATED SOIL (ZONE 3)	37766.00	ft^3	Calculated
Ca	AVERAGE AIR OVA CONCENTRATION (v/v)	1914.00	ppm	Calculated
Ref. Conc. LAB	BTEX CONCENTRATION FOR BORING IN ZONE 3 (mass/mass)	28900.00	ug/kg	USEPA 8020, Sample JE3, (ABB, 1990)
Ref. Conc. OVA	OVA CONCENTRATION FOR BORING IN ZONE 3 (v/v)	504.00	ppm	Field measurement, (ABB, 1990)
Ref. Conversion	Ca DIVIDED BY REF. CONC. OVA	3.80		Calculated
Conc. Avg.	AVERAGE SOIL BTEX CONCENTRATION (mass/mass)	109751.19	ug/kg	Calculated
Vol Soil	VOLUME OF CONTAMINATED SOIL	28324.50	ft^3	Calculated
n	POROSITY	0.25	dimensionless	Estimated
W	UNIT WEIGHT OF SOIL	150.00	lb/ft3	Estimated
Mass Soil	TOTAL MASS OF SOIL IN ZONE 3	1931215.91	kg	
Mass BTEXs(3)	MASS OF BTEX IN SOIL IN ZONE 3	211.95	kg	Calculated
Mass Product	MASS OF CONTAMINANT IN FREE PHASE	4483.73	kg	See prod. volume estimate
Mass BTEXp	MASS OF BTEX IN FREE PHASE (ASSUME 16% OF TOTAL MASS)	717.40	kg	Calculated
Mass BTEX(3)	TOTAL MASS OF BTEX IN ZONE 3	929.35	kg	Calculated

MASS OF HYDROCARBON ASSOCIATED WITH THE GROUNDWATER PLUME (ZONE 2)
AND TOTAL MASS OF SOLUBLE BTEX

PROJECT NAME:	NAS Cecil Field, Jet Engine Test Cell Site			
MASS OF CONTAMINANT				
DATE: 10/31/96	ENGINEER: FJU CHECKED BY: [signature]			
Symbol	Description	Quantity	Units	Source
Vol Total	TOTAL VOLUME OF CONTAMINATED SOIL	63111.00	ft^3	CAD maps
	CONTRIBUTING TO GROUNDWATER CONTAMINATION			Zones previously
	(EXCLUDING THE FREE PRODUCT ZONE THEREFORE: ZONE 2- ZONE 3)			defined
Ca	AVERAGE AIR OVA CONCENTRATION (v/v)	558.00	ppm	Calculated
Ref. Conc. LAB	BTEX CONCENTRATION FOR BORING IN ZONE 3 (mass/mass)	28900.00	ug/kg	USEPA 8020, Sample JE3, (ABB, 1990)
Ref. Conc. OVA	OVA CONCENTRATION FOR BORING IN ZONE 3 (v/v)	504.00	ppm	Field measurement, (ABB, 1990)
Ref. Conversion	Ca DIVIDED BY REF. CONC. OVA	1.11		Calculated
Conc. Avg.	AVERAGE SOIL BTEX CONCENTRATION (mass/mass)	31996.43	ug/kg	Calculated
Vol Soil	VOLUME OF CONTAMINATED SOIL	47333.25	ft^3	Calculated
n	POROSITY	0.25	dimensionless	Estimated
W	UNIT WEIGHT OF SOIL	150.00	lb/ft3	Estimated
Mass Soil	TOTAL MASS OF SOIL IN ZONE 2 (EXCLUDING ZONE 3)	3227267.05	kg	Calculated
Mass BTEXs(2)	MASS OF BTEX IN SOIL IN ZONE 2	103.26	kg	Calculated
	(EXCLUDING THE FREE PRODUCT AREA)			
Mass BTEX(3)	TOTAL MASS OF BTEX FROM PRODUCT AREA (ZONE 3)	929.35	kg	From Zone 3
Mass BTEXt	**TOTAL MASS OF SOLUBLE BTEX (ZONE 2)**	**1032.61**	**kg**	**Calculated**
%MASSZN3	**PERCENT MASS OF SOLUBLE CONTAMINANT IN SOURCE ZONE (ZONE 3)**	**90.0**	**percent**	**Calculated**

APPENDIX C-2

GROUNDWATER MODEL AND DESCRIPTION

BIOSCREEN Modeling Summary: Jet Engine Test Cell Site, NAS Cecil Field, Jacksonville, FL:

A synopsis of each modeling scenario is provided in this appendix followed by the model results each describes. Model assumptions included in one modeling scenario should be considered applicable unless otherwise stated in the model summary.

CALIBRATION MODEL

ASSUMPTIONS:

The first step in modeling the Jet Engine Test Cell site was to calibrate the model to existing conditions. Because of the ongoing source at the Jet Engine Test Cell, assuming that concentrations have remained stable over time is relatively accurate. This assumption was applied directly in the model setup as an infinite plume source was used for the initial calibration.

Listed below are other general assumptions made during the calibration model.

- JP-5 is the contaminant of concern. The half-life for benzene the major contaminant of concern is 2 years. This half-life is used to represent the half-life of total BTEX as well.
- Sulfate concentrations in the heart of the contaminant plume are considered negligible (near zero) compared to the average background concentration used.
- Methane concentrations near the source zone are assumed to be 6 mg/ℓ. This concentration is lower than the median concentration reported in the BIOSCREEN manual and is consistent with concentrations reported at NAS Cecil Field, Site 8, a former fire training area.

INPUT PARAMETERS:

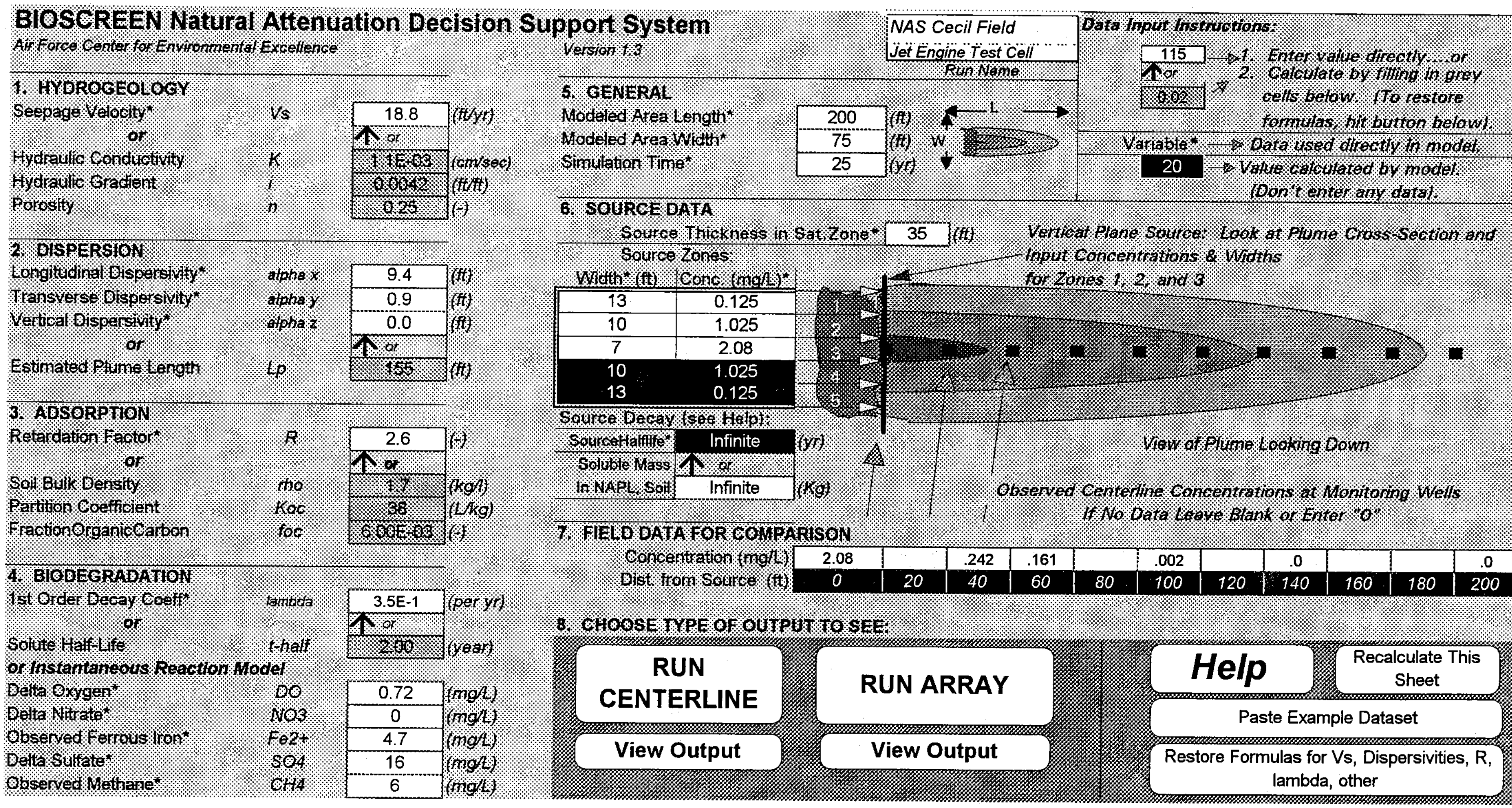
Supporting calculations and a listing of input parameters are provided following this summary. The data input screen for the calibration model is shown in Figure 1.

RESULTS:

Transverse dispersion and the plume concentrations as well as an illustration of the plume using the first-order decay and instantaneous reaction models is shown in Figures 2 and 3, respectively.

Plume illustrations are deceptive due to differing scales and the units of concentration. The units of concentration are mg/ℓ and the target level for total BTEX is 50 μg/ℓ.

First order decay appears to be the best model of the degradation at the Jet Engine Test Cell site. The relation between existing groundwater data and the calibrated plume is best shown in Figure 4. The Instantaneous Reaction model is also useful in determining the plume extent as the First Order Decay model appears to spread beyond 200 feet when the plume is approximately 100 feet from



Figur BIOSCREEN Calibration Input Screen, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) / *Distance from Source (ft)*

	0	20	40	60	80	100	120	140	160	180	200
38	0.000	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
19	0.125	0.146	0.093	0.052	0.028	0.014	0.007	0.004	0.002	0.001	0.000
0	2.080	0.718	0.304	0.134	0.060	0.027	0.013	0.006	0.003	0.001	0.001
-19	0.125	0.146	0.093	0.052	0.028	0.014	0.007	0.004	0.002	0.001	0.000
-38	0.000	0.002	0.004	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000

Model to Display:

No Degradation Model

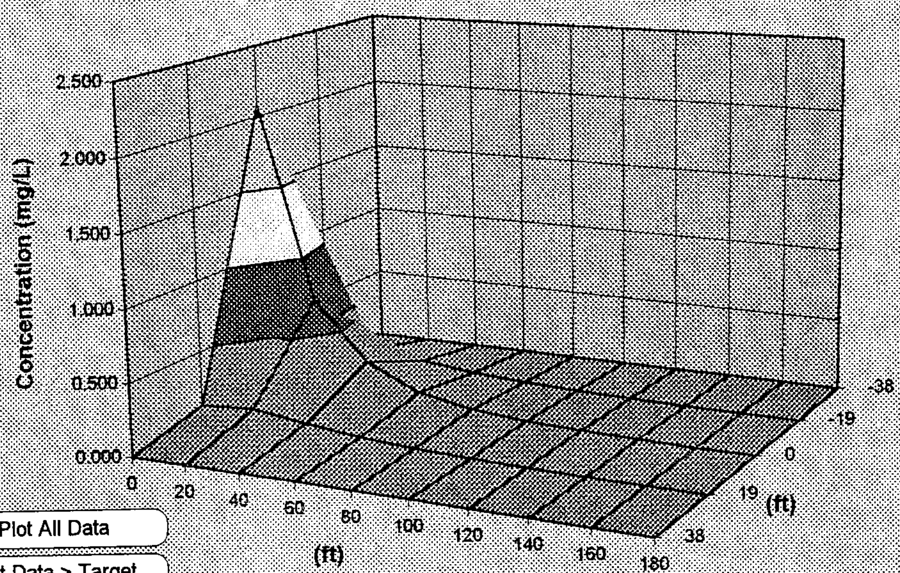
1st Order Decay Model

Instantaneous Reaction Model

Time: **25 Years**

Target Level: **0.050** mg/L

Displayed Model: **1st Order Decay**



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	4.5	*(Kg)*
- Actual Plume Mass	0.3	*(Kg)*
= Plume Mass Removed by Biodeg	**4.1**	*(Kg)* (93 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
na	na	na	na	na	*(Kg)*

Original Mass in Source (Time = 0 Years)	Infinite	*(Kg)*
Mass in Source Now (Time = 25Years)	Infinite	*(Kg)*
Current Volume of Groundwater in Plume	1.7	*(ac-ft)*
Flowrate of Water Through Source Zone	0.200	*(ac-ft/yr)*

Mass HELP

Recalculate

Figure 2, BIOSCREEN Plume Output Calibration, First Order Decay, NAS Cecil Field, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft)	Distance from Source (ft): 0	20	40	60	80	100	120	140	160	180	200
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	2.080	1.419	1.126	0.741	0.179	0.000	0.000	0.000	0.000	0.000	0.000
-19	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-38	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

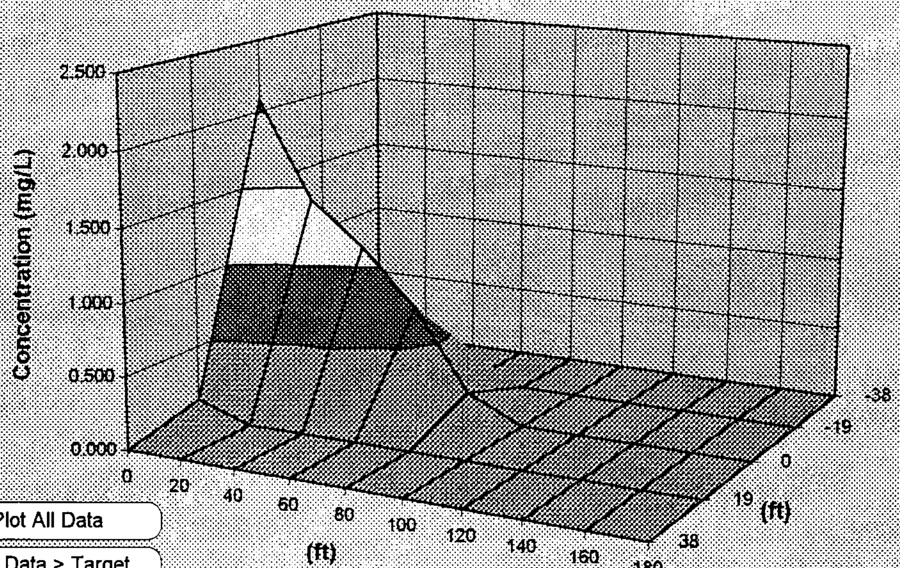
Model to Display:

No Degradation Model

1st Order Decay Model

Instantaneous Reaction Model

Time: **25 Years**   Target Level: **0.050** mg/L   Displayed Model: **Inst. Reaction**



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	75.5	*(Kg)*
- Actual Plume Mass	1.2	*(Kg)*
= Plume Mass Removed by Biodeg	**74.4**	*(Kg)*
	(98 %)	

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
-4.6	+0.0	+30.3	-103.1	+38.7	*(Kg)*

Original Mass In Source (Time = 0 Years)	Infinite	*(Kg)*
Mass in Source Now (Time = 25Years)	Infinite	*(Kg)*
Current Volume of Groundwater in Plume	0.5	*(ac-ft)*
Flowrate of Water Through Source Zone	0.200	*(ac-ft/yr)*

Mass HELP

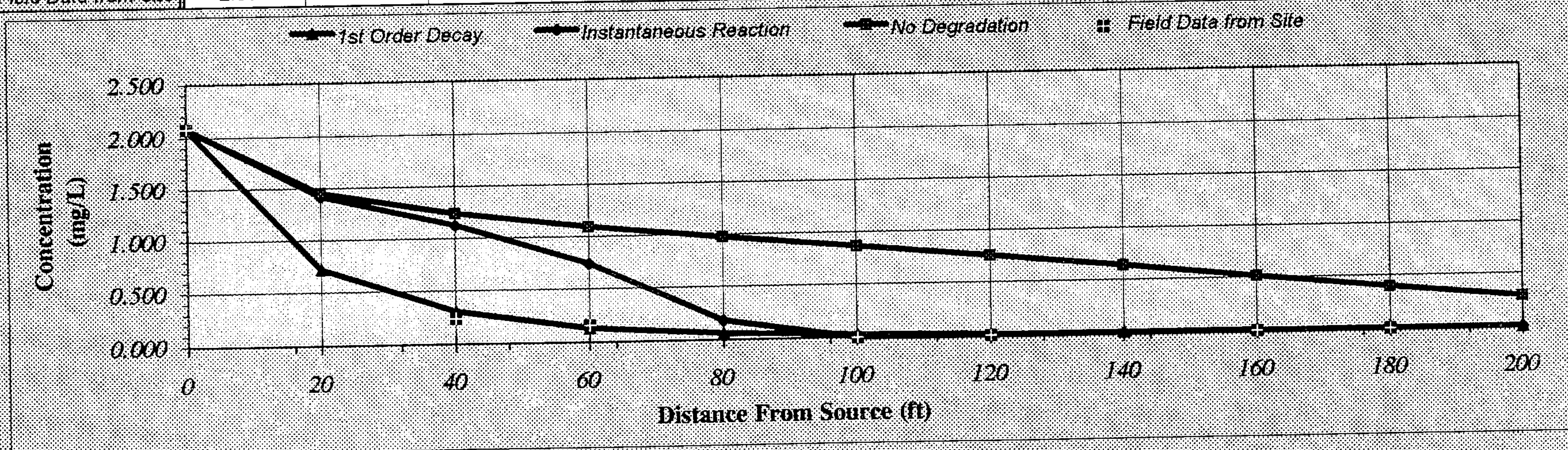
Recalculate

Figure , BIOSCREEN Plume Output Calibration, Instantaneous Reaction, NAS Ce. ield, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	2.080	1.450	1.237	1.091	0.973	0.865	0.754	0.638	0.516	0.394	0.281
1st Order Decay	2.080	0.718	0.304	0.134	0.060	0.027	0.013	0.006	0.003	0.001	0.001
Inst. Reaction	2.080	1.419	1.126	0.741	0.179	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	2.080		0.242	0.161		0.002					



Calculate Animation

Next Timestep

Prev Timestep

Time:

25 Years

Return to Input

Recalculate This Sheet

Figure 4, Centerline Calibration, Jet Engine Test Cell RAP the source zone (based on field observations). This may be due to increased biodegradation downgradient of the source area. Plume centerline plots appear to be the most useful in determining the effectiveness of the model and the biodegradation of the contaminants and are used predominantly in this modeling effort.

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL RAP	J. Ullo	8570.06
	CHK. BY B. Svendsen	DATE 10/7/96

Biosecreen Data Input:

1.) Hydrogeologic Data:

K = use 3 ft/day (From USGS)

$$3\ \text{ft/day} \times \frac{12\text{in}}{1\text{ft}} \times \frac{2.54\ \text{cm}}{1\text{in}} \times \frac{1\ \text{day}}{86400\text{s}}$$

$$= 1.1 \times 10^{-3}\ \text{cm/s}$$

n = 0.25 (estimated)

i = Assuming an eastward flow direction (derived from figure 3-2. Using MW-10 and MW-27 AND MW-16 and PZ-8

Calc:

$$\frac{\text{Elev MW10} - \text{Elev MW27}}{\text{Distance Between}} = \frac{73.78 - 73.21\ (\text{ft})}{115\ \text{ft}} = 0.00496\ \text{ft/ft}$$

$$\frac{\text{Elev MW16} - \text{Elev PZ8}}{\text{Distance Between}} = \frac{73.72 - 73.38}{100\ \text{ft}} = 0.0034\ \text{ft/ft}$$

Avg i = 0.0042

2) Dispersivity:

Based on existing plume centerline measurement: 155 ft.

3.) Adsorption Data:

$$R = 1 + \frac{K_d \cdot \rho_b}{n} \qquad K_d = K_{oc} \cdot f_{oc}$$

K_{oc} = 38 l/Kg for benzene ρ_b = 1.7 kg/l

f_{oc} = 0.006 from MW-20 measured 9/29/93

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL RAP	J. Ullo	8570.06
	CHK. BY: B. Svendsen	DATE: 10/7/96

Bioscreen Data Input (continued):

4) Biodegradation Data: 1st order Decay Coefficient

Use $t_{1/2}$ = 2 years for Benzene in groundwater from Howard et al. 1991.

Delta O_2: Background O_2 from non contaminated wells:

MW #	Conc. mg/l
2	1.96
7	1.80
14D	1.51
18	0.80
21	0.93
27	2.00
PZ-9	1.70
17	0.61
26	0.72
Avg.	1.28

O_2 in contaminated zone:

MW # (Source Area)	Conc. mg/l
9	0.62
10	0.66
16	0.61
19	0.56 *
20	1.17
23	0.57
24	1.12
PZ 2	—
PZ 4	1.70
PZ-6	1.90
PZ-8	1.80 / avg. 1.07 mg/l

ΔO_2 (Background $\bar{x}$ − x_{min})

$1.28 - 0.56 = 0.72$ mg/l O_2

∴ Use 0.72 mg/l O_2

* x_{min}

ABB Environmental Services, Inc.

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, Jet Engine Test Cell RAP	J. Ullo	8570.06
	CHK. BY	DATE
	B. Svendsen	10/7/96

Bioscreen Data Input (continued)

4) Biodegradation Data (cont.):

Delta NO_3 : 0 mg/l field detection limit not low enough.

Ferrous Iron : Source Area Concentrations :

MW #	Conc. mg/l
9	0.6
10	3.2
16	3.4
19	1.3
20	7.2
23	0.7
24	10.0
PZ-2	10.0
PZ-4	9.6
PZ-6	3.4
PZ-8	2.0

Avg. 4.67 mg/l

Delta SO_4 : 16 mg/l* field detection limit not low enough (see next page for estimate)

Observed CH_4 : 6 mg/l From Site 8, NAS Cecil and Overall site averages

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL RAP	Joe Ullo	8570.06
	CHK. BY [signature]	DATE 10/14/96

ΔSO_4 Estimation (Background)

From SITE 7: Background SO_4 concentrations

WELL #	SO_4 (mg/l)
16-13S	15*
16-17S	12*
16-15S	10*
16-21S	66
16-29S	78
16-35S	35
16-24S	26*

* Upgradient average: 16 mg/l
Total Average: 34.6 mg/l

From SITE 17: Background SO_4 concentrations

WELL #	SO_4 (mg/l)
17-1S	10*
17-6S	20
17-8S	<500**
17-9S	<25**
17-13S	110
17-16S	<100**
17-19S	78*

* Upgradient average: 44 mg/l
Total Average: 54.5 mg/l

** Values not included in calculations

Assume SO_4 depleted in soure area.

∴ Use 16 mg/l as conservative estimate at Jet Engine Test Cell background

ABB Environmental Services, Inc.

PROJECT	COMP. BY	JOB NO.
NAS Cecil Field, JET ENGINE TEST CELL RAP	J. Ullo	8570.06
	CHK. BY	DATE
	[signature]	10/7/96

Bioscreen Data Input (continued):

5.) General Data: Model Area length: 200 ft Width: 75 ft. (measured)

Simulation Time: 25 years for calibration

6.) Source Data: Source Thickness: 35' based on MW 14D

Source Zone Concentration: From Total VOA contamination map Figure 3-5

Soluble Mass: 1,033 kg See spreadsheets in Appendix C-1

7.) Field Data For Comparison: From Total VOA contamination map Figure 3-5

BIOSCREEN Modeling Summary: Jet Engine Test Cell Site, NAS Cecil Field, Jacksonville, FL:

FATE AND TRANSPORT: 25 AND 50 YEARS

Prior to the remedial recommendation, the fate of the contaminant plume should be modeled and downgradient receptors considered. In this modeling step, the source area was assumed to remain in place for time periods of 25 years (25 years from today) and 50 years (from today).

Two modeling approaches could be applied to address soil contamination: 1) assuming the source zone is just downgradient of the affected soil area and 2) modeling most of the plume with the source near the point of highest groundwater concentration, piezometer PZ-4. A modification of the second alternative was used. The mass of contaminant in the soil located in the area of the known groundwater contaminant plume was considered to be the source zone for this step (Figure 8-5). Contributions of soil contamination in areas where groundwater contamination was not detected were considered minor and neglected during this step.

All other assumptions made during the calibration model are applicable here.

The input dataset is identical except that the simulation time is increased accordingly and the soluble mass of 1,033 kg of BTEX was used. Figure 5 shows the data set for the 25 year simulation.

RESULTS

Based on centerline concentrations no appreciable contaminant transport is expected within the next century (Figures 6 and 7). The source area hardly degrades in the First Order Decay model and remains above NFA levels up to 50 years from now as shown in the Instantaneous Reaction model. This is due primarily to the large soluble mass of contaminant associated with the contaminated soil and free product in the source area. Without source removal, complete plume degradation within a reasonable time frame is improbable.

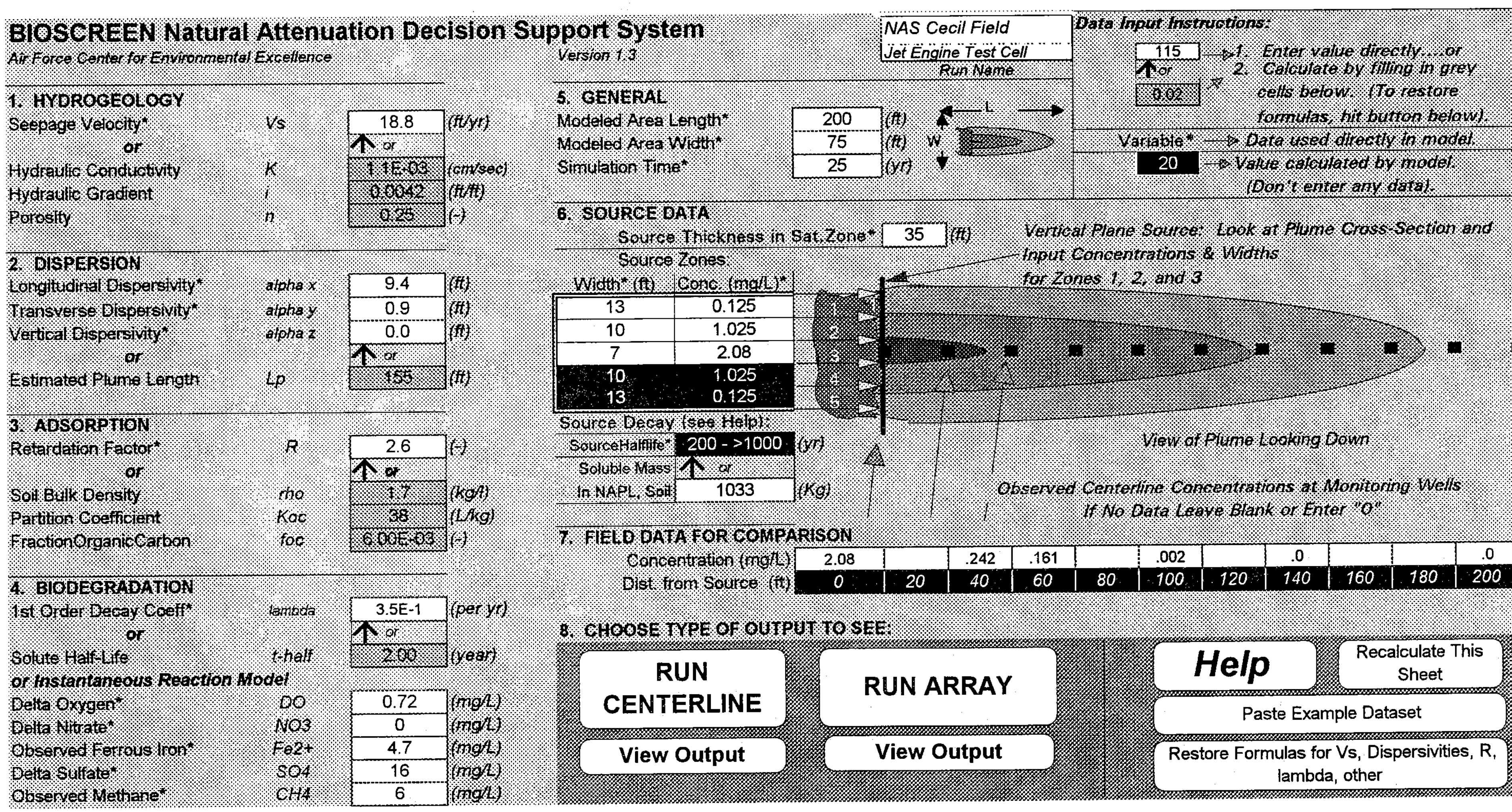
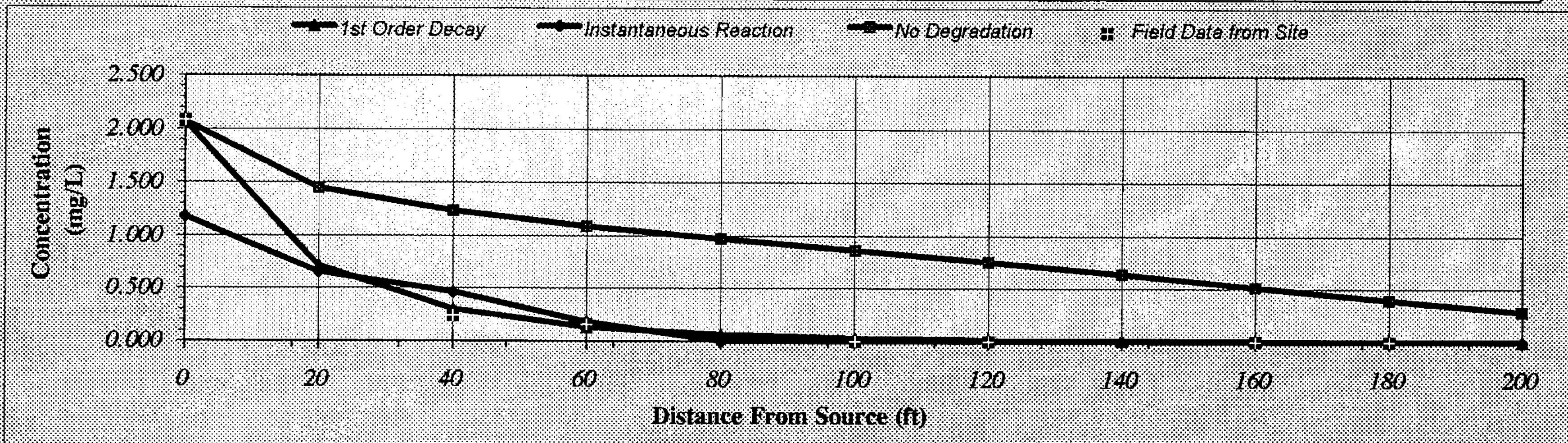


Figure 5; BIOSCREEN Input Screen Year 2021, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	2.071	1.445	1.233	1.088	0.971	0.863	0.753	0.637	0.515	0.394	0.281
1st Order Decay	2.071	0.715	0.303	0.133	0.060	0.027	0.013	0.006	0.003	0.001	0.001
Inst. Reaction	1.179	0.653	0.463	0.182	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	2.080		0.242	0.161		0.002					



Calculate Animation

Next Timestep

Prev Timestep

Time:

25 Years

Return to Input

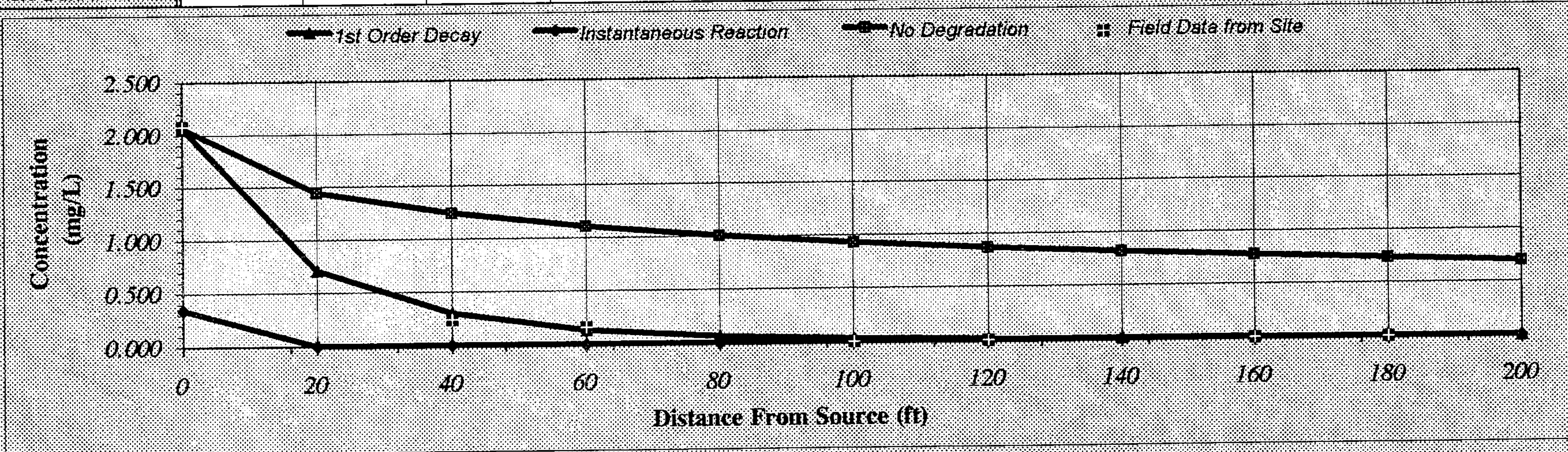
Recalculate This Sheet

Figure 6 Centerline Projection: Year 2021, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

Distance from Source (ft)

TYPE OF MODEL	0	20	40	60	80	100	120	140	160	180	200
No Degradation	2.062	1.442	1.237	1.103	1.005	0.930	0.870	0.819	0.775	0.735	0.697
1st Order Decay	2.062	0.712	0.301	0.133	0.060	0.027	0.013	0.006	0.003	0.001	0.001
Inst. Reaction	0.341	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	2.080		0.242	0.161		0.002					



Calculate Animation | Next Timestep | Prev Timestep

Time: 50 Years

Return to Input

Recalculate This Sheet

Figure 7, Centerline Projection: Year 2046, Jet Engine Test Cell RAP

BIOSCREEN Modeling Summary: Jet Engine Test Cell Site, NAS Cecil Field, Jacksonville, FL:

GROUNDWATER BTEX CONCENTRATIONS FOLLOWING SOURCE REMOVAL

BIOSCREEN modeling results indicate that source removal is necessary to expedite biodegradation of the existing plume. Source removal is proposed for the Jet Engine Test Cell site. This modeling step uses the 1996 groundwater concentrations in the source zone to estimate the time for biodegradation of the plume with the source area removed.

The following assumptions for modeling the plume behavior after source removal differ from those stated in the existing condition model:

- Downgradient groundwater concentrations are not considered in this modeling effort. Although this groundwater will remain contaminated following source removal, degradation of the lesser contaminated downgradient areas should occur at a rate equivalent to areas of higher contamination.
- The input of zero kilograms for soluble mass leads to a calculation error in the BIOSCREEN model. A negligible mass of contaminant was assumed for the soluble mass and is considered most representative of conditions following source removal.

INPUT PARAMETERS:

As stated above, a negligible Soluble Mass in NAPL, Soil of 0.1 kg was assumed (Figure 8).

The simulation time must also be changed as initial conditions are assumed to have changed. In this modeling step simulation time represents the time elapsed following source removal.

RESULTS:

Following source reduction, BIOSCREEN results indicate that biodegradation of the existing plume to concentrations below target levels may require up to 11 years based on first order decay (Figure 9). This would be a very conservative estimate as evidence of biological activity has been demonstrated. The Instantaneous Reaction model shows groundwater concentrations to have decreased below no further action levels prior to one quarter following source removal (Figure 10).

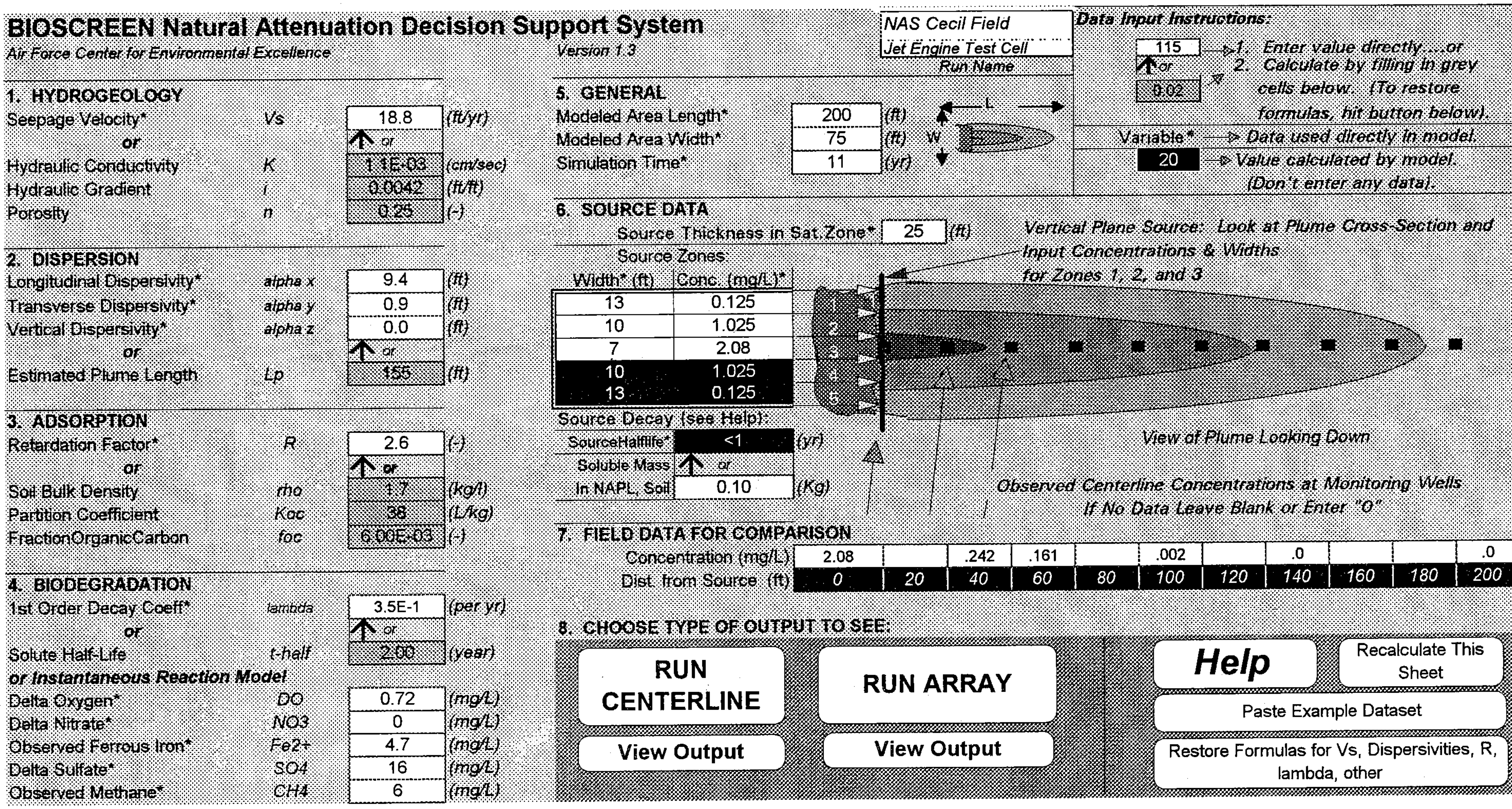
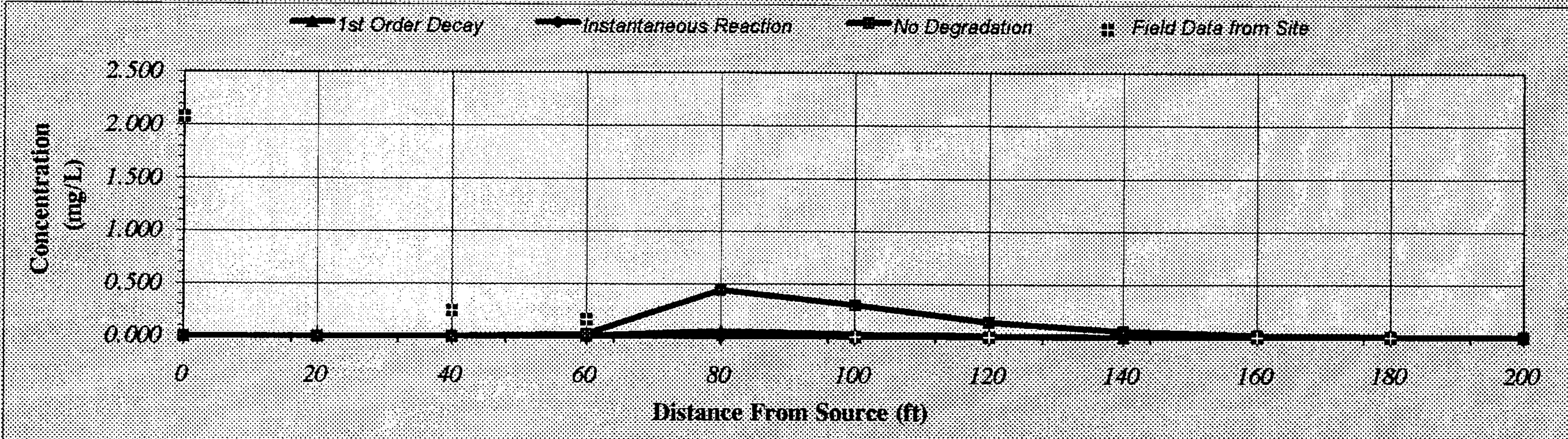


Figure 8; BIOSCREEN Calibration Input Screen with Source Removal, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.000	0.000	0.001	0.021	0.437	0.293	0.139	0.054	0.017	0.004	0.001
1st Order Decay	0.000	0.000	0.000	0.003	0.047	0.022	0.008	0.003	0.001	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	2.080		0.242	0.161		0.002					



Calculate Animation | Next Timestep | Prev Timestep

Time: 11 Years

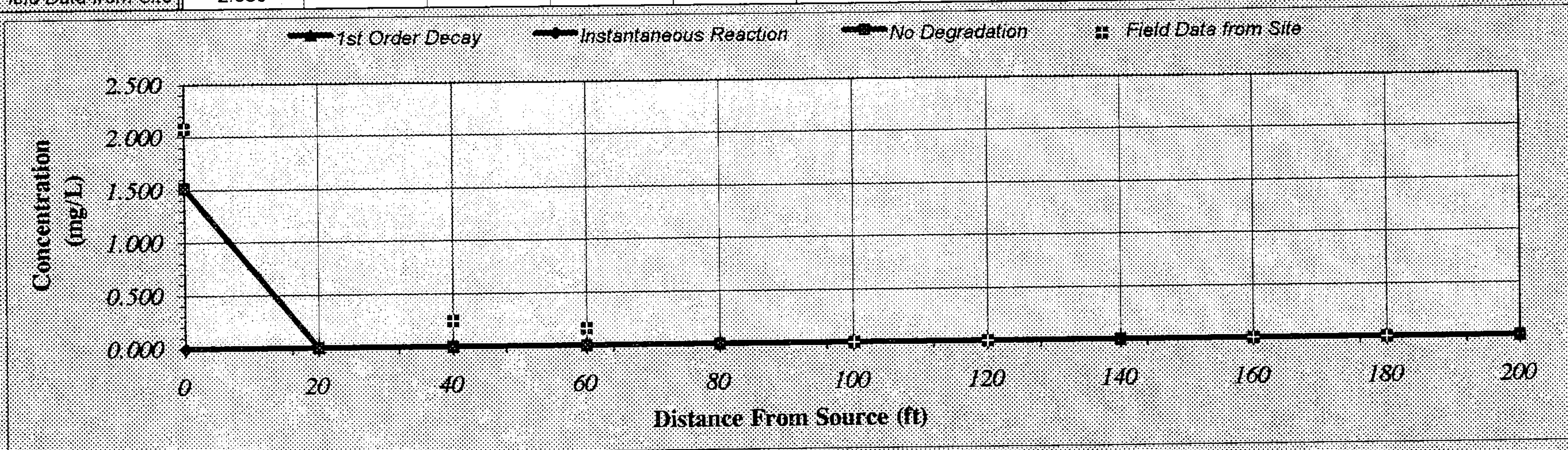
Return to Input

Recalculate This Sheet

Figure 9. BIOSCREEN Centerline with Zero Source Area, Year 2007, Jet Engine Test-Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	*Distance from Source (ft)* 0	20	40	60	80	100	120	140	160	180	200
No Degradation	1.513	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1st Order Decay	1.513	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	2.080		0.242	0.161		0.002					



Calculate Animation | Next Timestep | Prev Timestep

Time: *0.25 Years*

Return to Input | Recalculate This Sheet

Figure 10, BIOSCREEN Centerline with Zero Source Area, One Quarter Following Source Removal, Jet Engine Test Cell RAP

BIOSCREEN Modeling Summary: Jet Engine Test Cell Site, NAS Cecil Field, Jacksonville, FL:

CALIBRATION AND ATTENUATION OF NAPHTHALENE:

BIOSCREEN is not designed to model the biological degradation of naphthalene, however, napthalene will undergo both aerobic and anaerobic decay. By adjusting the input data set, this modeling step attempted to calibrate the BIOSCREEN model for naphthalene and estimate the time for napthalene degradation.

Those assumptions made during the model calibration of the BTEX plume were applied for the naphthalene calibration model. Assumptions made during source removal and BTEX degradation were also applied during the modeling of naphthalene degradation following source removal.

INPUT PARAMETERS:

The following input parameters were adjusted to match the modeled contaminant in the calibration model for naphthalene (Figure 11):

- The estimated plume length was changed to 145 feet using Figure 3-6.
- The partition coefficient was changed to 550 for naphthalene.
- Source data groundwater concentrations were changed to match Figure 3-6.
- The soluble mass remains infinite over the 25 year calibration period.

These input parameters were changed to model naphthalene degradation following source removal, however an illustration of this input dataset is not provided:

- For the naphthalene centerline calibration with source removal the simulation time was changed to 8 years to model the plume degradation following source removal.
- The soluble mass term was considered negligible following source removal. A value of 1 kg was used to avoid calculation errors.

RESULTS:

For the naphthalene calibration model, the naphthalene centerline distribution is underestimated by the model (Figure 12). The concentration of naphthalene remains near source area concentrations up to 40 feet downgradient of the source. This may be caused by the numerous releases and the extent of free product contamination. By offsetting either the First Order Decay or the Instantaneous Reaction model 40 feet downgradient of the source, a good correlation may be obtained for the degradation of the downgradient portions of the plume.

Assuming first order decay, the centerline projection following source removal shows that napthalene concentrations in the source zone will be below no further action levels eight years following source removal (Figure 13). This estimate, as with the 11 year estimate for the degradation of total BTEX, is very conservative.

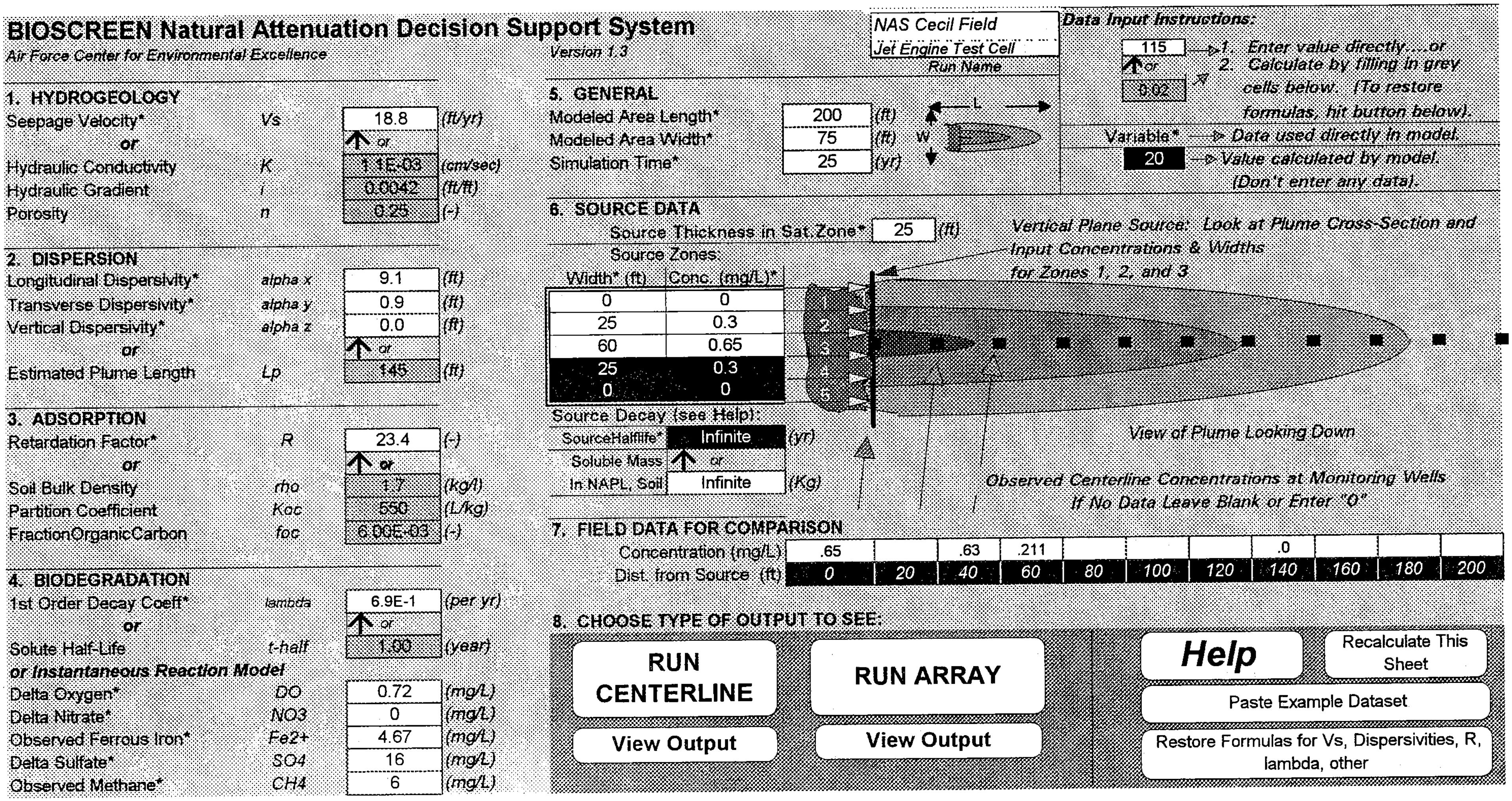
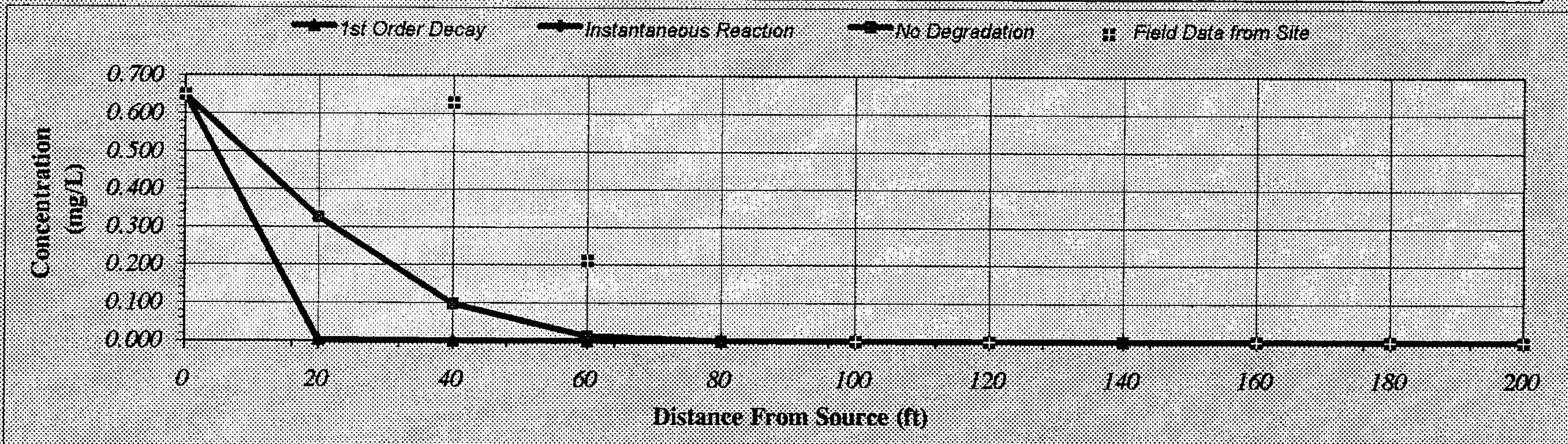


Figure 11; BIOSCREEN Calibration Input Screen for Naphthalene, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	*Distance from Source (ft)* 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.650	0.325	0.096	0.012	0.001	0.000	0.000	0.000	0.000	0.000	0.000
1st Order Decay	0.650	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.650	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.650		0.630	0.211							



Calculate Animation | Next Timestep | Prev Timestep

Time: *25 Years*

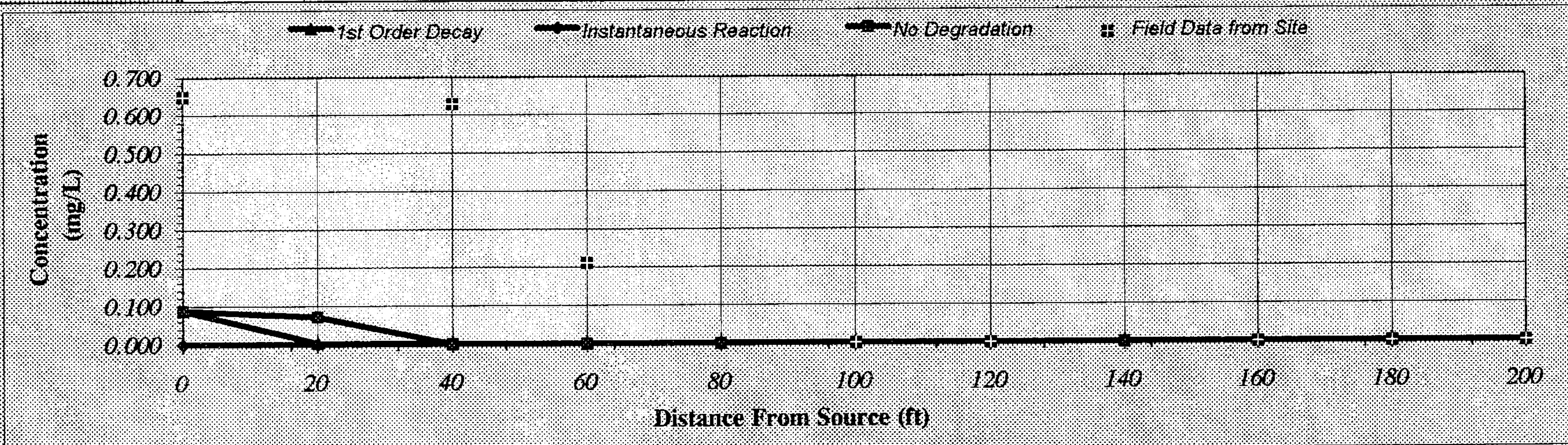
Return to Input

Recalculate This Sheet

Figure 12, Centerline Calibration for Naphthalene, Jet Engine Test Cell RAP

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	20	40	60	80	100	120	140	160	180	200
No Degradation	0.087	0.070	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1st Order Decay	0.087	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.650		0.630	0.211							



Calculate Animation Next Timestep Prev Timestep

Time: *8 Years*

Return to Input

Recalculate This Sheet

Figure 13, Centerline Calibration for Naphthalene with Source Removal, Year 2004 Jet Engine Test Cell RAP

<u>REFERENCES</u>

Howard, P.H., R.S. Boethling, et. al., 1991, Handbook of Environmental Degradation Rates, Chelsea, Michigan: Lewis Publishers.

Montgomery, J.H.,L.M. Welkom, 1989, Groundwater Chemicals Desk Reference, Chelsea, Michigan: Lewis Publishers.

Montgomery, J.H., 1991, Groundwater Chemicals Desk Reference, Vol. 2, Chelsea, Michigan: Lewis Publishers.

United States Environmental Protection Agency (USEPA), 1996, BIOSCREEN Natural Attenuation Decision Support System, User's Manual, Version 1.3, National Risk Management Research Laboratory, Office of Research and Development, USEPA, Cincinnati, Ohio,June.

APPENDIX D

BASIS OF DESIGN

BASIS OF DESIGN
Jet Engine Test Cell RAP
NAS Cecil Field, Florida

The purpose of the RAP is to present a plan for remediation of petroleum contamination at the Jet Engine Test Cell site in accordance with the requirements of Chapter 62-770, Florida Administrative Code (FAC). The basis of the selected remedial alternative is site location and reuse. Major components in the implementation of the RAP include free-product removal and source zone reduction (Phase I) followed by the natural attenuation of the remaining surficial, petroleum-contaminated groundwater (Phase II).

Remedial Alternative Considerations:

The thin layer of free product has been identified in the vicinity of the tank containment area with an estimated in situ thickness of about 3 inches. This free product represents a significant mass of hydrocarbon to be remediated. Because of the nature of the soils and the relatively thin layer of free product at the site, free product recovery efforts would likely have limited success. To achieve a more complete source reduction, direct excavation of the free product area is recommended.

The Jet Engine Test Cell site is located in an industrial area and industrial reuse following base closure is expected. There are no known receptors at the Jet Engine Test Cell and contaminant migration is projected to be minimal. Based on this information and the results of natural attenuation monitoring at the site, natural attenuation is the preferred alternative at the Jet Engine Test Cell.

Phase I:

Phase I will consist of excavation in the area of known free product contamination. Excavation to a depth of approximately 8 feet below land surface is estimated to remove about 90 percent of the source material at the Jet Engine Test Cell site. Excavation to this depth will involve the removal of soils below the natural groundwater table. Free product infiltration into the open excavation is not expected, but provisions will be made for free product removal and disposal. The total volume of soil to be excavated is 1,568 cubic yards (approximately 2,200 tons). This soil will be thermally treated offsite as outlined in Chapter 62-775 FAC.

The excavation shall have sides sloped or shored in accordance with applicable standards to prevent unstable conditions during excavation that could pose hazards to personnel or surrounding structures and pavements. Stormwater and dust controls will also be implemented. The location of all subsurface utilities shall be field verified prior to subsurface disturbance.

Contaminated soil outside of the tank containment area will remain in place following the excavation in Phase I. These soils will be addressed during Phase II of the remedial action.

It is estimated that approximately 2 weeks would be necessary for site mobilization and site staging for Phase I. Pre-treatment samples can be collected during this time period to allow time for laboratory analysis. Approximately 1 working week (5 days) will be required to complete field activities for this phase.

Phase II:

Phase II of this RAP will consist of natural attenuation of the remaining groundwater and soils. During this time period a monitoring program shall be implemented to assure that the selected remedial alternatives meeting remedial action requirements as outlined in Chapter 62-770 FAC. Sampling will be conducted quarterly for the first year and semi-annually for additional years to verify that the contaminant mass and mobility are effectively being reduced.

Model results indicate that natural attenuation will take between 3 months and 11 years to reduce petroleum contaminants below regulatory requirements. ABB-ES estimates that a more realistic clean-up time will be between 2 and 5 years.

Future Activities

Remaining contaminated soil within the tank containment area not directly addressed in this RAP is associated with two underground storage tanks (USTs) scheduled to remain in service following the remedial action. The presence of free and entrained product in the tank beds is likely. Final decommissioning and tank removal at the Jet Engine Test Cell is scheduled for 1999. At that time, excavation should continue to a depth of approximately 8 feet (1 foot below the mean low water table) to remove the remaining source area, if the presence of product or tank leakage is evident. Until this time, an impermeable liner will be placed between the remaining USTs upgradient of the clean backfill used for the area of excavation considered in this RAP.

APPENDIX E

REMEDIAL ACTION PLAN CHECKLIST

REMEDIAL ACTION PLAN CHECKLIST

Bureau of Waste Cleanup
Florida Department of Environmental Protection

Facility Name: NAS Cecil Field **Reimbursement Site:** [ ]

Location: Jacksonville, Florida **State Contract Site:** [ ]

FAC ID No.: ____________

Reviewer: ____________ **Date:** ____________ **Consultant:** ABB Environmental Services

Date of CAR Approval: December 19, 1994

This checklist should not be applied in blanket fashion. Technical judgement may be necessary in determining the applicability of some items. However, all information listed that is relevant to the remedial design should be provided.

PAGE(S) I. GENERAL

12-1 (1) RAP signed, sealed, and dated by Florida P.E. (per FS 471.025)

NA (2) indication whether proposed plan is for reimbursement program or state contracted cleanup

4-1 (3) recap of CAR information and conclusions pertinent to RAP preparation

3-2,3-11-3-13 a) horizontal and vertical extent of contamination in soil and groundwater

APP. C b) volumes of affected soil and groundwater;

APP. C c) estimated mass of contaminants in soil and groundwater.

3-6 d) depth to water table

3-6, APP C e) groundwater flow direction and gradient

8-1 f) hydraulic conductivity of aquifer and method of determination

APP C g) transmissivity of aquifer and method of determination

4-1 h) confining layer location

4-1 i) lithology of site

3-8 & 3-9 (4) current sampling results (within six (6) months) used for remediation system design

1-1 (5) latest date underground storage tanks and product lines have tested tight

2-3 (6) potable water considerations

2-3 a) method of potable water supply to area

2-3 b) location of private wells in 1/4-mile, and public wells in 1/2-mile radius of site

NA c) indication whether FDEP district office drinking water program was notified if contaminant groundwater could be expected to reach any public or private water well. Method of notification, person notified, and date.

2-1 (7) underground utilities which may enhance contaminant transport shown

8-15 (8) cleanup time

8-15 a) estimated time of cleanup: groundwater; soil

8-12 b) method used to determine cleanup time

NA (9) fencing treatment area required, unless public access is restricted by institutional controls

NA (10) discussion of required maintenance for proposed equipment, including site visit frequency and special O&M considerations

7-1 (11) all local, state, and federal permits obtained and conditions stated

SEP CVR (12) itemized cost estimate for project: capital, operation, maintenance, sampling, and closure

NA (13) feasibility of leasing equipment considered (cost cannot exceed purchase price)

6-1-6-9 (14) alternative analysis or discussion of other alternatives considered

NA (15) cost effective analysis provided if design is innovative

NA (16) statement that signed and sealed as-built drawings to be provided

NA (17) nuisance noise and odor to neighbors avoided by careful location of equipment items and exhaust stacks or other mitigating measures

II. REMOVAL AND/OR REPLACEMENT (R/R) OF PETROLEUM STORAGE SYSTEMS: Technical and Reimbursement Considerations

(1) General

NA a) indication whether R/R will be claimed as reimbursable expense

NA b) acknowledgement that R/R reimbursement is exclusive of hardware

NA c) acknowledgement that any relocation and facility renovation activities during R/R are not reimbursable

NA d) if dewatering involved during R/R, then documentation provided regarding proper disposal, or verification that water not contaminated

7-1, APP C e) indication of quantity and location of soil removed, or to be removed, from below the static water table

(2) PRIOR TO JULY 1, 1992: R/R reimbursement justification based on association of contamination with the tank (or tank pit)

8-11 a) verification of petroleum storage system as potential contamination source by either verified leak, apparent leak, or overlapping when soil and/or groundwater contamination plumes superimposed on a site map showing tank bed

1-1, 7-5 b) indication of whether R/R has already been done, or to be done after RAP approval

NA c) proper disposal of water, soil, and sludge from the R/R

7-2 d) scaled site map including:

(1) identification and location of all storage system components to be R/R
(2) boundaries and dimensions of excavation

Yes or No e) FDEP reviewing engineer: Agree that tanks which were subject of R/R were associated with the contamination? If disagree, then include statement in RAP Approval Order, even if tanks already removed

(3) **ON OR AFTER JULY 1, 1992:** R/R reimbursement is based on pertinence of tank removal to the achievement of cleanup criteria set for in 62-770, F.A.C.

7-5 a) R/R justified as meaningful and necessary for achievement of 62-770 FAC cleanup criteria

NA b) if R/R is part of a RAP Modification, then show cost-effectiveness in comparison to other alternatives and no action

NA c) if R/R was done during IRA, then discussion of necessity of R/R in order to remove contaminated soil and/or free product

NA d) if R/R is associated with a MO or NFA, then show that the removal of soil, product, and groundwater contributes or contributed to achieving MO or NFA criteria

Yes or No e) FDEP reviewing engineer: Agree that R/R contributed (or will contribute) in a meaningful way to site cleanup? If disagree, then include statement in RAP Approval Order even if tanks already removed

III. FREE PRODUCT REMOVAL

3-7 (1) free product plume identification

/-4 (2) description of free product recovery system

NA (3) oil/water separator sizing calculations and detention time

NA (4) free product storage tank of adequate size for reasonable maintenance

NA (5) automated product pump shutdown for high level in product tank

NA (6) disposition free product after its recovery

IV. SOIL REMEDIATION - GENERAL

7-1, APP C (1) volumes of all contaminated and excessively contaminated soils

NA (2) recap of IRA activities and soil volume already excavated

8-10 (3) effect of soil leachate from non-excessively contaminated soils on groundwater contaminant levels evaluated

8-10 (4) indication that excessively contaminated soils (per soil guidance manual) will be remediated, or rationale for "no action" alternative for soil remediation provided

6-9 (5) disposition of excavated, contaminated soils

6-9 (6) indication that hazardous soils (e.g., ignitable, corrosive, reactive, toxic, or petroleum refining waste) will be disposed of properly

V. LAND FARMING OF SOIL

NA (1) adequate surface area available (________ sq ft) to spread soils 6 to 12 inches thick

IA (2) location of landfarming operation

NA (3) landfarming area is flat (less than 5% slope)

NA (4) impermeable base provided. Type:

NA (5) surface water runoff controls provided

NA (6) groundwater monitoring plan proposed if landfarm is outside of immediate contamination area

NA (7) frequency of tilling provided

NA (8) frequency and details of nutrient application or other enhancements provided (if proposed)

NA (9) soil sampling frequency and sampling methods provided

NA (10) potential for land farm causing nuisance conditions evaluated

NA (11) underlying soil and groundwater monitoring procedures provided and acceptable

NA (12) landfarming will be continued until the TRPH concentration is 10 ppm or less (by EPA Method 9073) and the BTEX concentration is less than 100 ppb (by EPA method 5030/8020); or TRPH concentration is 50 ppm or less, and PAH concentration is 1 ppm or less, and VOH concentration is 50 ppb or less. Alternate TRPH standard may be considered if appropriate and acceptable means of soil disposal is identified.

NA (13) cost-effectiveness evaluated

NA (14) ultimate disposition of soils discussed

NA (15) need to fence landfarm area considered

VI. LANDFILLING OF SOILS

NA (1) landfill lined permitted by FDEP

NA (2) name and location of landfill provided along with conditions of acceptance

NA (3) cost-effectiveness considerations

VII. SOIL THERMAL TREATMENT

NA (1) name and location of thermal treatment facility provided

NA (2) facility is permitted for thermal treatment of petroleum contaminated soils

7-1 (3) indication of whether pretreatment soil samples will be collected at site or at thermal treatment facility

6-9 (4) cost-effectiveness evaluation

VIII. COMMERCIAL BIOREMEDIATION OF SOIL

NA (1) name and location of bioremediation facility provided

NA (2) facility is permitted for bioremediation of petroleum contaminated soils

NA (3) indication of whether pretreatment soil samples will be collected at site or at bioremediation facility

NA (4) cost-effectiveness evaluation

IX. IN SITU BIOVENTING OF SOIL

NA (1) soil cleanup criteria identification

NA (2) estimated mass of contaminants in the vadose

NA (3) pilot test determination of: a) soil temperature, permeability, pH, moisture, b) nutrient requirements; c) presence of suitable indigenous microbes; and d) oxygen requirement (usually as pounds of air to pound of hydrocarbon degraded)

NA (4) layout: a) location of air injection and air extraction and wells with respect to contaminated soil plume location and depth; b) location and depth of soil gas monitoring probes with respect to contaminated soil plume and the air injection and extraction wells.

NA (5) mechanical details, equipment sizing calculations, and operating parameters: a) well type - vertical or horizontal; b) well construction details; c) indication whether soil vacuum pump will be used alone (with induced influx of air from unsealed surface acting as oxygen source) or accompanied by air injection pump as oxygen source; d) vacuum pump/blower specifications and horsepower; e) method and design details of moisture addition if site soils are dry; e) method and design details of nutrient delivery system, if necessary

NA (6) estimated cleanup time

NA (7) instruments, controls, gauges, and valves: a) subsurface soil gas monitoring probes; b) pressure gauges; c) shutoff/throttling valves; d) nutrient and moisture addition control devices and meters

NA (8) monitoring plan: CO_2; pertinent bioremediation parameters; contaminants of concern.

NA (9) air emissions: a) generally, no air emissions treatment necessary because vapor flow rates are so low and biodegradation of petroleum results in production of CO_2 and water; b) evaluation of need for offgas treatment if pilot test indicated that a significant amount of coincidental hydrocarbon volatization occurs.

X. SOIL VACUUM EXTRACTION

NA (1) Prerequisites

NA a) relatively permeable soil

NA b) depth to groundwater > 3 ft

NA c) relatively volatile contaminants

(2) Pilot study (results of onsite testing, unless pilot study approaches size of full-scale system)

6-1 a) pilot test components designed and located for cost-effective subsequent integration into full-scale design

NA b) diagram of pilot layout indicating location of vapor extraction well, and radial distance of monitoring wells from the vapor extraction well

NA c) air flow, cfm

NA d) radius of influence, ft; vacuum (inches of water) at limit of radius of influence

NA e) water elevations at monitoring wells to assess groundwater mounding; observed mound, inches

NA f) vacuum readings at monitoring wells and at various radial distances from extraction well to aid in full-scale design

NA g) measurement of offgas contaminant concentrations for the purpose of selecting and sizing cost-effective offgas treatment for full-scale system

6-1 h) determination of soil's permeability (Rule of thumb): permeability should be greater than 10^{-9} sq cm)

(3) Full-scale design

NA a) location(s) and radius of influence, ft; overlapping radii for adequate coverage of excessively contaminated soil plume

NA b) vapor extraction well(s) construction details

NA 1) no. of wells; cfm ea well; total cfm; well type (vertical or horizontal); well diameter; well depth; water table (ft bls); screen slot size; screened interval (ft bls); well sealed w/bentonite or non-shrinking grout at screen design depth to prevent short-circuiting.

NA 2) screen location close to water table to optimize collection of vapors across vadose depth but not so close as to collect excessive water

NA c) operating vacuum @ wellhead(s), inches water

1) calculation of piping system friction losses

2) calculation of vacuum pump motor hp based on system losses plus required vacuum at wellhead

NA d) vacuum source type; regenerative blower; positive displacement vacuum pump; other

NA 1) design: cfm @ inches water; operating cfm @ inches water

NA 2) mfgr; model; motor hp; rpm; performance curves; hp calculations or curves

NA 3) nonferrous materials of construction and/or assembly to minimize potential for sparking and friction

NA 4) explosion proof motor specified

NA e) moisture separator/condensation trap ("knock out pot") prior to inlet of vacuum pump

NA f) surface sealing provided for vacuum extraction, or existing concrete or asphalt adequate

NA g) safety:

NA 1) system operation at approximately 25% of Lower Explosive Limit (LEL)

NA 2) bleed valve to control flammable vapor concentrations

NA h) instrumentation, gauges, and appurtenances:

NA 1) vacuum gauges at each well; temperature gauges (@ vacuum pump and/or exhaust gas stack)

NA 2) sample ports for influent from each well, and for the offgas from the treatment unit

NA 3) air flow control: shout/throttling valve at each well; other air flow control device or method

NA 4) high level switch in knock out pot to either shut down vacuum pump or drain the pot (w/proper disposal of the contaminated water)

NA i) air emissions (general):

NA 1) expected concentrations and quantities of any contaminants discharged to air

NA 2) method of cost-effective offgas treatment to be provided during first two months of system operation (Provide details in Section XI or XII for carbon adsorption or thermal oxidation of offgas, or details of any alternate method proposed)

NA j) system monitoring proposal provided:

NA 1) air emissions to be sampled and analyzed monthly per Department guidance

NA 2) soil cleanup criteria provided

NA 3) provision for monitoring wells to serve as vacuum measurement locations (at various radial distances from extraction wells), or other provisions for verification of proper operation

XI. VAPOR-PHASE CARBON ADSORPTION (for control of air emissions)

NA (1) Cost-effectiveness evaluation in comparison to other alternatives.

NA (2) Mechanical details, sizing calculations, and operating parameters: a) gas flow rate; b) gas temperature; c) effect of moisture level on adsorption; d) identification of contaminants; e) contaminant concentrations; f) retention (expressed as a percent or pounds of contaminant adsorbed per pound of carbon); g) carbon usage rate; h) configuration of carbon vessels in series; i) pressure drop; j) pressure relief valve for carbon vessels; k) proper disposal/regeneration and replacement of spent carbon.

NA (3) Instrumentation, controls, gauges, and valves: a) high pressure shutdown switch and pressure relief valve; b) pressure gauges; c) temperature gauges; d) sampling ports

NA (4) Safety: a) evaluation of need to isolate carbon units from other equipment items in the process train by an in-line flame arrestor; b) identification of the Lower Explosive Limit (LEL) for contaminants; c) observance of appropriate requirements in Series 500 articles of the National Electrical Code - equipment shall meet either Class I, Group D, Division 1 or Class I, Group D, Division 2 hazardous area requirements, whichever is applicable when an equipment item is located in a hazardous area as defined by the code.

XII. THERMAL/CATALYTIC OXIDATION (for control of air emissions)

NA (1) Cost-effectiveness evaluation in comparison to other alternatives.

NA (2) Mechanical details, equipment sizing calculations, and operating parameters: a) type - thermal or catalytic; b) combustion air flow rate; c) supplemental fuel type - propane or natural gas; d) temperature and retention time; e) stack height; f) stack diameter.

NA (3) Instrumentation, controls, gauges, and valves: Schematic or mobile unit manufacturer's drawings indicating instrumentation, controls, gauges, and valves for all process streams (contaminant-laden influent, fuel gas, and combustion air).

NA (4) Safety considerations include but are not limited to: a) bleed valve or dilution control valve to maintain influent flammable vapor concentration at 25% of the Lower Explosive Limit (LEL); b) evaluation of whether a flame arrestor should be installed in the pipeline between thermal oxidation unit and a soil vapor vacuum extraction pump which feeds the oxidizer; c) air purge prior to re-ignition; d) observance of appropriate requirements in Series 500 articles of the National Electrical Code - equipment shall meet either Class I, Group D, Division 1 or Class I, Group D, Division 2 hazardous area requirements, whichever is applicable when an equipment item is located in a hazardous area as defined by the code; and e) use of thermal or catalytic oxidizers which meet appropriate fire codes for handling natural or propane gas and prevention of furnace explosions - National Fire Protection Association, Industrial Risk Insurer's, Factory Mutual, etc. Some of the most important safety shutdowns for gas-fired burners occur upon: high gas pressure; low gas pressure; loss of combustion supply air; loss of failure to establish flame; loss of control system actuating energy; and power failure.

XIII. GROUNDWATER EXTRACTION

NA (1) feasibility of using existing on-site wells for groundwater extraction considered

NA (2) a) recovery well or trench location(s) and construction details included

b) recovery well depth appropriate for depth of contamination reported in CAR. The recovery well depth should optimize petroleum mass recovery relative to groundwater recovery.

NA c) well diameter

NA ___ d) screening interval appropriate

NA ___ (3) predicted horizontal and vertical area of influence with hydraulic gradient provided

NA ___ (4) expected drawdown in recovery well or trench (_____ft)

NA ___ (5) consideration of multiple well configurations to minimize drawdown

NA ___ (6) groundwater pump(s) description , pump characteristic curve, design flowrate (____gpm at ____ft TDH provided) mfgr; model; motor hp

NA ___ a) hydraulic design (including friction losses and suction lift considerations acceptable

NA ___ (7) automated well level controls provided for stopping/starting groundwater pump(s)

NA ___ (8) totalizing flowmeter installed on influent line from each groundwater recovery pump

NA ___ (9) check valve provided on pump discharge piping if not integral to pump

NA ___ (10) shutoff/throttling valve provided on pump discharge piping

XIV. GROUNDWATER TREATMENT SYSTEM - GENERAL

NA ___ (1) expected or calculated influent concentrations acceptable (based upon pumping test dynamic sample, weighted averaging procedure, or other reasonable assumptions)

NA ___ a) summary of the expected influent concentrations: benzene________; toluene______; ethylbenzene________

xylene________; MTBE_______; total naphthalenes_______

PAHs ________; EDB________; 1-2 dichloroethane_______

others ____

NA ___ (2) feasibility of discharge to sewage treatment plant evaluated

NA ___ a) consideration given to less time and/or level of treatment required to meet sewage system pretreatment standards

NA ___ (3) site piping plan, and schematics of all treatment components, piping valves, controls and appurtenances provided

NA ___ a) influent and effluent sampling ports provided

NA ___ b) piping type and size provided

NA ___ (4) Iron fouling: a) groundwater analyses: total ____ppm; dissolved____ppm; and b) consideration whether iron fouling should be controlled by filtration of influent to remove particulately-bound iron, and/or by removal or sequestering of dissolved iron to prevent precipitation in process equipment items.

(Generally, "normal" concentration of dissolved iron in water is approx. 0.1 to 0.3 ppm, and unless the pH of the water falls below 5, it rarely exceeds 1 ppm.)

NA ___ (5) Calcium carbonate: Consideration whether pretreatment or other measures necessary to prevent fouling by calcium carbonate (Langalier Index calculation based on groundwater samples may aid in this consideration)

NA ___ (6) need for pretreatment or O&M for biofouling considered

XV. AIR STRIPPING TREATMENT PROCESS

NA ___ (1) Packed Tower:

NA ___ a) type, size, and surface area of packing

NA ___ b) calculations, criteria, design parameters

tower height ; tower diameter
packing height ; water flow rate

air flow rate ; blower hp

air/water ratio ; pressure drop across packing

NA c) pressure gauge to indicate effects of fouling over time

NA d) mist eliminator

NA e) observation port

NA f) O&M considerations (fouling potential)

NA (2) Diffused Aerator (tank type):

a) calculations, parameters (tank volume; contact time, air flowrate, pressure drop, contaminant removal efficiency) and design assumptions

NA (3) Low Profile Air Stripper

NA a) Number of trays; water flow rate; air flow rate; air/water ratio; pressure drop; blower horsepower; mist eliminator;

NA (4) General:

NA a) maximum ambient air impact calculations; emissions stack height

NA b) equipment description if emissions treatment necessary

NA c) automated recovery well shutdown when blower failure occurs

NA d) daily analysis screening with portable GC, or other appropriate measures, during system startup until system consistently meets discharge criteria

XVI. LIQUID-PHASED CARBON ADSORPTION

NA (1) indication whether adsorption is for primary treatment of groundwater or polishing of effluent

NA (2) carbon specifications

NA (3) carbon unit(s) sizing calculations (carbon usage rate, contact time, pressure losses) /design assumptions

NA (4) isotherm data from pilot study needed if carbon adsorption used as primary treatment and total VOA concentrations are appreciable (VOA > 100 ppb typically) in order to estimate carbon capacity required and sampling frequency

NA (5) TOC in groundwater determined and effect on carbon usage considerations

NA (6) need for sand filter or cartridge unit considered prior to carbon unit

NA (7) pressure gauge and pressure relief valve provided on carbon (and sand) filter

NA (8) carbon disposal and replacement method

NA (9) series configuration of carbon units considered to allow for maximum carbon utilization and prevention of contaminant breakthrough to system effluent

NA (10) automated recovery well shutdown if primary carbon unit pressure too high

NA (11) schedule for sampling between and after carbon adsorption units

XVII. IN SITU AIR SPARGING OF GROUNDWATER

NA (1) Prerequisites:

NA a) No or little free product which could spread via sparge turbulence, or prolong sparging

NA b) Volatile (C3-C10) petroleum fractions with Henry's Constant > = .00001 atm.m^3/mole (approx. rule of thumb, unless biosparging is proposed)

NA c) no high concentrations of metals (iron, magnesium) to form oxides which plug aquifer or well screens, or high concentrations of dissolved calcium, which could react with CO_2 in air to clog aquifer w/calcium carbonate

(Notes: Langelier Index calculation regarding equilibrium between calcium carbonate and dissolved CO_2 may be helpful. Generally, precipitation of dissolved iron is less likely when water is acidic, approx. of pH less than 6.)

(2) Pilot study results

NA (3 stage pilot study recommended prior to RAP design): vapor extraction only; sparging only; combined extraction and sparging

A pilot study is generally necessary, unless plume size is relatively small and aquifer characteristics favorable

NA a) pilot test components designed and located for cost-effective subsequent integration into full-scale design

NA b) diagram of pilot layout indicating locations of air injection well, vapor extraction well, and radial distance of monitoring wells from the air injection well

NA c) air flow rates for each stage: vapor extract, cfm; sparging, cfm; combined cfm

NA d) radius of influence for each stage: vapor extract, ft; sparging, ft; combined ft

NA e) groundwater mounding observed during each stage: vap extract, inches; sparging, inches; combined, inches

NA f) measurement of parameters which are pertinent to full-scale design at various radial distances from the air injection well (for example: vacuum readings, pressure readings, water elevations, dissolved oxygen, pH, and conductivity)

NA g) measurement of vapor extraction system offgas contaminant concentrations for the purpose of selecting and sizing cost-effective offgas treatment for full-scale system

NA h) determination of soil's permeability. (should be greater than 10^{-9} sq cm for sparging to be feasible)

NA i) need for groundwater recovery for plume control evaluated.

(3) Full-scale design

NA a) groundwater contamination plume coverage:

NA 1) location(s) and radius of influence for full-scale air injection well(s); Adequate coverage by overlapping radii of influence if multiple well system

NA b) air injection well(s): no. of wells; well design; operating air press at wellheads; cfm each well; total cfm ______

NA c) avoidance of long screen allowing air to diffuse at top portion only, where air flow resistance is least (typ screen is 1 to 3 ft lg)

NA d) well depth and screened interval (or depth of sparge tip) appropriate w/ respect to depth of contamination ______

NA e) vapor extraction well(s) in conjunction w/sparging situated properly to recover volatiles and prevent their release to atmosphere:

NA 1) injection cfm of air typically 20 to 80 % of vapor extraction cfm. (0.2 to 0.8)

NA 2) automatic shutdown of air injection upon loss or low vapor extraction system vacuum, or failure of vacuum pump motor, in order to prevent air emissions

NA 3) adequate and cost-effective treatment of vapor extraction system offgas proposed to prevent air emissions

NA f) compressor:

design: cfm @ psig; operating cfm @ psig
compressor: type; mfgr; model; motor hp; rpm; performance curves;
air filter at compressor inlet; oil trap or oil-free compressor to avoid introducing more contamination to aquifer

NA g) safety: pressure relief valve at discharge of compressor and/or high pressure switch for automatic shutdown

NA h) instrumentation and gauges: pressure indicating gauges at each sparging well

NA i) air flow control: shutoff/throttling valve at each well; other flow control device or method

NA j) cost-effectiveness evaluation of proposed full-scale design includes cost of pilot study

XVIII. IN SITU/ENHANCED BIORECLAMATION

8-1-8-6 (1) groundwater parameters evaluation (pH, DO, TDS, N, P, Temp, TOC, and Alk, etc.)

9-1-9-5 (2) monitoring program discussion. TOC to be monitored

NA (3) additional oxygen source provision

NA (4) oxygen and nutrients method of application and application rate to contaminated area evaluated

NA (5) suitable soils present (non-clayey, good transport, low adsorption properties)

NA (6) bench scale and/or in situ pilot study proposal

XIX. LEAD REMOVAL

NA (1) discussion of area(s) where groundwater lead concentrations exceeds 15 ppb

NA (2) lead concentrations; unfiltered (___ppb); filtered (___ppb); background (___ppb);

NA (3) proposal for lead removal by filtration if unfiltered sample is greater than 15 ppb and filtered sample is less than 15 ppb

NA (4) method of lead removal, including pertinent design calculations

XX. INFILTRATION GALLERY

NA (1) field percolation test (preferably with double ring infiltrometer) provided if gallery base is located in the vadose zone

NA (2) infiltration gallery construction details and location (upgradient location if site layout allows)

NA (3) gallery calculations/assumptions with mounding analysis

NA (4) piezometer and cleanout pipe in gallery

NA (5) geotextile filter fabric to be installed around the above gallery

NA (6) discussion or modeling of gallery's effect on plume migration

XXI. INJECTION WELL

NA (1) discussion of injection zone and relevant lithology information

NA (2) injection well location and proposed construction details

NA (3) screening interval appropriate

NA (4) effluent discharge pump description, pump characteristic curve, and design flow rate (____gpm at ____ft TDH)

NA (5) carbon polishing unit (or equivalent)

NA (6) air release valve at highest point of effluent discharge piping

NA (7) injection rate (well hydraulics) calculations

NA (8) Underground Injection Control (UIC) permit conditions met

NA (9) evaluation of injection well's effect on potable wells and plume migration

XXII. ALTERNATE DISPOSAL METHODS

NA (1) cost-effectiveness comparison of alternatives (including general permit fee of $2,500 per year in the cost estimate for NPDES disposal, if it is one of the alternatives being compared)

NA (2) for surface water discharge:

NA a) conditions for NPDES general permit met

NA b) indication that notice of intent for NPDES permit will be submitted after RAP approval

NA (3) if applicable, consumptive use permit obtained from water management district

NA (4) approval from municipality for sewer discharge, and conditions and effluent standards to be met

NA (5) applicable permits for stormwater discharge

XXIII. SAMPLING REQUIREMENTS

9-1, 9-2 (1) designated monitoring wells and their sampling frequency:

upgradient_MW-2_______; downgradient_MW-27______; highest concentration__MW-28_____

NA (2) weekly sampling of influent from recovery well(s) and effluent at treatment system for first month, monthly sampling for first year

9-5 (3) filing of annual status reports acknowledgement

9-5 (4) water table contours and depth and extent of free product to be determined at monthly or quarterly sampling event

9-1 (5) sampling program includes appropriate contaminants/procedures as specified in 62-770.600

NA (6) periodic maintenance and site inspection limited to twice a month for first quarter, monthly thereafter, or justification for alternative frequency provided

NA: Not applicable.