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FINAL REMEDIAL ACTION PLAN SITE 1116 WITH TRANSMITTAL NAS PENSACOLA FL
8/29/2002
TETRA TECH

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August 29, 2002

Project Number N4130

Ms. Tracie Vaught
Remedial Project Manager
Technical Review/Federal Facilities
Florida Department of Environmental Protection
2600 Blair Stone Road
Mail Station 4535
Tallahassee, Florida 32399-2400

Reference: CLEAN Contract Number N62467-94-D-0888
Contract Task Order (CTO) Number 0211

Subject: Final Remedial Action Plan
Site 1116
Outlying Landing Field Bronson
Pensacola, Florida

Dear Ms. Vaught:

Tetra Tech NUS Inc. (TtNUS) is pleased to submit the Final Remedial Action Plan for Site 1116 at Outlying Landing Field Bronson, Pensacola, Florida for your review. This report has been prepared for the U.S. Navy Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) under CTO 0211, for the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract Number N62467-94-D-0888.

If you have any questions regarding the enclosed material, or if I can be of assistance in any way, please contact me at (850) 385-9899, or e-mail at walkerg@ttnus.com.

Sincerely,

(f.r.) Gerald Walker, P.G.
Project Manager

Enclosures

cc: Mr. B. Glover, SOUTHNAVEFACENGCOM
Mr. G. Campbell, NAS Pensacola
Ms. D. Wroblewski, TtNUS (cover letter only)
Mr. G. Roof, TtNUS
Mr. M. Perry, TtNUS (unbound copy)
Project Office File

Remedial Action Plan
for
Site 1116

Outlying Landing Field Bronson
Pensacola, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0211

August 2002

02JAX0185

REMEDIAL ACTION PLAN
FOR
SITE 1116

OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Foster Plaza 7
Pittsburgh, PA 15220-2745

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0211

AUGUST 2002

PREPARED UNDER THE SUPERVISION OF:

Gerald Walker

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TALLAHASSEE, FLORIDA

APPROVED FOR SUBMITTAL BY:

Debra M Wroblewski

DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

The professional opinions rendered in this decision document identified as Remedial Action Plan for Site 1116, Outlying Landing Field Bronson, Pensacola, Florida were developed in accordance with commonly accepted procedures consistent with applicable standards of practice. Decision documents were prepared under the supervision of the signing engineer and are based on information obtained from others. If conditions are determined to exist differently than those described in this document, then the undersigned professional engineer should be notified to evaluate the effects of any additional information on the project described in this document.

Gregory S. Roof, P.E.
Professional Engineering Number 50842
Tetra Tech NUS, Inc. Engineering Number 7988

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ACRONYMS

ASTM	American Society for Testing and Materials
bls	Below Land Surface
CAR	Contamination Assessment Report
COCs	Chemicals of Concern
DO	Dissolved Oxygen
EDB	Ethylene Dibromide
°F	Degrees Fahrenheit
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FL-PRO	Florida Petroleum Range Organics
ft	Feet/Foot
ft^2	Square Feet
ft/day	Feet per day
GCTLs	Groundwater Cleanup Target Levels
LTTD	Low Temperature Thermal Desorption
µg/L	Micrograms per Liter
MDES	Mobile Dual-Phase Extraction System
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MWR	Morale, Welfare, and Recreation
NAS	Naval Air Station
ND	Not Detected
NPWC	Navy Public Works Center
NS	Not Sampled
O&M	Operations and Maintenance
OLF	Outlying Landing Field
ORP	Oxygen Reduction Potential
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PAHs	Polynuclear Aromatic Hydrocarbons
ppm	Parts per Million
RAP	Remedial Action Plan
SARA	Site Assessment Report Addendum
SCTLs	Soil Cleanup Target Levels
SOUTHNAVFACENGCOM	Southern Division, Naval Facilities Engineering Command

ACRONYMS (Continued)

TRPH	Total Recoverable Petroleum Hydrocarbons
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
USTs	Underground Storage Tanks
VOCs	Volatile Organic Compounds
yd^3	Cubic Yards

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (TtNUS) has completed a Remedial Action Plan (RAP) for Site 1116 at the Outlying Landing Field (OLF) Bronson, Pensacola, Florida, in accordance with the requirements of Chapter 62-770, Florida Administrative Code (FAC). This plan is being submitted to the Florida Department of Environmental Protection (FDEP) for approval.

TtNUS performed the following tasks during the RAP:

- Reviewed the Contamination Assessment Report (CAR) [Navy Public Works Center (NPWC), 1997], Site Assessment Report Addendum (SARA) (Ttnus, 2001), and SARA II (TtNUS, 2002).

- Evaluated remedial alternatives to address the soil and free product contamination.

- Prepared a RAP to remediate the contaminated soil, remove free product, and provide remedial equipment specifications.

- Specified a sampling plan to track the remediation status of the site.

The remedial action goals of this RAP are 1) identify a method to perform free product recovery in the source area, and 2) select a remedial alternative to reduce hydrocarbon constituents within the soil matrix. This RAP identified soil excavation and disposal as the selected alternative for remedial action at Site 1116. The remedial alternative was selected because it was determined to be the most effective method for the removal of free product and remediation of soil impacted by Bunker C fuel oil. If implemented, it is expected to require approximately three to six months to mobilize and remove soil above soil cleanup target levels (SCTLs). Post remedial action activities specified in Chapter 62-770, FAC will require a minimum of 12 months of groundwater monitoring.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This RAP was prepared by TtNUS for the United States Navy Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) under Contract Task Order 0211, for the Comprehensive Long-term Environmental Action Navy, Contract Number N62467-94-D-0888. The RAP was prepared to recommend treatment options for the contaminated soil and free phase hydrocarbons (free product) present at OLF Bronson, Site 1116, Pensacola, Florida as a result of a release of Bunker C fuel at the site.

In March 1997, a CAR for OLF Bronson, Site 1116, Pensacola, Florida was submitted by Naval Air Station (NAS) Pensacola NPWC to FDEP for review. TtNUS completed a SARA for the site on March 14, 2001, and an additional SARA (SARA II) was completed by TtNUS and submitted to FDEP on February 8, 2002. Following the submission of the TtNUS SARA II, the FDEP requested the preparation and submittal of a RAP to address Bunker C Fuel oil released at Site 1116.

The purpose of this RAP is to evaluate remedial alternatives and select one to address impacted soil and free product in accordance with the requirements of the letter from the FDEP. This RAP will evaluate alternatives to protect human health and the environment, reduce hydrocarbon constituent concentrations within impacted soil and groundwater, and retard further migration of hydrocarbon constituents to downgradient areas. The RAP will also provide a conceptual design for the selected remedial alternative.

1.2 SITE DESCRIPTION

Site 1116 is located within the confines of OLF Bronson. OLF Bronson is located in northwest Florida on the east side of Perdido Bay approximately five miles west of Pensacola, Florida and approximately one mile from the Alabama state line. Located on OLF Bronson are four abandoned airstrips and the remains of old support buildings for the airfield. OLF Bronson is now known as the Blue Angel Recreation Park and is used for recreation purposes (NPWC, 1997). Figure 1-1 and Figure 1-2 illustrate the site location and site vicinity, respectively.

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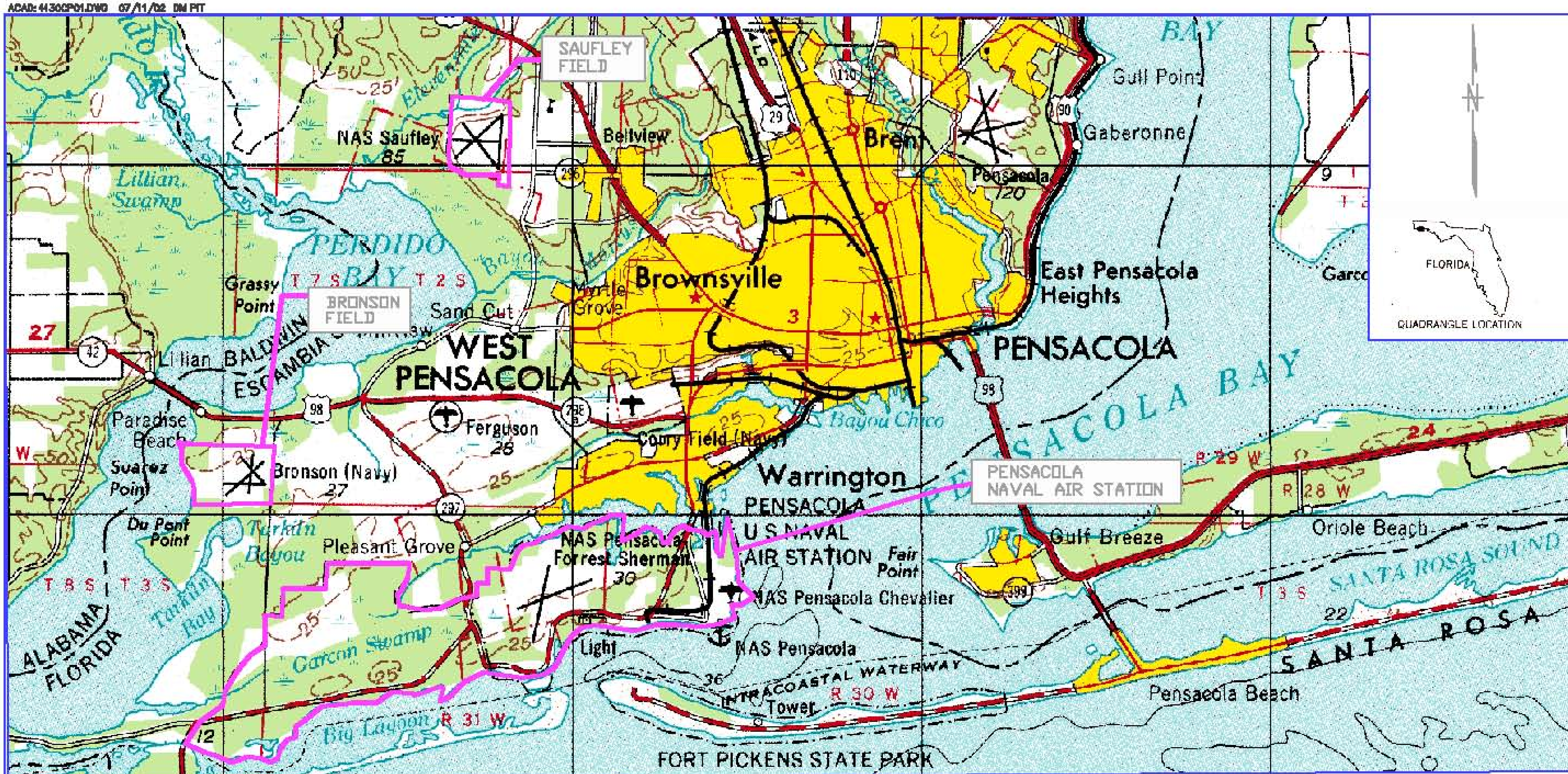

SOURCE: USGS TOPOGRAPHIC QUADRANGLE
PENSACOLA, FLORIDA-ALABAMA (1967 EDITION)

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SCALE IN FEET

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DRAWN BY DM / DATE 7/11/02		SITE LOCATION MAP REMEDIAL ACTION PLAN UST SITE NO. 1116 OUTLYING LANDING FIELD BRONSON PENSACOLA, FLORIDA	CONTRACT NO. 4130
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COST/SCHED-AREA			APPROVED BY / DATE
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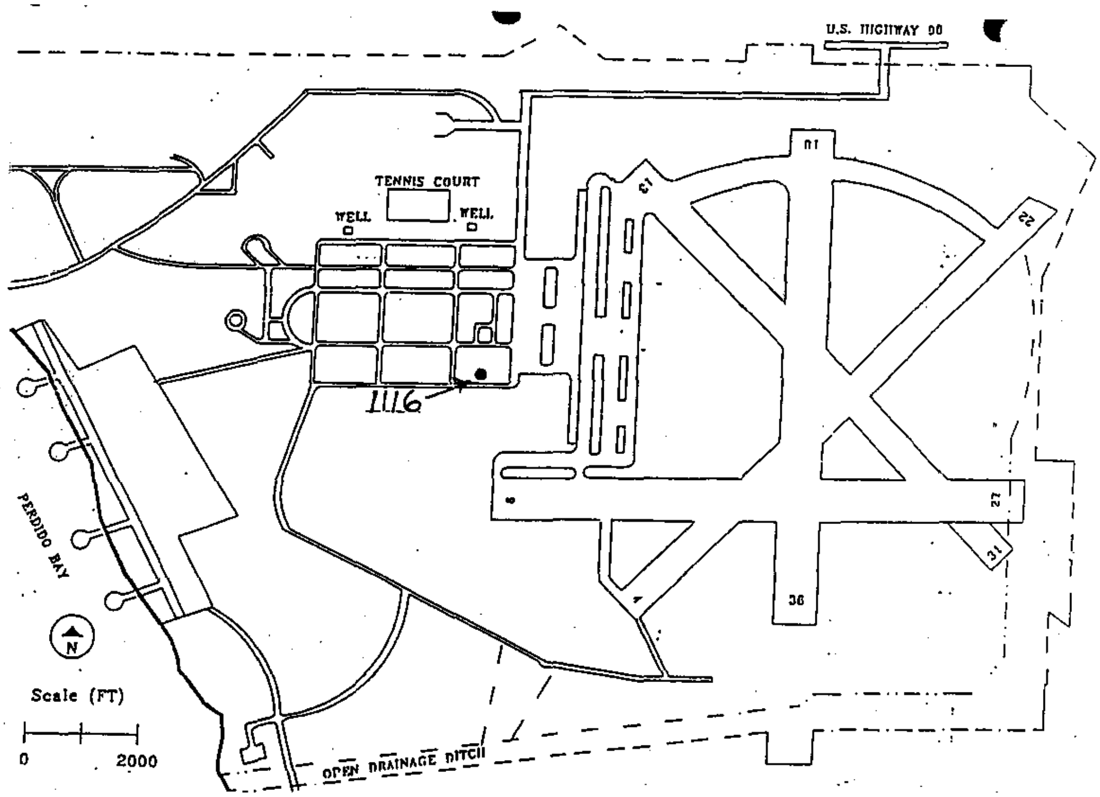

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COST/SCHED-AREA				APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO. FIGURE 1-2	REV. 0

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OLF Bronson consists of approximately 950 acres of mostly grass and forest. The area surrounding OLF Bronson is sparsely populated. Two small communities, Paradise Beach and Perdido Heights, are located approximately one mile to the north of the old airfield. A few houses are located around the perimeter of the old airfield, but most of the surrounding area is wetland, forest, or the waters of Perdido Bay. Scattered residential structures, mobile homes, farm buildings, stores, and churches characterize the areas north, south, and east of OLF Bronson. Perdido Bay is located west of OLF Bronson.

Site 1116 is located at latitude 30^{o} 23' 03" N, longitude 87^{o} 25' 01" W. The underground storage tanks (USTs) were located on the west side of a concrete slab, the remains of Building 1116. To the north, east, and west of the site are dense woods, and to the south is a dirt road running east to west past Building 1116. The dirt road is rarely used. East of Building 1116 and south of the dirt road is a large rock pile. Figure 1-3 shows the location of buildings, facility boundaries, and former tanks.

1.3 SITE HISTORY

OLF Bronson was used as an outlying landing field for NAS Pensacola from 1942 to 1950. When first opened in 1942, the 950-acre airfield was originally called Tarklin Field, but in 1944 the name was changed to OLF Bronson. During that time, the base used aviation gasoline, oil products, and solvents. OLF Bronson was closed as an active airfield in late 1950. Helicopters used the area for occasional training until 1995. Presently, all the runways are inactive. All original buildings at OLF Bronson have been dismantled and portions of the base have been sold to private parties. Maps of OLF Bronson show Building 1116 was designated as a Boiler House. As of 1997, the only employees at Bronson were Morale, Welfare, and Recreation personnel (NPWC, 1997).

In 1990, SOUTHNAVFACENGCOM contracted the engineering services of E. C. Jordan Consultants to develop a petroleum UST program for OLF Bronson. Under that contract, all but 35 USTs and the piping associated with the tanks were removed. In September 1993, the NPWC was retained by the SOUTHNAVFACENGCOM to remove the remaining 35 USTs.

On June 22, 1994, NPWC personnel discovered petroleum soil contamination at Site 1116 during the removal of four underground fuel oil storage tanks and one butane tank located at the site. The contaminated soil was completely removed and eventually disposed of at a permitted thermal treatment facility. A closure assessment was performed during the removal of the underground tanks, but no groundwater samples were collected (NPWC, 1997).

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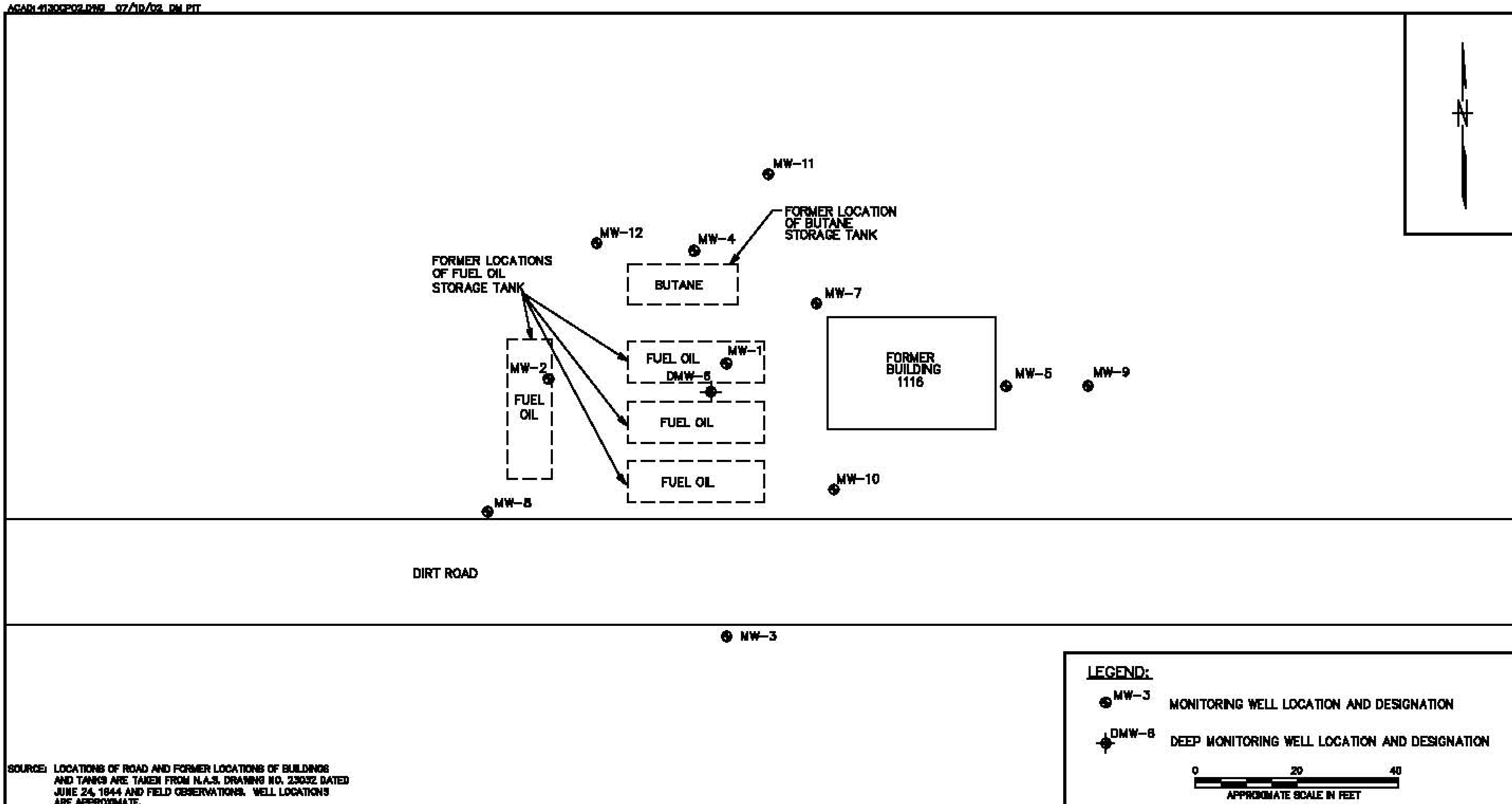

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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CHECKED BY — DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE PLAN
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130
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1.4 REPORT ORGANIZATION

This report is organized into eight sections. The following is a list of the sections and a brief description of their purpose:

- Section 1.0: Introduction. Presents the report's purpose, scope, site information, and report organization.
- Section 2.0: CAR Findings and Conclusions. Reviews the approved SARAs and summarizes the CAR and SARAs findings and conclusions.
- Section 3.0: RAP Goals. Sets the soil and free product treatment objectives for the remedial system/plan.
- Section 4.0: Contaminant Distribution. Estimates the mass of contaminants in the soil and groundwater.
- Section 5.0: Remedial Alternative Technology Screening. Presents the alternatives for remediation, determines the suitability for the site, and develops budgetary costs for each.
- Section 6.0: Remedial System Design. Presents all of the assumptions made and provides the conceptual design of the preferred remedial alternative.
- Section 7.0: Operations and Maintenance (O&M) and Monitoring. Establishes start-up and O&M procedures and provides a monitoring plan for the remediation system and sampling frequencies to evaluate the system's effectiveness.
- Section 8.0: Remedial Action Plan Summary.
- References. Lists all references used.

2.0 CONTAMINATION ASSESSMENT REPORTS FINDINGS AND CONCLUSIONS

In March 1997, a CAR for OLF Bronson, Site 1116, Pensacola, Florida was submitted by NAS Pensacola NPWC to the FDEP for review. TtNUS completed a SARA for the site on March 14, 2001, and a SARA II was completed by TtNUS and submitted to FDEP on February 8, 2002. The CAR and SARAs were conducted to determine the extent of soil and groundwater contamination at the site. The following is a summary of the findings of the CAR and SARAs for Site 1116.

2.1 LITHOLOGIC FINDINGS

During the installation of monitoring wells at Site 1116, the soil was logged for lothological purposes. The borings from monitoring wells MW-1 to MW-5 revealed that the predominant site lithology is comprised of fine to medium grained silty sand with organics and orange-tan in color from 0 to 3 feet (ft) below land surface (bls); fine to medium grained silty sand, frosted grained, and tan in color from 3 to 11 ft bls; and fine to medium grained silty sand, frosted grained, aeolian deposit and tan to beige in color 11 to 19.5 ft bls. See Figure 1-3 for monitoring well locations. Deep vertical monitoring well DMW-6 was inconsistent with the shallow monitoring wells MW-1 to MW-5. The lithology for DMW-6 was composed of fine grained sand (fill), brown in color, from 0 to 11 ft bls; fine grained silty sand, dark brown to charcoal gray in color, heavy petroleum staining, from 11 to 17 ft bls; fine to medium grained clayey sand, exceedingly wet, beige in color, from 17 ft to 30 ft bls; and very fine to fine grained silty sand, occasional dark minerals and moderately sorted, white in color, from 30 to 35 ft bls. Boring logs are located in the CAR and SARAs for Site 1116.

2.2 GROUNDWATER AND AQUIFER CHARACTERISTICS

The CAR indicated that the depth to groundwater ranged from approximately 10.5 to 13 ft bls and flows generally to the southwest. TtNUS measured the depth to groundwater on August 21, 2001 during the preparation of the SARA II and determined that the depth to groundwater ranged from 12 to 16 ft bls and flowed in a general southwestern direction. Table 2-1 presents the groundwater level measurement results from August 21, 2001. Figure 2-1 presents the groundwater elevation map from August 2001.

On May 9, 1996 W.E.S., Inc. performed a rising head slug test at Site 1116 to assess the hydraulic conductivity of the surficial zone of the sand-and-gravel aquifer. Slug test results indicated the estimated horizontal hydraulic conductivity at Site 1116 to be 0.6899 feet per day (ft/day). The calculated linear groundwater flow velocity at Site 1116 was estimated to be 0.0069 ft/day or 2.5181 feet per year (NPWC, 1997).

Table 2-1
Water Table Elevations

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

Well ID	Date of Measurement	Top of Casing Elevation[1]	Depth to Free Product	Depth to Water	Thickness of Free Product	Potentiometric Surface Elevation[2]
MW-1	8/21/01	50.01	12.3	13.83	1.53	37.67
MW-2	8/21/01	49.67	ND	12.93	ND	36.74
MW-3	8/21/01	48.77	ND	12.15	ND	36.62
MW-4	8/21/01	49.80	ND	12.87	ND	36.93
MW-5	8/21/01	49.52	ND	12.73	ND	36.79
DMW-6	8/21/01	49.92	ND	13.13	ND	36.79
MW-7	8/21/01	50.00	12.55	14.20	1.65	37.41
MW-8	8/21/01	49.30	ND	12.60	ND	36.70
MW-9	8/21/01	52.89	ND	16.03	ND	36.86
MW-10	8/21/01	51.92	ND	14.83	ND	37.09
MW-11	8/21/01	53.01	ND	15.85	ND	37.16
MW-12	8/21/01	52.13	ND	15.00	ND	37.13

Notes:
(1) Top of casing and groundwater elevations are relative to an arbitrary site reference.
(2) Potentiometric Surface Elevation = Top of Casing Elevation - [Depth to Water - (Free Product Thickness * free product specific gravity)]
free product specific gravity = 0.974
All measurements reported in feet.
ND = not detected

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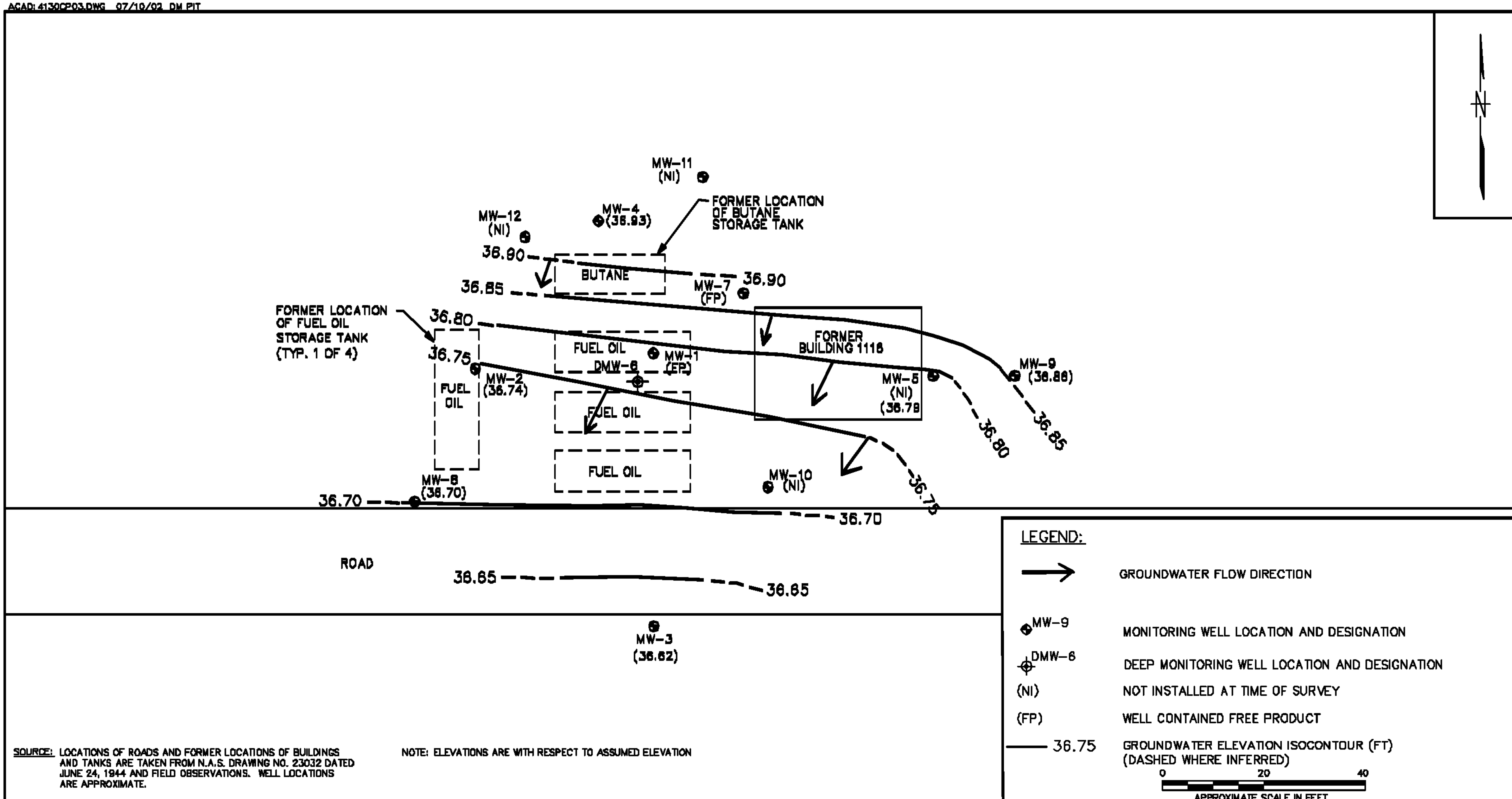

SOURCE: LOCATIONS OF ROADS AND FORMER LOCATIONS OF BUILDINGS AND TANKS ARE TAKEN FROM N.A.S. DRAWING NO. 23032 DATED JUNE 24, 1944 AND FIELD OBSERVATIONS. WELL LOCATIONS ARE APPROXIMATE.

NOTE: ELEVATIONS ARE WITH RESPECT TO ASSUMED ELEVATION

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DM DATE 7/10/02

CHECKED BY DATE

COST/SCHED-AREA

SCALE AS NOTED

GROUNDWATER ELEVATIONS – 8/21/01
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130

APPROVED BY DATE

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2.3 TANK REMOVAL AND INITIAL REMEDIAL ACTION

NPWC personnel discovered petroleum-impacted soil at Site 1116 during the removal of four fuel oil USTs and one butane tank located at the site. An unknown amount of heating fuel oil had leaked into the soil. A closure assessment indicated petroleum hydrocarbon vapor levels in the soil were greater than 50 parts per million (ppm) regulatory standard for diesel/kerosene releases. Approximately 200 cubic yards (yd^3) of petroleum-impacted soil was removed. The excavated soil was stockpiled on site and eventually treated at a permitted thermal treatment facility and disposed. Clean soil was used to fill the excavation. No groundwater samples were collected during the closure assessment (NPWC, 1997).

2.4 SOIL CONTAMINATION ASSESSMENT

The vertical and horizontal extent of petroleum impacted soil in the vadose zone was assessed through soil vapor analysis performed during the field investigations described in the CAR and two SARAs for Site 1116 (NPWC, 1997, TtNUS, 2001 and TtNUS 2002). The CAR soil assessment at Site 1116 consisted of screening the soil for petroleum vapors with an organic vapor analyzer (OVA) during the soil borings and installation of monitoring wells. Samples from twenty-three soil borings were collected at intervals of 1, 4, 7, 10, and 12 ft bls in January 1996 (Figure 2-2). Soil samples were also collected during the installation of monitoring wells MW-1 through MW-5 at intervals of 1, 4, 7, 10, and 11 ft bls. Groundwater was typically found at approximately 13 ft bls. An additional soil sample was collected approximately 1 ft above the water table at each of the monitoring well locations and analyzed for total recoverable petroleum hydrocarbons (TRPH). The soil sample collected at MW-1 was reported at a concentration of 110 milligrams per kilogram (mg/kg), which did not exceed the FDEP residential direct exposure or leachability SCTL of 340 mg/kg for TRPH. No TRPH was detected in the soil samples from the remaining monitoring well locations.

The OVA screening results of the soil borings and monitoring well samples greater than 50 ppm, along with their respective locations, are shown on Figure 2-3. Soil vapor headspace readings were detected above 50 ppm in soil samples from B1, B2, B3, B4, B8, B9, B14, B15, and B16 and monitoring well MW-1. The soil vapor readings detected above 50 ppm were reported in soil samples collected at depths of between 10 to 12 ft (NPWC, 1997). NPWC concluded that excessive soil contamination appeared to be limited to the water table level and 2 ft above the groundwater table or capillary fringe of the groundwater table.

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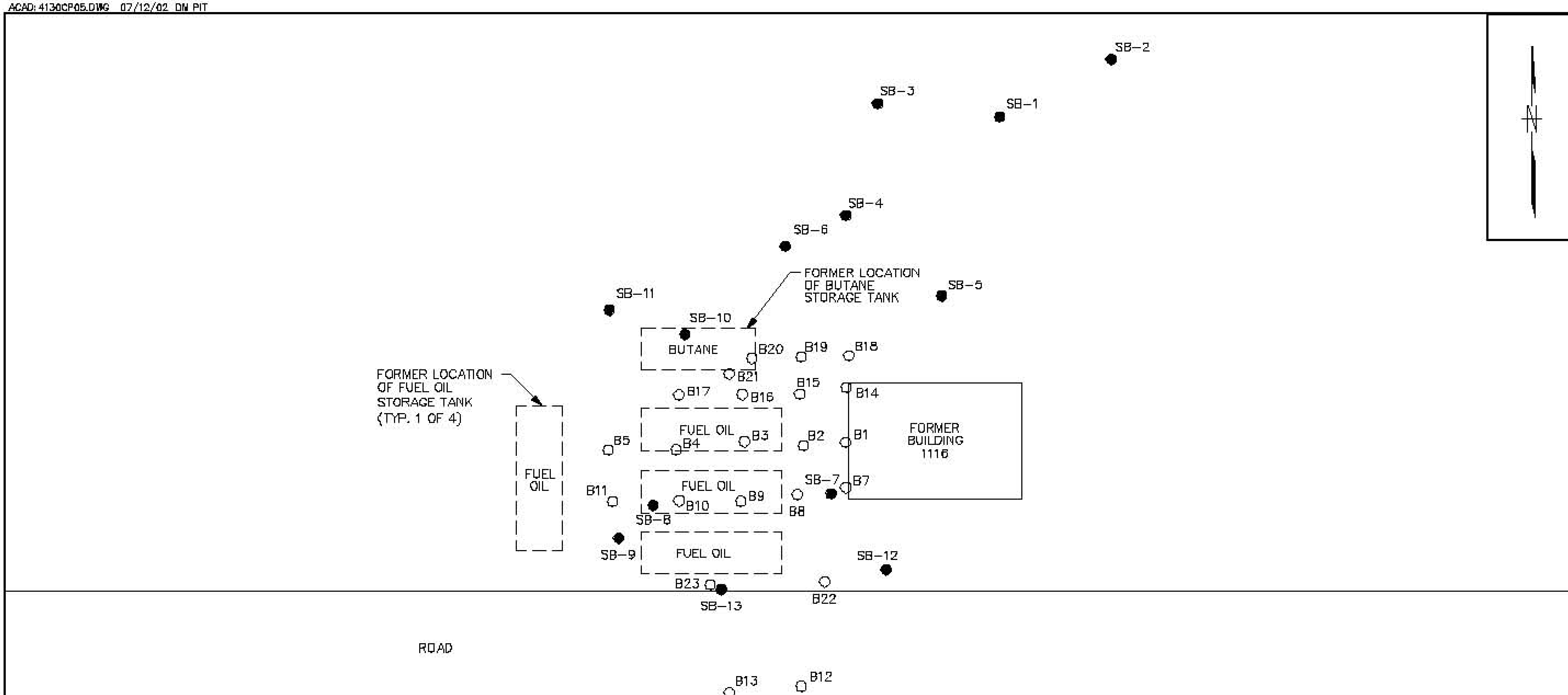

LEGEND:

- SB-9 ● SOIL BORING LOCATION AND DESIGNATION (TtNUS)
- B4 ○ SOIL BORING LOCATION AND DESIGNATION (PWC)

0 20 40

APPROXIMATE SCALE IN FEET

SOURCE: LOCATIONS OF ROADS AND FORMER LOCATIONS OF BUILDINGS AND TANKS ARE TAKEN FROM N.A.S. DRAWING NO. 23032 DATED JUNE 24, 1944 AND FIELD OBSERVATIONS. WELL LOCATIONS ARE APPROXIMATE.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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CHECKED BY — DATE
COST/SCHED-AREA
SCALE AS NOTED

SOIL BORING LOCATIONS
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130
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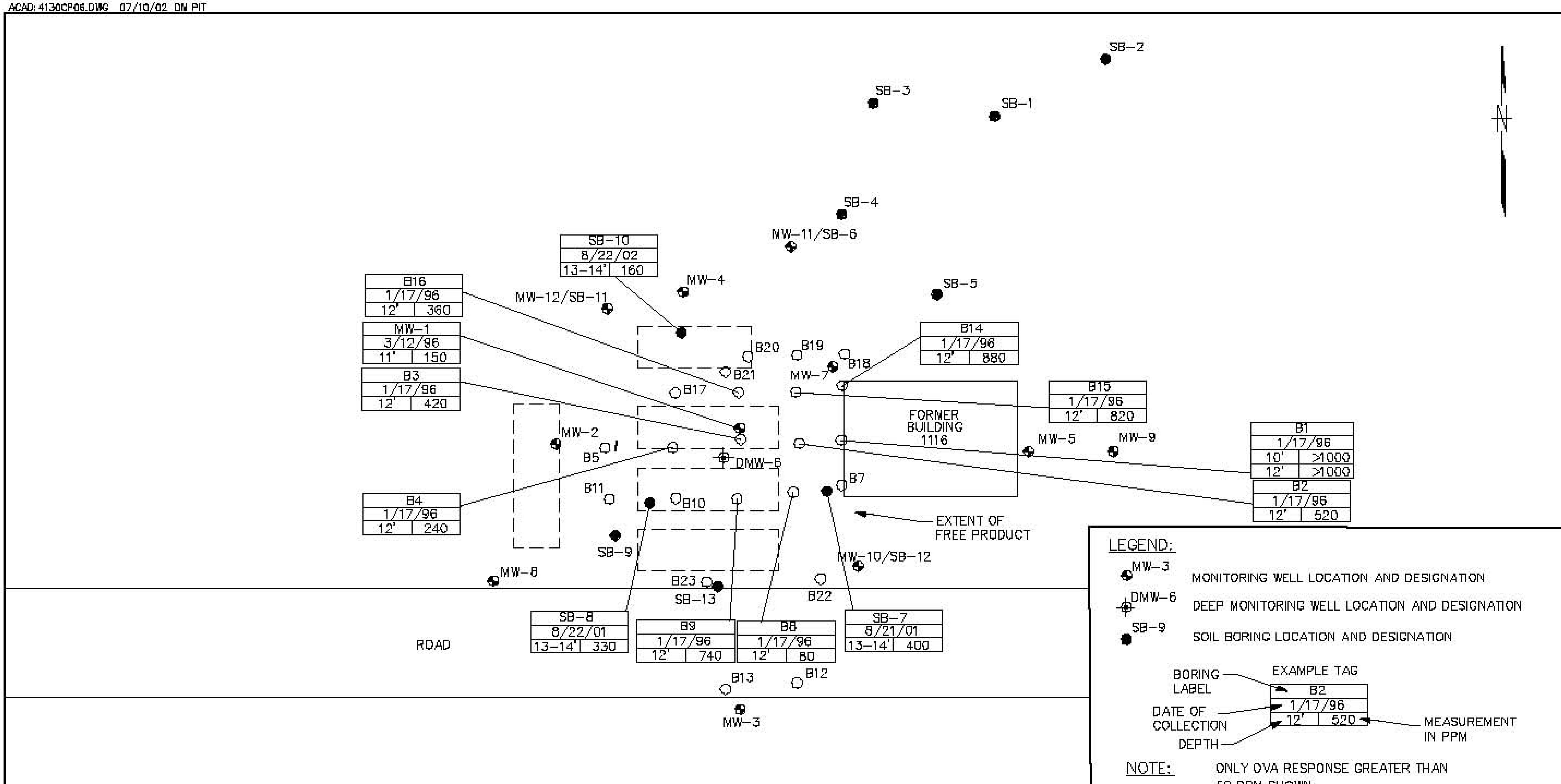

SOURCE: LOCATIONS OF ROADS AND FORMER LOCATIONS OF BUILDINGS AND TANKS ARE TAKEN FROM N.A.S. DRAWING NO. 23032 DATED JUNE 24, 1944 AND FIELD OBSERVATIONS. WELL LOCATIONS ARE APPROXIMATE.

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DM DATE 7/12/02
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

OVA SCREENING RESULTS
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130
APPROVED BY DATE
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In August 2001, TtNUS personnel installed additional soil borings and monitoring wells based on the comments of FDEP (TtNUS, 2002). The purpose of the additional sampling was to more precisely delineate where free product was present. TtNUS personnel advanced 13 additional soil borings at Site 1116 (Figure 2-2). Stained soil, petroleum odor, and positive OVA field screening responses were observed in soil samples collected at three soil boring locations, SB-7, SB-8, and SB-10. Each of these three soil samples was collected from below the water table. Three of the soil borings (SB-6, SB-11, and SB-12) were converted to monitoring wells MW-10, MW-11, and MW-12. OVA vapor analysis results are presented in Figure 2-3. Soil samples were not collected for laboratory analysis during the SARA.

2.5 GROUNDWATER CONTAMINATION ASSESSMENT

During the initial CAR, W.E.S., Inc. collected groundwater samples from shallow groundwater monitoring wells MW-1 through MW-5 and deep vertical extent monitoring well DMW-6. Groundwater samples were analyzed for volatile organic aromatics, polynuclear aromatic hydrocarbons (PAHs), ethylene dibromide (EDB), TRPH, and total lead. Samples were collected between March and June of 1996 by W.E.S., Inc. (NPWC, 1997).

Monitoring well MW-1 was the only well in which petroleum contaminants were detected above FDEP groundwater cleanup target levels (GCTLs). No kerosene analytical group parameters were detected in monitoring wells MW-2 through DMW-6. Xylene was detected at 12 micrograms per liter (μg/L) in monitoring well MW-1, which is below the FDEP GCTL of 20 μg/L. Naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene were detected at concentrations of 210 μg/L, 170 μg/L, and 270 μg/L, respectively in monitoring well MW-1, which was above the three compound’s GCTLs of 20 μg/L. TRPH was detected in monitoring wells MW-1 and MW-2 at concentrations of 2.8 milligrams per liter (mg/L) and 0.17 mg/L, respectively, which were below the FDEP GCTL of 5 mg/L. Lead was not detected in any of the wells. EDB was not detected in monitoring wells MW-2 through DMW-6. Monitoring well MW-1 was not analyzed for EDB.

During the SARA, TtNUS installed three additional monitoring wells (MW-7, MW-8, and MW-9) based on FDEP comments on the CAR. On July 9, 2000, TtNUS personnel collected groundwater samples from monitoring wells MW-3, MW-6, MW-8, and MW-9 located on Site 1116. Monitoring wells MW-1 and MW-7 were not sampled due to the presence of free product. The groundwater samples were analyzed for VOCs by United States Environmental Protection Agency (USEPA) Method 8260B, PAHs by USEPA Method 8310, and TRPH by the Florida Petroleum Range Organics (FL-PRO) method. No constituents were detected above FDEP GCTLs in the monitoring wells sampled.

During the SARA II, TtNUS personnel collected a round of groundwater samples from August 22 to 24, 2001. Monitoring wells MW-2 through MW-6 and MW-8 through MW-12 were sampled. Monitoring well MW-1 and MW-7 were not sampled due to the presence of free product. Groundwater samples were analyzed for PAHs by USEPA Method 8270 and TRPHs by the FL-PRO method. Additional samples for monitoring wells MW-4, MW-6, and MW-11 were collected on September 25 and September 26, 2001 and analyzed for TRPH. MW-2 was resampled for both TRPH and PAHs on the same date. Positive detection of petroleum constituents were reported for monitoring wells MW-4, MW-5, MW-10, and MW-12. MW-4 was reported at 31.8 mg/kg, above GCTL of 5 mg/kg for TRPH. PAHs were not detected above the laboratory detection limits for the groundwater samples collected from Site 1116.

2.6 FREE PRODUCT

On February 16 and August 21, 2001, free product thickness and static water level data were collected using an oil/water interface probe. Free product was detected in monitoring wells MW-1 (1.2 ft and 1.53 ft) and MW-7 (2.5 ft and 1.65 ft) on the respective dates. The free product was a high viscosity material similar to Bunker C fuel oil. Free product and water level measurements are summarized in Table 2-1. Soil boring observations and free product detections were used to delineate free product. Soil borings SB-7, SB-8, and SB-10 were reported to be “stained with free product” (TtNUS, 2002). Monitoring wells MW-1 and MW-7 have been reported to contain free product during each investigation. The free product is estimated to cover 2,250 square feet (ft^2) and is centered on monitoring well MW-1. An estimate of the extent of free product at the site was made in the SARA II and is shown on Figure 2-4.

2.7 CAR, SARA, AND SARA II CONCLUSIONS

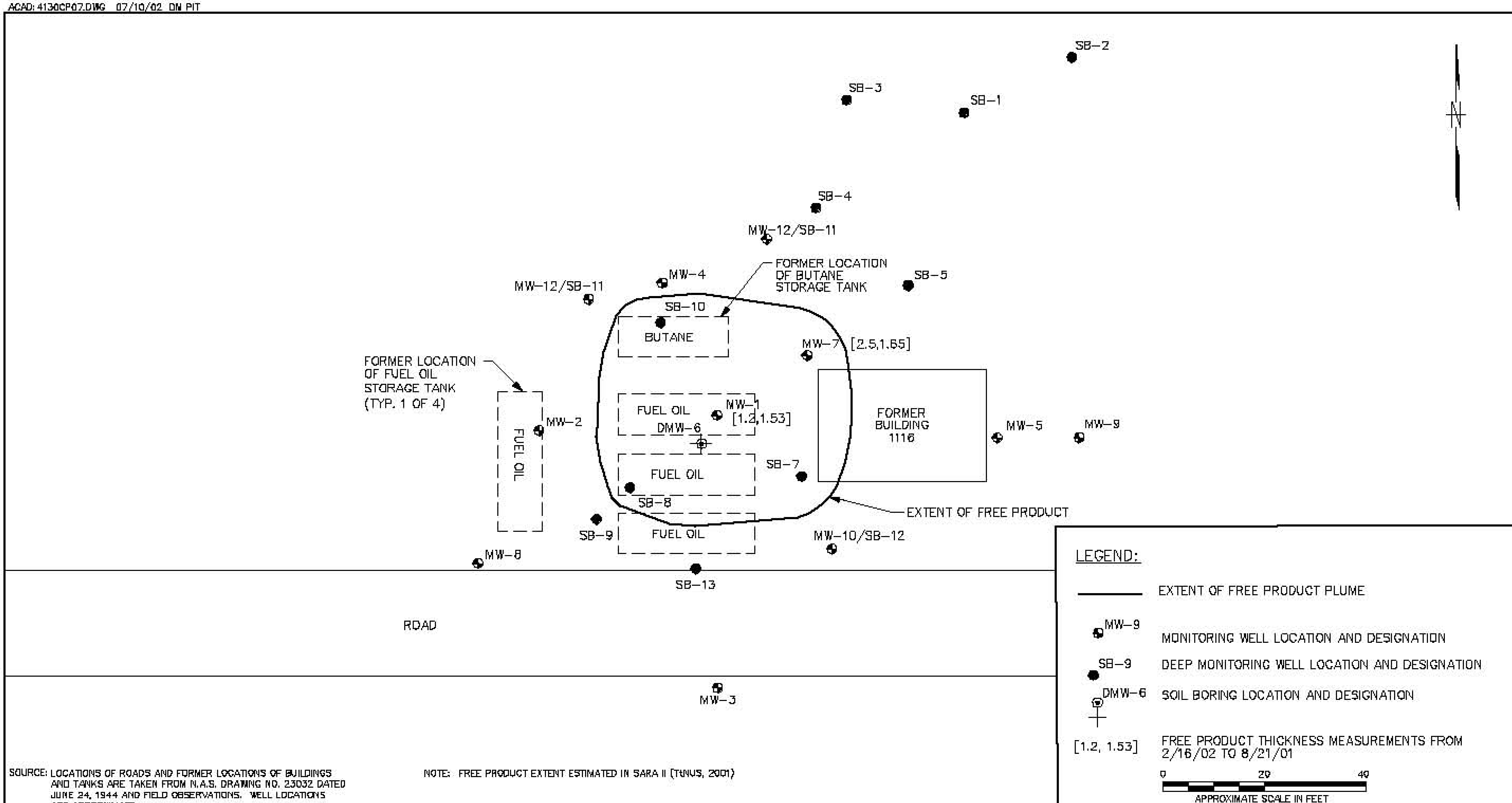
The most recent investigative data for the site from the SARA II (TtNUS, 2002) concluded the following:

- A coal tar type free product plume is present at the site over a 2,250 ft^2 area with a thickness up to 2.5 ft.

- Current and historic groundwater flow data indicate flow is typically southwest.

- Soil samples from 13 on-site soil borings (MW-1, B1, B2, B3, B4, B8, B9, B14, B15, B16, SB-7, SB-8, and SB-10) contained OVA responses that exceeded FDEP limit of 50 ppm for kerosene products.

- Free product was present in monitoring wells MW-1 and MW-7. Groundwater samples for monitoring well MW-4 indicated that the FDEP GCTL for TRPH was exceeded.



SOURCE: LOCATIONS OF ROADS AND FORMER LOCATIONS OF BUILDINGS AND TANKS ARE TAKEN FROM N.A.S. DRAWING NO. 23032 DATED JUNE 24, 1944 AND FIELD OBSERVATIONS. WELL LOCATIONS ARE APPROXIMATE.

NOTE: FREE PRODUCT EXTENT ESTIMATED IN SARA II (TtNUS, 2001)

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DM — DATE 7/12/02
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COST/SCHED-AREA
SCALE AS NOTED

EXTENT OF FREE PRODUCT
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130
APPROVED BY — DATE
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DRAWING NO. FIGURE 2-4 — REV. 0

- The elevated OVA readings indicate that the soil contamination appears to be within the "smear zone" from 10 to 14 ft bls and is located in the area of the former fuel tanks.

- In the SARA II, TtNUS recommended preparing a RAP for the contaminated soil and free product at Site 1116.

2.8 CAR, SARA, AND SARA II FINDINGS FOR REMEDIAL ACTION CONSIDERATION

The CAR for Site 1116 stated that the fuel released at the site was diesel fuel. Upon further testing, TtNUS found a very viscous free product that was referred to as Bunker C fuel oil. Bunker C fuel oil is a sticky, black liquid similar in appearance and smell to asphalt sealing compounds and has been used to generally describe thick and sticky residual fuel (Environment Canada, 1996).

At 50 degrees Fahrenheit ($^{\circ}$F), Bunker C fuel oil has a consistency of liquid honey or corn syrup. At 32 $^{\circ}$F, it barely flows. Bunker C fuel oil, in addition to being used in the majority of large marine diesel engines, is used in power generating stations, industrial boilers and furnaces, and pumping plants. Because Bunker C fuel oil is less dense than water, fresh Bunker C fuel oil will float in water either at or just below the surface. As the oil ages or "weathers," it becomes heavier, but it will still float under most conditions. When the oil comes into contact with sediment, sand, or other soil materials, it may adhere together forming lumps or tar balls.

It is expected that due to the age of the tanks (1940s) and the chemical properties of Bunker C fuel oil, the weathered fuel has formed a small plume at the water table level and within the "smear zone." The CAR and SARAs support this assumption based on the fact that all of the reported contamination was found at or near the water table in both soil and groundwater samples. Therefore, the primary contaminant of concern is TRPH, which was detected at concentrations above the GCTL. It is assumed that the fuel oil has weathered and degraded to a point where long chain hydrocarbons (which do not readily degrade) are the most prominent contaminants at the site.

3.0 RAP GOALS

The objective of this RAP is to present a proven, reliable, and cost-effective method to remediate petroleum impacted soil, remove free product, retard plume migration at the site, and protect human health and the environment by reducing the concentrations of hydrocarbons detected at the site to target cleanup levels.

The goals and expected accomplishments of the RAP include the following:

- Identify a method to perform free product recovery in the source area, to the extent practicable, in accordance with Chapter 62-770.300, FAC.

- Select a remedial alternative to reduce hydrocarbon constituents within the soil matrix (smear zone).

The target cleanup concentrations for the soil at Site 1116 are based on Chapter 62-777, FAC. The following subsections list the target levels for the site-specific chemicals of concern (COCs).

3.1 SOIL TARGET LEVELS

The goal of the remedial action is to remove all soils exhibiting an OVA response greater than 50 ppm. In addition, any soil samples collected shall be tested by FDEP Kerosene Analytical Group criteria as stated in Chapter 62-770 FAC.

3.2 GROUNDWATER TARGET LEVELS

The most recent groundwater analytical results of the SARA II indicate that dissolved fraction hydrocarbon constituents were detected in the source area where free product is present. However, no remedial action goal will be established for groundwater until free product is removed. After remedial actions have been completed for the site soil and free product, groundwater monitoring will be conducted in accordance with Chapter 62-770, FAC.

4.0 CONTAMINANT DISTRIBUTION

4.1 ESTIMATED MASS OF CONTAMINANTS IN SOIL

Data acquired during the contamination assessments determined soil contamination exists within the "smear zone" from 10 to 14 ft bls. The groundwater table was encountered at 12 to 15 ft bls. The lateral limits of the free product plume were estimated based on soil borings and groundwater monitoring performed at the site during the investigation for the SARA II, and defined as depicted in Figure 2-4. These limits were also used to determine the volume of impacted soil. The smear zone contamination is conservatively estimated at 6 ft thick (10 ft to 16 ft bls) and covers an estimated surface area of approximately 2,250 ft^2, yielding a total volume of approximately 500 yd^3 of contaminated soil.

Soil samples were collected from the drill cuttings created during the installation of monitoring wells MW-1 through MW-5. The samples were analyzed for TRPH. The TRPH concentration from the fixed laboratory analysis of the soil sample collected at MW-1 was 110 mg/kg (NPWC, 1997). There was no TRPH detected in the soil samples collected from the MW-2 through MW-5 boring locations. Based on this information, the estimated quantity of adsorbed hydrocarbons within the smear zone is approximately 154 pounds. Appendix A presents calculations for the estimated mass of impacted soil.

4.2 ESTIMATED MASS OF FREE PRODUCT

Data acquired during the contamination assessments determined the presence of free product within the "smear zone" from 10 to 14 ft bls. The lateral limits of the free product plume were estimated in the SARA II and have been defined as depicted in Figure 2-4. Based on the assumed lateral limits of the free product plume and specific site characteristics, the total volume of free product was estimated. Multiple free product thickness equations from the USEPA guidance document, *How To Effectively Recover Free Product at Leaking Underground Storage Tank Sites* (USEPA, 1996), were used to determine the volume of free product located in the subsurface. Free product quantity estimates ranged from 179 gallons to 700 gallons. The equations, which resulted in the smaller quantities of free product, take into account the density of the product. Due to the high density and chemical properties of Bunker C fuel oil, it is expected that the thickness of fuel oil measured in the monitoring wells at the site greatly exaggerate the amount of actual free product located in the subsurface. Due to these factors, it is expected that the lower estimates of product are more accurate. Therefore, it was estimated that approximately 179 gallons of free product is located in the subsurface at Site 1116, based on the De Pastrovich equation. Free product volume calculations are provided in Appendix B.

Calculating the volume of free product in the subsurface is an estimate, and actual product volumes can vary significantly. The contaminant distribution estimate is based on data obtained during the SARA investigations (TtNUS, 2001 and TtNUS, 2002).

5.0 REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING

TtNUS conducted a screening of available technologies in order to determine a timely and cost-effective remedial alternative for the subject site. Potential remedial technologies and process options for soil and free product removal have been identified and evaluated based on their ability to meet clean-up objectives (effectiveness), applicability based on site conditions, feasibility of implementation, reliability, anticipated duration, and cost.

5.1 EVALUATION OF SOIL TREATMENT ALTERNATIVES

Based on the SARA data, a total volume of approximately 500 yd^3 of soil exhibits OVA results greater than 50 ppm and free product present. TtNUS has investigated alternate methods for the removal of hydrocarbons from the soils at the site. The following actions have been identified for remediation of soil and will be evaluated in this RAP:

- Soil excavation and off-site disposal
- Soil excavation and on-site treatment

The following technologies have been ruled out and the reasons why are listed below:

- Natural Attenuation – Natural attenuation is not acceptable to the FDEP if free-phase petroleum hydrocarbons are present.

- In situ Soil Vapor Extraction – This technology is applied to sites where the contaminants are primarily VOCs. Diesel fuel, heating oils, and kerosene, which are less volatile than gasoline, are not readily treated by soil vapor extraction (USEPA, 1994).

- Enhanced Bio-Degradation – The effects of enhanced bio-degradation are uncertain on Bunker C fuel oil impacted soils.

The following sections briefly discuss each of the selected soil remedial actions with respect to their suitability for implementation at this site.

5.1.1 Excavation and Off-site Disposal or On-site Treatment

This alternative consists of the physical removal and on-site treatment or off-site disposal of impacted soils with hydrocarbon constituents exceeding the target cleanup levels. Prior to complete excavation of impacted soils, removal of approximately a 2,250-ft^2 area of soil to the depth of approximately 10 ft bls would be required to access the contaminated zone. Additionally, due to the depth of the excavation, a 1-ft horizontal step-out for every 2 ft of vertical excavation is required to provide a slope for safety measures and in accordance with Occupational Safety and Health Administration (OSHA) regulations. The slope would require an additional area of soil be removed surrounding the excavation. The contaminated soil assumed to be located in the 10 to 16 ft smear zone would be removed. Excavation below the water table (approximately 12 to 15 ft bls) will require dewatering with collection, treatment, and disposal of collected water.

The area of excavation will include a section of the dirt road that passes the site. This road is rarely traveled and the excavation should cause no disturbance to day-to-day activities at the site.

Removal operations can be accomplished using standard excavation equipment, with some modifications due to the depth required for excavation. Preceding removal and stockpiling of the impacted soil, analysis of samples collected from the excavation area will be performed to confirm extent of excavation. Once sampling is complete and the excavation is completed the excavation will be back-filled with clean fill material and the site and the dirt road will be restored to their original condition.

5.1.1.1 Off-site Disposal

The stockpiled soil and other debris generated during excavation will be characterized, loaded, and transported off site to a permitted facility for treatment and/or disposal. It is assumed that since the soil is petroleum impacted, the soil can be disposed of in a landfill that accepts non-hazardous solid bulk waste, as opposed to a hazardous waste landfill regulated by Resource Conservation and Recovery Act land disposal restrictions. The Perdido Landfill located in the Pensacola region is a nearby Subtitle D Landfill, which will accept petroleum-impacted soil if it passes the toxicity characteristic leaching procedure analysis. Water collected during dewatering would need to be contained, sampled, and disposed in accordance with regulatory guidelines.

5.1.1.2 On-site Treatment

The stockpiled soil can be treated at the site either by biopiles, land farming, or by a mobile low temperature thermal desorption (LTTD) unit. Biopiles and land farming are used to reduce concentrations of petroleum constituents in excavated soils through the use of biodegradation by aeration. While tilling and plowing aerate land farms, biopiles are aerated most often by forcing air to move by injection or extraction through slotted piping placed throughout the pile. Biopiles and land farms have been proven effective in reducing concentrations of nearly all the constituents of petroleum products. While the lighter petroleum products are removed by volatilization, the heavier petroleum products do not evaporate and breakdown as a result of biodegradation. However, higher molecular weight petroleum constituents, such as heating and lubricating oils (i.e., those found at Site 1116) and to a lesser extent in diesel fuel and kerosene, require a longer period of time to degrade (USEPA, 1994). It is expected that the weathered Bunker C fuel oil would require a longer time duration for soil cleanup as compared to lighter fuel compounds. Because of the long time period to degrade fuel oils by land farming or biopiles, these two options are ruled out, and it is recommended that LTTD be used for the selected remedial option for on-site treatment.

LTTD, also known as low-temperature thermal volatilization, thermal stripping, and soil roasting, is an ex-situ remedial technology that uses heat to physically separate petroleum hydrocarbons from excavated soils. Thermal desorbers are designed to heat soils to temperatures sufficient to cause constituents to volatilize and desorb (physically separate) from the soil. The vaporized hydrocarbons are generally treated in a secondary treatment unit (e.g., an afterburner, catalytic oxidation chamber, condenser, or carbon adsorption unit) prior to discharge to the atmosphere. Treated soil may be re-deposited on site or used as cover in landfills. Thermal desorption systems fall into two general classes: stationary facilities or mobile units. Contaminated soils are excavated and either transported to stationary facilities or mobile units that are used for local treatment on site. LTTD has proven very effective in reducing concentrations of petroleum products including gasoline, jet fuels, kerosene, diesel fuel, heating oils, and lubricating oils. LTTD is applicable to constituents that are volatile at temperatures as great as 1,200 °F (USEPA, 1994). Due to the Bunker C fuel oil at Site 1116, the recommended LTTD would require a temperature range of 800 °F to 1200 °F. A Rotary Dryer-Alloy LTTD can achieve this temperature range.

The primary advantage of excavation and off-site disposal or on-site treatment by LTTD is the complete removal or treatment of contaminants from the site over a short time duration. Impacted soils can be physically removed from the site in a matter of days, as opposed to the months or years that are required using in-situ treatment alternatives, thus eliminating the potential for dispersion of hydrocarbon constituents to unaffected soil or groundwater during the remedial process. If on-site treatment is performed, the treated soil can be placed back into the excavation, and soil disposal costs are not incurred.

The estimated costs for soil excavation, transportation, and off-site disposal or on-site treatment by LTTD, and site restoration is presented in Table 5-1 and Appendix C, Table C1. It should be noted that the costs calculated for this LTTD alternative include the cost for a typical small LTTD system and does not take into account the rotary dryer-alloy LTTD system. The cost for a rotary dryer-alloy LTTD system is typically higher and actual costs may increase if a large Rotary Dryer-Alloy LTTD unit is the only system available.

5.2 EVALUATION OF FREE PRODUCT REMOVAL ALTERNATIVES

Based on the CAR and SARAs data, the total volume of approximately 181 gallons of free product is located in the subsurface at Site 1116 (see Appendix B). It should be noted that this is only an estimate and actual free product volumes may differ significantly from this estimate. TtNUS has investigated various methods for the removal of free product from the site. The following methods have been identified for removal of free product and will be evaluated in this RAP:

- Dewatering during soil excavation
- Skimming systems
- Dual-phase extraction

The following sections briefly discuss each of these free product removal actions with respect to their suitability for implementation at this site.

5.2.1 Dewatering During Soil Excavation

Free product may be recovered prior to and during the excavation dewatering using trash pumps or conventional vacuum trucks. During excavation activities, recovered free product and groundwater in the excavation will be removed. Due to the viscous nature of the aged Bunker C fuel oil, it is expected that most free product will be recovered during excavation activities. The removed product and water from dewatering activities will be treated at or disposed of at an off-site facility.

Free product dewatering is expected during soil excavation activities, and therefore the duration of the excavation phase of the project would determine the time limit for free product removal. Preliminary calculations indicate a remedial time period of 30 days for excavation and disposal. An estimated cost for dewatering is included In Table 5-2, and as part of the Soil Excavation and On-site Treatment or Off-site Disposal Alternative presented in Appendix C, Table C1.

Table 5-1
Soil Remedial Alternatives Cost Summary

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	ESTIMATED YEARS OF OPERATION	O&M PRESENT WORTH	TOTAL PRESENT WORTH
Excavation and Off-site Disposal	$153,000	$0	1	$0	$153,000
Excavation and On-site Treatment	$190,000	$0	1	$0	$190,000
Note: See Appendix C for detailed cost estimates for the soil remediation alternatives.					

Table 5-2
Free Product Remedial Alternatives Cost Summary

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

ALTERNATIVE	CAPITAL COST	ANNUAL O&M	ESTIMATED YEARS OF OPERATION	O&M PRESENT WORTH	TOTAL PRESENT WORTH
Excavation and Dewatering	**	**	15 days	**	**
Passive Skimming/ Bailing	$23,000	$94,000	5	$385,000	$449,000
MDES	$54,000	$14,000	1	$11,000	$87,000

Note: See Appendix C for detailed cost estimates for the free product remediation alternatives.
MDES = Mobile Dual-Phase Extraction System
** Costs included in the excavation alternatives

5.3 SKIMMING SYSTEMS

Skimming systems are typically used to collect free product with little or no recovery of water. In general this approach involves using skimming devices to remove product floating on the water table (USEPA, 1996). Free product removal using skimming equipment is applicable in settings where long-term hydraulic control of the dissolved hydrocarbon plume is not required. In most settings skimmer operations will not control the liquid hydrocarbon plume. The most common use of these systems is inclusion in an interim action where free product has entered open excavations. In general, skimming systems are applicable to settings in which the amount of free product is small and exists in permeable conduits such as utility bedding or buried underground structures. The hydraulic conductivity should be greater than ±10 centimeters per second to ensure a sufficient influx of free product to the skimmer. Skimmers may also be used in conjunction with other free product removal programs such as in monitoring and extraction wells used for water table depression methods (USEPA, 1996).

For long-term operations, skimmers are placed in wells and gravel-filled trenches with sumps. Recovery may be enhanced by the use of hydrophobic gravel packs in wells. Field studies have shown that gravel packs constructed from hydrophobic materials allow for free product to enter wells and sumps more rapidly. Recovery rates for long-term operations are generally very low.

The selection of skimming equipment is based primarily on the size of the recovery installation (well, trench) and expected rate of recovery of free product. Two types of skimming equipment are available. Mechanical skimming equipment actively extracts free product from recovery initiation, whereas passive skimming equipment accumulates free product over time. Mechanical skimming systems rely on pumps (either surface mounted or within the well) or other motors to actively extract free product from the subsurface. Mechanical skimming systems are more often used where larger volumes of free product are present. Passive skimming systems do not actively pump free product; instead they slowly accumulate it over time. There are two basic forms of passive skimmers; filter canisters and absorbent socks.

Based on the viscosity of the free product, a passive skimming system would likely be used along with hand bailing. Hand bailing may help induce a groundwater flow toward the recovery wells, and therefore increase the amount of free product recovered at the site. It is expected that due to the viscosity and slow movement of the free product a mechanical skimming system would be inefficient since it would most likely operate for a short period of time before shutting down and then activate again several hours later. This cycle would result in a very small amount of time where the system would actively be removing the free product.

To capture the free product plume, filter canisters would be placed in the wells where free product has been detected (monitoring wells MW-1 and MW-7) along with the recovery well located at the site. Additionally, a new well would be installed on the western side of the free product plume to capture free product in this area. To recover additional product, the wells would be hand bailed on a weekly interval when the skimmers are emptied and adjusted.

Since there is a minimal groundwater flow at the site and due to the chemical characteristics of the contaminant, it is expected that the free product levels in the monitoring wells would persist for one to two years. However, this time calculation does not include desorption factors. Experience with passive skimming systems at sites with similar lithology and similar fuel oil contaminants indicate that adsorbed petroleum hydrocarbons within saturated zone soils continually leach into groundwater prolonging remedial time periods. This leaching process cannot be predicted accurately. In addition, since there is a minimal groundwater flow at the site, free product flow may also be retarded. Cost calculations, therefore, were prepared using a more conservative remedial time period of five years for the passive skimming system. An estimated cost for installation of a passive skimming system and five years of operation is presented in Table 5-2 and Appendix C, Table C2.

5.3.1 Dual-phase Recovery

The approach of dual-phase recovery is to extract free product and vapor by vacuum-enhanced pumping techniques. Dual-phase systems recover free product and facilitate vapor-based unsaturated zone cleanup through each well point (USEPA, 1996). This approach has several benefits compared to other free product recovery methods. A cone of depression is not formed at the air/oil interface or the air/water interface. Therefore, smearing of the free product zone is minimized. Vapor-phase hydrocarbons and mobile free product are collected simultaneously.

There are two main conceptual approaches to dual-phase recovery, although they differ only in the vertical positioning of the pump intake. 1) Recovery of free product and water by a single vacuum/liquids pump. 2) Extraction of free product, air, and water with a single pump and a vacuum extraction point set at the air/product interface. This technology is commonly referred to as “bioslurping.”

Dual phase extraction can be applied using either an in situ system or via specialized mobile vacuum trucks. The use of mobile vacuum trucks is a variation of multi-phase extraction/dual-phase extraction, and also known as aggressive fluid vapor recovery, mobile multi-phase extraction, or MDES. In this RAP the technology will be referred to as MDES. Permanent dual-phase extraction systems typically involve large capital costs for equipment and installation. Permanent dual-phase recovery systems are also typically used for long-term operations. MDES allows sites with small amounts of free product to be remediated via dual-phase extraction with reduced capital cost. MDES is the proposed dual-phase extraction technology for Site 1116 due to reduced costs. A mobile vacuum truck equipped for MDES would also eliminate the need for an on-site remedial system. The vacuum pressures provided by the vacuum truck may provide a large radius of influence, thereby effecting a larger area. Additionally, the dual-phase system can be connected to multiple wells at one time. Based on phone conversations made between TtNUS and an MDES subcontractor, the radius of influence for extraction wells could range from 20 ft to 200 ft. However, due to the site conditions and the type of fuel contaminant, the radius of influence will be assumed at the low range of 20 ft.

Dual-phase recovery systems are most applicable in medium to low permeability media or thin (less than 0.5 ft) saturated thickness (with water table depths of 5 to 20 ft), settings in which conventional pumping approaches or trenches are inappropriate or ineffective, and free product plumes that are located under paved or sealed surfaces (USEPA, 1996).

The free product at the site is highly viscous oil compared to other petroleum oils, this may cause difficulties in the dual phase extraction process. This could potentially cause an increase in the cost of cleanup or an inability to recover the free product.

To accomplish free product removal with MDES, monitoring wells MW-1, MW-7 and a new well installed on the western side of the free product plume, would be used as the extraction wells. Based upon the use of MDES at similar sites in Northeast Florida and moderate free product levels, it is estimated that free product recovery may be achieved with six MDES events. An estimated cost of MDES implementation with one year of O&M is presented in Table 5-2 and Appendix C-3.

5.4 COST COMPARISON AND RATIONAL FOR SELECTION

A table comparing the estimated cost of remediation of soil and free product at the subject site using the combinations of the evaluated alternatives is provided in Table 5-3. Based on a review of the advantages, disadvantages, costs, and TtNUS project experience at sites with similar conditions, TtNUS recommends the excavation and disposal alternative to remediate the soil and dewatering to address free product contamination at this site.

Excavation and disposal provides the highest degree of overall protection to human health and the environment by providing an immediate reduction in risk and hydrocarbon concentrations. The equipment and controls needed for excavation and disposal are reliable, easily operated, commonly available, and typically require minimal O&M cost. Minimal permitting is required for the implementation and operation of soil excavation and disposal. In addition, excavation and disposal will also provide a shorter duration to achieve cleanup standards and goals compared to the other alternatives.

Table 5-3
Cost Comparison for Combined Soil and Free Product Remedial Alternatives

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

COMBINED ALTERNATIVE	TOTAL PRESENT COST
Passive Skimming/Bailing	$449,000
MDES	$87,000
Soil Excavation and Off-site Disposal	$153,000
Soil Excavation and On-site Treatment	$190,000

Note: See Appendix C for detailed cost estimates for the soil and free product remediation alternatives.

6.0 REMEDIAL SYSTEM DESIGN

The preferred remedial alternative presented in this RAP was selected based on it being a technical, cost, and schedule effective method for recovery and/or treatment of hydrocarbons within the vadose zone at the site. It is also the only technology that provides a short-term reduction in risk. The potential remedial technologies and process options for soil remediation and free product removal were identified and screened, and the results were presented in Section 5.0. The selected alternative is soil excavation and off-site disposal with free product collection during dewatering.

6.1 TECHNOLOGY DESCRIPTION AND SYSTEM DESIGN

Major components of soil excavation and disposal/treatment include the following:

- Site preparation (pre-excavation activities)
- Excavation and transportation to off-site location
- Backfill and compaction
- Site restoration and/or grading

Figure 6-1 presents the boundaries of the excavation area. As indicated on Figure 6-1, the soil located between 10 and 16 ft bls within the inner boundary marked (soil to be excavated and disposed), will be considered petroleum-impacted soil. Since the contaminated soil is located at 10 to 16 ft bls, only the contaminated soil will be disposed off site. The uncontaminated soil above shall be returned to the excavation as backfill. Additional soil shall be excavated to provide the safety sloping required to achieve the required depth as indicated on Figure 6-1. Based on the soil plume boundary and an average thickness of 10 ft to 16 ft bls, (16 ft bls, as a result of over-excavation 1 ft below the water table) the estimated volume of soil to be disposed is 500 yd^3 (see Appendix A).

6.1.1 <u>Site Preparation (Pre-Excavation Activities)</u>

Prior to excavation activities, pre-excavation soil characterization sampling shall be completed in order to define the extent of excavation. Characterization soil samples shall be shipped to a fixed-based laboratory and analyzed for the gasoline and kerosene analytical group. At a minimum, characterization soil sampling shall be performed in accordance with the Florida regulatory guidelines provided for UST removals.

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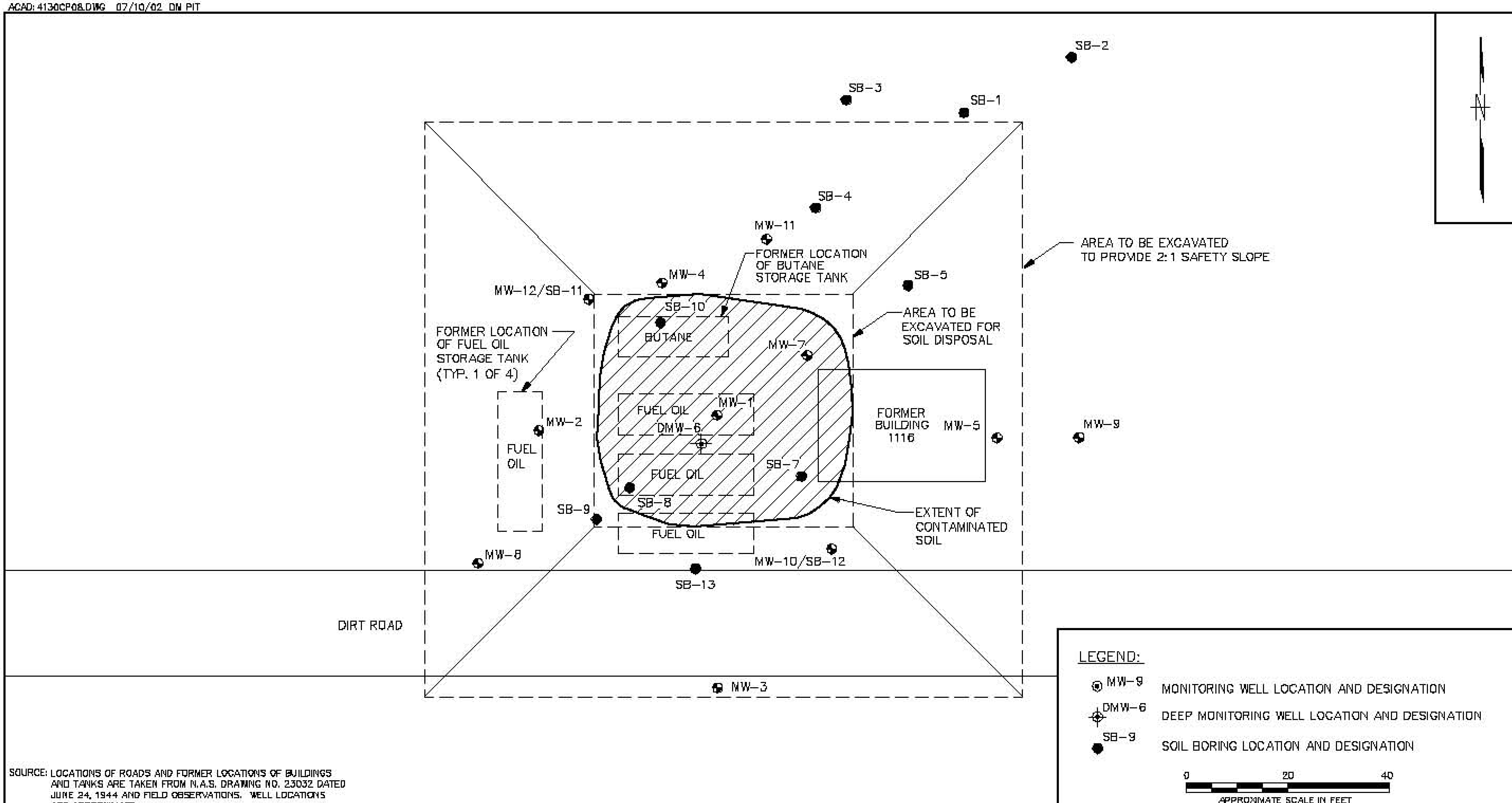

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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COST/SCHED-AREA
SCALE AS NOTED

EXCAVATION BOUNDARIES
REMEDIAL ACTION PLAN
SITE 1116
OUTLYING LANDING FIELD BRONSON
PENSACOLA, FLORIDA

CONTRACT NO. 4130
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 6-1 REV. 0

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Prior to excavation activities, the limits of excavation shall be surveyed and staked in the field. The designated areas shall be flagged and boundaries will be established by florescent yellow caution tape to define the exclusion zone.

Prior to beginning any excavation activities or any intrusive work, the designated areas shall be checked for any substructures, utility lines, and other potential interference. A professional survey to verify locations of site utilities was not conducted for this report; however, active or inactive subsurface obstructions may include electric lines, piping for sewer, gas distribution, etc.

Monitoring wells within the limits of the excavation shall be properly abandoned prior to excavation activities. The monitoring wells that are abandoned shall be abandoned in accordance with all state and local requirements, this typically involves grouting from the bottom of the well to approximately 2 ft bls with bentonite-cement grout. The grout shall be pumped from the bottom of the borehole to the top by pressure grouting using a tremie pipe. The total depth of the well shall be sounded prior to sealing, and the level of grout shall be monitored during pumping with a weighted tape to insure complete placement of the grout. The grout level shall be checked 24 hours after emplacement and refilled to replace any losses due to settling.

The following wells shall be abandoned: MW-1, DMW-6, and MW-7. Additionally, monitoring wells MW-2, MW-3, MW-4, MW-5, MW-8, MW-10, MW-11, and MW-12 may be removed if they interfere with slope stabilization of the excavation hole.

The existing concrete foundation from Building 1116, considered clean construction debris, is to be demolished and disposed of in accordance with standard practices.

The contractor will prepare all required planning documents, such as an Erosion and Sediment Control Plan, Health and Safety Plan, Removal Action Plan, and Soil Disposal Plan and also obtain all necessary permits.

6.1.2 Excavation and Off-site Transportation

Soil excavation shall be within the area shown on Figure 6-1. Soil excavated from 10 to 16 ft bls in the depicted area shall be handled as petroleum contaminated soil. Additional excavation will be required to provide the 2:1 slope or as required by OSHA. However, shoring may be used in lieu of the sloping of the excavation sidewalls. Excavation will be conducted using standard earthmoving equipment. All operators shall be certified to be in compliance with 29 Code of Federal Regulations 1910.120 health and safety requirements.

Excavation to a depth approximately 1 ft below the groundwater table may be required to implement free product removal where free product is encountered. Free product that is exposed in the open excavation shall be recovered to the extent practicable by using high vacuum suction, product absorbing socks, and over excavation.

The excavation shall have sides sloped or be shored in accordance with applicable standards to prevent unstable conditions during excavation that could pose hazards to personnel. Stormwater run-on and run-off controls shall be implemented to prevent migration of sediment or contaminated stormwater during site activities.

The limits of excavation shown on Figure 6-1 are representative of the footprint of the free product and soil contaminant plume. The soil in the excavation area is described as silty sand and the sides of the excavation should naturally slope. Excavations will be cut back and sloped to allow for safe entry into the excavation in accordance with OSHA regulations. Open excavations will be protected with suitable barriers, such as, temporary fences. The tops of the excavation will be provided with a berm of clean soil to minimize the amount of run-on that can enter the excavation.

Free product floating on the groundwater table at the bottom of the excavation shall be removed. Collected water, free product, and materials will be disposed of off site.

If it is necessary to temporarily stockpile contaminated soil, the stockpile will be provided with erosion and sedimentation control such as silt fences or hay bails. Captured sediment from the contaminated soil stockpiles must be treated. Contaminated soil and treated soil stockpiles will be placed on an impermeable surface, or liner, of a 5-mil thickness minimum. Stockpiles will be graded to promote flow toward the excavation. Water and free product seeping out of the stockpiles of contaminated soil must be captured for treatment or disposal. Stockpile locations selected by the contractor are subject to review and approval.

The total volume of excavation to include the removal of contaminated soil and adequate side sloping is estimated to be 2538 yd^3. Based on the actual water table at the time of excavation, the total volume may vary.

6.1.3 Site Restoration

Backfill of excavated areas may be performed simultaneously with excavation if the confirmatory sampling has determined that the excavation in the particular area is complete. All water from the excavation during soil replacement shall be removed as necessary to accommodate compaction. To minimize recontamination of the backfill soil by groundwater, a low (i.e., less than 0.5 percent) organic content soil will be used as backfill material. Backfill material will be well-graded granular soil consisting of silica sand or other approved materials. Backfill will contain less than 0.5 percent organic carbon as measured in accordance with American Society for Testing and Materials (ASTM) D2074-87. Moisture-density testing will be in accordance with ASTM D698-91. Certification that the borrow source is free of petroleum hydrocarbon contamination is required from the borrow source prior to delivery. Backfill material will be placed in 12-inch lifts and compacted to 90 percent standard Proctor density. Compactive effort shall be no less than four passes of the earth-moving equipment. Approximately 500 yd^3 of backfill material shall be required. If excavation and backfill operations are performed simultaneously, a separation distance shall be maintained between the toe of the slope for excavation and the toe of the slope for backfill to prevent or minimize cross-contamination by direct contact with free product or excessively contaminated soil. After all disturbed areas of excavation have been successfully backfilled, the site shall be graded to drain. The excavation shall be graded to match surrounding elevations, and the grade will be sloped from the center outward so that runoff will flow away from the backfilled area. The slope shall be blended into the surrounding areas, and the grade changes shall be gradual. If necessary, prior to backfilling an appropriate amount of 1½- to 2-inch diameter crushed stone may be provided as a bottom layer in order to stabilize saturated material resulting from groundwater encroachment into the open excavation.

In addition, grassy areas disturbed during the excavation shall be repaired by hydro-seeding. The road adjacent to the site is unpaved and shall be restored to original condition during backfill operations.

Following completion of the excavation, backfill, and site restoration, groundwater monitoring wells that were abandoned or destroyed during remedial activities shall be replaced as determined necessary to complete the post-remedial groundwater monitoring. A final survey shall be performed to identify the limits of excavation, final grading elevations, and new monitoring well locations. An as-built site plan shall be prepared for the excavation project area. A completion report consistent with the requirements of Chapter 62-770.300, FAC shall be provided summarizing volumes removed, disposed, replaced, site activities, and confirmatory soil sampling results.

7.0 POST REMEDIAL ACTION MONITORING

After the completion of soil and free product remediation actions, an assessment of dissolved-phase groundwater contamination will be conducted. Hence, no post-remedial action monitoring will be completed following the completion of excavation activities.

8.0 REMEDIAL ACTION PLAN SUMMARY

The Remedial Action Plan Summary form is included in Appendix F.

REFERENCES

Environment Canada, 1996. "Bunker C Fuel Oil and the Irving Whale", March.

FDEP (Florida Department of Environmental Protection), 1999. Petroleum Contamination Site Cleanup Site Criteria, Florida Administrative Code, Chapter 62-770. August.

NPWC (Navy Public Works Center), 1997. *Contamination Assessment Report – Site 1116, U.S. Navy Outlying Landing Field (OLF) Bronson, Pensacola, Florida*. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. March.

TtNUS (Tetra Tech NUS, Inc.), 2001. *Site Assessment Report Addendum, For Site 1116 – Outlying Landing Field (OLF) Bronson, Pensacola, Florida*. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. March.

TtNUS, 2002. *Site Assessment Report Addendum II, For Site 1116 – Outlying Landing Field (OLF) Bronson, Pensacola, Florida*. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. February.

USEPA (U.S. Environmental Protection Agency), 1994. *How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank sites, A Guide for Corrective Action Plan Reviewers*. USEPA 510-B-95-007. October.

USEPA, 1996. *How To Effectively Recovery Free Product at Leaking Underground Storage Tank Sites, A Guide For State Regulators*, USEPA 510-R-96-001. September.

APPENDIX A

SOIL CALCULATIONS

TABLE A-1

ESTIMATED MASS OF CONTAMINANTS IN VADOSE ZONE SOIL MATRIX

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

INPUT:

Estimated Impacted Area	**2,250**	**ft^2**		
Estimated Average Impacted Thickness	**6**	**ft**		
Estimated Impacted Volume	**13,500**	**ft^3**		
Average TRPH Concentration[1]			**110**	**mg/kg**

CALCULATIONS:

Estimated Mass of Impacted Unsaturated Soil	**1,397,088**	**lbs**	**635,040**	**kg**
Estimated Mass of Hydrocarbons in Soil	**154**	**lbs**	**70**	**kg**

NOTES

[1] Highest TRPH result was used to determine average.

TPH - Total petroleum hydrocarbons
mg/m^3 - milligram per kilogram
ft = feet
ft^2 = square feet
ft^3 = cubic feet

kg = kilograms
lbs = pounds

Assumed density of silty soil 1.4 tons per cubic yard. ("Pocket Ref", 1994)

Estimated Mass of Impacted Unsaturated Soil = impacted volume (ft^3) x (1 yd^3/27 ft^3) x (1.4 tons/1 yd^3) x (907.2 kg/ton)

Estimated mass of hydrocarbons = hydrocarbon concentration (mg/kg) x mass of impacted soil (kg) x (kg/10^6 mg) x (2.2 lb/kg)

PREPARED BY:________________________________ **CHECKED BY:** ________________________________
Date

APPENDIX B

FREE PRODUCT VOLUME CALCULATIONS

Table B-1
Estimating Thickness and Volume of Free Product

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

Method of de Pastrovich (1979)

$$H_f = \frac{H_o\,(\rho_w - \rho_o)}{\rho_o}$$

Where: H_f = thickness of mobile hydrocarbon in the adjacent formation
H_o = hydrocarbon thickness measured in well
ρ_ω = the density of water
ρ_o = the density of the liquid hydrocarbon

H_o = 48.46 cm
ρ_ω = 1 gm/cm^3
ρ_o = 0.974 gm/cm^3

$$\mathbf{H_f} = \frac{48.46(1 - 0.974)}{0.974} = \boxed{1.29}\ \text{cm} \qquad \boxed{0.042}\ \text{ft}$$

Assumptions:
- density of H_2O is at STP
- density of Bunker C fuel oil 0.974 gm/cm^3 (USEPA 1996)
- product measured = average of MW-1 and MW-7 (from latest sampling event)

This method depends only upon the density of the liquid hydrocarbon relative to the density of water. For example, a hydrocarbon liquid with a specific gravity of 0.8, and assuming that the specific gravity of water is equal to 1, the hydrocarbon thickness in the formation (the actual thickness) is only one-fourth the thickness measured in the well (the apparent thickness). The principal weakness of this method is that it does not account for the effects of different soil types. In general, the ratio of apparent to true free product thickness increases as soil grain size decreases. Thus, this method may be more accurate in finer grained soil (e.g., silt, clay) than coarser-grained soil (e.g., sand, loam).

Estimated Volume of Total Free Product in Subsurface

Assumptions:
Estimated area of free product = 2,250 ft^2 (TtNUS, 2002)
Actual thickness of product in subsurface = 1.30 cm or 0.043 feet (see above)
Effective porosity = 0.25 (NPWC, 1997)

Volume of product area = area x thickness
2250 ft^2 x 0.042 ft = 95.49 ft^3

Free product volume = volume of product area x effective porosity
95.49 ft^3 x 0.25 = 23.87 ft^3

Gallons of free product = free product volume x 7.4794 gallons/ft^3
23.87 ft^3 x 7.48 gallons/ft^3 = 178.57 gallons

Total volume of free product in subsurface = **179 gallons**

Table B-1 (cont.)
Estimating Thickness and Volume of Free Product

Remedial Action Plan
Site 1116, Outlying Landing Field Bronson
Pensacola, Florida

INPUT:

L	**Estimated Length of Plume**	50	ft
W	**Estimated Width of Plume**	45	ft
H_o	**Measured Thickness of Free Product In Well**	1.6	ft
r_o	**Estimated Density of Free Product**	0.974	g/cm^3
r_w	**Density of Water**	1	g/cm^3
h_a	**Estimated Distance From Water Table to Free Product**	0	ft

CALCULATIONS:

A	**Area of Plume**	2250	ft^2
H_f	**Thickness of Free Product In Adjacent Formation**	0.0416	ft
V	**Volume of Free Product**	700	gal

From Method of Ballestros et al. (1994)
(See "How To Effectively Recover Free Product At Leaking Underground Storage Tank Sites" (EPA 1996)

NOTES

A = L (ft) x W (ft)

$H_f = ((1-(\rho_o/\rho_w)) \times H_o) - h_a$ (ft)

$V = A\ (ft^2) \times H_f\ (ft) \times (7.48\ gal/ft^3)$

PREPARED BY: ________________________ **CHECKED BY:** ________________________
Date

APPENDIX C

ESTIMATED ALTERNATIVE COSTS

Table C-1
Excavation and Disposal or On-site Treatment Cost

Remedial Action Plan
Site 1107, Outlying Landing Field Bronson
Pensacola, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)	
DIRECT COSTS	
Site Preparation and Mobilization	$18,000
Workplan and Health & Safety Plan	$6,000
Field Sampling & Oversight	$14,000
Summary Data Report	$7,000
Excavation Activities	$50,000
Off-site Disposal of Soil	$37,000
On-site Treatment by LTTD	$71,000
Site Restoration and Demobilization	$7,000
Costs for Excavation and Off-site Disposal	$139,000
(Sum of Direct Costs minus Onsite Treatment)	
Indirect Costs	
Contingency (@20%)	$14,000
Total Costs for Excavation and Off-site Disposal	**$153,000**
Costs for On-site Treatment by LTTD	$173,000
(Sum of Direct Costs minus Disposal Cost)	
Indirect Costs	
Contingency (@20%)	$17,000
Total Costs for Excavation and On-site Treatment	**$190,000**

Table C-1 (Continued)
Excavation and Disposal or On-site Treatment Cost

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation and Mobilization				
Silt fencing/signs/misc. materials	1	ls	$5,000	$5,000
Decontamination pad	1	ls	$1,000	$1,000
Pressure washer (assume base will provide decon water)	1	mo	$1,050	$1,050
Pick-up truck	21	day	$35	$735
General site mob/demob	1	ls	$1,000	$1,000
Site clearing of trees (Dozer D7 with U-blade, including operator)	8	hr	$141	$1,128
Wood Chipper	0.5	acre	$1,925	$963
Foreman (4 weeks * 50 hr/week) Assume 10 hour days	200	hrs	$34	$6,800
Foreman oversight for the entire field event, prep, excavation, demob, etc.				
Total For Site Preparation and Mobilization				**$17,676**
Site Sampling & Oversight				
Workplan and Health & Safety Plan				
Jr. Level Engineer	40	hrs	$45	$1,800
Sr. Scientist	16	hrs	$90	$1,440
Word Processor	16	hrs	$35	$560
CADD	32	hrs	$40	$1,280
ODCs	1	ls	$500	$500
Total for Workplan and Health & Safety Plan				**$5,580**
Field Sampling & Oversight				
Jr. Level Geologist	150	hrs	$35	$5,250
ODCs	1	ls	$1,000	$1,000
Excavation extent characterization sampling (assume 20 each)				
RCRA 8 Metals	20	ea	$110	$2,200
VOCs 8260	20	ea	$70	$1,400
PAH 8310	20	ea	$90	$1,800
TRPH FL-PRO	20	ea	$60	$1,200
Sampling equipment	1	ls	$1,000	$1,000
Total for Field Sampling & Oversight				**$13,850**
Summary Data Report				
Jr. Level Engineer	20	hrs	$45	$900
Senior Scientist	8	hrs	$80	$640
Mid-level Engineer	60	hrs	$60	$3,600
Word Processor	16	hrs	$35	$560
CADD	32	hrs	$40	$1,280
ODCs	1	ls	$500	$500
Total for Summary Data Report				**$7,480**

Table C-1 (Continued)
Excavation and Disposal or On-site Treatment Cost

Excavation				
Excavation of Soil:				
(assume two trackhoes 10 hrs/day, one for 10 days, the other for 20 days)				
Trackhoe operator labor included in costs				
2.5 yd^3, Track Loader	300	hrs	$116	$34,839
Dewatering (Assume vacuum truck on site for 10 days, collection, transport, and disposal of contaminated water)				$5,000
Laborers (2 for assistance with excavation activities)	400	hrs	$24	$9,600
Compaction tests	1	ls	$1,000	$1,000
Subtotal for Excavation				**$50,439**
Off-site Disposal of Soil				
Common fill for backfill (load and haul) includes spreading and compaction	500	yd^3	$8	$4,000
Transportation, and disposal of contaminated soil to a Subtitle D Facility	700	ton	$47	$32,550
Cost derived from quote from Andy Adams of Waste Transportation & Disposal Services				
(1-800-901-0081) cost quoted was $46.50/ton with treatment at an off-site soil burner.				
Subtotal for Off-site Disposal of Soil:				**$36,550**
On-site Treatment of Soil by LTTD				
Permitting/Engineering for Site	1	ea	$37,131	$37,131
(permitting site with treatability studies, interface with regulators)				
Minimum Mob/Demob Charge for Small Portable LTTD Unit	1	ea	$5,304	$5,304
Direct firing, Rental and Operations Cost to treat soil	700	ton	$23	$16,072
Front end loader with operator				
(for moving soil)	200	hr	$65	$12,972
Subtotal for soil treatment by LTTD				**$71,479**
Site Restoration and Demobilization				
Hydroseeding	1	acre	$503	$503
Demobilization of Equipment	1	ls	$1,000	$1,000
Drill and install 11 - 2" PVC monitoring wells, each 19 feet deep	209	ft	$28	$5,846
Subtotal Site Restoration and Demob:				**$7,349**

Assumption:
No repair to current unpaved road beyond backfill w/compaction specified herein. No replacement of slab to the east of contaminated area.

Table C-2
Passive Skimming/Bailing Alternative

Site 1116, Outlying Landing Field, Bronson
Remedial Action Plan
Pensacola, Florida

Estimated by: RLM
Checked by:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Free Product Removal/Skimming System		$9,000
Total Direct Costs		$9,000
INDIRECT COSTS		
Health and Safety, HASP		$6,000
Sampling and Analysis Plan		$8,000
Total Indirect Costs		$14,000
Total Capital Costs (Direct + Indirect)		$23,000
OPERATIONS AND MAINTENANCE		
Treatment System O&M		$25,000
Annual Groundwater Monitoring		$42,000
Quarterly Status Reports		$27,000
Total Annual O&M		$94,000
PRESENT WORTH OF O&M (7%, 5 yrs)	($385,419)	$385,000
Total Capital and O&M Cost		$408,000
Contingency (10%)		$41,000
TOTAL COST		**$449,000**

Table C-2 (Continued)
Passive Skimming/Bailing Alternative

Estimated by: RLM

Checked by:

Free Product Recovery by Passive Skimming/Hand Bailing

INITIAL COSTS	Quantity	Unit	Unit Cost	Total Cost
Free Product Removal/Skimming System				
Skimmer, 1" Diameter, 47" L, 0.10 gal capacity	5	ea	$367	$1,835
Material Storage Building (for storage of drums & equipment)	1	ea	$3,038	$3,038
Labor				
1 Technician	10	hrs	$35	$350
1 Jr. level Engineer	10	hrs	$45	$450
Sub-total for Skimming System				$5,673
Additional Well Installation				
Mob/demob	1	ea	$500	$500
2" PVC Monitoring well installation	15	ft	$28	$420
IDW (1 drum each for soil cuttings and well development)	2	ea	$150	$300
Labor				
1 Technician (well installation)	8	hrs	$35	$280
1 Jr. level geologist (well installation)	8	hrs	$45	$360
1 Technician (well development)	8	hrs	$35	$280
Sub-Total For Well Installation				$1,360
Sub-Total For Initial Costs				$7,033
Engineering and Design (20%)				$2,110
Total for Initial Costs				**$9,142**
Treatment System O&M (Annual)				
System Maintenance				
Labor:				
Technician, 30 hrs per month	360	hrs	$30	$10,800
Sr. Engineer, 2 hrs per month	24	hrs	$90	$2,160
Project Mgr, 8 hrs per month	96	hrs	$100	$9,600
Purchase drums for product storage	4	ea	$50	$200
Recovered product drum disposal, 4 per year	4	ea	$150	$600
Truck ($35 each trip, 4 trips a month or 48 trips a year)	48	ea	$35	$1,680
Total Annual O&M				**$25,040**

Table C-2 (Continued)
Passive Skimming/Bailing Alternative

Estimated by: RLM

Checked by:

Health and Safety Plan for Monitoring Activities				
Labor:				
H&S Supervisor	16	hrs	$60	$960
Mid-level Geologist/Scientist	40	hrs	$45	$1,800
Word Processor	16	hrs	$35	$560
CADD	32	hrs	$40	$1,280
Editor	8	hrs	$60	$480
Copying: 50 pgs x 25 copies	1250	page	$0.10	$125
Binding/shipping, 25 copies	25	ea	$20	$500
Total HASP				**$5,705**
Sampling and analysis Plan (SAP) for Monitoring Activities				
Labor:				
Jr.-Level Geologist/Scientist	80	hrs	$45	$3,600
Senior Geologist	16	hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)				
Word Processor	16	hrs	$35	$560
CADD	32	hrs	$40	$1,280
Editor	8	hrs	$60	$480
Copying: 50pgs x 25 copies	1250	page	$0.10	$125
Binding/shipping, 25 copies	25	ea	$20	$500
Total SAP				**$7,825**
TOTAL INDIRECT COSTS				**$13,530**
Groundwater Monitoring per Event				
Assumptions:				
Use of existing wells				
Labor				
Staff Technician	40	hrs	$35	$1,400
Staff Geologist	40	hrs	$40	$1,600
Car rental: two days per event	2	ls	$46	$92
Total labor:				$3,092

Table C-2 (Continued)
Passive Skimming/Bailing Alternative

Estimated by: RLM

Checked by:

<u>Lab analysis:</u>				
Volatile Organics, Method 8260, assume 12 wells, 3QC	15	ea	$90	$1,350
PAHs, Method 8310, assume 12 wells, 2 QC	14	ea	$90	$1,260
TRPH (FLPRO) assume 12 wells, 2 QC	14	ea	$60	$840
Natural Attenuation Parameters				
Methane, Ethane, Ethene, assume 12 wells	12	ea	85	$1,020
Total Iron, assume 12 wells	12	ea	15	$180
Dissolved Iron, assume 12 wells	12	ea	15	$180
Sulfate, assume 12 wells	12	ea	15	$180
Sulfides, assume 12 wells	12	ea	15	$180
Nitrates, assume 12 wells	12	ea	15	$180
Nitrides, assume 12 wells	12	ea	15	$180
Orthophosphate, assume 12 wells	12	ea	15	$180
Chloride, assume 12 wells	12	ea	15	$180
Total lab analysis:				$5,910
<u>Expendables and Equipment</u>				
Gloves (2 boxes per event)	2	box	$10	$20
Teflon tubing (400 feet per event)	400	ft	$1.45	$580
Silicon tubing (50 feet per event)	50	ft	$1.55	$78
Shipping and supplies (tape, bubble wrap, ice)	1	ls	$250	$250
Pumps for purging wells, 2 pumps, 2 days rental	4	days	$35	$140
First Aid kit	1	ls	$50	$50
Rental of Horiba U-22 meter for conductivity, Oxidation-Reduction Potential, pH, dissolved oxygen, turbidity, and temperature.	2	days	$65	$130
Oil water interface probe	4	days	$25	$100
Disposal of purge water, assume nonhaz., drums	1	ls	$250	$250
Total expendables and equipment rental:				$1,598
<u>Total Costs for One Groundwater Monitoring Event</u>				**$10,600**
Quarterly Status Reports				
(assume four status reports each year)				
1 Jr. Level Geologist 16 hrs	64	hrs	$45	$2,880
1 Senior Geologist 4 hrs	16	hrs	$80	$1,280
Technical Expert 2 hrs	8	hrs	$75	$600
CAD Technician	8	hrs	$40	$320
Production:	1	ls	$100	$100
Word processing 8 hrs	32	hrs	$35	$1,120
Editor 2 hrs	8	hrs	$60	$480
Total Annual Costs for Status Reports				**$6,780**

Table C-3
Mobile Dual-Phase Extraction (MDES)

Site 1116, Outlying Landing Field, Bronson
Remedial Action Plan
Pensacola, Florida

Estimator: RLM
Checked by:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS	
Free Product Recovery Via Mobile Dual-Phase Extraction	$49,000
MDES Costs for Oversight and Free Product Monitoring	$5,000
Total Direct Costs	$54,000
INDIRECT COSTS	
Health and Safety, HASP	$6,000
Engineering and Administration, SAP	$8,000
Total Indirect Costs	$14,000
Total Capital Costs (Direct + Indirect)	$68,000
OPERATIONS AND MAINTENANCE	
Status letter Reports	$3,000
Reporting, Final Site Activities/System Operation Report:	$8,000
Total O&M costs	$11,000
Total Capital and O&M Cost	$79,000
Contingency (20%)	$8,000
TOTAL COST	**$87,000**

Table C-3 (Continued)
Mobile Dual-Phase Extraction (MDES)

Free Product Recovery by MDES

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Free Product Recovery Via Mobile Enhanced Multi-Phase Extraction				
8 hour MDES event	6	ea	$3,165	$18,990
Off-gas treatment (truck-based, if necessary)	6	ea	$1,500	$9,000
Over time for MDES rig	6	hrs	$450	$2,700
Oily water removal, 6 events @ 2100 gal/event	12600	gal	$0.16	$2,016
Sub-total for initial costs				$32,706
Labor OH (30%)				$9,812
Engineering and Design (20%)				$6,541
Total Direct Costs				**$49,059**
MDES Costs for Oversight and Free Product Monitoring				
Oversight by staff engineer during MDES event (10 hrs per event)	60	hrs	$45	$2,700
Free product monitoring by technician	48	hrs	$30	$1,440
(Assume 4 hrs once every two weeks for 6 month project duration)				
Rental of free product interface probe	12	day	$24	$292
Pickup Truck Rental	12	day	$35	$420
Total				**$4,852**
Health and Safety Plan				**$5,705**
(See Table C-2)				
Sampling and Analysis Plan				**$7,825**
(See Table C-2)				
Status Letter Reports				
(assume two reports, one after two events and one after the four events)				
1 Jr. Level Geologist	32	hrs	$45	$1,440
1 Senior Geologist	8	hrs	$80	$640
Technical Expert	4	hrs	$75	$300
CAD Technician	4	hrs	$40	$160
Production:	1	ls	$100	$100
Word processing	16	hrs	$35	$560
Editor	4	hrs	$60	$240
Total				**$3,440**
REPORTING, Final Site Activities/System Operation Report:				
1 Jr. Level Geologist	100	hrs	$45	$4,500
1 Senior Geologist	16	hrs	$80	$1,280
Technical Expert	6	hrs	$75	$450
Production:				
Word processing	12	hrs	$35	$420
Editor	8	hrs	$60	$480
CADD Operator,	8	hrs	$40	$320
Reproduction: 100 pgs @ 20 copies	2000	pg	$0.10	$200
Shipping/binding: 20 reports	20	ea	$20	$400
Total report cost:				**$8,050**

APPENDIX D

FDEP REMEDIAL ACTION SUMMARY FORM

DEP Form # 62-785.900(4)
Form Title: Remedial Action Plan Summary
Effective Date: July 6, 1998

Remedial Action Plan Summary

Site Name Site 1116 DEP Site ID No. _

Location Outlying Landing Field Bronson, Pensacola Current Date 8/7/02

Media Contaminated: Groundwater (Soil) **Date of Last GW Analysis** 8/21/01

Sediment Soil Air

Type(s) of Product(s) Discharged:

Gasoline Analytical Group

(Kerosene Analytical Group (Diesel))

Other types of contaminants (solvents, etc.)

List: "Bunker C" Oil

Plume Characteristics:

- Estimated Petroleum Mass (lbs):
  Groundwater ________ Soil 154 lbs
- Area of Plume 2,250 (ft^2)
- Depth of Plume 10-16 (ft)

Groundwater Recovery and Specifications:

- No. of Recovery Wells _____
  Vertical Horizontal
- Design Flow Rate/Well __________ (gpm)
- Total Flow Rate ______________ (gpm)
- Hydraulic Conductivity _________ (ft/day)
- Recovery Well Screen Interval________(ft)
- Depth to Water _________ (ft)

Method of Groundwater Remediation:

Pump-and-Treat:

Air Stripper

Low Profile Packed Tower

Diffused Aerator

Activated Carbon

Primary Treatment Polishing

In Situ Air Sparging - Pressure:__________(psi)

- No. of Sparge Points ______
  Vertical Horizontal
- Design Air Flow Rate/Well ________ (cfm)
- Total Air Flow Rate ______________ (cfm)

Biosparging:

- No. of Sparge Points ______
  Vertical Horizontal
- Design Air Flow Rate/Well ________ (cfm)

Bioremediation:

In Situ Ex Situ

Other ______________________________

Free Product Present: (Yes) No

- Estimated Volume 179 (gal)
- Maximum Thickness 1.65 (in)
- Method of Recovery (check all that apply):

Method of Groundwater Disposal:

Infiltration Gallery Sanitary Sewer

Surface Discharge/NPDES Injection Well

Other ______________________________

Method of Soil Remediation:

Excavation:

Volume to be excavated 500 (yds^3)

Thermal Treatment Land Farming On Site

(Landfill) Bioremediation

Other ______________________________

Vapor Extraction System (VES):

- No. of Venting Wells _____________
  Vertical Horizontal
- VES - Applied Vacuum _______________ (wg)
- Design Air Flow Rate _______________ (cfm)
- Design Radius of Influence _____________ (ft)
- Air Emissions Treatment
  Thermal Oxidizer Catalytic Converter
  Carbon Other ______________

Soil Bioventing:

- No. of Venting Wells ________
  Vertical Horizontal
- Design Air Flow Rate ____________(cfm)

In Situ Bioremediation

Other ______________________________

Natural Attenuation:

Groundwater Soil

- Method of Evaluation:
  Historical Trends
  Site-Specific Parameters

Estimated Time of Cleanup: 30 (days)

- Method of Estimation:
  Pore Volumes (no. of pore vols. =_)
  Exponential Decay (Decay Rate) ______(day^{-1})
  Groundwater Transport Model ____________
  Other Excavation Experience

Estimated Cost:

DEP Form # 62-785.900(4)
Form Title: Remedial Action Plan Summary
Effective Date: July 6, 1998

✓Manual Bailing ✓Skimming Pump

Other AFVR

- Est. Capital Cost (incl. install.) $ 153,000
- Est. O & M Cost (per year) $ 0
- Est. Total Cleanup Cost $ 153,000