

FINAL
SITE ASSESSMENT REPORT
AS-527 AND THE SOUTH END OF
THE AIRCRAFT DIRECT REFUELING AREA
MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

CONTRACT TASK ORDER 0124

Prepared For:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under the:

LANTDIV CLEAN Program
Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

JANUARY 14, 1993

CTO-0124

**FINAL SITE ASSESSMENT REPORT
CERTIFIED PROFESSIONAL GEOLOGIST'S STATEMENT**

I, John Barone, a Certified Professional Geologist in the State of North Carolina, confirm that this report and its contents have been prepared in accordance with the approved Work Plan, dated June 6, 1992 and with the standards of best professional practice.



John Barone
Certified Professional Geologist
State of North Carolina
Registration Number 507

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EXECUTIVE SUMMARY

In accordance with the State of North Carolina's Underground Storage Tank (UST) Regulations, a Site Assessment was performed at the Marine Corps Air Station, New River, Jacksonville, North Carolina. The Site Assessment study was performed to address concerns related to the JP-5 pipeline and the south end of the Aircraft Direct Refueling Area. This area includes a six inch underground pipeline, numerous USTs, as well as all associated piping. This area provides JP-5 aviation fuel to the daily air traffic at the air station.

The field investigation was initiated on June 15, 1992 and concluded on June 24, 1992. Assessment activities included reviewing background information, installation of ten penetrometers, soil and groundwater sampling for analysis, and installation of seven shallow Type II and two deep Type III groundwater monitoring wells. Hydraulic conductivity tests were also performed on two selected monitoring wells.

Analyses performed on 20 soil samples indicated total petroleum hydrocarbon (TPH) concentrations ranging from less than detection limits to 2,577 milligrams per kilogram (mg/kg). Based on the Site Sensitivity Evaluation (SSE), the site has a ranking score of 46 which corresponds to a action limit of 10 mg/kg. Accordingly, one soil sample analyzed exhibited a TPH concentration which exceeds the action limit of 10 mg/kg. TPH analysis indicated the petroleum type detected in the soils is most representative of JP-5 jet fuel.

Volatile organic compounds (VOCs) were detected in all nine of the groundwater samples from monitoring wells and all ten of the groundwater samples from the hydropunches. The nature of the VOCs detected were purgeable aromatic hydrocarbons. Several of the groundwater samples exhibited VOC concentrations which exceed the State of North Carolina's Water Quality Standard (WQS) or Federal Maximum Contaminant Level (MCLs). In addition, one groundwater sample exhibited low concentrations of semivolatiles.

Based on the results of the field and analytical data, there does not appear to be a significant health risk from the impacted groundwater. Drinking water at the base is supplied by production wells which are not located within a 1,500 foot radius of the site. In addition, groundwater in the deeper water-bearing zones at the site (greater than 40 feet) do not appear to have been impacted by volatile or semivolatile compounds. TPH concentrations indicate that soils are above the State action level and potentially contaminated. Consequently, a potential risk exists from dermal contact and/or inhalation of contaminated particulates.

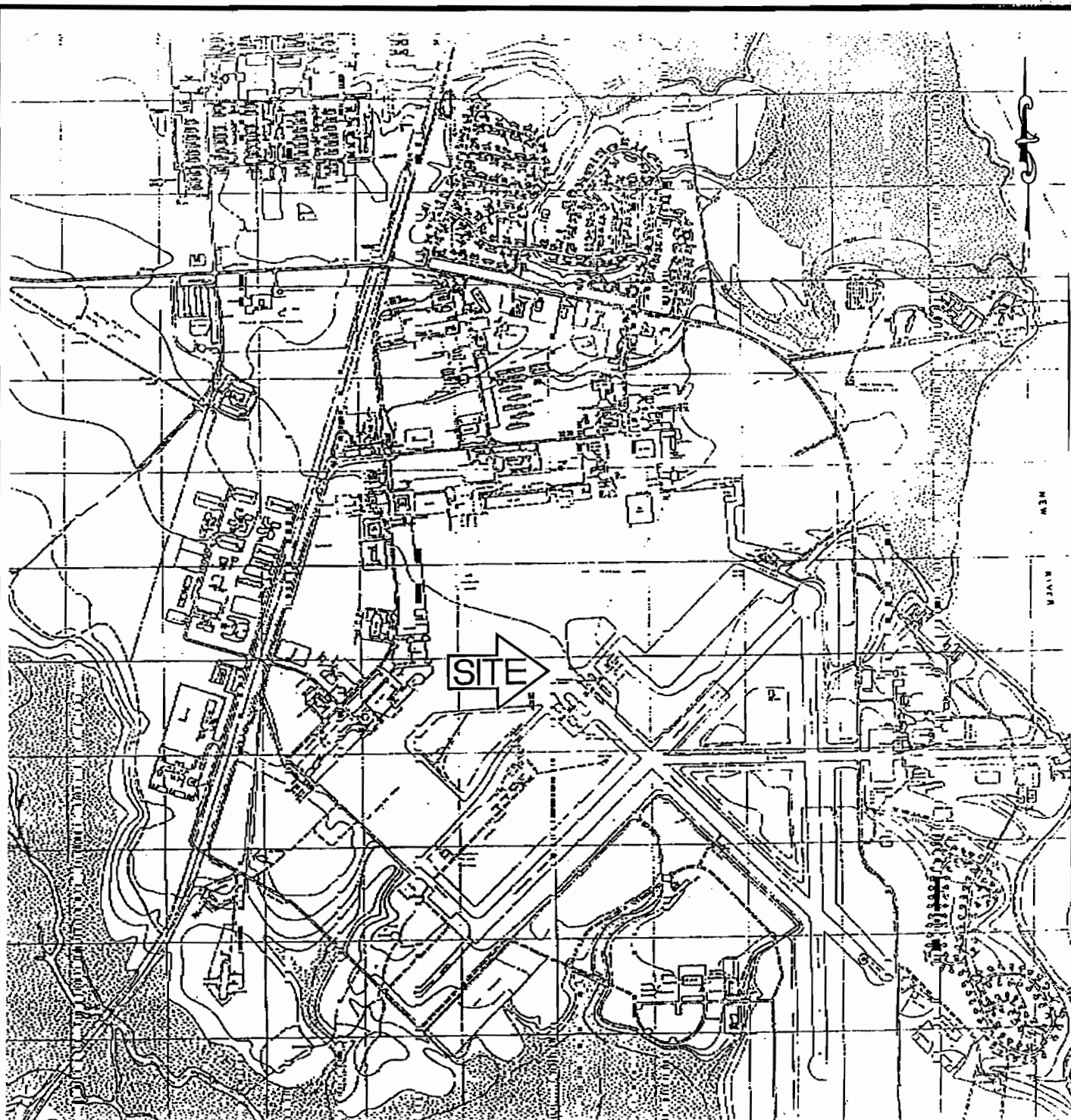
Soil remediation is recommended in the vicinity of the northern portion of the refueling area and along the removed JP-5 pipeline area. However, no remedial alternatives should be discussed until additional work has been completed to further determine the horizontal extent of soil contamination. For groundwater, however, passive remediation is feasible if, following soil remediation, it can be demonstrated that the source of contamination was removed. It is believed that once the source of the contamination is removed (i.e., soils), groundwater quality will be at levels below State WQS or Federal MCLs.

1.0 INTRODUCTION

A Site Assessment was conducted by Baker Environmental, Inc., (Baker) at Building AS-527, which includes the southern end of the Aircraft Direct Refueling Area. The site is located at the Marine Corps Air Station (MCAS), New River, Jacksonville, North Carolina. The location of the site is shown on Figure 1-1.

The specific objectives of the site assessment were to investigate the geologic and hydrogeologic conditions in the area of concern, and to evaluate the extent and severity of potential subsurface fuel contamination or migration resulting from the aircraft refueling area, JP-5 pipeline, and associated below grade valve box (Building AS-527).

Field activities commenced on June 15, 1992 and continued through June 24, 1992. These activities included monitoring well installation (both shallow Type II and deep Type III wells), soil and groundwater sampling, penetrometer installation, field screening of soil for volatile organic vapor, fluid level measurements, and hydraulic conductivity (slug) tests. Standard operating procedures for these activities can be found in Appendix A. The Site Health and Safety Plan related to these field activities is provided in Appendix B.



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SOURCE: U.S.G.S. TOPOGRAPHIC MAP

1 inch = 2000ft.

FIGURE 1-1
AIRCRAFT REFUELING AREA - BUILDING AS-527
SITE LOCATION MAP

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

2.0 SITE HISTORY/PREVIOUS INVESTIGATIONS

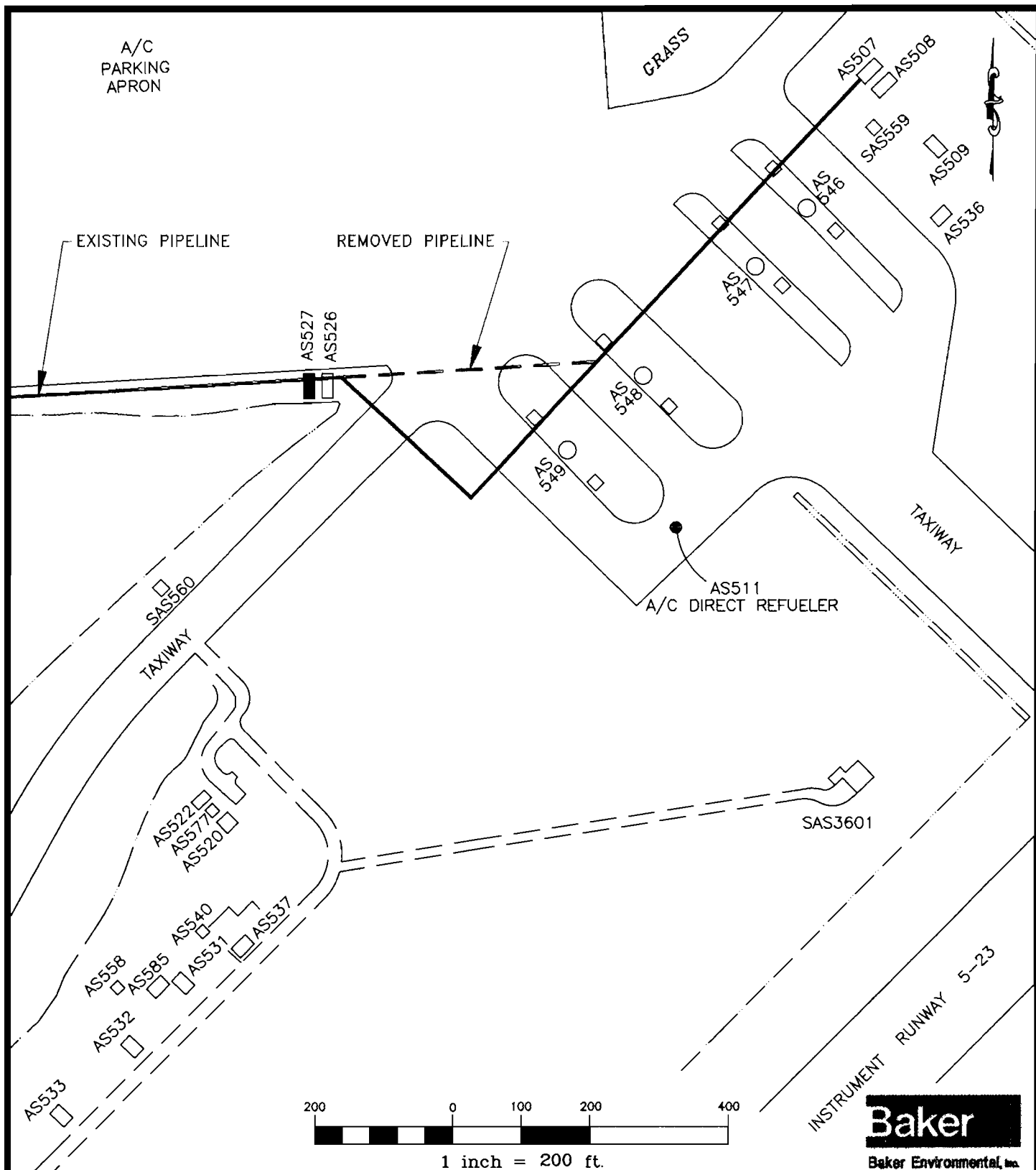
AS-527 is located on the west side of the taxiway near the southern end of the Aircraft Direct Refueling Area. AS-527 itself is not actually a building but a below grade valve box associated with the JP-5 pipeline. This pipeline supplies aviation fuel to the refueling area. Figure 2-1 is a site plan for this area showing the location of AS-527 and surrounding structures.

In December 1991, Baker performed a site assessment for the entire JP-5 pipeline. This additional information is discussed in the Final Site Assessment Report, dated July 9, 1992, for the Campbell Street JP-5 Pipeline (not included in this report). As shown on Figure 2-2, three soil borings, six hydropunches, one deep Type III monitoring well, and three shallow Type II monitoring wells were installed along the southern end of the pipeline in the vicinity of AS-527.

Soil and groundwater samples were collected from these sampling locations. The soil samples were analyzed for total petroleum hydrocarbons (TPH) by EPA Method 5030/3550; groundwater samples from monitoring wells were analyzed by EPA Method 601, EPA Method 602, and EPA Method 625; and hydropunch samples were analyzed by EPA Method 602 only. Tables 2-1, 2-2 and 2-3 list the laboratory analytical results for soils and groundwater for MW-3, MW-4, MW-5, DW-3, and hydropunches 15 through 20.

Soil TPH values from these previously sampled locations ranged from less than detection limits to 893.46 parts per million (ppm) or milligrams per kilograms (mg/kg) in soil boring SB-2. Groundwater results from this area have shown levels of benzene ranging from less than detection limits to 2.42 parts per billion (ppb) or micrograms per liter ($\mu\text{g/L}$) in HP-18.

As part of the Final Site Assessment for the Campbell Street JP-5 Pipeline, a soil gas survey was conducted by Tracer Research Corporation and the results were discussed within this past report.



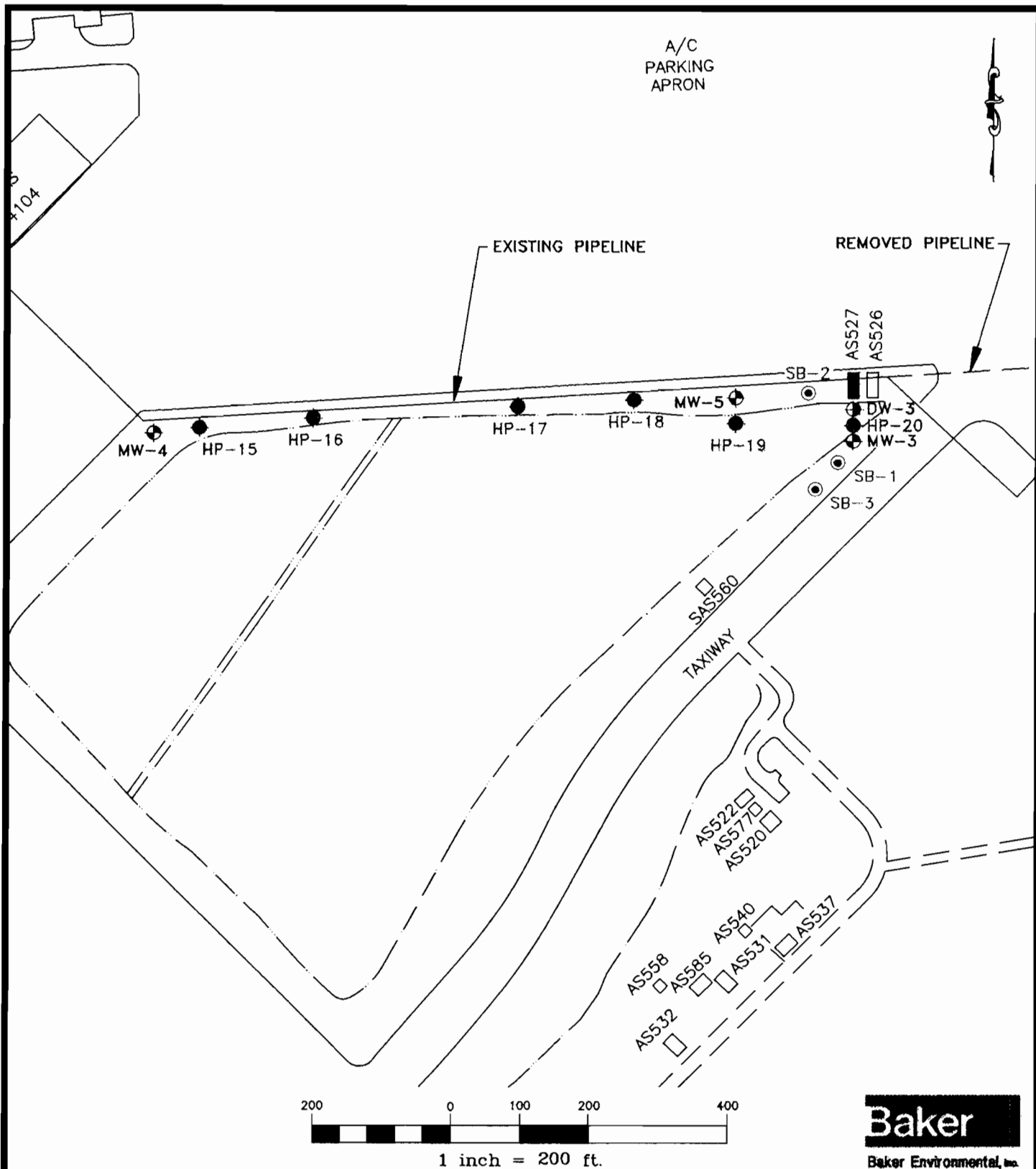
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- BELOW GRADE VALVE BOX
- == ACCESS ROAD
- EXISTING JP-5 PIPELINE
- - - REMOVED JP-5 PIPELINE

SOURCE: LANTDIV, OCT. 1991

FIGURE 2-1
SITE PLAN
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA



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LEGEND

- DW-3 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., DECEMBER 1991
- HP-20 HYDROFUNCH INSTALLED BY BAKER ENVIRONMENTAL, INC., DEC. 1991
- MW-5 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., DECEMBER 1991
- SB-3 SOIL BORING INSTALLED BY BAKER ENVIRONMENTAL, INC., DEC. 1991
- BELOW GRADE VALVE BOX

SOURCE: LANTDIV, OCT. 1991

FIGURE 2-2
LOCATION OF PREVIOUSLY INVESTIGATED
AREA
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

TABLE 2-1

**SUMMARY OF TOTAL PETROLEUM HYDROCARBONS, pH, AND FLASHPOINT ANALYSES
FOR SOIL SAMPLES - DECEMBER 1991**

Boring No.	Field Sample No.	Parameter				Sample Depth (feet, below ground surface)
		Total Petroleum Hydrocarbons (mg/kg)	Petroleum Type ⁽²⁾	pH	Flashpoint (°F)	
MW-3	PL-S-MW3-01	742.06	weathered jet fuel	NA ⁽³⁾	NA	2.0 - 4.0
MW-3	PL-S-MW3-02	795.19	weathered jet fuel	6.01	> 140	4.0 - 6.0
MW-4	PL-S-MW4-01	0.456	weathered jet fuel	NA	NA	2.0 - 4.0
MW-4	PL-S-MW4-02	2.55	weathered jet fuel	4.04	> 140	4.0 - 6.0
MW-4	PL-S-MW8-02 ⁽⁴⁾	NA	not applicable	4.20	> 140	4.0 - 6.0
MW-5	PL-S-MW5-01	-- ⁽¹⁾	NA	NA	NA	2.0 - 4.0
MW-5	PL-S-MW5-02	--	NA	4.9	> 140	4.0 - 6.0
B-1	PL-S-B1-01	792.30	weathered jet fuel	NA	NA	2.0 - 4.0
B-1	PL-S-B1-02	811.00	weathered jet fuel	NA	NA	4.0 - 6.0
B-1	PL-S-B5-01 ⁽⁵⁾	358.07	weathered jet fuel	NA	NA	2.0-4.0
B-2	PL-S-B2-01	--	NA	NA	NA	0.0-2.0
B-2	PL-S-B2-02	893.46	weathered jet fuel	NA	NA	2.0-4.0
B-3	PL-S-B3-01	--	NA	NA	NA	2.0-4.0
B-3	PL-S-B3-02	100.55	weathered jet fuel	NA	NA	4.0-6.0
DW-3	PL-S-DW3-01	626.85	weathered jet fuel	NA	NA	2.0-4.0
DW-3	PL-S-DW3-02	182.93	weathered jet fuel	NA	NA	4.0-6.0

Notes:

- (1) - = Less than method detection limit
- (2) EPA Method 5030/3550 estimated range of petroleum type
- (3) NA = Not analyzed
- (4) Duplicate sample of field sample number PL-S-MW4-02
- (5) Duplicate sample of field sample number PL-S-B1-01

Total Petroleum Hydrocarbons analyzed by EPA Method 5030/3550. pH analyzed by EPA Method SW-9047. Flashpoint analyzed by EPA Method SW-1010. Samples obtained January 8 to 14, 1992.

TABLE 2-2

**SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES COLLECTED FROM MONITORING WELLS
JANUARY 1992**

Parameter/Method	MW-3	MW-4	MW-5	MW-8 ⁽⁷⁾	MW-10 ⁽⁸⁾	DW-3	DW-4	Field Blank	Federal Maximum Concentration Level (µg/L)	NC Water Quality Standard (µg/L)
EPA Method 601										
Purgeable Halocarbons (1)	--	NA	NA	--	NA	NA	NA	--		
EPA Method 602 (2)										
MTBE (3)	--	--	--	--	NA	--	--	--	NE ⁽⁹⁾	50 ⁽¹⁰⁾
Benzene	--	--	--	--	--	1.94	--	--	5.0	1.0
Toluene/EDB (4)	--	--	--	--	--	0.94	8.23	--	1,000/0.05	1,000/0.0005
Ethylbenzene	0.08	--	--	--	--	0.38	--	0.08	700	29
m-, p- Xylene and Chlorobenzene	--	--	--	--	--	3.50	--	--	NE/100	NE/300
o-Xylene	2.15	--	0.66	--	--	--	--	--	NE	NE
1,3 & 1,4-Dichlorobenzene	37.72	--	2.05	--	--	1.18	--	--	NE/75	620/1.8
1,2-Dichlorobenzene	20.61	--	1.63	--	--	0.77	--	--	600	620
Total Xylenes ⁽¹²⁾	2.15	--	0.66	--	NA	3.50	--	--	10,000 ⁽¹¹⁾	400 ⁽¹¹⁾
Total VOCs (6)	60.56	--	4.34	--	NA	8.71	8.23	0.08	NE	NE
EPA Method 625 (6)										
Naphthalene	--	NA	NA	NA	28	NA	NA	--	NE	NE

Notes: -- = Less than method detection limit

NA - Not Analyzed

(1) Purgeable Halocarbons analyzed by EPA Method 601.

(2) Purgeable Aromatics analyzed by EPA Method 602.

(3) MTBE - Methyl Tertiary Butyl Ether.

(4) EDB - Ethylene Dibromide

(5) Sum of total organic volatile compounds detected by EPA Method 602.

(6) Base Neutral/Acid Extractables (BNAs).

(7) Duplicate Sample Obtained from MW-4, Method 602.

(8) Duplicate Sample Obtained from MW-3, Method 625.

(9) NE = Not Established.

(10) MTBE WQS is an Interim Standard.

(11) The MCL and NCWQS for Xylene (Total) Includes Meta, Para, and Ortho Xylenes.

(12) Total Xylenes value includes a combined value for chlorobenzene and m- and p-Xylene.

Table reflects only those parameters which were detected. Groundwater samples obtained on January 15 and 16, 1992.

TABLE 2-3

SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES COLLECTED BY HYDROPUNCH PROCEDURE
DECEMBER 1991

Well No.	Field Sample No.	Parameter (µg/L)								Total Xylenes ⁽¹¹⁾	Total VOCs ⁽⁸⁾
		MTBE ⁽³⁾	1,3 and 1,4-Dichlorobenzene	1,2-Dichlorobenzene	Benzene	Toluene/EDB ⁽⁴⁾	Ethylbenzene	Chlorobenzene and m- & p-Xylenes	o-Xylene		
HP-15	PL-W-H15	0.27	--(1)	--	--	0.65	--	--	--	--	0.92
HP-16	PL-W-H16	0.29	--	--	--	0.65	--	--	--	--	0.94
HP-17	PL-W-H17	0.39	--	--	0.20	0.97	--	--	--	--	1.56
HP-18	PL-W-H18	128.55	1.54	0.95	2.42	3.79	0.14	4.72	0.76	5.48	142.87
HP-19	PL-W-H19	1.08	2.01	3.40	2.13	0.60	0.33	1.86	--	1.86	11.41
HP-20	PL-W-H20	0.16	6.95	16.05	1.96	--	0.39	0.65	0.75	1.40	26.91
HP-20	PL-W-H21 ⁽²⁾	0.31	66.75	156.08	--	0.49	12.08	10.83	6.57	17.40	253.11
Federal MCLs ⁽⁶⁾		NE ⁽⁸⁾	NE/75	600	5.0	1,000/0.05	700	NE/NE	NE	10,000 ⁽¹⁰⁾	NE
NCWQS ⁽⁷⁾		50 ⁽⁹⁾	620/1.8	620	1.0	1,000/0.0005	29	300/NE	NE	400 ⁽¹⁰⁾	NE

Notes:

- (1) -- = Less than method detection limit
 (2) Duplicate sample of field sample number PL-W-H20
 (3) MTBE = Methyl Tertiary Butyl Ether
 (4) EDB = Ethylene Dibromide
 (5) Sum of Total Organic Compounds detected by EPA Method 602
 (6) MCL = Maximum Contaminant Level
 (7) NCWQS = North Carolina Water Quality Standard
 (8) NE = Not Established
 (9) MTBE WQS is an Interim Standard
 (10) The MCL and NCWQS for Xylene (Total) includes Meta, Para, and Ortho Xylenes
 (11) Total Xylene value includes a combined value for chlorobenzene and m- and p-Xylenes.

Samples analyzed by EPA Method 602.

Groundwater samples obtained on December 17 and 18, 1991.

3.0 POTENTIAL RECEPTORS/SITE UTILITIES

3.1 Site Description

AS-527 is a below grade valve box for the JP-5 pipeline. It is located along the west side of the taxiway, in the grass area that borders the aircraft parking area. The five direct refueling lanes are situated west of AS-527, across the taxiway. The piping system for these lanes extends on both the north and south sides into numerous USTs and small support buildings.

The entire refueling area is surrounded by open flat terrain that is the active duty runways for all air traffic. Immediately to the north of AS-527 is a vast concrete aircraft parking area.

3.2 Off-Site Contamination Sources

There are no off-site sources of contamination present in close proximity of the refueling area.

3.3 Potential Receptors/Site Utilities

3.3.1 Local Land Use

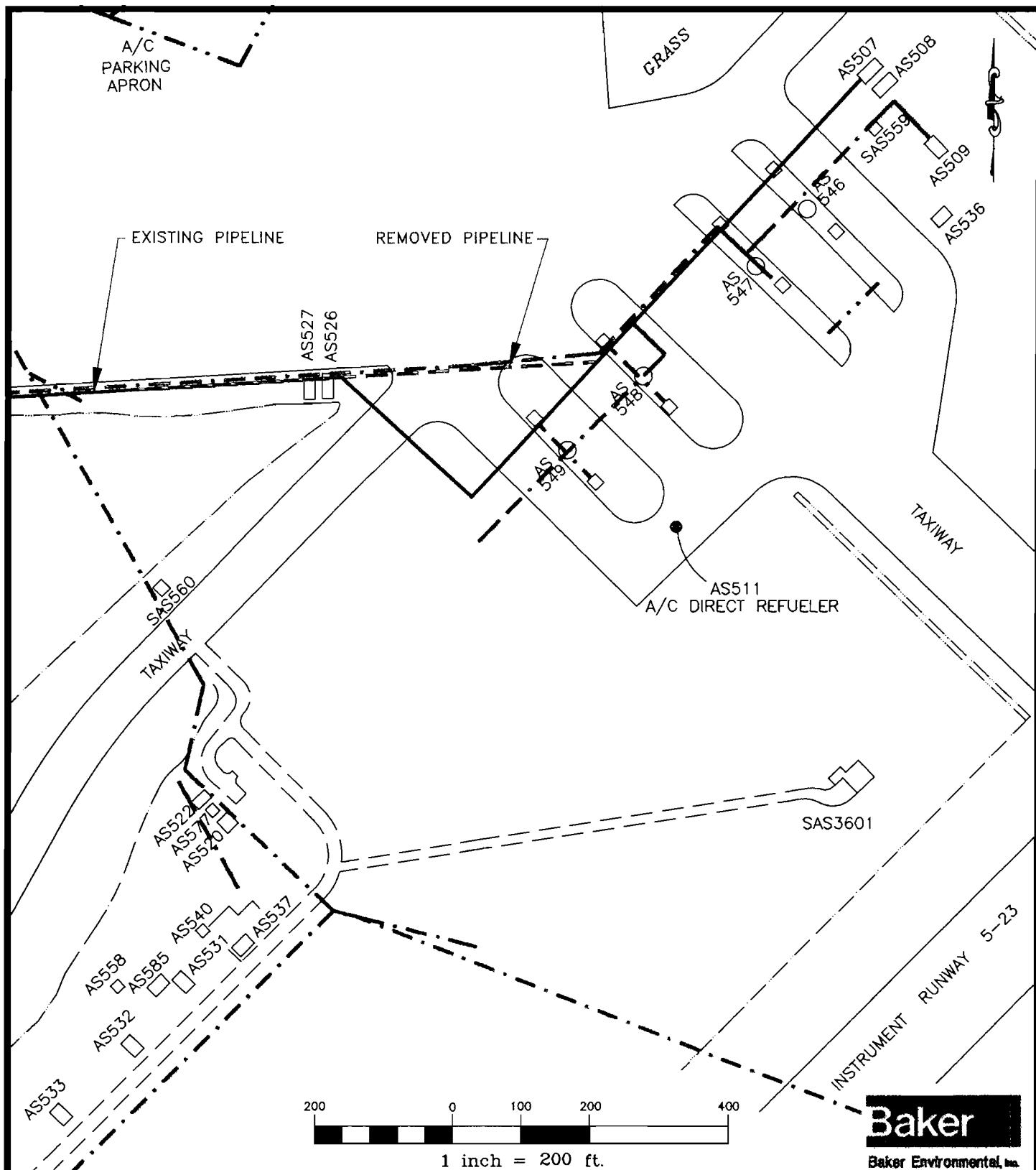
Land cover in the subject area is mixed urban. Local land uses are related to base operations. Undeveloped, wooded land is located to the far south and west of the site. Further, there does not appear to be any other facilities in the immediate vicinity of the site that may store petroleum products other than the JP-5 pipeline that extends to the refueling area.

3.3.2 Inventory of Water Supply Wells

As required by the North Carolina Department of Environment, Health and Natural Resources (DEHNR), information on water supply and observation wells located within a 1,500 foot radius of the site must be identified. This was accomplished by reviewing U.S. Geological Survey (U.S.G.S.) literature (1989). According to published information in the U.S.G.S. document, there are no water supply wells within a 1,500 foot radius of AS-527 or the refueling area.

3.3.3 Site Utilities

Site utilities within the study area, including underground and aboveground, were identified by Activity and Public Works Office (PWO) personnel prior to initiating the field program. As shown on Figure 3-1 water and electrical lines, in addition to the existing and removed JP-5 pipelines, are located in the immediate vicinity of AS-527. Telephone lines as well as the actual pipe layout for the fuel system are also present at this site but are not shown on Figure 3-1 due to unavailable information. Based on known utilities identified at the site, the water and fuel distribution lines appear to be the main underground utilities that may provide a pathway for migration of contaminants. It is believed that these utility lines have been backfilled with more permeable soils than the native soils.



LEGEND

- EXISTING PIPELINE
- - - REMOVED PIPELINE
- . - . APPROXIMATE LOCATION OF ELECTRICAL LINE
- - - - APPROXIMATE LOCATION OF WATER LINE
- . . . APPROXIMATE LOCATION OF STORM DRAIN LINE

FIGURE 3-1
LOCATION OF UNDERGROUND UTILITIES
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

4.0 SITE TOPOGRAPHY AND SURFACE WATER FEATURES

4.1 Surface Water

The Aircraft Direct Refueling Area is situated approximately 1.0 mile west of the New River Estuary. Southwest Creek and associated marshlands are located approximately 0.4 miles west of the site. Storm water runoff from the runways and concreted areas of the site is collected by a network of drainage ditches. These manmade ditches parallel the runways and taxiways and allow the runoff water to eventually flow by means of storm drains into the New River Estuary. These surface water features are shown on Figure 1-1.

4.2 Site Topography

The area surrounding AS-527 and the refueling area is primarily flat. Figure 4-1 is a topographic map in the vicinity of the site. In general, the site is in an area of low relief. The site is approximately 22 feet above mean sea level (MSL).

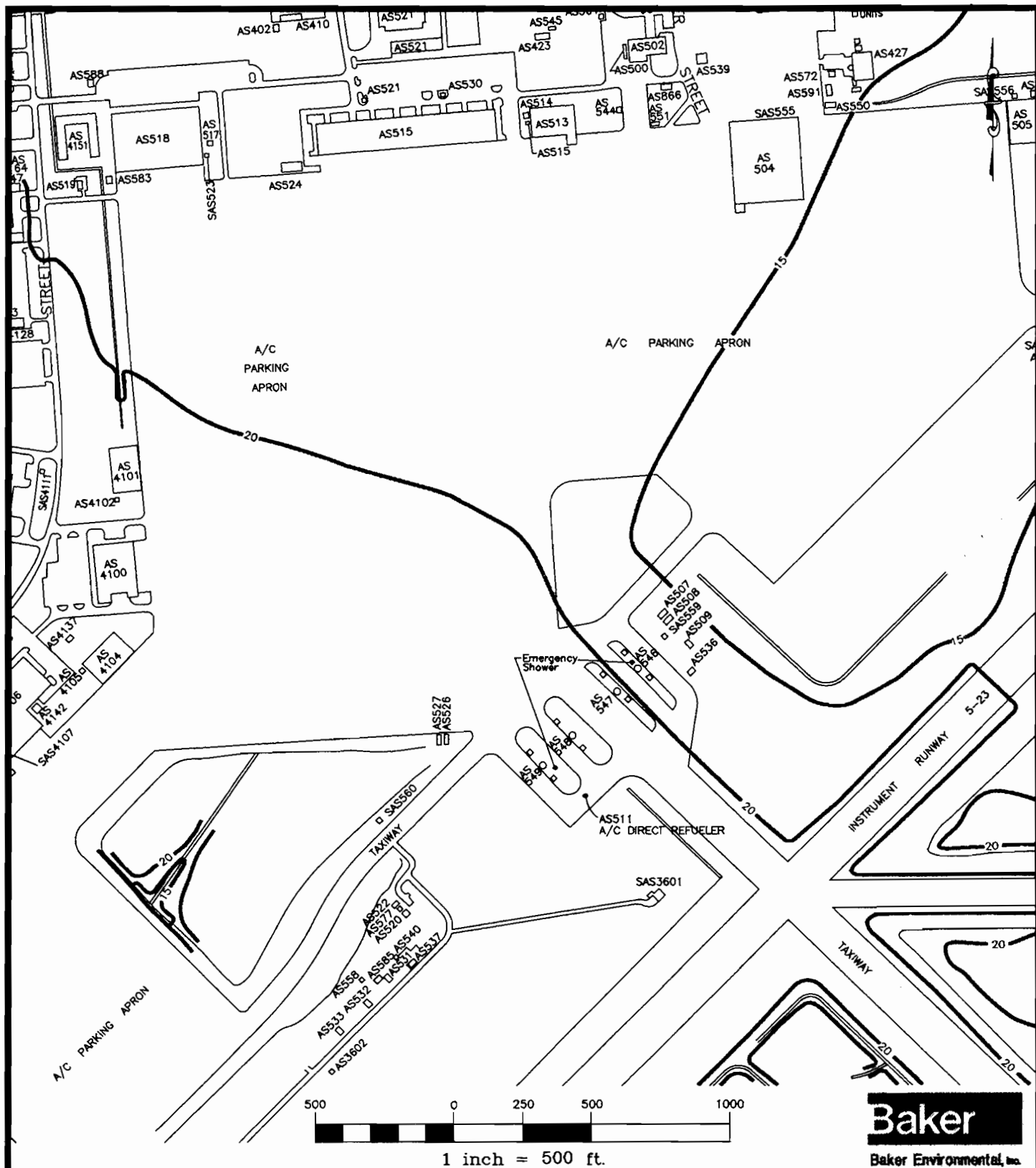


FIGURE 4-1
SITE TOPOGRAPHIC MAP
AIRCRAFT REFUELING AREA - BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

SOURCE: LANTDIV, OCT. 1991

5.0 SITE SOILS AND GEOLOGY

5.1 Regional Geology

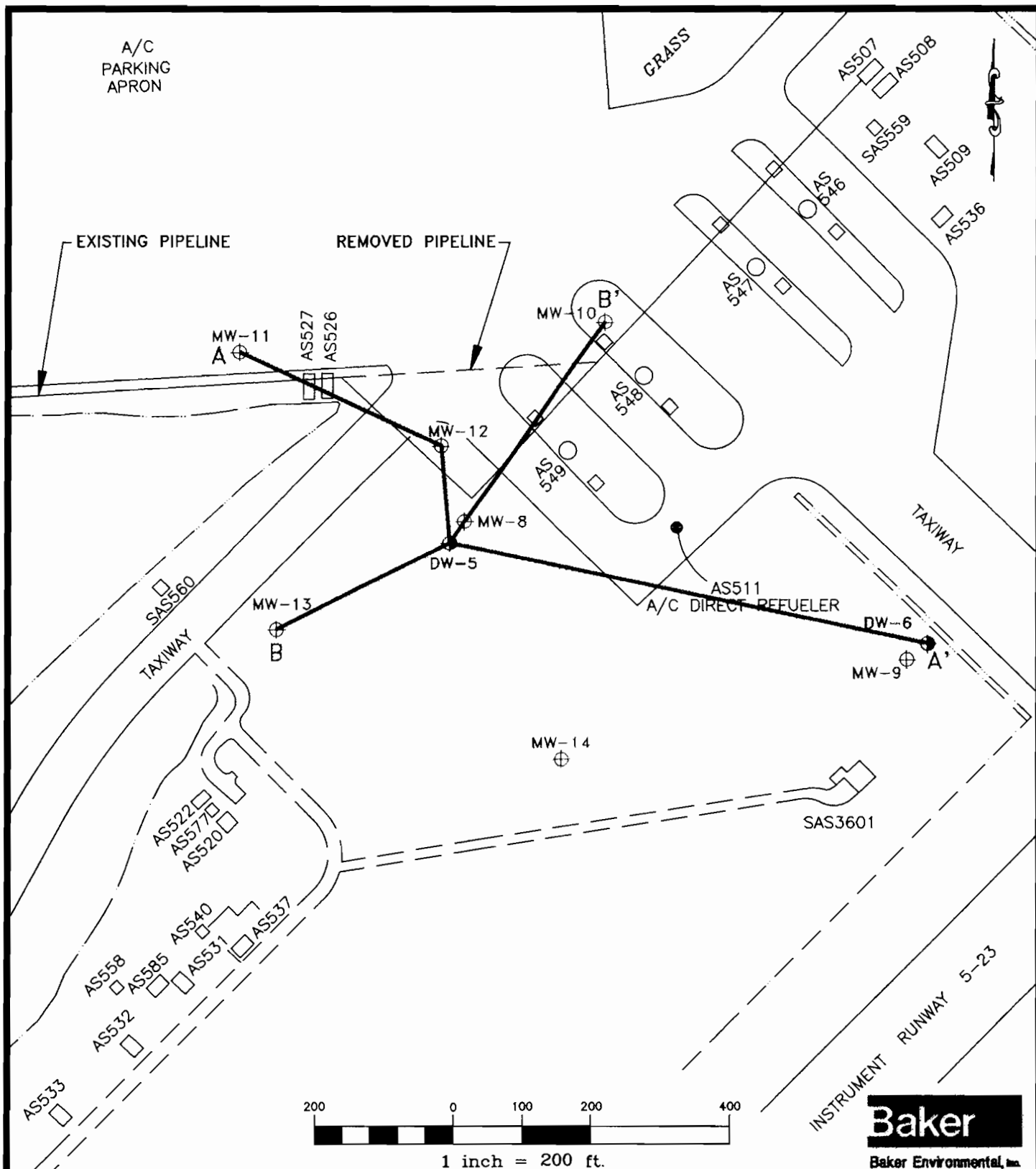
Camp Lejeune, North Carolina, is situated in the Atlantic Coastal Plain physiographic province. The region is underlain by several thousand feet of unconsolidated deposits of gravel, sand and clay ranging in age from Lower Cretaceous to Holocene, resting on a bedrock basement of PreCambrian and Triassic/Jurassic age. Generally, these deposits dip and thicken gently eastward (i.e., seaward) with thicknesses ranging from 1,500 feet to 5,000 feet. The sediment complex at Jacksonville, North Carolina is approximately 1,500 feet thick (U.S.G.S W-RIR 89-4128).

5.2 Site Geology

The area is underlain by undifferentiated layers of sediments consisting of sands and silts which extend to depths between 50 and 100 feet. These serve as the surficial aquifer and are of Pleistocene and Holocene age. Underlying these deposits are the Belgrade and River Bend Formations, of Oligocene age, which contain the Castle Hayne Aquifer, the main water supply producing aquifer for the base (Section 7.1).

Hydrogeologic cross-sections were generated based on information obtained during advancement of the soil borings. As shown on Figure 5-1, two hydrogeologic cross-sections, A to A' and B to B', traverse the site to characterize horizontal and vertical subsurface soil conditions. In general, traverse A to A' was made northwest to southeast and traverse B to B' was made southwest to northeast across the site.

Cross-section A to A', Figure 5-2, depicts the hydrogeologic conditions encountered from boring MW-11 (northwest) to DW-6 (southeast). In general, the site is underlain first by a 3-foot sand layer followed by a approximately 5-foot layer of clay. These units vary widely in thickness across this traverse, and generally show the sand layer thinning to the southeast. Extending from roughly 16 feet MSL downward, fine to medium sands occur with occasional traces of silt and/or clay present. Borings DW-5 and DW-6 reveal that at an elevation of 10 feet below MSL (approximately 32 feet below the ground surface) fine gravel exists with varying degrees of fine to medium sand present. This material change indicates the beginning of a new geologic formation believed to be the Castle Hayne.



LEGEND

MW-8 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY
BAKER ENVIRONMENTAL, INC., JUNE 1992

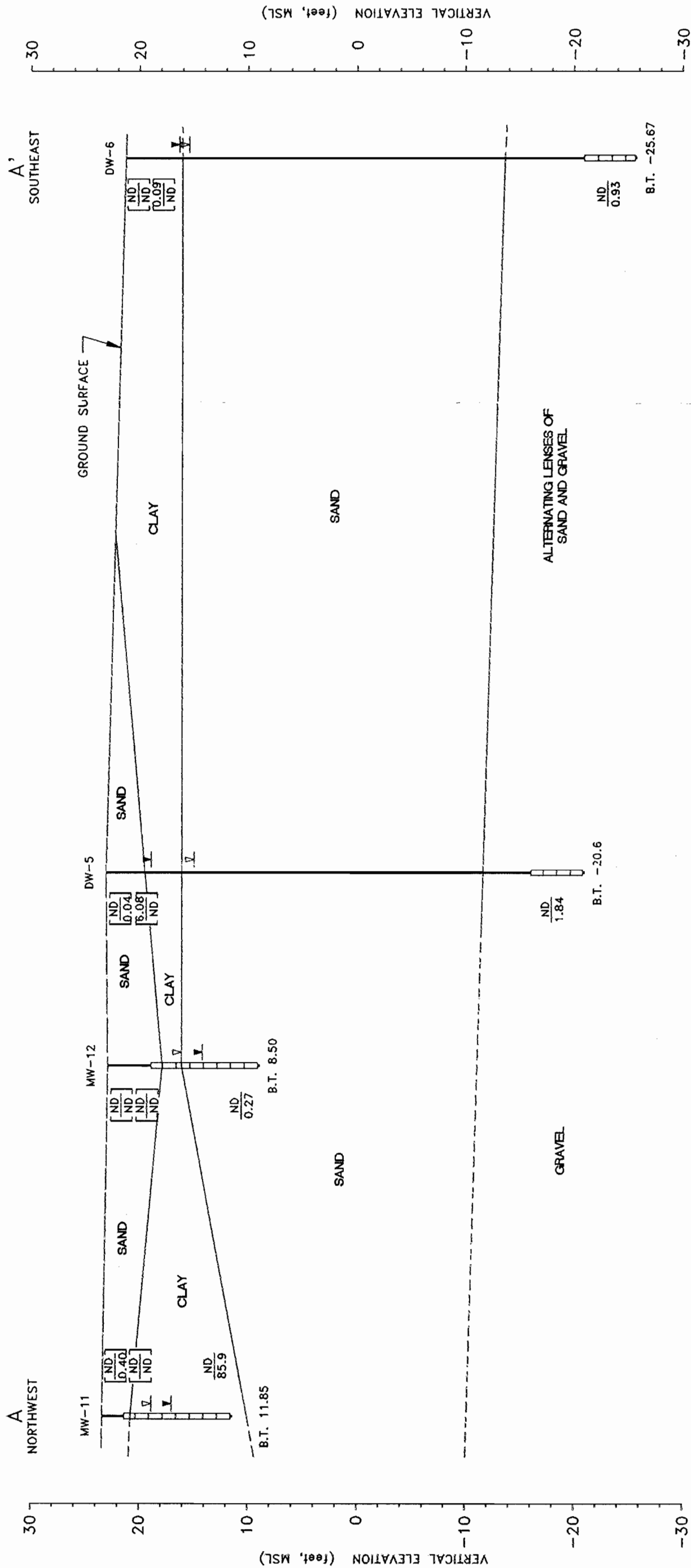
DW-5 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY
BAKER ENVIRONMENTAL, INC., JUNE 1992

A-A' HYDROGEOLOGIC CROSS-SECTION TRAVERSE

SOURCE: LANTDIV, OCT. 1991

FIGURE 5-1
HYDROGEOLOGIC CROSS-SECTION
LOCATION MAP
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA



Baker
Baker Environmental, Inc.

FIGURE 5-2
HYDROGEOLOGIC CROSS-SECTION A-A'
WITH SOIL AND GROUNDWATER ANALYTICAL RESULTS
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

LEGEND GROUNDWATER ELEVATION (JUNE 23-24, 1992) GROUNDWATER ENCOUNTERED DURING DRILLING BORING TERMINATED, ELEVATION MSL BENZENE CONCENTRATIONS (ug/L) IN GROUNDWATER TOTAL VOC CONCENTRATIONS (ug/L) IN GROUNDWATER TPH CONCENTRATIONS (LOW-MEDIUM) (mg/kg) IN SOILS TPH CONCENTRATIONS (MEDIUM-HIGH) (mg/kg) IN SOILS WELL SCREEN INTERVAL NOT DETECTED AT METHOD DETECTION LIMITS ESTIMATED --- PROJECTED	THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.

Figure 5-3 depicts the hydrogeologic cross-section B to B' for conditions encountered from boring MW-13 (southwest) to MW-10 (northeast). In general, cross-section B to B' shows conditions similar to those encountered in cross-section A to A'. A sandy material extends from the surface to a depth of approximately 4 feet, followed by a 2-foot layer of clay. These two layers are uniform in thickness and are parallel to ground surface. Sand dominates as depth increases but silt and/or clay still remain in smaller quantities. As in cross section A-A', deep well boring logs show the presence of a fine gravel material at approximately 10 feet below MSL associated with the beginning of the Castle Hayne Formation.

5.3 Soil Boring Activities

Nine soil borings were advanced at the south end of the refueling area. These soil borings are designated MW-8 through MW-14 (soil borings converted into shallow Type II groundwater monitoring wells), and DW-5 and DW-6 (soil borings converted into deep Type III groundwater monitoring wells). This numbering sequence was chosen to provide a correlation between a previous Baker Site Investigation (the Campbell Street JP-5 Pipeline, January 1992) and this report. Instead of installation of four soil borings, normally included in a Baker UST Site Investigation, two pilot holes were installed for placement of each deep well. The locations of these borings are shown on Figure 5-4.

The procedures used to perform the soil boring activities are provided in Appendix A. Copies of Baker's Field Test Boring Records for each soil boring are provided in Appendix C. These records depict soil conditions encountered at the time of drilling operations.

Seven soil borings (MW-8 through MW-14) were advanced from approximately 12 to 14 feet below ground surface. Soil borings were advanced with a truck-mounted drill rig using 6-1/4-inch inside diameter (I.D.), hollow-stem augers. These borings were later converted into shallow Type II groundwater monitoring wells.

Two soil borings (DW-5 and DW-6) were advanced to a depth of 44 and 47 feet, respectively. After a small diameter pilot hole was advanced for sample recovery as well as determining casing placement, these borings were later converted into deep Type III monitoring wells. The initial soil borings were advanced until a confining layer to a new aquifer was encountered, using 8-1/4-inch I.D. hollow stem augers. For DW-5, 34 feet of 6-inch PVC casing was set and grouted in place and allowed to set over night; and for DW-6, 37 feet of 6-inch PVC casing was set. These borings were later advanced 10 more feet each using a 5-7/8-inch tricone drill bit

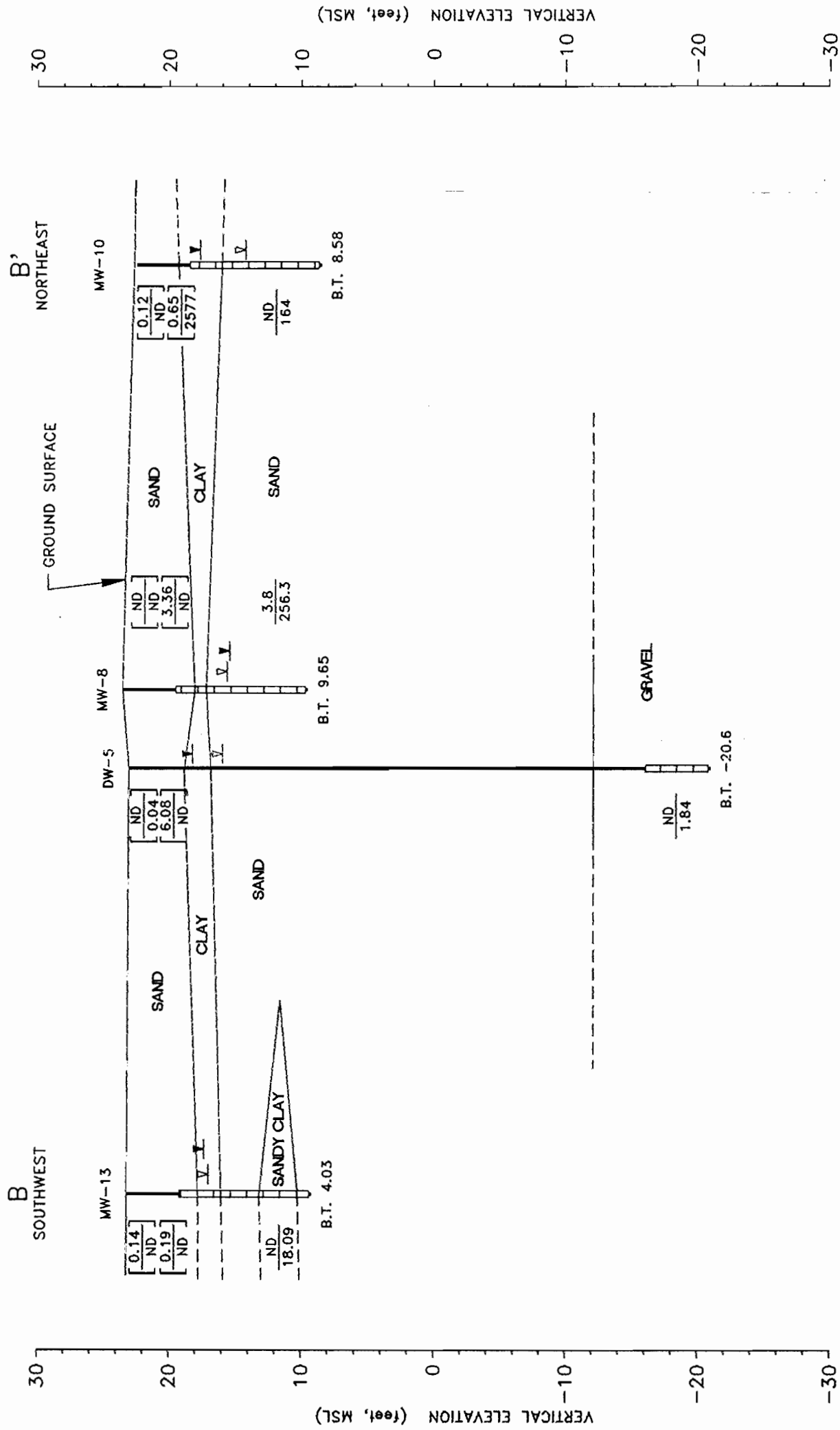


FIGURE 5-3
HYDROGEOLOGIC CROSS-SECTION B-B'
WITH SOIL AND GROUNDWATER ANALYTICAL RESULTS
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

LEGEND

GROUNDWATER ELEVATION (JUNE 23-24, 1992)

GROUNDWATER ENCOUNTERED DURING DRILLING

BORING TERMINATED, ELEVATION MSL

BENZENE CONCENTRATIONS (ug/L) IN GROUNDWATER

TOTAL VOC CONCENTRATIONS (ug/L) IN GROUNDWATER

TPH CONCENTRATIONS (LOW-MEDIUM) (mg/kg) IN SOILS

TPH CONCENTRATIONS (MEDIUM-HIGH) (mg/kg) IN SOILS

WELL SCREEN INTERVAL

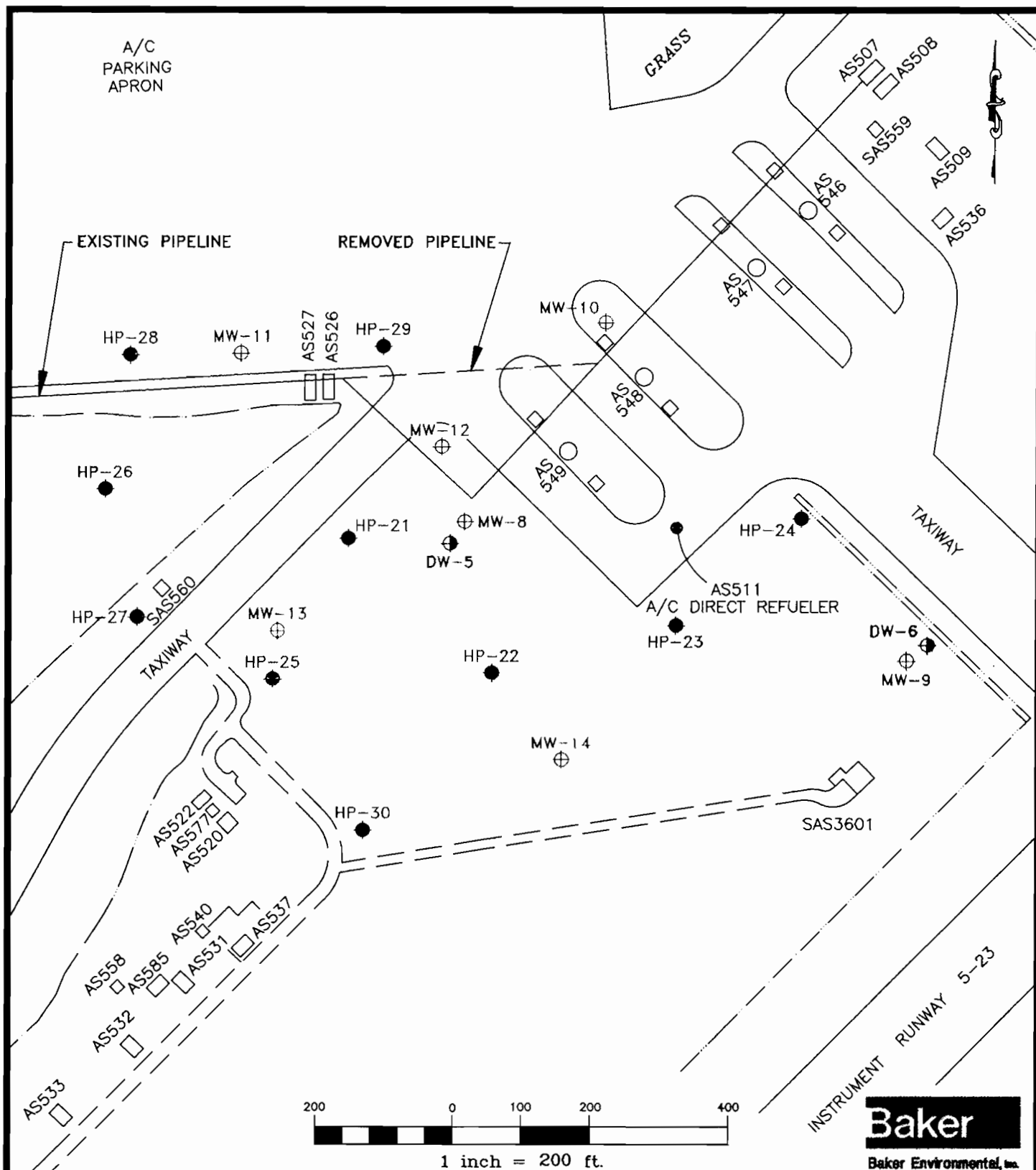
NOT DETECTED AT METHOD DETECTION LIMITS

ESTIMATED PROJECTED

Horizontal Scale: 1 inch = 100 ft.

Vertical Scale: 1 inch = 10 ft.

THE SOIL BORING INFORMATION IS CONSIDERED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THE RESPECTIVE BORING LOCATIONS. SUBSURFACE CONDITIONS INTERPOLATED BETWEEN BORINGS ARE ESTIMATED BASED ON ACCEPTED SOIL ENGINEERING PRINCIPLES AND GEOLOGIC JUDGEMENT.



LEGEND

MW-8 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY
BAKER ENVIRONMENTAL, INC., JUNE 1992

DW-5 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY
BAKER ENVIRONMENTAL, INC., JUNE 1992

HP-21 HYDROPUNCH INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

SOURCE: LANTDIV, OCT. 1991

FIGURE 5-4
MONITORING WELL AND HYDROPUNCH
LOCATION MAP
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

and mud rotary drilling methods. A total of 44 and 47 feet of 2-inch PVC (including a 4.7-foot screen) was set and grouted in place to complete wells DW-5 and DW-6, respectively.

Soil cuttings obtained during drilling activities were shoveled into 55-gallon drums which were immediately transported to an on site roll-off storage box, emptied, and reused. After all activities were completed, the used empty drums were removed from site by the drilling contractor. The roll-off box remained on site until it was transported off site for disposal.

Standard penetration tests (SPT) were conducted following ASTM 1586-D guidelines. The split-spoon samples were collected at continuous 2-foot intervals until the final depth of the boring (except for DW-5 and DW-6 which were sampled at 5-foot intervals after reaching the water table). Soil samples were visually classified by the on-site geologist and described on a Field Test Boring Record. The classification included characterization of soil type, color, moisture content, relative density (blow counts), and other pertinent information such as evidence of petroleum contamination. Copies of the Field Test Boring Records are provided in Appendix C.

In addition to soil classification, each soil sample was screened with an HNu photoionization detector (PID) to measure the presence or absence of total volatile organic compounds (TVOCs). These screening measurements were used to assist in determining the initial contamination location and the possible placement of additional groundwater monitoring wells to locate the extent of contamination.

5.4 Soil Boring Results

The soil borings performed throughout the site area revealed the existence of sands ranging from fine to medium-grained mixed with varying percentages of silt and interbedded clay layers. These materials extend to depths of approximately 30 feet below ground surface. The relative densities for these soils classified as very loose to medium dense for noncohesive soil, and very soft to stiff for cohesive soils, based upon the high blow counts during the hammering of split spoons. Depth to which the soil borings penetrated the water table varied between 4 and 8 feet.

Below a depth of 30 feet, soils made a transition between fine to medium-grained sands to fine gravel. It is believed that this fine gravel is a transition between the surficial aquifer and the Castle Hayne Formation, the main water supply producing aquifer for the base. When this

material was encountered, it was established that the outer casing of the deep wells would be set and grouted in place.

During drilling operations, a soil sample was retained for grain size characteristic testing by ASTM D422. The grain size distribution curve for this sample is provided in Appendix E. Based on the grain size analysis, the soil sample classifies as SM (silty sands) according to the Unified Soil Classification System (USCS).

6.0 EXTENT OF SOIL CONTAMINATION

6.1 Soil Sample Collection

The soil samples were collected via split-spoon sampling as discussed in Section 5.3. In general, samples selected for analyses were obtained at depths near and above the water table. Only soil samples obtained above the water table were submitted for analyses. Standard sampling intervals were performed in 2-foot intervals until the boring was terminated (with the exception of soil borings DW-5 and DW-6, where samples were collected at 5-foot intervals after encountering the water table).

Each soil sample collected for analysis was transferred into a properly labeled, laboratory prepared bottle and stored on ice. The samples were transported via Federal Express to Solutions Laboratories, Inc. (Solutions) in Chesapeake, Virginia, for analysis. The analyses were performed according to the following methods: TPH - EPA Method 5030/3550; pH - Method SW-9047; and flashpoint - Method SW-1010. Appropriate chain-of-custody documentation accompanied the samples to the laboratory.

Additional details on soil sampling procedures and sample preparation are provided in Appendix A. Copies of the actual chain-of-custody forms are provided in Appendix D.

6.2 Field Screening of Soils

Soil samples collected during the soil borings were screened with a PID to measure for the presence or absence of TVOC. Results of the field screening are shown on Table 6-1 and on the Field Test Boring Records presented in Appendix C. As shown on Table 6-1, the TVOC concentrations ranged from 0 to 700 ppm (sample collected below the water table from MW-10) in the samples screened. The highest PID readings were detected in samples collected from MW-8, MW-10, and DW-6. These elevated PID readings, however, were from soil samples collected below the water table. Accordingly, contaminated groundwater may have contributed to these high readings. The highest PID reading above the water table was from soil boring MW-8 at 6 to 8 feet (500 ppm).

TABLE 6-1

SUMMARY OF PID FIELD SCREENING OF SOIL SAMPLES

Boring No.	Sample Depth (feet)/PID Readings (ppm)						
	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	8.0 - 10.0	10.0 - 12.0	12.0 - 14.0
MW-8	0	2(1)(4)	4(4)	500	(5) 200	200	18
MW-9	0	0(4)	2(4)	0	0	0	0
MW-10	0	0(4)	0(4)	600	400	700	600
MW-11	NA(3)(4)	NA(4)	NA	45	9	10	--(2)
MW-12	0	0(4)	0(4)	0	0	0	0
MW-13	0	0(4)	0(4)	0	0	0	0
MW-14	NA	NA(4)	NA(4)	NA	NA	NA	NA
DW-5	0	0(4)	0(4)	300	20	NA	NA
DW-6	0	0(4)	0(4)	NA	NA	0	NA

Notes: (1) Result presented as the maximum concentration detected.

(2) -- = Below termination of boring

(3) NA = Not Analyzed

(4) Indicates soil sample selected for analytical analyses.

(5) Bold line denotes groundwater levels encountered at time of boring.

PID = Photoionization Detector

PID readings obtained using a HNu Model 101 organic vapor analyzer.

TABLE 6-1 (Continued)

SUMMARY OF PID FIELD SCREENING OF SOIL SAMPLES

Boring No.	Sample Depth (feet)/PID Readings (ppm)							
	15.0 - 17.0	20.0 - 22.0	25.0 - 27.0	30.0 - 32.0	35.0 - 37.0	40.0 - 42.0	42.0 - 44.0	45.0 - 47.0
MW-8	--(2)	--	--	--	--	--	--	--
MW-9	--	--	--	--	--	--	--	--
MW-10	--	--	--	--	--	--	--	--
MW-11	--	--	--	--	--	--	--	--
MW-12	--	--	--	--	--	--	--	--
MW-13	--	--	--	--	--	--	--	--
MW-14	--	--	--	--	--	--	--	--
DW-5	4(1)	0	0	0	0	NA(3)	0	--
DW-6	0	0	0	0	0	0	NA	0

Notes: (1) Result presented as the maximum concentration detected.
 (2) -- = Below termination of boring
 (3) NA = Not Analyzed
 (4) Indicates soil sample selected for analytical analyses.
 (5) Bold line denotes groundwater levels encountered at time of boring.
 PID = Photoionization Detector
 PID readings obtained using a HNu Model 101 organic vapor analyzer.

6.3 Soil Sampling

Subsurface soil samples were collected from the nine boring locations (MW-8 through MW-14, DW-5 and DW-6) as shown on Figure 5-4. Two grab soil samples from each boring were collected and submitted for analysis. For the analytical program, each of the selected grab samples was analyzed for TPH and one of the two grab samples from each soil boring was analyzed for pH and flashpoint. Additionally, two duplicate samples for TPH were submitted for TPH analysis. Laboratory results are presented on Table 6-2. Chain-of-custody records and laboratory analytical results are provided in Appendices D and E, respectively.

As required by the State of North Carolina, TPH concentrations in soil are evaluated to determine if further actions are required for remediation. If TPH concentrations are below 10 ppm (mg/kg), no further actions are required. Concentrations in soil are evaluated by the Site Sensitivity Evaluation (SSE) developed by DEM. The purpose of the SSE is to evaluate the sensitivity of groundwater to contamination by the release of petroleum-related substances from the vadose zone. In the event that TPH concentrations are above 100 ppm, soil remediation is required to reduce TPH concentrations below 10 ppm. Since this site contains TPH concentrations above 100 ppm, the remediation level is 10 ppm. A copy of the completed SSE form is provided in Attachment A-1 of Appendix A.

TPH results fell into both the low to medium and medium to high boiling point petroleum hydrocarbon ranges and are representative of jet fuel (Table 6-2). Of the 20 soil samples analyzed (including two duplicate samples), one in the medium to high range was found to have TPH concentrations which exceed 10 mg/kg, the action limit established by the SSE score. The detected TPH concentrations ranged from 0.04 mg/kg in DW-5 (0 to 2.0 feet) to 2,577 mg/kg in MW-10 (2.0 to 4.0 feet).

The laboratory analytical results for pH and flashpoint indicated the soil concentrations were below hazardous values.

6.4 Horizontal Extent of Soil Contamination

Figures 6-1 and 6-2 show the extent of TPH concentrations, indicative of jet fuel, for both the low to medium and medium to high ranges. Detected TPH concentrations ranged from 0.65 mg/kg in MW-10 (4.0 to 6.0 feet) in the low to medium range to 2,577 mg/kg in MW-10 (2.0 to 4.0 feet) in the medium to high range. As shown on Figure 6-1, none of the soil samples

TABLE 6-2

SUMMARY OF TOTAL PETROLEUM HYDROCARBONS, pH, AND FLASHPOINT ANALYSES FOR SOIL SAMPLES

Boring No.	Field Sample No.	Parameter					Sample Depth (feet, below ground surface)
		Total Petroleum Hydrocarbons (mg/kg)		Petroleum Type ⁽²⁾	pH	Flashpoint (°F)	
MW-8	ARSS-MW801	-- ⁽¹⁾	--	Not Applicable	3.69	> 220	2-4
MW-8	ARSS-MW802	3.36	--	Jet Fuel	NA ⁽³⁾	NA	4-6
MW-8	ARSS-MW1501 ⁽⁴⁾	--	1.53	Jet Fuel	NA	NA	4-6
MW-9	ARSS-MW901	--	--	Not Applicable	3.74	> 220	2-4
MW-9	ARSS-MW902	--	--	Not Applicable	NA	NA	4-6
MW-9	ARSS-MW1601 ⁽⁶⁾	--	--	Not Applicable	NA	NA	2-4
MW-10	ARSS-MW1001	--	--	Not Applicable	NA	NA	2-4
MW-10	ARSS-MW1002	0.65	2577	Jet Fuel	3.94	> 220	4-6
MW-11	ARSS-MW1101	--	--	Not Applicable	NA	NA	0-2
MW-11	ARSS-MW1102	--	--	Not Applicable	7.16	> 220	2-4
MW-12	ARSS-MW1201	--	--	Not Applicable	5.92	> 220	2-4
MW-12	ARSS-MW1202	--	--	Not Applicable	NA	NA	4-6

Notes:

- (1) Less than method detection limit
- (2) EPA Method 5030/3550 estimated range of petroleum type
- (3) NA = Not Analyzed
- (4) Duplicate sample of field sample number ARSS-MW802
- (5) Duplicate sample of field sample number ARSS-MW901
- (6) Different sample interval due to encountering groundwater at shallower depth at time of boring

Total Petroleum Hydrocarbons analyzed by EPA Method 5030/3550. pH analyzed by EPA Method SW-9047. Flashpoint analyzed by EPA Method SW-1010. Samples obtained from June 16 to June 21, 1992.

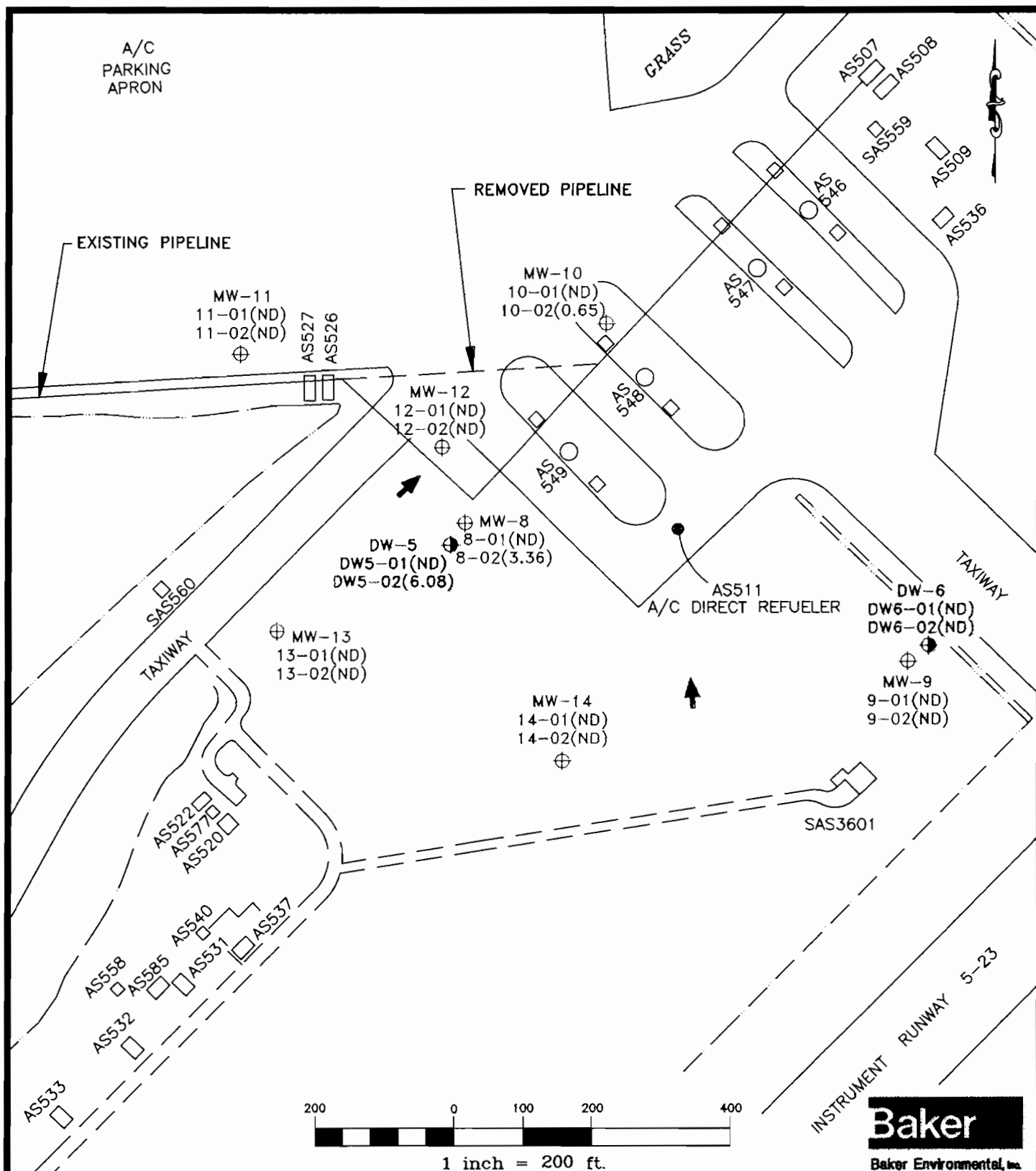
TABLE 6-2
(Continued)
SUMMARY OF TOTAL PETROLEUM HYDROCARBONS, pH, AND FLASHPOINT ANALYSES FOR SOIL SAMPLES

Boring No.	Field Sample No.	Parameter					Sample Depth (feet, below ground surface)
		Total Petroleum Hydrocarbons (mg/kg)		Petroleum Type(2)	pH	Flashpoint (°F)	
low-med (5030)	med-high (3550)						
MW-13	ARSS-MW1301	--	--(1)	Not Applicable	NA(3)	NA	2-4
MW-13	ARSS-MW1302	--	--	Not Applicable	4.39	> 220	4-6
MW-14	ARSS-MW1401	--	--	Not Applicable	4.55	> 220	2-4
MW-14	ARSS-MW1402	--	--	Not Applicable	NA	NA	4-6
DW-5	ARSS-DW501	--	--	Not Applicable	NA	NA	2-4
DW-5	ARSS-DW502	6.08	--	Jet Fuel	3.95	> 220	4-6
DW-6	ARSS-DW601	--	--	Not Applicable	4.26	> 220	0-2(6)
DW-6	ARSS-DW602	--	--	Not Applicable	NA	NA	2-4

Notes:

- (1) Less than method detection limit
- (2) EPA Method 5030/3550 estimated range of petroleum type
- (3) NA = Not Analyzed
- (4) Duplicate sample of field sample number ARSS-MW802
- (5) Duplicate sample of field sample number ARSS-MW901
- (6) Different sample interval due to encountering groundwater at shallower depth at time of boring

Total Petroleum Hydrocarbons analyzed by EPA Method 5030/3550. Samples obtained from June 16 to June 21, 1992. pH analyzed by EPA Method SW-9047. Flashpoint analyzed by EPA Method SW-1010. Samples obtained from June 16 to June 21, 1992.



LEGEND

⊕ SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

⊙ DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

11-01 FIRST SAMPLE INTERVAL, BORING SPECIFIC

11-02 SECOND SAMPLE INTERVAL, BORING SPECIFIC

(0.12) TPH CONCENTRATION IN mg/kg (ppm)

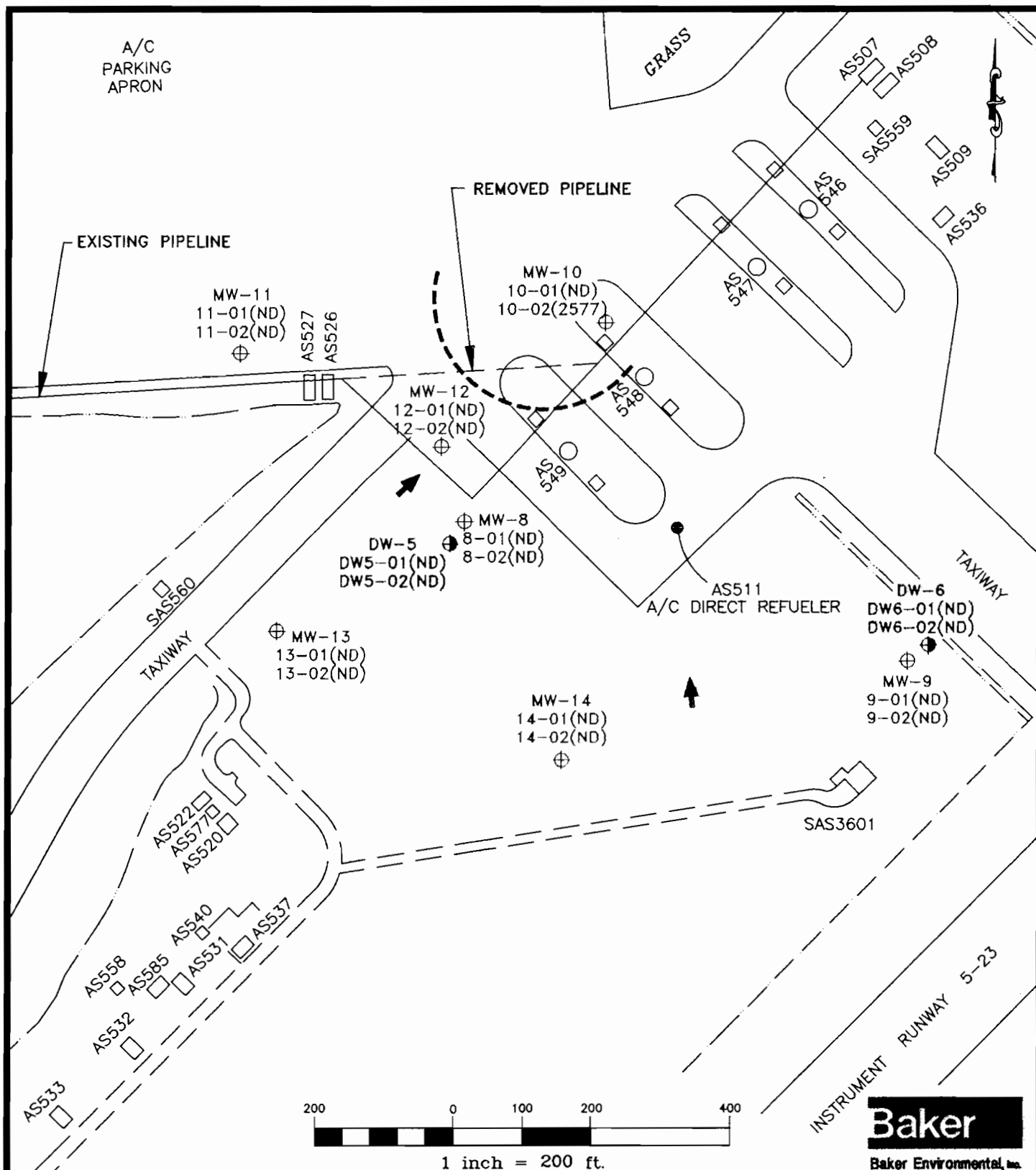
(ND) NOT DETECTED - LESS THAN METHOD DETECTION LIMIT

➔ ESTIMATED GROUNDWATER FLOW DIRECTION

SOURCE: LANTDIV, OCT. 1991

FIGURE 6-1
TPH (LOW-MEDIUM) CONCENTRATIONS
IN SOIL
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA



LEGEND

- MW-8 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992
- DW-5 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992
- 11-01 FIRST SAMPLE INTERVAL, BORING SPECIFIC
- 11-02 SECOND SAMPLE INTERVAL, BORING SPECIFIC
- (0.40) TPH CONCENTRATION IN mg/kg (ppm)
- (ND) NOT DETECTED - LESS THAN METHOD DETECTION LIMIT
- ➔ ESTIMATED GROUNDWATER FLOW DIRECTION
- ESTIMATED EXTENT OF TPH CONTAMINATION (>10 mg/kg)
- SOURCE: LANTDIV, OCT. 1991

FIGURE 6-2
TPH (MEDIUM-HIGH) CONCENTRATIONS
IN SOIL
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

analyzed exhibited TPH concentrations over 10 mg/kg for low to medium boiling point petroleum hydrocarbons. Accordingly, the extent of TPH soil contamination is not shown. Two detections, however, in the low to medium range, were 3.36 mg/kg in MW-8 and 6.08 mg/kg in DW-5. Both of these wells are situated within 15 feet of each other and are placed next to large USTs and their piping systems.

As shown on Figure 6-2, the high TPH value exists at MW-10 located on one of the grass islands in the middle of the refueling area. This area exhibited the highest TPH concentration. The full extent of the TPH contaminated area, however, has not been fully evaluated north and east of MW-10. Based on the previous Baker investigation, the area west of MW-10 near the removed pipeline has been impacted by TPH contamination.

The potential sources of contamination include frequent releases of fuel onto the ground surface from fueling of aircraft, overfilling of nearby USTs, leaking of nearby USTs in the area, and leaking of connecting pipes (both above and below ground). The specific source of the contamination, however, cannot be identified at this time.

6.5 Vertical Extent of Contamination

The vertical extent of soil contamination was evaluated using field screening results and analytical data. Soil TPH analyses (low to medium) indicate that in 5 of 20 samples collected, petroleum contamination extends to the water table (approximately 4 to 8 feet below ground surface), with the highest detections in MW-8 and DW-5. Soil TPH concentrations (medium to high) had detections at 4 of 18 samples collected. Groundwater was referenced at approximately 8 feet at these wells. In general, TPH concentrations increase with depth with the highest concentrations detected just above the water table. This was also confirmed by PID readings.

7.0 SITE HYDROGEOLOGY

7.1 Regional Hydrogeology

The hydrogeologic framework of the Jacksonville, North Carolina area includes seven principal aquifers listed in superposition as follows: (1) the surficial water table; (2) the Castle Hayne; (3) Beaufort; (4) Peedee; (5) Black Creek; (6) Upper Cape Fear; and (7) Lower Cape Fear. Only the surficial and Castle Hayne Aquifers are of concern in this report. Aquifers below the Castle Hayne lie in a thick sequence of sand and clay. Although some of these aquifers are used for water supply elsewhere in the coastal plain, they contain saltwater in the Camp Lejeune area and are not used. (U.S.G.S., W-RIR 89-4096) The generalized relation between geologic and hydrogeologic units for this area are presented on Table 7-1.

The surficial aquifer is found in beds and lenses of sand and clay. These deposits range in thickness from 25 to 100 feet and overlie the sediments containing the Castle Hayne. The sand lenses (i.e., the major water-bearing strata) are very heterogeneous and discontinuous because of the complex marine/estuarine environments in which they were deposited. In some areas, the surficial aquifer is reported to contain water contaminated by waste disposal practices (Putnam, 1983).

The Castle Hayne Aquifer underlies the surficial aquifer. Most of the supply wells in the area tap this aquifer at depths ranging from 50 to 300 feet. This aquifer ranges in thickness from 250 to 400 feet but brackish water is normally encountered below 300 feet. The water-bearing zones are a series of sandstone, limestone and clay beds of the Oligocene River Bend Formation and the Middle Eocene Castle Hayne Formation.

The upper half of the Castle Hayne Aquifer is primarily sand; the lower half is sand and limestone. The top of the aquifer ranges from about 20 feet above sea level in the northern part of the area to about 40 feet below sea level in the southeastern part. The aquifer thickens toward the southeast from 175 feet at the MCAS to about 375 feet at the coast (U.S.G.S., W-RIR 89-4096).

Clay layers occur in both the Castle Hayne and the surficial aquifers. However, no continuous clay layer separates the surficial and the Castle Hayne. The clay layers appear to be more continuous in the northwestern part of the base (U.S.G.S., W-RIR 89-4096).

TABLE 7-1

**GENERALIZED RELATION BETWEEN GEOLOGIC AND HYDROGEOLOGIC UNITS IN
THE COASTAL PLAIN OF NORTH CAROLINA**

Geologic Units			Hydrogeologic Units
System	Series	Formation	Aquifer and Confining Unit
Quaternary	Holocene Pleistocene	Undifferentiated	Surficial Aquifer
Tertiary	Pliocene	Yorktown Formation ⁽¹⁾	Yorktown Confining Unit
	Miocene	Eastover Formation ⁽¹⁾	Yorktown Aquifer
		Pungo River Formation ⁽¹⁾	Pungo River Confining Unit
			Pungo River Aquifer
			Belgrade Formation ⁽²⁾
	Oligocene	River Bed Formation	Castle Hayne Aquifer
	Eocene	Castle Hayne Formation	Beaufort Confining Unit
	Paleocene	Beaufort Formation	Beaufort Aquifer
			Peedee Confining Unit
	Cretaceous	Upper Cretaceous	Peedee Formation
Black Creek and Middendorf Formations			Black Creek Confining Unit
			Black Creek Aquifer
			Upper Cape Fear Confining Unit
Cape Fear Formation			Upper Cape Fear Aquifer
			Lower Cape Fear Confining Unit
			Lower Cape Fear Aquifer
Lower Cretaceous ⁽¹⁾			Unnamed Deposits ⁽¹⁾
			Lower Cretaceous Aquifer
Pre-Cretaceous Basement Rocks		--	

(1) Geologic and hydrologic units probably not present beneath Camp Lejeune.

(2) Constitutes part of the surficial aquifer and Castle Hayne Confining Unit beneath Camp Lejeune.

(3) Estimated to be confined to deposits of Paleocene Age in the study area.

Source: U.S.G.S., Water Resources Investigations Report 89-4096, "Assessment of Hydrologic and Hydrogeologic Data at Camp Lejeune Marine Corps Base, North Carolina," 1989.

Confining sediment beds restrict the direct exchange of groundwater between the surficial and the Castle Hayne aquifers. However, some hydraulic connection between the two aquifers has been observed (Department of the Navy, 1990).

7.2 Site Hydrogeology

The hydrogeologic characteristics of the water table aquifer (surficial) are influenced, in part, by various land development activities at the refueling area. The vast area covered by concrete hinders aquifer recharge through the ground surface. Considering surface water factors discussed in Section 4.0, most of the groundwater recharge would migrate laterally towards natural and developed discharge areas through the surficial aquifer. Downward movement of groundwater is assisted by the presence of relatively permeable sediments.

Groundwater was generally encountered beneath the site at approximately 4 to 8 feet below ground surface in the shallow and deep wells. Table 7-2 summarizes fluid level measurements and groundwater elevations for the site obtained June 23 and 24, 1992. As shown on Table 7-2, petroleum product (free product) was detected in one of the new monitoring wells (MW-10). Accordingly, the groundwater elevation was corrected to compensate for the layer of petroleum product. An estimated specific gravity of 0.82 was used for JP-5 jet fuel.

Based on the ground water elevation data taken on June 23, 1992, shallow ground water appears to be flowing north-northeast across the site (Figure 7-1). Note that monitoring well MW-11 was not used to generate contour map because the groundwater level was measured on June 24, 1992. Based on measurements obtained on June 23, the horizontal groundwater gradient in the shallow water-bearing zone was calculated at 1.1×10^{-2} .

Based upon the hydraulic conductivity tests performed on June 23, 1992, the average hydraulic conductivity for the shallow water-bearing zone is 6.18×10^{-2} feet/day (2.18×10^{-5} cm/sec). These values were calculated using the Geraghty and Miller aquifer test solver (AQTESOLV) program which uses the Bouwer and Rice (1976) method for an unconfined aquifer. Further, the average values calculated are consistent with known values of hydraulic conductivity for fine sands which are present in the shallow water-bearing zone (Fetter, 1980). The results of the hydraulic conductivity test are summarized on Table 7-3. A copy of the actual field data and AQTESOLV computer printouts are provided in Appendix F.

TABLE 7-2

SUMMARY OF FLUID LEVEL MEASUREMENTS
JUNE 23 and 24, 1992

Well No.	Top of Casing Elevation(1) (feet, above MSL)	Depth to Product (feet, below top of casing)	Depth to Groundwater (feet, below top of casing)	Product Thickness (feet)	Product Elevation (feet, above MSL)	Groundwater Elevation (feet, above MSL)	Corrected Groundwater Elevation(3) (feet, above MSL)
MW-8	23.54	--(2)	8.26	--	--	15.28	--
MW-9	22.25	--	5.17	--	--	17.08	--
MW-10	22.68	8.10	8.16	0.06	14.58	14.52	14.56
MW-11(4)	23.59	--	6.27	--	--	17.32	--
MW-12	22.40	--	7.91	--	--	14.49	--
MW-13	22.69	--	5.09	--	--	17.60	--
MW-14	23.33	--	5.71	--	--	17.62	--
DW-5(4)	22.89	--	4.16	--	--	18.73	--
DW-6	21.21	--	5.24	--	--	15.97	--

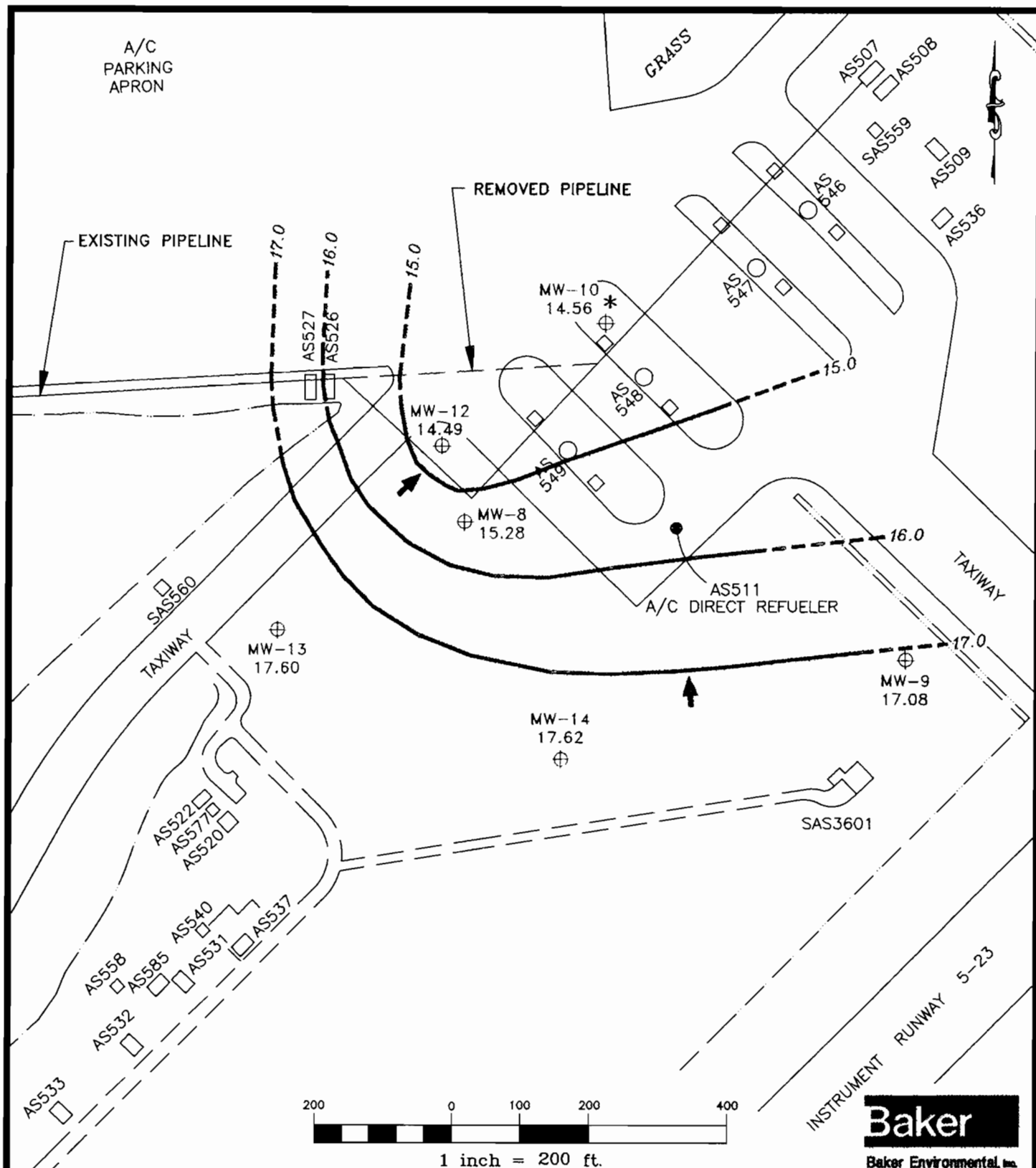
Notes: (1) MSL - Mean Sea Level

(2) -- = Not Detected

(3) Corrected Groundwater Elevations were determined by using the following equation:

Corrected groundwater elevation = apparent groundwater elevation + (product thickness x 0.82), where 0.82 is the estimated specific gravity for JP-5 jet fuel.

(4) Groundwater measurements collected on June 24, 1992.



LEGEND

MW-8 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

15.28 GROUNDWATER ELEVATION (WELL SPECIFIC) IN MSL

* CORRECTED GROUNDWATER ELEVATION

15.28 GROUNDWATER CONTOUR IN MSL

➔ ESTIMATED GROUNDWATER FLOW DIRECTION

SOURCE: LANTRIV, OCT. 1991

FIGURE 7-1
POTENTIOMETRIC SURFACE MAP
SHALLOW WATER-BEARING ZONE, JUNE 23-24, 1992
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

TABLE 7-3
SUMMARY OF HYDRAULIC CONDUCTIVITY TESTS

Well No.	Hydraulic Conductivity Falling Test		Hydraulic Conductivity Rising Test	
	ft/day	cm/sec	ft/day	cm/sec
MW-13	5.54×10^{-2}	1.96×10^{-5}	3.20×10^{-3}	1.13×10^{-6}
MW-14	1.88×10^{-1}	6.62×10^{-5}	7.26×10^{-4}	2.56×10^{-7}

Hydraulic conductivity average for site: 6.18×10^{-2} ft/day (2.18×10^{-5} cm/sec)

Notes: Hydraulic conductivity test results analyzed using Bouwer and Rice method as presented in the Geraghty & Miller "AQTESOLV" program, Version 1.10.

Hydraulic conductivity tests conducted on June 23, 1992 using an In-Situ Environmental Data Logger (Model SE-1000C) and pressure transducer.

Using the groundwater gradient calculated in Section 7.2, and the average hydraulic conductivity determined for the site, the average groundwater flow velocity was estimated using a variation of Darcy's equation:

$$V = Ki/ne$$

Where: V = estimated groundwater flow velocity

K = hydraulic conductivity

i = groundwater gradient

ne = average effective porosity, as a decimal fraction

Using the average value $K = 6.18 \times 10^{-2}$ feet/day, calculated from the aquifer tests, a groundwater gradient of 1.1×10^{-2} , and an effective porosity of 0.30 (Fetter, 1980), the average groundwater flow velocity for the shallow water-bearing zone was calculated as 2.3×10^{-3} feet/day or 8.3×10^{-1} feet/year.

7.3 Monitoring Well Installation

All nine soil borings were converted into Type II or III groundwater monitoring wells. The locations of these wells are shown on Figure 5-4. Wells were installed at specific boring locations in order to evaluate the horizontal and vertical extent of groundwater contamination in the vicinity of the site, and to provide information on the groundwater flow patterns in the area. The depths of the monitoring wells ranged approximately from 14 to 47 feet below ground surface. Table 7-4 provides a summary of well construction details. North Carolina Well Permit Applications are provided in Attachment A-2 of Appendix A.

Monitoring wells MW-8 through MW-14, the shallow Type II monitoring wells, were constructed of 2-inch nominal diameter Schedule 40 (except MW-11 which required Schedule 80 because of its location in a traffic area), flush-joint and threaded PVC casing, with a 10-foot long, 0.010-inch slotted screen. The deeper Type III monitoring wells, DW-5 and DW-6, were constructed with 5-foot long, 0.010-inch slotted screen. A medium-grained sand pack (approximate grain size 0.25 mm) extending 1 to 2 feet above the top of the screen was placed in the annulus between the screen and the borehole wall in both types of wells. A bentonite pellet seal was placed above the sand pack and hydrated with potable water. The remaining annular space was back-filled with a cement/bentonite mixture to ground surface. A PVC

TABLE 7-4

SUMMARY OF WELL CONSTRUCTION DETAILS

Well No.	Date Installed	Top of Casing Elevation ⁽¹⁾ (feet, above MSL)	Ground Surface Elevation (feet, above MSL)	Boring Depth (feet, below ground surface)	Depth of Outer Casing (feet, below ground surface)	Well Depth (feet, below ground surface)	Screen Interval Depth (feet, below ground surface)	Depth to Sand Pack (feet, below ground surface)	Depth to Bentonite (feet, below ground surface)
MW-8	6-18-92	23.54	23.6	14.0	NA ⁽²⁾	13.8	4.1 to 13.8	2.0	0.5
MW-9	6-18-92	22.25	22.3	14.0	NA	13.8	4.0 to 13.8	2.0	0.5
MW-10	6-18-92	22.68	22.5	14.0	NA	13.8	4.3 to 13.8	2.0	0.5
MW-11	6-21-92 6-22-92	23.59	23.8	12.0	NA	11.8	2.0 to 11.8	2.0	0.5
MW-12	6-18-92	22.40	22.5	14.0	NA	13.8	4.0 to 13.8	2.0	0.5
MW-13	6-18-92	22.69	23.0	14.0	NA	13.8	4.0 to 13.8	2.0	0.5
MW-14	6-17-92	23.33	23.4	14.0	NA	13.8	4.1 to 13.8	2.0	0.5
DW-5	6-20-92 6-22-92	22.89	23.4	44.0	34.0	43.8	39.1 to 43.8	37.0	34.0
DW-6	6-19-92 6-20-92	21.21	21.3	47.0	37.0	46.8	42.1 to 46.8	40.0	37.0

(1) MSL - Mean Sea Level

(2) NA = Not Applicable

locking cap was fitted at the top of each well. Well construction records for each monitoring well are presented in Appendix G and are summarized on Table 7-4.

The procedures for installation of the monitoring wells are discussed in the Technical Methods/Standard Operating Procedures provided in Appendix A. Schematic diagrams of typical Type II and Type III monitoring wells are provided on Figures 7-2 and 7-3, respectively.

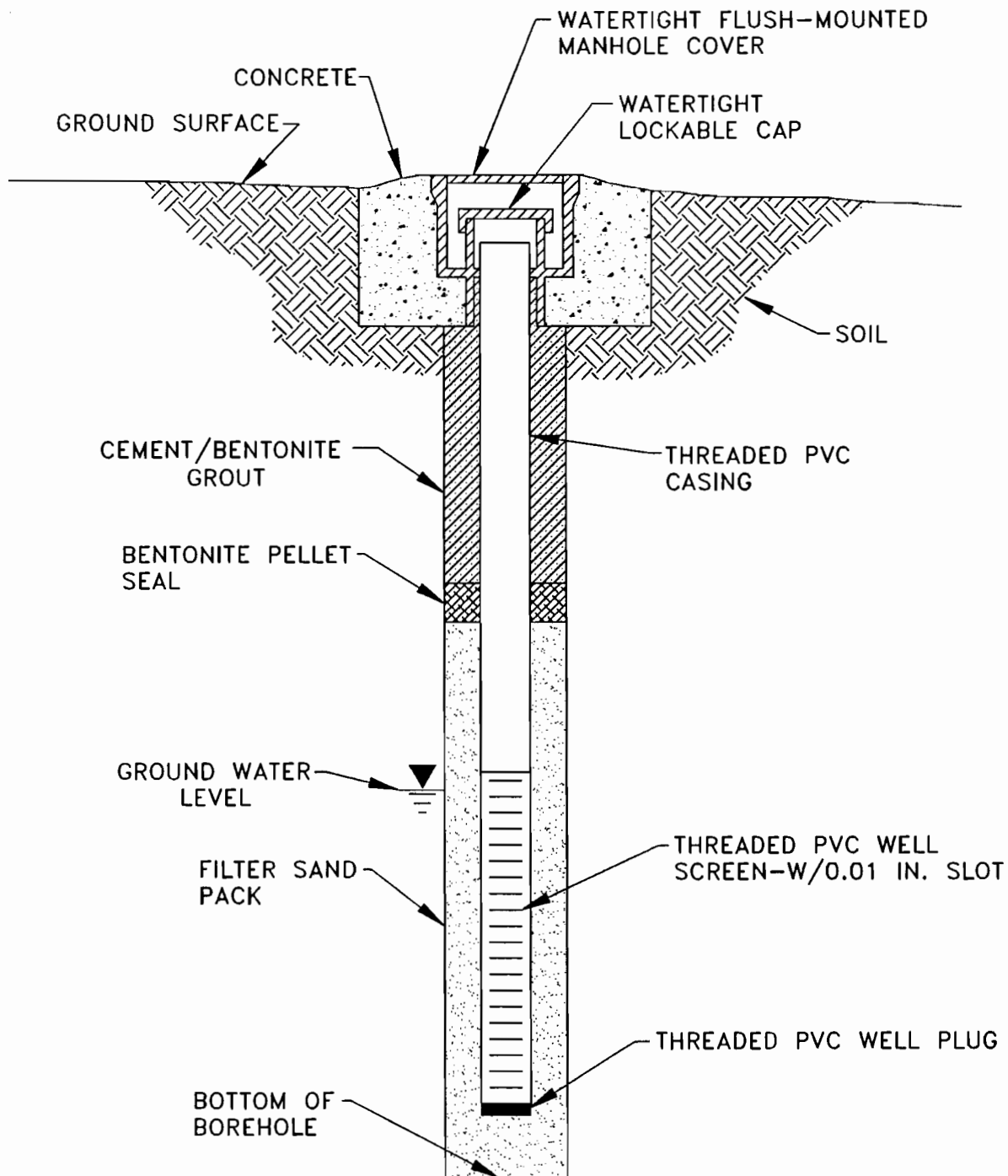
Following well construction activities, each well was developed to remove sediments from the well and to facilitate the hydraulic connection between the well and the aquifer. The monitoring wells were developed by pumping with centrifugal pump until the water was essentially sediment-free. Approximately 40 gallons of water (approximately 25 well volumes) were removed from each well. The water recovered from each well was containerized in labeled, 55 gallon steel drums and stored on site until a vacuum truck emptied all staged drums.

Following well installation, each newly installed well was surveyed by a surveyor registered in the State of North Carolina using standard procedures. The firm of James E. Stewart and Associates, Inc., of Jacksonville, North Carolina, was retained to perform the surveying services. The top of casing elevations were measured for each monitoring well location to the nearest 0.01 foot and ground surface elevations were measured to the nearest 0.1 foot. A temporary benchmark was established on-site based on existing National Geodetic Vertical Datum (NGVD) elevations relative to MSL. The top of casing and ground surface elevations for each monitoring well are provided on Table 7-4.

7.4 Hydropunch - Groundwater Testing

Within the vicinity of the refueling area, ten hydropunch (penetrometer) samples of groundwater were collected from the shallow water-bearing zone for field and laboratory analyses. Since the geologic material underlying the site is very sandy, groundwater recovery into the hydropunch was rapid. The sample locations are shown in Figure 5-4. Copy of the Penetrometer Record is provided in Appendix H.

The hydropunch drive casing was advanced into the surficial soils using hydraulic pressure. The hydropunch was operated in the hydrocarbon sampling mode. In this mode, the hydropunch is pushed to intercept the water table. Water is first allowed to flow into the device then it is collected by lowering a small bailer down through the drive casing. Water is

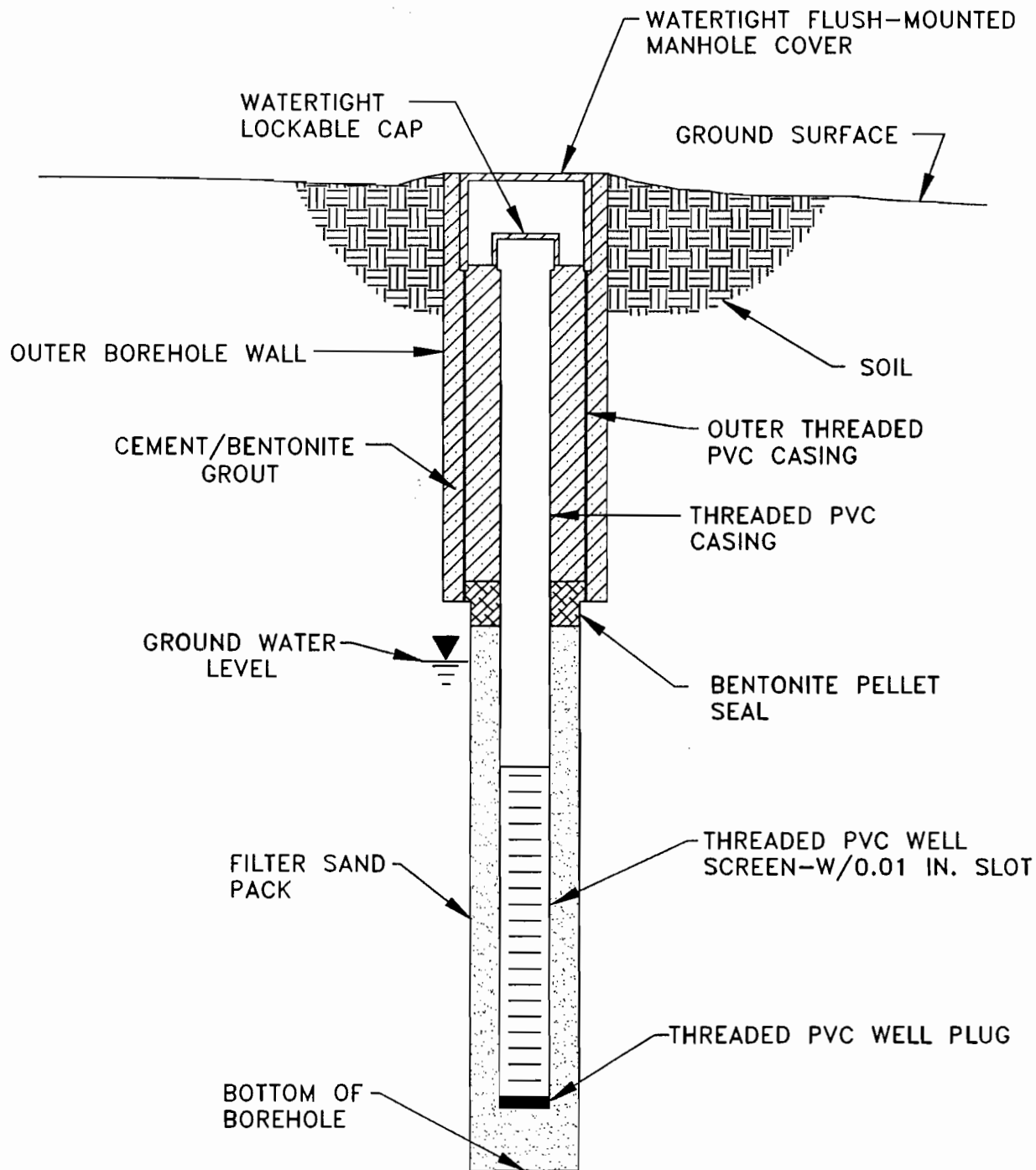


N.T.S.

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Baker Environmental, Inc.

FIGURE 7-2
TYPICAL SHALLOW TYPE II GROUNDWATER MONITORING WELL
CONSTRUCTION DIAGRAM
AIRCRAFT REFUELING AREA - BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA



N.T.S.

Baker
Baker Environmental, Inc.

FIGURE 7-3
TYPICAL DEEP TYPE III GROUNDWATER MONITORING WELL
CONSTRUCTION DIAGRAM
AIRCRAFT REFUELING AREA - BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

slowly poured from the bailer directly into a laboratory prepared bottle. The Hydropunch Field User's Guide, which explains the operating sequence, can be found in Attachment A-3 of Appendix A.

At the time groundwater samples were collected, pertinent information such as turbidity, color or petroleum odor was recorded in the field log book by the site geologist. From the sample, 80 milliliters of groundwater was collected for analysis. This sample was transferred to the appropriate laboratory-prepared bottle, properly labeled and stored on ice. The sample was transported via Federal Express to Solutions, in Chesapeake, Virginia, where it was analyzed by EPA Method 602.

Portions of the groundwater sample were tested in the field for the presence or absence of petroleum aromatic hydrocarbons. The field testing procedure is discussed in detail in Section 8.2 and in Attachment A-4 of Appendix A.

All hydropunch components were decontaminated after use. The components were decontaminated by high-pressure steam. Decontamination fluids were contained within a temporary decontamination area to prevent the fluids from contacting the ground surface. These fluids were eventually transferred into 55-gallon steel drums, and stored on site and later transferred to a vacuum truck.

7.5 Fluid Level Measurements and Well Elevation Survey

Fluid level measurements for each monitoring well were recorded during the field investigation and prior to groundwater sampling. The depth to water was measured using an oil/water interface probe capable of detecting product layers as thin as 0.01 feet. Depths were measured to the nearest 0.01 foot. The interface probe was decontaminated between readings by washing with a non-phosphate soap solution, rinsing with distilled water, and final rinsing with reagent-grade hexane. Fluid level measurements are summarized on Table 7-2. Free product was encountered only in MW-10.

8.0 EXTENT OF GROUNDWATER CONTAMINATION

8.1 Groundwater Samples Collected by Hydropunch Procedure

Ten (10) groundwater samples were collected using hydropunch procedures. The samples were transferred into laboratory prepared, sample containers and placed immediately on ice. The groundwater samples were collected by slowly pouring water from a bailer into the appropriate sample containers to minimize volatilization. It was transported by Federal Express to Solutions, in Chesapeake, Virginia, for analysis. Appropriate chain-of-custody documentation, accompanied the samples to the laboratory. Each hydropunch groundwater sample was analyzed for purgeable aromatic hydrocarbons by EPA Method 602. The analytical results for groundwater collected with the hydropunch procedure are presented in Table 8-1.

As shown on Table 8-1, several VOCs were detected at concentrations above method detection limits. Toluene and ethylene dibromide (EDB) concentrations could not be resolved by the laboratory. However, the combined value exceeded the Federal MCL (0.05 µg/L) and NCWQS for HP-21 (484 µg/L). In addition, dichlorobenzenes (1,2- and 1,3-) were also detected at high concentrations at HP-21. These compounds, however, analyzed by EPA 602 may be other semivolatile compounds that have a retention time so close to the retention times of the dichlorobenzene compounds that the integrator quantifies the compounds as a dichlorobenzene.

8.2 hnu-hanby (Field Test for Aromatic Hydrocarbons)

The hnu-hanby Field Test is a procedure for the analysis of petroleum aromatic hydrocarbons over a wide range of concentrations in groundwater. The hnu-hanby test was performed by the site geologist on the groundwater samples collected from the hydropunch procedure. Additional information and step-by-step procedures are outlined in Attachment A-4 of Appendix A.

Petroleum fuel type and estimated concentration in ppm were recorded in the field log book by the site geologist. Actual Penetrometer Records for each hydropunch is provided in Appendix H.

TABLE 8-1

SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES COLLECTED BY HYDROPUNCH PROCEDURE

Well No.	Field Sample No.	EPA Method 602 Parameters (µg/L)							Total VOCs ⁽⁴⁾
		1,3-Dichloro- benzene	1,2-Dichloro- benzene	Toluene/ EDB ⁽³⁾	Ethylbenzene	m- & p- Xylenes	o-Xylene	Total Xylenes	
HP-21	ARSW-HP21	--	906	484	--	--	238	238	1,628
HP-22	ARSW-HP22	--	--	--	--	--	--	--	--
HP-23	ARSW-HP23	--	--	--	--	--	--	--	--
HP-24	ARSW-HP24	--	--	--	--	--	--	--	--
HP-25	ARSW-HP25	2.25	--	--	3.77	--	--	--	6.02
HP-26	ARSW-HP26	--	--	--	--	--	--	--	--
HP-27	ARSW-HP27	--	--	--	--	--	--	--	--
HP-28	ARSW-HP28	--	--	--	--	--	--	--	--
HP-29	ARSW-HP29	7.35	7.95	--	--	10.92	--	10.92	26.22
HP-30	ARSW-HP30	--	--	--	--	--	--	--	--
HP-31	ARSW-HP31 ⁽²⁾	7.51	8.28	--	--	10.73	--	10.73	26.52
Federal MCLs ⁽⁵⁾		NE	600	1,000/0.05	700	NE	NE	10,000 ⁽⁹⁾	NE
NCWQS ⁽⁶⁾		620	620	1,000/0.0005	29	NE	NE	400 ⁽⁹⁾	NE

Notes:

- (1) Less than method detection limit
- (2) HP-31 is a duplicated sample of HP-29
- (3) EDB = Ethylene Dibromide. Method could not resolve Toluene and EDB. Concentrations reported as a combined value.
- (4) Sum of total Volatile Organic Compounds detected by EPA Method 602 and Ortho Xylenes
- (5) MCL = Maximum Contaminant Level
- (6) NCWQS = North Carolina Water Quality Standard
- (7) NE = Not Established
- (8) MTBE WQS is an Interim Standard
- (9) The MCL and NCWQS for Xylene (Total) includes Meta, Para, and Ortho Xylenes

Samples analyzed by EPA Method 602.

Groundwater samples obtained on June 16 to 22, 1992. Table reflects only those parameters which were detected. Complete list of tested parameters are provided in Appendix E.

The results of the hnu-hanby field test are presented in Table 8-2. As shown on Table 8-2, the hnu-hanby field test results are compared to the laboratory results obtained by EPA Method 602. The hnu-hanby tests is an approximation of field conditions where as the laboratory analytical results are more accurate than the field tests. Results of the hnu-hanby field test indicated petroleum aromatics in HP-21, HP-25, and HP-29. These samples also contained total VOC by laboratory EPA 602 methods.

8.3 Groundwater Sampling and Analyses

Groundwater was sampled from the nine installed shallow and deep wells (MW-8 through MW-14, DW-5 and DW-6) on June 23 and 24, 1992. Groundwater samples from each well were analyzed by EPA Method 602 (purgeable aromatic hydrocarbons) and three wells by EPA Method 625 (base neutral/acid extractables). Additionally, two duplicate samples were collected and analyzed by EPA Method 602.

Prior to groundwater sampling, three to six well volumes were purged from each well. A dedicated polyethylene bailer was used to purge the wells. Purge water was containerized in 55-gallon, steel drums and stored until a water vacuum truck arrived. Three measurements of pH, specific conductance and temperature were made prior to sampling to ensure that the groundwater had stabilized. Measurements were taken after three consecutive well volumes, prior to the final well volume removal. Well volumes for each well and a summary of groundwater field parameters is shown on Table 8-3.

Groundwater samples were collected from the wells using dedicated polyethylene bottom-loading bailers. The samples were transferred into laboratory-prepared sample containers and placed immediately on ice. Groundwater samples were collected by slowly pouring water from the bailer into the appropriate sample container to minimize volatilization. Samples were transported via Federal Express to Solutions, in Chesapeake, Virginia, for analysis. Appropriate chain-of-custody documentation, along with a trip blank sample, accompanied the samples to the laboratory. Copies of the chain-of-custody documentation, along with laboratory analytical results are provided in Appendices D and E, respectively.

Analytical results and their respective parameters for the groundwater samples are provided on Table 8-4. Concentrations of VOCs were detected in all of the nine wells sampled. The total VOC concentrations ranged from 2.14 µg/L in MW-13 to 930 µg/L in the duplicate sample for MW-10.

TABLE 8-2

**SUMMARY OF FIELD SCREENING RESULTS FOR
AROMATIC HYDROCARBONS (hnu-hanby Method)**

Hydropunch No.	Date Performed	Depth (feet below ground surface)	hnu-hanby Concentration (ppm)	Total VOCs ⁽¹⁾ (in ppm)
HP-21	6-17-92	15	20	2.028
HP-22	6-16-92	15	-- ⁽²⁾	1.67×10^{-2}
HP-23	6-16-92	15	--	8.9×10^{-5}
HP-24	6-16-92	15	--	3.2×10^{-5}
HP-25	6-17-92	15	5	8.8×10^{-2}
HP-26	6-17-92	15	--	5.6×10^{-5}
HP-27	6-17-92	15	--	9.4×10^{-5}
HP-28	6-22-92	15	--	6.6×10^{-5}
HP-29	6-22-92	15	5	2.9×10^{-2}
HP-30	6-16-92	15	--	2.2×10^{-5}
HP-31 ⁽³⁾	6-22-92	15	--	2.9×10^{-2}

(1) This value represents the concentration of Volatile Organic Compounds (VOCs) detected by EPA Method 602 from the same location as the field test.

(2) -- = Not detected at 1 ppm (Detection Limit).

(3) HP-31 is a duplicate sample of HP-29.

Samples were analyzed using the hnu-hanby, Field Test (see Appendix A).

TABLE 8-3

SUMMARY OF GROUNDWATER FIELD PARAMETERS

Well No.	Field Parameter			
	pH ⁽¹⁾	Specific ⁽²⁾ Conductance at 25°C (cm/μmhos)	Temperature ⁽²⁾ (°C)	Well Volumes ⁽³⁾
MW-8	5.0	90	21.0	4
	5.0	85	19.5	5
	5.0	85	21.0	6
MW-9	5.0	30	20.0	4
	5.0	30	19.0	5
	5.0	30	19.0	6
MW-10	5.55	110	20.0	4
	5.0	110	20.5	5
	5.0	115	21.0	6
MW-11	5.56	200	24.0	3
	5.56	189	22.0	4
	5.59	205	22.0	5
MW-12	6.0	110	20.0	4
	6.0	110	19.5	5
	6.0	110	19.0	6
MW-13	5.0	60	20.0	4
	5.0	60	20.0	5
	5.0	60	19.5	6
MW-14	5.0	35	21.5	4
	5.0	30	20.0	5
	5.0	30	19.5	6
DW-5	7.5	320	21.0	1
	7.99	265	20.5	2
	7.98	260	19.5	3
DW-6	5.0	250	22.5	1
	5.0	210	21.5	2
	5.0	230	21.0	3

Notes: Groundwater samples obtained on June 23 and 24, 1992.

(1) pH measured using an Orion pH meter, Model No. 290A and/or litmus paper

(2) Specific conductance and temperature measured using YSI conductivity meter, Model No. 335 CT.

(3) Well volume = volume of water in the well times total number of well volumes purged.

TABLE 8-4

SUMMARY OF CHEMICAL ANALYSES FOR GROUNDWATER SAMPLES COLLECTED FROM MONITORING WELLS

Method/Contaminant	Well Number/Sample Number										Federal MCL Maximum Contaminant Level (µg/L)	NC Water Quality Standard (µg/L)
	MW-8/ ARSW- MW8	MW-9/ ARSW- MW9	MW-10/ ARSW- MW10	MW-11/ ARSW- MW11	MW-12/ ARSW- MW12	MW-13/ ARSW- MW13	MW-14/ ARSW- MW14	MW- 15(7) ARSW- MW15	DW-5/ ARSW- DW5	DW-6/ ARSW- DW6	Trip Blank	
EPA Method 602(2)(µg/L) Purgeable Aromatic Hydrocarbons												
Benzene	3.8	—(1)	—	—	—	—	—	—	—	—	—	1.0
Toluene/EDB(3)	36.2	—	—	—	—	—	—	—	—	—	—	1,000/0.0005
Ethylbenzene	18.0	—	22	6.4	—	—	—	—	—	—	—	29
m-, p-Xylene	41.7	—	25	—	—	—	—	—	—	—	—	NE
o-Xylene	45.7	—	48	—	—	—	—	271	—	—	—	NE
1,3-Dichlorobenzene	—	—	—	18.6	—	—	—	363	—	—	—	NE
1,4-Dichlorobenzene	93.8	—	64.2	18.7	—	2.14	—	—	—	—	—	620
1,2-Dichlorobenzene	17.1	—	—	42.2	—	—	—	296	—	—	—	1.8
Total Xylenes	87.4	—	73	—	—	—	—	271	—	—	—	620
Total VOCs(6)	256.3	—	159.2	85.9	—	2.14	—	930	—	—	—	400(4)
EPA Method 625(6)(µg/L) Base Neutral/Acid Extractables												
Acenaphthene	—	NA(8)	4.1	NA	—	NA	NA	NA	NA	NA	NA	NE
Fluorene	—	—	6.6	—	—	—	—	—	—	—	—	NE
Naphthalene	—	—	19	—	—	—	—	—	—	—	—	NE

Notes: (1) -- = Less than method detection limit.

(2) Purgeable aromatics analyzed by EPA Method 602. Method could not resolve toluene and EDB. Laboratory reported the concentrations as a combined value.

(3) EDB = Ethylene Dibromide. Method could not resolve Toluene and EDB. Concentrations reported as a combined value.

(4) The MCL and NCWQS for Xylene (Total) includes Meta, Para, and Ortho Xylenes.

(5) Sum of total volatile organic compounds detected by EPA Method 602.

(6) Base Neutral/Acid Extractables (BNAs) analyzed by EPA Method 625.

(7) MW-15 is a duplicate sample obtained from MW-10.

(8) NA = Not Analyzed.

(9) NE = Not Established.

Table reflects only those parameters which were detected. Complete list of tested parameters are provided in Appendix E. Groundwater samples obtained on June 23 and 24, 1992.

The NCWQS for benzene was exceeded in MW-8 (3.8 µg/L). In addition, the Federal MCL and NCWQS for 1,4-dichlorobenzene was exceeded in MW-8, and the NCWQS in MW-10 and MW-11. As mentioned in Section 8.2, the dichlorobenzenes detected may be other semivolatiles because they were not detected by EPA 625 analysis.

Semivolatile constituents were only detected in MW-10. Concentrations of acenaphthene, fluorene, and naphthalene were detected. Currently, there are no MCLs or WQS for these constituents.

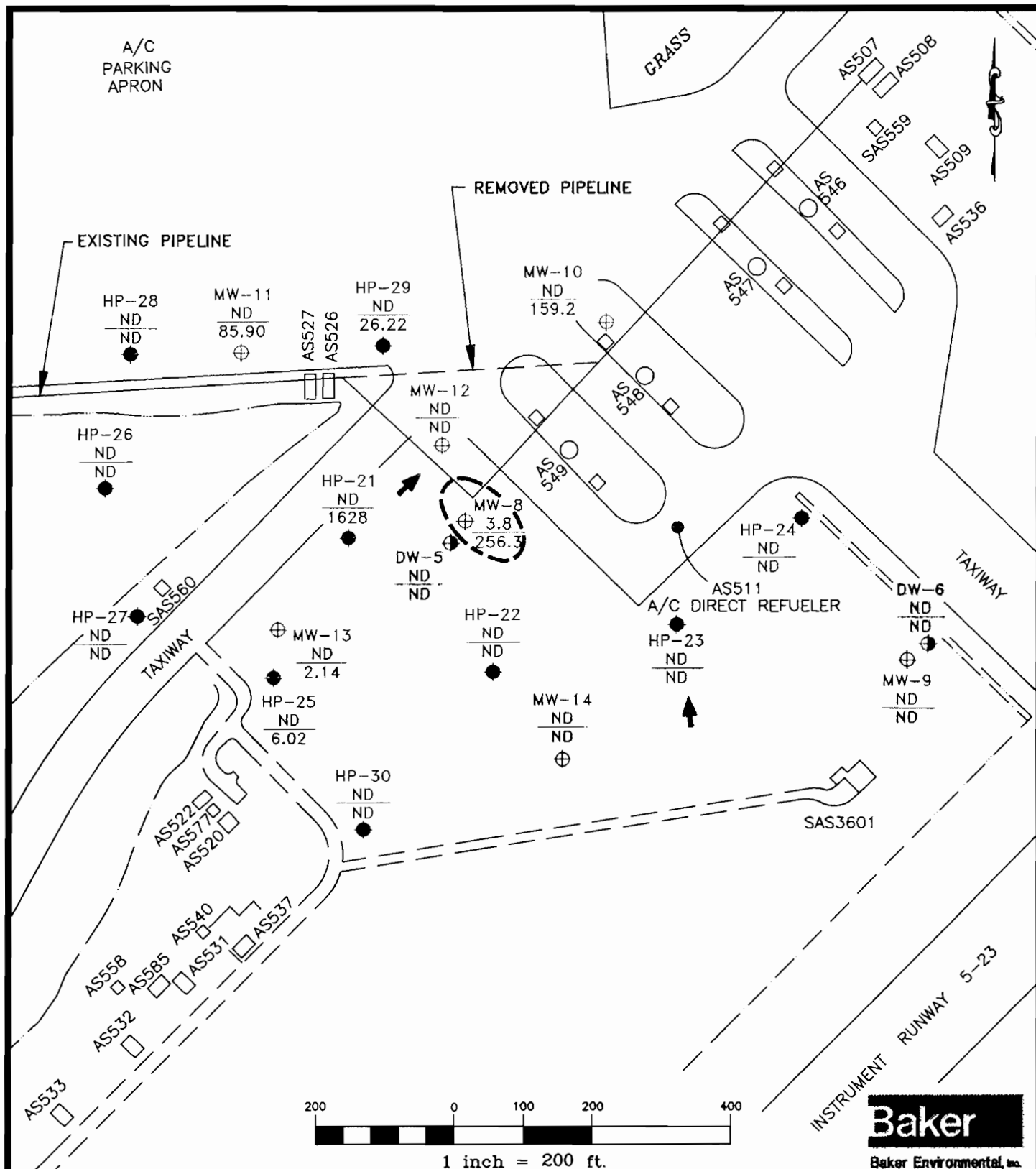
8.4 Extent of Horizontal Groundwater Contamination

The horizontal extent of groundwater contamination was evaluated using the hnu-hanby field data obtained from the penetrometers, and analytical data obtained from the shallow Type II and deep Type III wells. The extent of benzene and total VOC contamination in the shallow water-bearing zone is depicted on Figure 8-1. As shown on Figure 8-1, the extent of benzene contamination is limited to the vicinity of MW-8. In addition, high total VOC concentrations are also present near HP-21 and MW-10. Based on the field and analytical data, groundwater contamination is limited to the areas nearest to the fuel lanes and pipeline. The source of the contamination is most likely the soils which have been impacted by releases from the pipeline.

8.5 Extent of Vertical Contamination

As shown on Figures 8-1, groundwater contamination in the shallow water-bearing zone is highest in MW-8 with 256.3 µg/L and MW-10 with 159.2 µg/L for total VOCs. These two wells are situated directly in the center of the refueling area and the extensive piping system. These wells had a screen interval between approximately 4.0 to 14.0 feet.

Groundwater contamination in the deeper water-bearing zone was evaluated to approximately 47 feet below ground surface. The two deep wells have total VOC values of less than method detection limits indicating the absence of contamination in the lower aquifer. These deep wells have screen intervals of 47 to 42 feet for DW-5 and 44 to 39 feet for DW-6.



LEGEND

MW-8 SHALLOW TYPE II GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

DW-5 DEEP TYPE III GROUNDWATER MONITORING WELL INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

HP-21 HYDROPUNCH INSTALLED BY BAKER ENVIRONMENTAL, INC., JUNE 1992

0.42 BENZENE CONCENTRATION IN ug/l (ppb)

0.94 TOTAL VOC CONCENTRATION IN ug/l (ppb)

(ND) NOT DETECTED - LESS THAN METHOD DETECTION LIMIT

→ ESTIMATED GROUNDWATER FLOW DIRECTION

--- ESTIMATED EXTENT OF BENZENE CONTAMINATION (>1.0 ug/l)

SOURCE: LANDOV, OCT. 1991

FIGURE 8-1
BENZENE AND TOTAL VOC
CONCENTRATIONS IN GROUNDWATER
AIRCRAFT REFUELING AREA
BUILDING AS-527

MARINE CORPS AIR STATION, NEW RIVER
JACKSONVILLE, NORTH CAROLINA

9.0 PRELIMINARY EXPOSURE ASSESSMENT

The objectives of the preliminary exposure assessment section are to: (1) qualitatively determine the fate and transport of contaminants found at the site; (2) identify the major contaminants at the site; (3) identify the actual and/or potential pathways of exposure; and (4) identify the actual and/or the potential human and/or environmental receptors.

9.1 Fate and Transport of Petroleum in the Environment

Petroleum products are complex hydrocarbon mixtures. A typical fuel mixture can consist of more than one hundred compounds (EPRI, 1989). The fate and transport of petroleum products in soil is dependant on the chemical and physical properties of the product. In general, when petroleum hydrocarbons (PHCs) are released into unsaturated soils, they tend to migrate vertically due to gravitational force, with some lateral spread (Schwendeman, 1989). The migration pathway may be interrupted by adsorption to soil particles, inhibition by a geologic formation, (i.e., low transmissive capability) or by cultural features (i.e., pipe channels or foundations).

The subsurface transport of contaminants is also controlled by complex interactions between chemical, physical, and biological processes. Some conditions which effect migration are:

- Soil texture
- Soil uniformity or non-uniformity
- Soil layer configuration
- Depth to water table
- Soil structure
- Flow stability
- Soil moisture

Mathematical models have been developed to assist in estimating chemical movement in soils. The Seasonal Soil Compartment Model (SESOIL), developed for the U.S. Environmental Protection Agency's Office of Toxic Substances, has been used to determine the mobility and fate of certain chemicals. This SESOIL model classifies organic compounds into four categories (EPRI, 1989):

- Chemicals which preferentially adsorb onto soil particles.
- Chemicals which volatilize rapidly.
- Chemicals which pose an immediate threat to groundwater supplies.
- Chemicals for which there is no dominant migration pathway.

The major implication of this model is that because of their molecular weight, lighter PHCs are more likely to volatilize, while heavier PHCs will tend to bind tightly to soil particles.

The relative environmental partitioning of petroleum constituents and examples of various migration pathways are presented in Tables 9-1 and 9-2, respectively. As is evident, benzene, ethylbenzene, toluene, and xylenes (BTEX) have multiple migration pathways. The chemical nature of these compounds is such that they are volatile, adsorb to soil particles, and are water soluble. In contrast, the heavier PHCs, such as polycyclic aromatic hydrocarbons (PAHs), tend to adsorb to soil particles and become immobilized. Therefore, the lighter constituents of oils (i.e., BTEX) may be found in the air, soils, and/or groundwater, while the heavier constituents of oils (i.e., PAHs) will usually be found only in soils.

9.2 Identification of Major Contaminants

9.2.1 Soils

The soil analytical data is presented in Appendix E. The soil data indicates that TPH was detected in 5 of the 20 soil samples collected. Positive values for TPH ranged from 0.65 mg/kg (MW-10) to 2577 mg/kg (MW-10). One of the 5 positive results for TPH exceeded the DEHNR action level of 10.0 mg/kg established for TPH in soil.

Nine soil samples were analyzed for pH and flashpoint. pH ranges were between 3.69 to 7.16. Flashpoint results indicate that all soils have a flashpoint of greater than 220°F. A summary of analytical findings for the soil samples is shown on Table 6-2.

9.2.2 Groundwater

The analytical data for the groundwater is presented in Appendix E.

TABLE 9-1

**RELATIVE ENVIRONMENTAL PARTITIONING OF PETROLEUM
CONSTITUENTS BASED ON SESOIL RESULTS**

Petroleum Compound	Adsorption Onto Soil Particles (%)	Volatilization (%)	Soluble Portion in Groundwater and Soil Moisture (%)
Benzene	3	62	35
Ethylbenzene	21	59	20
(n)Heptane	0.1	99.8	0.1
(n)Hexane	0.1	99.8	0.1
(n)Pentane	0.1	99.8	0.1
Benz(a)Anthracene	100	0	0
Benz(a)Pyrene	100	0	0
Naphthalene	61	8	31
Phenanthrene	88	2	10
1-Pentene	0.1	99.8	0.1
Phenol	9	0.01	91
Toluene	3	77	20
(o)Xylene	15	54	31

Source: EPRI, 1989

TABLE 9-2

CATEGORIES OF MIGRATION PATHWAYS

Adsorb to Soil Particles	Volatilize in Air	Solubilize in Groundwater	Multiple Pathways
Benzo(a)Pyrene	(n) Hexane	Phenol	Benzene
Phenanthrene	(n) Heptane		Ethylbenzene
Benz(a)Anthracene	(n) Pentane 1-Pentene		Naphthalene Toluene (o) Xylene

Source: EPRI, 1989

The monitoring well groundwater data is summarized on Table 8-4. Groundwater samples were collected from nine monitoring wells and analyzed by EPA Method 602 for purgeable aromatic hydrocarbons. Additionally, groundwater from three monitoring wells (MW-8, MW-10 and MW-12) was collected and analyzed by EPA Method 625 for base neutral/acid extractables (BNAs).

Varying levels of purgeable aromatics; benzene, toluene, ethylbenzene, xylenes, and dichlorobenzenes were detected in the groundwater. The maximum concentration of contamination was detected in monitoring well MW-8. Elevated levels of 1,4-dichlorobenzene were detected in MW-8 (93.8 µg/L) and MW-10 (64.2 µg/L). The North Carolina Water Quality Standard (NCWQS) established for benzene (1.0 µg/L) was exceeded in MW-8 (3.8 µg/L). The Federal Maximum Contaminant Level (MCL) established for 1,4-dichlorobenzene (75 µg/L) was exceeded in monitoring well MW-8 (93.8 µg/L). All other groundwater concentrations were less than the established State and Federal standards.

Groundwater collected from monitoring well MW-8 indicated the presence of acenaphthene (4.1 µg/L), fluorene (6.6 µg/L), and naphthalene (19 µg/L). There are no Federal or State standards established for these contaminants.

9.3 Identification of Human Exposure Pathways

The possible human exposure pathways for this site include: ingestion of groundwater, inhalation of volatiles, dermal contact with contaminated soils, and accidental ingestion of soil. There are no drinking water sources (i.e., supply wells) within a 1,500 foot radius of this site. Dermal contact with contaminated soil should be addressed in the event that remediation or construction activities are performed at this site. Because of the high volume of activity conducted at this site accidental ingestion of contaminated soil should be addressed as a concern.

9.4 Identification of Receptors

Potential human receptors may exist through exposure to suspected contamination in the soil. TPH levels indicate the possible presence of contamination in the soil. Potential human receptors may come in contact with contaminated soils through accidental ingestion, inhalation of particulates, or dermal contact. In addition, potential human receptors may exist in the event that remediation or construction activities are conducted at the site.

9.5 Risk Evaluation

Because drinking water in the area is supplied by a public water source, contamination detected in the groundwater should not pose a significant health risk. TPH concentrations in the soil are above the State Action Level and are potentially contaminated. Consequently, a potential risk exists from dermal contact and/or inhalation of contaminated particulates. In addition, if remediation or construction activities are conducted in this area, soils should be sampled to determine presence or absence of contamination prior to commencement. A preliminary exposure assessment summary is provided in Table 9-3.

TABLE 9-3
PRELIMINARY EXPOSURE ASSESSMENT SUMMARY

Exposure Pathways	Maximum Detected Levels	Potential for Migration of Contaminants	Potential for Human Exposure
Soil	TPH: 2,577 mg/kg pH: 7.16 FP: > 220°F Only 1 sample, MW-10, had a TPH value above 10 mg/kg. MW-10 had a recorded level of 0.06 feet of free product.	Soils here are predominantly fine sands and silty sand. This permeable material would allow for substantial contamination migration if a release should occur. Current findings do not indicate the presence of a large contaminated area within the study area. The highest TPH value was recorded at a depth of 4 to 6 feet at MW-10.	Covered by over 95 percent concrete and/or asphalt, the site poses no immediate exposure. If the site is disturbed due to construction or remediation activities, exposure to worker does exist by direct contact and the inhalation of dust generated from the site.
Groundwater	Benzene: 3.8 µg/L Toluene: 484 µg/L Ethylbenzene: 22 µg/L Total Xylenes: 271 µg/L 1,3-Dichlorobenzene: 363 µg/L 1,4-Dichlorobenzene: 93.8 µg/L 1,2-Dichlorobenzene: 906 µg/L Acenaphthene: 4.1 µg/L Fluorene: 6.6 µg/L Naphthalene: 19 µg/L	Groundwater, on the average, was 6 to 8 feet below ground surface. It is believed that migration through this material would be possible. However, a flow velocity of 0.83 feet/year would drastically reduce the migration of contamination.	Because the base drinking water is supplied by the deeper Castle Hayne Aquifer and because there are no water supply wells within a 1/4-mile radius of the site, no groundwater exposure pathways are believed to exist.
Vapor	No detection by use of photo-ionization detector.	With little possibility of release of vapors through the concrete surface, and no concentrations detected at the site, vapor migration is unlikely.	In the event that the site is disturbed due to construction or remediation of areas of contamination, inhalation from the volatilization of the TPH could occur.

10.0 PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

This section of the Site Assessment Investigation discusses the type and extent of soil and groundwater contamination in the vicinity of the Aircraft Refueling Area and AS-527 and evaluates applicable remediation alternatives for soil and groundwater remediation. A remediation alternative consists of a combination of technologies or a single technology capable of addressing the site-specific contamination at the site.

10.1 Objectives

The objectives of this Remediation Assessment are as follows:

- Evaluate whether soil and groundwater require remediation;
- Identify areas requiring remediation; and,
- Evaluate technologies for soil and groundwater remediation and their associated costs.

Several remedial technologies were evaluated with respect to their ability to correct the specific contamination detected in the vicinity of the Aircraft Refueling Area and AS-527.

10.2 Potential/Feasibility of Remediation

TPH concentrations above 10 ppm, the State action limit, were exhibited in only one of the 20 soil samples analyzed during this investigation. This sample was collected from the soil boring for monitoring well MW-10 at depth of 4 to 6 feet. Monitoring well MW-10 is located at the refueling as shown on Figure 5-4. The TPH concentration detected was representative of medium to high boiling point petroleum hydrocarbons which can be indicative of jet fuel.

The extent of area requiring soil remediation in the immediate area north of MW-10 is not known at this time. However, the area impacted by petroleum hydrocarbons is believed to extend north along the refueling lanes (based on information received by Activity personnel). Given the levels of TPH detected in the soils immediately above the groundwater table, soil remediation in this area is necessary to the depth of the water table (5 to 8 feet).

In January 1992, Baker performed a site investigation in the vicinity of the refueling area. During that investigation, TPH soil contamination was found in the area of the removed JP-5

pipeline, east of AS-527. Several soil samples exhibited TPH concentrations over 100 mg/kg. Accordingly, this area should also be considered for soil remediation.

Soil remediation requirements for TPHs are determined by the SSE developed by the DEM. Based on the SSE (46), it is determined that the remediation requirement for this site is 10 mg/kg.

The levels of VOCs (i.e., purgeable aromatic hydrocarbon constituents) and semivolatile (i.e., base/neutral acids extractables constituents) detected in the groundwater samples from monitoring wells were relatively low. However, one of the hydropunch groundwater samples (HP-21) had elevated levels of purgeable aromatics. Groundwater remediation requirements for VOCs and semivolatile compounds are determined relative to Federal MCLs established by the EPA and WQS established by the State of North Carolina.

Results of the analytical data for groundwater sampled from monitoring wells indicate the WQS for benzene, and 1,4-dichlorobenzene (Federal MCL for 1,4-dichlorobenzene, also) was exceeded in several monitoring wells (MW-8 - benzene - 3.8 µg/L and 1,4-dichlorobenzene - 93.8 µg/L; MW-10 and MW-11 - 1,4-dichlorobenzene - 64.2 µg/L and 18.7 µg/L, respectively). The hydropunch sample collected from HP-21 exhibited concentrations of 1,2-dichlorobenzene (906 µg/L) which exceeds the WQS or MCL. Semivolatile compounds were also detected in low concentrations in MW-10, but no water quality standards have been developed for these constituents.

In addition to dissolved petroleum hydrocarbon contamination, a thin layer of floating petroleum product (free product) was also detected in one monitoring well using the oil/water interface probe. Monitoring well MW-10 contained 0.06 feet of free product. This thin layer, however, was probably more indicative of a "sheen" rather than an actual layer of product because during purging activities, product was not noted in the bailer. Accordingly, free product removal will not be addressed for remediation this time, but it is recommended that fluid levels be measured periodically to check for the presence of product.

The highest levels of VOCs were detected in the vicinity of MW-8, MW-10, and HP-21. Although at several sampling locations the State WQS or Federal MCL were exceeded, the degree to which they were exceeded was not very significant. It is believed that if the source of the contamination (the soils) is removed, groundwater VOC concentrations will decrease over time.

The remediation goal is determined based on applicable regulatory requirements and availability of feasible remedial action alternatives; the proposed remediation endpoints for the Aircraft Refueling Area and AS-527 is the reduction of TPH in the soil below 10 ppm. It is anticipated that once soil contamination is removed, groundwater concentrations will decrease to within Federal MCL and State WQS levels. For future consideration, however, groundwater remediation alternatives will be discussed in the following sections.

10.3 Potential Remediation Alternatives

A brief description of applicable soil and groundwater remediation alternatives follows. Information regarding respective remedial technologies was obtained from documents developed by the EPA (EPA/625/6-87-015).

10.3.1 Soil

Soil remediation technologies used by themselves or in combinations are considered to be source control alternatives. Some of the commonly used alternatives for soil remediation are:

- Passive remediation
- Vacuum extraction
- Excavation followed by one of the technologies listed below:
 - ▶ Disposal at an off-site landfill
 - ▶ Bioremediation
 - ▶ Low temperature thermal treatment
 - ▶ Incineration

A brief description of these alternatives is offered in Sections 10.3.1.1 through 10.3.1.6.

10.3.1.1 Passive Remediation

This alternative means that no design or construction remedial alternative is taken and is included in this study as a baseline for comparison with the other considered alternatives. Despite the title of "Passive Remediation", however, activity at the site continues as monitoring. Should the monitoring indicate a deterioration of site conditions that allow the

"Passive Remediation" alternative, direct action becomes advisable. The costs associated with this alternative are for monitoring.

10.3.1.2 Vacuum Extraction

Vacuum extraction has proven effective as a method of reducing VOCs. This method involves installing vacuum extraction wells in the contaminated soil to volatilize the VOCs from the aerated soil pores. Once the VOCs are volatilized, additional treatment may be required, depending on VOC content of the vapor stream. The vapor stream may be vented directly to the atmosphere or undergo treatment by carbon adsorption or catalytic oxidation. Field tests are needed at the facility to determine the vacuum level required for the volatilization and transport of contaminants and to measure the radius of influence of vacuum extraction wells. This technology may be enhanced through injection of volatile-free air into the zone of contamination. The time required to complete remediation varies from several months to several years, depending on site geology, hydrogeology and extent of contamination. Vacuum extraction cannot be applied to reduce heavy metal content and can only partially reduce TPHs.

Capital costs vary greatly (\$20 to \$50/cubic yard) and depend on the size and depth of the plume, the nature of the contaminant, and the selected design criteria. A range of these costs include:

- Vapor extraction well - \$ 50 to 80/vertical foot (1985\$)
- Well connection lateral - \$1,000 to 1,550 each (1985\$)
- Vapor collection header - \$20 to \$105/linear ft. (1985\$)
- Blower facility - \$50K to 105K (1985\$)
- Monitoring probe - \$10 to \$15/vertical ft. (1985\$)
- Operational & Maintenance (O&M) - \$5,000 to 20,000/year
- Monitoring with portable meter - \$10 to \$15/visit (1985\$)

10.3.1.2 Excavation

Excavation is not a stand-alone alternative and is usually practiced in combination with another procedure or process, such as disposal at an off-site landfill, bioremediation, low temperature thermal treatment or incineration. The volume of soil to be excavated is usually estimated from sampling and analytical results. Post-excavation sampling is usually

conducted to confirm that all the contained soil has been fully excavated. The excavated area is filled with certified clean fill. Excavation poses a hazard through the release of VOCs to the atmosphere.

The costs associated with excavation include the removing of soil, the potential for shoring, post-excavation sampling and backfilling of the excavation. Additional costs are incurred for follow-up treatment or disposal of the contaminated soil. Estimated costs range between \$20 to \$50 per cubic yard.

10.3.1.3 Disposal at an Off-Site Landfill

The excavated soil is sampled and analyzed for hazardous waste characteristics prior to treatment or disposal at an appropriate landfill.

Costs associated with this alternative include transportation of the excavated material, and landfill disposal fees. Disposal fees will vary depending on the contaminants present and contaminant levels. The following are estimates for disposal and transportation:

Disposal

- Industrial wastes - \$40 to \$85/ton (1985\$)
- Ignitable wastes - \$125/ton (1985\$)
- Highly toxic wastes - \$300/cubic yard (1991\$)
- Nonhazardous solid waste - \$60/cubic yard (1990\$)

Transportation

Approximately \$3.00 per loaded mile (1985\$)

10.3.1.4 Bioremediation

Bioremediation is a proven technology for treating soils, sludges, and wastewater by using microorganisms to degrade organic material. An oxygen source and naturally occurring microbes are mixed with nutrients, (primarily phosphates and nitrogen) and are added to the soil or waste to be treated. Given sufficient residence time, the microbe/nutrient mixture promotes degradation of soil contaminants. Bioremediation is suitable for treatment of

contamination caused by petroleum hydrocarbons, aromatics, halogenated aromatics, phenols, organophosphates, and many herbicides and pesticides. About 85% of the organic constituent can be degraded over a period of six to twelve months.

This technology can be practiced in engineered land treatment cells or as landfarming. In landfarming, contaminated soil is excavated and laid in 6 to 12-inch lifts, tilled and treated with nutrients. This technology can also be practiced, in a few instances, in-situ. Bioremediation has been used by the petroleum industry for the past two to three decades to treat oily sludges. The tilling provides oxygen needed to promote the reaction. Reaction time can be reduced from months to days using a bioreactor.

Bioremediation costs vary widely depending on site geology, hydrogeology and extent of contamination, but are relatively less expensive than other alternatives. An average cost for this type of treatment is \$75 per cubic yard (1990\$).

10.3.1.5 Low Temperature Thermal Treatment

Low temperature thermal treatment (LTTT) is a demonstrated ex-situ process that provides evaporation of VOCs from contaminated soil without heating the soil matrix to combustion. Typical temperatures for LTTT are from 200°F to 1,000°F. This technology utilizes a thermal processor, an indirect heat exchanger to dry and heat contaminated soils, to strip the moisture and VOCs from the soil. Water is sprayed on the processed soil to provide cooling and to minimize dust emissions. The thermal processor is equipped with a self-contained burner which is typically fired by fuel oil. The LTTT process requires an emissions control system for the off-gas and a water treatment system for the condensate generated from cooling the off-gas. Contaminant removal efficiencies in excess of 95% can be achieved.

The costs associated with LTTT include excavation, fuel requirements, equipment, post-excavation sampling, and backfilling of the excavation. The operating cost of the thermal processor unit is relatively inexpensive relative to incineration, depending on the type and extent of contamination. Estimated costs for solids and/or highly toxic liquids can range between \$420 to \$842/ton (1986\$).

10.3.1.6 Incineration

Incineration is a proven technology that uses high temperature oxidation to destroy organic constituents in soil. The most commonly used incineration processes are liquid injection, rotary kiln, fluidized bed, and multiple hearth furnaces. Of these technologies, rotary kiln has the most experience. Rotary kiln incinerators are sloping cylindrical, refractory-lined shells, typically fired by the fuel content of the waste supplemented by natural gas or fuel oil. The waste is heated by heat transfer from the combustion gases. Kilns often contain an afterburner to ensure complete combustion of the off-gases. Wastes are fed at the higher end of the sloping cylinder. The rotation creates turbulence and moves the waste toward the discharge end. Combustion temperatures range between 1,500°F and 3,000°F with residence times for solids ranging from minutes to one hour. These units are highly efficient in destroying organic material but usually do not treat metals. Incineration is not practical if total destruction of organics is not required, or if the heating value of the waste is so low as to require too much supplemental fuel, or if the heating value of the waste is so high that the waste stream must be severely reduced.

Incineration can be performed on site in a mobile incinerator or at a commercial incineration facility off site.

The costs associated with incineration include excavation, rental of a mobile incinerator or transportation of the soil to an off-site commercial incinerator, supplemental fuel requirements, post-excavation sampling, and backfilling of the excavation. This approach is relatively expensive depending on the type and extent of contamination. The following cost ranges are expected:

- Drummed - \$130 to \$425/ton (1986\$)
- Liquids - \$55 to \$425/ton (1986\$)
- Relatively clean liquids with high Btu - \$14 to \$56/ ton (1986\$)

10.3.2 Groundwater

Dissolved contamination is the main consideration used to evaluate groundwater treatment alternatives. Some of the commonly used alternatives for treating VOC groundwater remediation are:

- Passive remediation with continued monitoring
- Bioremediation
- Air stripping
- Carbon adsorption

The three technologies listed above entail groundwater pumping and subsequent treatment. The treated water may be reinjected or discharged in accordance with permit requirements. They may be used singularly or can be combined. A brief description of these alternatives is offered in Sections 10.3.2.1 through 10.3.2.3.

10.3.2.1 Passive Remediation with Continued Monitoring

This option means that no design or construction remedial alternative is taken, except for the development and maintenance of a long-term monitoring program. This alternative is included in this study as a baseline for comparison with other considered alternatives. A groundwater monitoring program is recommended for several years. The monitoring program should consist of periodic sampling and analysis for the constituents of concern and checking for free product. The results of the monitoring program should be evaluated to track impacts to the environment and public health, and to identify whether additional remedial action may be required.

10.3.1.1 Bioremediation

As presented in Section 10.3.1.1, bioremediation is applicable to contaminated soil. This technology can also be used in groundwater remediation. Typically groundwater is extracted from the subsurface, mixed with microbes, nutrients and a source of oxygen, and allowed sufficient residence time to promote biodegradation of the contaminants. Bioremediation differs from air stripping and carbon absorption techniques in that contaminants are not removed from the groundwater, but are instead converted to less hazardous compounds. The type of equipment used to bioremediate the groundwater would be trickling filters, biological towers, rotating biological contractors, etc.

Groundwater bioremediation costs vary widely depending on site geology, hydrogeology and extent of contamination.

Costs for performing bioremediation were discussed in Section 10.3.1.1

10.3.2.3 Air Stripping

Air stripping consists of contacting contaminated water with an air stream by counter current flow in a column. The volatile organic compounds transfer from the water into the air as the water and air make contact in the column. Air stripper columns come equipped with different types of internals designed to improve mass transfer between air and water. These include random packing, trickle trays and diffusion air strippers. Treated water leaves the column from the bottom while air containing volatile contaminants are vented out the top. The vented air may require treatment such as carbon absorption for VOC. Depending on the type of petroleum product present in the contaminated water, air stripping is capable of achieving VOC removal rates up to and greater than 95 percent. Lower reductions can be anticipated if heavier petroleum constituents associated with the USTs are present.

Costs for air stripping are relatively inexpensive. The major components of an air-stripping system include the packed column, the air supply equipment, and repumping equipment. Annual costs (including capital costs) are as follows:

- 100,000 gallon/day - \$11K to \$19K (1986\$)
- 200,000 gallon/day - \$17K to \$28K (1986\$)
- 500,000 gallon/day - \$30K to \$50K (1986\$)
- 1,000,000 gallon/day - \$55K to \$75K (1986\$)

10.3.2.4 Carbon Adsorption

Carbon adsorption consists of contacting the contaminated water stream with granular activated carbon by allowing it to flow through a series of packed carbon beds. The carbon with its large surface area acts as an adsorbent medium for VOCs and TPH in water. This technique is effective in the removal of organic compounds and many inorganic compounds. The spent carbon requires disposal or regeneration in accordance with strict regulatory procedures.

Costs for carbon adsorption are low to moderate, and depend primarily on the required frequency of carbon regeneration. For cylindrical, pressurized, downflow steel contactors based on a nominal detention time of 17.5 minutes and a carbon loading rate of 5 gpm per

squared foot, the following capital and operational and maintenance (O&M) costs are estimated (all costs are 1986\$):

- Capacity of 2 gpm - capital \$14K to O&M \$1.8K
- Capacity of 4 gpm - capital \$17K to O&M \$2K
- Capacity of 10 gpm - capital \$20K to O&M \$2.4
- Capacity of 40 gpm - capital \$39K to O&M \$4K
- Capacity of 100 gpm - capital \$60K to O&M \$6.2K
- Capacity of 400 gpm - capital \$97K to O&M \$13K

10.4 Recommended Technologies

One soil and one groundwater technologies appear applicable for remediation of the VOCs and TPH. Each option is discussed in the following sections.

10.4.1 Soil

Based on site history and results of soil sampling, it appears that TPH soil contamination is present in the vicinity of MW-10. Six soil remediation alternatives were described in Section 10.3. These included passive remediation, in-situ, and ex-situ alternatives.

The passive remediation alternative was eliminated from further consideration because it does not comply with DEM objectives and does not reduce the effects of the contamination to the environment. The full extent of petroleum contamination is not defined in the northern portion of the study area. It is recommended that additional assessment activities be performed in this area to further evaluate the extent of contamination. Once the limit of contamination is defined, an appropriate remediation alternative may be selected.

The relative costs of the recommended alternatives for treating contaminated soils can be more accurately determined following further study. The adsorbed-phase soil contamination represents an ongoing source of dissolved phase groundwater contamination. Therefore, soil remediation efforts should be completed prior to or in combination with potential groundwater remediation efforts.

10.4.2 Groundwater

Based on site history and results of groundwater sampling, it appears that contamination migrated from the soil into the groundwater. The four technologies described in Section 10.3 were briefly evaluated for their application to the site and with respect to effectiveness, implementability and relative cost. The passive remediation alternative is feasible if, following soil remediation, it can be demonstrated that the source of contamination was removed. It is believed that once the source of contamination is removed (i.e., soils), groundwater quality will be at levels below State WQS or Federal MCLs. Once the full extent of petroleum contamination is defined in the northern portion of the site, further evaluations of the remediation alternatives may be performed.

If the areas in the vicinity of AS-527 and the refueling station are currently being considered for corrective action, the proposed groundwater remediation activities may be expanded to include these areas. This would reduce overall design costs for the activity and accelerate groundwater remediation in these areas.

Prior to final consideration of soil and groundwater remediation technology, results of ongoing site activities related to the area of concern should be evaluated. Accordingly, this may result in additional delineation of the TPH concentrations in the soils contained within the area of concern (northern portion of the refueling area).

This information will assist in confirming the required remediation technology and the amount of material requiring remediation.

11.0 CONCLUSIONS

The following conclusions are based on the results of the Site Assessment:

- TPH concentrations detected in site soils ranged from 0.65 mg/kg to 2,577 mg/kg. A sample collected from the soil boring for monitoring well MW-10 (4.0 to 6.0 feet) exhibited a TPH concentration which exceeds the action limit of 10 mg/kg, based on the SSE evaluation. Based on the TPH analysis, the contamination present in the soils is most representative of jet fuel.
- Several groundwater samples collected from monitoring wells and hydropunches exhibited VOC concentrations (benzene, dichlorobenzenes, toluene/EDB, ethylbenzene, and total xylenes) which exceed the NCWQS or Federal MCL. Although these concentrations exceeded the WQS or MCLs, the levels were not significant.
- Detectable concentrations of BNAs were detected in monitoring well MW-10 (acenaphthene, fluorene, and naphthalene). Presently, no NCWQS or MCLs exist for these constituents.
- The direction of groundwater flow in the vicinity of the site appears to be north-northeast at a rate of approximately 0.83 feet/year.
- The average hydraulic conductivity calculated for the site is 6.18×10^{-2} feet/day or 2.18×10^{-5} cm/sec based on slug test data.
- The average groundwater gradient for the site is 0.011 based on water level data collected on June 23, 1992.
- Soils encountered at the site were predominantly fine sands and silty-sands. Some gravelly sands were also encountered at deeper depths. Based on grain size characteristic testing, the soils classify as SM according to the USCS.
- Remediation of the soils in the northern portion of the refueling area and along the removed JP-5 pipeline is recommended. It is anticipated that if these soils are remediated, the condition of the shallow water-bearing zone will improve without performing active groundwater remediation. After remediation of the soils is completed, periodic monitoring of monitoring wells should be performed to evaluate groundwater conditions.

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APPENDIX A
TECHNICAL METHODS/STANDARD PROCEDURES

APPENDIX A

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APPENDIX A

TECHNICAL METHODS/STANDARD PROCEDURES

A subsurface investigation was performed to evaluate the possible horizontal and vertical extent of potentially impacted soil and/or groundwater associated with Building AS-527. The investigation included a reviewing relevant literature, hydropunch (penetrometer) sampling of groundwater, hnu-hanby field test for aromatic hydrocarbons in groundwater, installing Type II and Type III groundwater monitoring wells, collecting soil and groundwater samples for analytical analysis, and performing hydraulic conductivity tests. The following sections describe the technical methods and procedures that were employed.

A.1 UTILITY/PIPING CLEARANCE

Prior to subsurface investigation activities, a utility check was performed to identify nearby underground utility lines and/or pipelines. Baker Environmental, Inc., supplied Marine Corps personnel with maps indicating proposed hydropunching and drilling locations. Coordination of the utility clearance for these proposed locations was the responsibility of the Camp Lejeune point of contact.

A.2 PERMITTING

In accordance with Title 15, Subchapter 2C, Section .0105 of the North Carolina Administrative Code, a permit was obtained from the North Carolina Division of Environmental Management (DEM) prior to performing soil borings which were converted to monitoring wells. Copies of the permit applications are provided in Attachment A-2.

A.3 HYDROPUNCH (PENETROMETER) PROCEDURE

A total of 10 hydropunch samples were obtained from the surficial aquifer at various locations within the vicinity of Building AS-527. The Hydropunch Field User's Guide explaining the basic operating sequence and trouble shooting procedure is found in Attachment A-3 at the end of Appendix A of this report.

The hydropunch groundwater sample was analyzed by the hnu-hanby field test for aromatic hydrocarbons to determine the presence or absence of groundwater contamination. Also, part

of each sample collected was sent to a laboratory and analyzed for purgeable aromatic hydrocarbons (EPA Method 602). The results of field testing were utilized in the determination of the actual locations of soil borings and monitoring wells.

A.4 hnu-hanby FIELD TEST FOR AROMATIC HYDROCARBONS

The hnu-hanby Field Test is a procedure for analysis of petroleum aromatic hydrocarbons over a wide range of concentrations in groundwater. Additional information and step-by-step procedure is provided in Attachment A-4 at the end of Appendix A. The hnu-hanby test was performed the groundwater sample obtained from the hydropunch procedure.

Petroleum fuel type and estimated concentration in ppm were recorded in the site geologist's notebook. The results of the hnu-hanby test, along with the chemical characteristics of the sample obtained by the laboratory analyses, were used to determine actual soil boring and monitoring well locations. Hydropunch logs depicting conditions encountered are provided in Appendix H.

A.5 SOIL BORING PROCEDURES

A total of 7 soil borings were advanced in the vicinity of Building AS-527. A site plan depicting locations of the 7 soil borings is shown on Figure 5-4 of the text. These soil boring locations were selected based on the suspected groundwater flow direction, results of the Baker investigation, and on additional information obtained from the hydropunch sampling and hnu-hanby tests performed in the field. The soil borings were performed by a truck-mounted drill rig. Soil borings MW-8 through MW-14 were advanced using 6-1/4 I.D. hollow-stem augers. Soil borings DW-5 and DW-6 were initially advanced by mud rotary, using a 5-7/8-inch tricone bit. They were then advanced using 8-1/4-inch I.D. hollow-stem augers to depths of 34 feet and 37 feet, respectively, to set the outer casing. The remainder of the boreholes were advanced using mud rotary (Section A.7.2). Soil cuttings obtained during drilling activities were containerized in 55-gallon steel drums and stored on site.

During drilling, Standard Penetration Tests (SPT) were conducted following ASTM 1586-D guidelines. For soil borings MW-8 through MW-14, the split-spoon samples were collected at consecutive intervals until the final depth of the boring. For soil borings DW-5 and DW-6, split-spoon samples were collected at consecutive intervals until groundwater was encountered; soil samples were then obtained at five-foot intervals for the remainder of the

borehole. Two-foot length split-spoon samplers were used to increase the likelihood that a sufficient quantity of each sample is retained for laboratory analysis.

The soil samples were visually classified by Baker's on-site geologist and recorded on a Field Test Boring Record (Appendix C). The soil descriptions included, but were not limited to, the following:

- Principal constituent type: GRAVEL, SAND, SILT, CLAY
- Color: brown, reddish brown, light gray, etc.
- Minor constituent, if present, and approximate proportion:
 - ▶ Trace (0-10 percent)
 - ▶ Little (10-20 percent)
 - ▶ Some (20-35 percent)
 - ▶ And (35-50 percent)
- Plasticity for cohesive soils: plastic (PL), nonplastic (NP)
- Relative density of noncohesive and cohesive soils: loose, dense, very dense; very soft, soft, medium stiff, respectively
- Moisture content: dry, damp, moist, wet

Drilling operations were performed using Level D personal protective clothing. Continuous air monitoring was conducted with an HNu photoionization detector (PID) during drilling activities. No volatile organic vapor concentrations exceeded 2.5 ppm in the breathing zone in the vicinity of any of the 9 soil borings. An upgrade of personal protection was not required, as discussed in the Site Health and Safety Plan (Appendix B).

A.6 MONITORING WELL INSTALLATION

A.6.1 Type II Monitoring Well

Upon completion of soil sampling and drilling to the specified depth at soil borings MW-8 through MW-14, shallow groundwater monitoring wells (Type II wells) were installed within the borings. Each monitoring well was constructed of 2-inch I.D., flush-threaded Schedule 40 PVC. A 10-foot section of 0.010-inch slotted PVC well screen was installed in each well. The length of screen to be used was determined by the field geologist based upon site specific conditions. A sand pack was placed around the slotted well screen extending approximately 2 feet above the top of the screen. A bentonite seal (minimum thickness of 1 foot) was placed on top of the sand pack. Finally, a Portland cement/bentonite grout mixture was placed in the borehole to ground surface. Each Type II monitoring well was completed by installing a 4-inch steel protective casing over the well. A 3 foot x 3 foot concrete pad, 4-inches thick, was constructed around each well. All monitoring well locations were completed below grade and constructed beneath a flush grade manhole layer. This was to protect the monitoring well installed in vehicle or air traffic areas. Actual well construction records for each monitoring well is provided in Appendix G.

A.6.2 Type III - Monitoring Well

For use in defining the vertical extent of petroleum contamination, deep groundwater quality monitoring wells (Type III) were installed. At two locations, DW-5 and DW-6, Type III wells were installed. The Type III well construction was used to minimize the potential for carrying contamination down into the deeper portion of the aquifer during drilling activities.

A soil boring was advanced utilizing 8-1/4-inch I.D. hollow stem augers through the formation material to a depth of approximately 35 feet below ground surface. A 6-inch I.D. PVC outer casing was installed to the total borehole depth and grouted in place using a Portland cement/bentonite grout mixture. A pressure grouting technique was used for the grouting of the casing, this technique consisted of pumping the grout through a 6-inch packer placed near the bottom of the casing, forcing the grout out of the casing and up the borehole. The process was completed when a sufficient amount of grout was observed flowing up from the outer annulus at the ground surface. The grout seal was then allowed to cure for approximately 24 hours.

After the grout seal in the outer casing had cured, the borehole was extended through the bottom of the outer casing approximately 10 feet below the bottom of the outer casing. A five-foot long, 2-inch I.D. 0.010-inch machine-slotted PVC well screen threaded to unslotted PVC riser casing was then installed.

The filter pack material was installed between the screen and the borehole annulus to approximately 2-feet above the screen. The filter pack material consisted of a prewashed and bagged sand. A bentonite seal approximately 2-feet thick was constructed on top of the filter pack material. A Portland cement/bentonite grout mixture was used to grout the remaining borehole annulus by tremie pipe to the ground surface. A four-inch steel protective casing was installed on the Type III well.

Similar to the Type II well completion, a three-foot by three-foot concrete pad was constructed around three of the wells. The wells were completed below grade and constructed beneath a flush grade manhole cover. This was to protect the monitoring well in vehicle traffic areas. Well completion diagrams depicting actual well construction details are provided in Appendix G.

A.6.3 Well Development

All monitoring wells were developed following their installation to remove fine ground materials that may have entered the well during construction and to provide a sufficient hydraulic connection between the monitoring well and the formation. This was accomplished by using a centrifugal pump. Equipment used for well development was decontaminated between each monitoring well with a high pressure steam clean wash followed by a potable supply water rinse. All fluid generated from well development and equipment decontamination was contained in 55-gallon drums and stored on site.

A.7 DECONTAMINATION PROCEDURES

Hydropunch samplers were decontaminated between samples either by steam-cleaning or by washing with a nonphosphate soap (Alconox), and rinsing with distilled water. In areas of extensive contamination, pesticide-grade hexane was applied for additional decontamination.

For performing the soil boring and monitoring well installation activities, the drilling equipment and tools (rods, augers, etc.) were steam-cleaned prior to advancing each borehole.

Steam-cleaning was performed using a potable water source. A temporary containment pad/area located near Building AS-527 was used by the driller for decontamination activities. Soils and fluids collected during decontamination activities were containerized in 55-gallon steel drums and labeled accordingly. Soils were eventually transferred into a roll-off box for off-site soil disposal.

A.8 FLUID LEVEL MEASUREMENTS

Fluid level measurements were obtained from all newly installed monitoring wells. The depth to water was measured using an oil/water interface probe capable of detecting product layers as thin as 0.01 feet. Depths were measured to the nearest 0.01 foot. The interface probe was decontaminated between readings with an Alconox solution, hexane and distilled water.

A.9 SAMPLE COLLECTION

Soil and groundwater samples were collected for chemical analyses. The following sections describe soil and groundwater sampling activities.

A.9.1 Soil Screening

During Baker Environmental's field assessment activities at the site, soil samples from each boring, (MW-8 through MW14, DW-5 and DW-6), were screened in the field for total volatile organic vapor (TVOV). Each soil sample was visually classified for physical characteristics and then placed in appropriate laboratory sample containers.

A.9.2 Soil Sampling

In order to estimate the extent of potentially contaminated soils, two soil grab samples from each borehole (total of 18 samples) and two duplicate soil samples were collected and submitted for TPH analysis. The first soil sample was collected from between 2.0 to 4.0 feet below ground surface and a second soil sample was collected from 4.0 feet below ground surface to the water table in seven wells; and 0 to 2.0 feet and 2.0 to the water table in two wells. Nine grab soil samples were collected and sent to a laboratory for flashpoint and pH analysis and one grab sample was tested for grain size characteristics. Collection of these samples was determined by the Baker field geologist. The samples were collected via split-spoon sampling as discussed in Section A.6.

Each grab soil sample was placed into a laboratory-prepared container, stored on ice in a cooler, and sent to the laboratory for analysis. The types of sample containers used for each analytical method are provided on Table A-1. Appropriate Chain-of-Custody (COC) documentation was sent with the samples to the laboratory. Copies of the COC are provided in Appendix D.

Acceptable TPH concentrations in soils were determined by the Site Sensitivity Evaluation (SSE) form developed by the North Carolina Department of Environmental Management (DEM). Based on the SSE, the site had a ranking score of 46. This resulted in an action limit guideline of 10 mg/kg for the site. The SSE ranking form is provided in Attachment A-1.

A.9.3 Groundwater Sampling

Groundwater samples were collected from the 10 hydropunch locations, the 7-Type II, and the 2-Type III groundwater monitoring wells, to evaluate the horizontal and vertical extent of potentially contaminated groundwater. All groundwater samples were analyzed for purgeable aromatic hydrocarbons (EPA Method 602). Selected monitoring wells were analyzed for base/neutral acid extractables (EPA Method 625). Monitoring wells were allowed to stabilize for a 24-hour period prior to sampling. The following paragraphs discuss the methods which were employed during sampling activities.

Prior to performing groundwater sampling, static fluid level measurements were obtained using an oil/water interface probe. The depth to groundwater was determined in the well at the time of measurement. The water level was measured to the nearest 0.01 foot from the top of the PVC well casing. The total depth of each well was also measured to the nearest 0.01 foot using a weighted measuring tape. The water levels and well depth measurements were used to calculate the volume of water in each well and the minimum volume of water that must be purged prior to sampling. All downhole equipment was decontaminated with pesticide-grade hexane and distilled water.

A minimum of one well volume was purged from the wells prior to sampling. Purged water was containerized in 55-gallon steel drums. During purging activities, three measurements of pH, specific conductance and temperature were obtained and recorded in the field log.

TABLE A-1
SUMMARY OF FIELD SAMPLING AND ANALYTICAL PROGRAM FOR SOIL SAMPLES

Parameter	No. of Samples	Bottle Requirements	Preservation Requirements	Holding Times	Analytical Method
Total Petroleum Hydrocarbons (TPH)	18	Glass, Teflon-Lined Cap 2-40 ml vials	Cool, 4°C	14 days	SW-846 (5030 and 3550)
Flashpoint	9	Polyethylene or Glass 8 oz.	None	None	SW-846 (1010)
pH	9	Polyethylene or Glass 4 oz.	None	None	SW-846 (9045)
Grain Size	1	500 g	None	None	ASTM D422

Note: Information listed above taken from the following documents:

- Test Methods for Evaluating Solid Waste SW-846, 3rd Edition, November 1986.
- Grain size - Annual Book of ASTM Standards, 1985.

Groundwater samples were collected from the wells using dedicated, disposable polyethylene bailers and immediately placed into appropriate, laboratory-prepared sample containers. The types of sample containers used for each analytical method are provided on Table A-2. Samples that were analyzed for VOCs were collected by slowly pouring water from the bailer into a 40 ml vial. Each vial was completely filled to prevent volatilization. Appropriate COC documentation was sent with the samples to the laboratory. One trip blank per cooler containing VOC samples was sent with the samples to the laboratory.

A.9.4 Sample Documentation in the Field

Five kinds of documentation were used in tracking and shipping analytical samples:

- Field log book
- Sample labels
- Chain-of-custody records
- Custody seals
- Commercial carrier airbills

At a minimum, the label for each sample bottle contained the following information:

- Site name
- Sample number
- Date and time of collection
- Sampler's initials
- Sample preservation and preservative used
- General types of analyses to be conducted

The sample information, as well as the analysis to be performed on the sample, was entered in the field log book in waterproof ink for each sampling point. An error in the field log was not erased; instead a single line was drawn through the error and initialed by the person completing the log.

TABLE A-2
SUMMARY OF FIELD SAMPLING AND ANALYTICAL PROGRAM FOR GROUNDWATER SAMPLES

Parameter	No. of Samples	Bottle Requirements	Preservation Requirements	Holding Times	Analytical Method
Purgeable Aromatic Hydrocarbons	19 ⁽¹⁾	Glass, Teflon lined Septum 2-40 ml vials	Cool, 4°C HCL to pH <2	14 days	EPA 602
Base/Neutral/Acid Extractables	3	Glass, Amber 2 - 800 ml	Cool, 4°C	7 days	EPA 625

Note: Information listed above taken from the following documents:

- 40 CFR 126 and 136, Appendix A.

(1) The 19 samples include samples from the hydropunch sampling (10), newly installed Type II monitoring wells (7), and Type III monitoring wells (2).

Additionally, the following items were entered:

- Dates and times of entry
- Sample depth and number
- Names of field personnel on site
- Names of visitors on site
- Field conditions
- Description of activities
- Sampling remarks and observations
- QA/QC samples collected
- List of photographs taken
- Sketch of site conditions

Sample numbers were designated by site code name ("ARS"), matrix ("S" for soil and "W" for groundwater), borehole number, and sample number taken from a particular borehole (example: ARS-S-MW8-01 would represent the first soil sample collected from soil boring MW-8). For duplicate samples an arbitrary sample number was chosen.

Custody of the samples was maintained by Baker personnel from the time of sampling until the time of shipment to the analytical laboratory.

Baker field personnel completed a COC record, in waterproof ink, to accompany each cooler forwarded from the site to the laboratory. Errors on the COC records were not erased; instead, a line was drawn through the error and initialed by the person completing the form. The original copy was placed in a sealable bag inside the appropriate cooler, secured to the cooler's lid.

When the sample cooler was shipped by commercial air carrier, the cooler was secured with custody seals so that the seals would be broken if the cooler was opened. The commercial carrier was not required to sign the COC record as long as the custody seals remained intact and the COC record stayed in the cooler. The only other documentation required was the completed airbill.

A.10 HYDRAULIC CONDUCTIVITY TESTS

Slug tests were conducted on two monitoring wells, MW-13 and MW-14 to estimate the horizontal hydraulic conductivity (K) of the shallow water-bearing zone at the site. Slug tests achieve this by measuring the rate at which water flows from a well into the surrounding formation when the elevation of water in the well casing is suddenly increased or decreased. This flow rate, the difference in elevation between initial water level in the formation and the displaced level, the length of well screening and other information on the well configuration, are utilized to calculate the K of the surrounding formation.

Prior to the initiation of each test, all equipment inserted into the well casing was decontaminated. The total depth of the well was measured to the nearest 0.01 foot with a steel tape. The static water depth from the top of the well casing was then measured to the nearest 0.01 foot using an oil/water interface probe. A known volume of water was then displaced within the well casing using a solid cylinder (slug) with a known volume. This raised the elevation of water within the casing above the natural groundwater elevation, causing water to flow from the well back into the surrounding formation. As the water flowed back, the elevation change within the casing was measured to the nearest 0.001-foot with a pressure transducer and recorded on an In-Situ, Inc., HERMIT 1000C™ Data Logger. These measurements were taken at predetermined time intervals using the logarithmic sampling schedule of the HERMIT 1000C™ until the elevation returned to a minimum of 90 percent of the original water level, prior to withdrawing the slug.

The solid cylinder (slug) was then removed from the well to perform a second test. This lowered the elevation of water within the casing below the natural groundwater elevation, causing water to flow into the well from the surrounding soil. As the water flowed back, the elevation change within the casing was again measured as before.

The estimates of K were prepared using the Bouwer-Rice method (Bouwer, 1976). The AQTESOLV™ program (Geraghty and Miller, 1989) was utilized to calculate and present the data collected in the field. Appendix F provides the AQTESOLV™ program output and the printouts of the actual field data.

A.11 LABORATORY QA/QC

To evaluate Laboratory Quality Assurance/Quality Control (QA/QC) performance and field sampling procedures, duplicate soil and groundwater samples were collected. The duplicate samples were generally collected at a ratio of one duplicate sample for every 10 actual samples (10 percent frequency). In the event that fewer than ten samples for a particular parameter were collected, one duplicate sample was still obtained.

To evaluate transportation and laboratory methods, one trip blank accompanied each shipment of samples to be analyzed for VOCs. Tables A-3 and A-4 summarize the QA/QC program for soil and groundwater samples, respectively.

The laboratory performing the analytical procedures, Solutions Laboratories, Inc, of Chesapeake, Virginia, also performed internal QA/QC tests. The results of these QA/QC tests are included with the analytical data provided in Appendix E.

TABLE A-3
SUMMARY OF ANALYTICAL PROGRAM FOR QA/QC SOIL SAMPLES

Parameter	Duplicate Samples (1)	Trip Blanks (2)	Bottle Requirements	Preservation Requirements	Holding Times	Analytical Method
Total Petroleum Hydrocarbons (TPH)	2	N/A	Glass, teflon-lined septum-40 ml	Cool, 4°C	14 days	SW-846 5030/3550

N/A - Not Applicable

Note: Information listed above taken from the following documents:

- Test Methods for Evaluating Solid Waste SW-846, 3rd Edition, November 1986.
- Method for Chemical Analysis of Water and Waste, EPA-600/4-79-020, March 1979, Revised March, 1983.

- (1) Bottle requirements and holding times for duplicate soil samples will be the same as those mentioned in Table A-1.
 (2) Trip blanks and aqueous samples.

TABLE A-4
SUMMARY OF ANALYTICAL PROGRAM FOR QA/QC GROUNDWATER SAMPLES

Parameter	Duplicate Samples (1)	Trip Blanks	Bottle Requirements	Preservation Requirements	Holding Times	Analytical Method
Purgeable Aromatics	2	1	Glass, Teflon lined Septum 40 ml (601 and 602)	HCL to pH < 2 (602)	14 days (601 and 602)	EPA 602

N/A = Not applicable

Note: Information listed above taken from the following documents:

- Test Methods for Evaluating Solid Waste SW-846, 3rd Edition, November 1986.
- 40 CFR 136, Appendix A.

(1) Bottle requirements and holding times for duplicate groundwater samples will be the same as those mentioned in Table A-2.

ATTACHMENT A-1
SITE SENSITIVITY EVALUATION FORM

Site Sensitivity Evaluation (SSE)

Guidelines for Remediation of Soil Contaminated by Petroleum
North Carolina Division of Environmental Management

Characteristic	Condition	Rating	
Soil pH	pH < 5.0 or pH > 9.0	4	4
	8.0 < pH < 9.0	2	
	5.0 ≤ pH < 6.0	2	
	6.0 ≤ pH ≤ 8.0	0	
Grain Size* Udden-Wentworth Scale	Contains >2/3, Gravel to Coarse Sand, (>1/2mm)	10	7
	Contains >2/3, Medium to Fine Sand (<1/2mm - 1/8mm)	7	
	Contains >2/3, Very Fine Sand to Coarse Silt (<1/8mm - 1/32mm)	4	
	Contains >2/3, Medium Silt and Clay (<1/32mm)	0	
Are Relict Structures, Sedimentary Structures, and/or Textures present in the zone of contamination & underlying "soils"	Present and intersecting the Seasonal High Water Table	10	0
	Present but not intersecting the Seasonal High Water Table	5	
	None Present	0	
Contaminant Class	I Low to Medium Boiling Point Hydrocarbons [C1-C15] and "some military jet fuels"	10	5
	II High Boiling Hydrocarbons [C12-C20] and "other jet fuels"	5	
Distance from Location of Deepest Contaminated Soil (>10 ppm TPH) to Seasonal High Water Table	5 - 10 feet	10	10
	>10-40	5	
	>40 feet	0	
Is the Top of Bedrock located above the Seasonal Low Water Table?	Yes	5	0
	No	0	
Is a Confining Layer present between bottom of contaminated soil and water table?	No	5	5
	Yes	0	
Time since release of contaminant has occurred	>1 yr. or unknown	10	10
	6 months-1 year	5	
	<6 months	0	
Artificial Conduits present within the zone of contamination	Present & intersecting the Seasonal High Water Table	10	5
	Present but not intersecting the Seasonal High Water Table	5	
	Not Present	0	
TOTAL SCORE			46

	Site Sensitivity Evaluation Score	Maximum Soils Cleanup Level ppm of TPH
Very Sensitive	>44	10
.	36-43	35
.	21-35	60
Least Sensitive	5-20	85

ATTACHMENT A-2
NORTH CAROLINA WELL PERMIT APPLICATIONS

NORTH CAROLINA
ENVIRONMENTAL MANAGEMENT COMMISSION
DEPARTMENT OF ENVIRONMENT, HEALTH AND NATURAL RESOURCES
RALEIGH, NORTH CAROLINA

COPY

PERMIT FOR THE CONSTRUCTION OF A WELL OR WELL SYSTEM

In accordance with the provisions of Article 7, Chapter 87, North Carolina General Statutes, and other applicable Laws, Rules and Regulations.

PERMISSION IS HEREBY GRANTED TO

United States Marine Corps

FOR THE CONSTRUCTION OF ten hydropunch and nine monitor wells, which will be exposed to the Surficial Aquifer, and which will be located at Camp Lejeune, Building AS 527, Jacksonville, Onslow County, in accordance with the application dated May 18, 1992, and in conformity with specifications and supporting data, all of which are filed with the Department of Environment, Health and Natural Resources and are considered a part of this Permit.

This Permit is for well construction only, and does not waive any provisions or requirements of the Water Use Act of 1967, or any other applicable laws or regulations. Well construction shall be in compliance with the North Carolina Well Construction Regulations and Standards.

This Permit will be effective from the date of its issuance until December 12, 1992, and shall be subject to other specified conditions, limitations, or exceptions as follows:

1. The well(s) shall be located and constructed as shown on the attachments submitted as part of the permit application.
2. This permit does not imply that you will be eligible for reimbursement of any costs associated with well installation from the Leaking petroleum Underground Storage Tank Trust Fund.

If any requirements or limitations of this Permit are unacceptable, you have the right to an adjudicatory hearing upon written request within 30 days. The request must be in the form of a written petition, conforming to Chapter 150B of the North Carolina General Statutes, and filed with the Office of Administrative Hearings, Post Office Drawer 27447, Raleigh, North Carolina 27611-7447. Unless such demand is made, this permit is final and binding.

Permit issued this the 12th day of June 1992.

NORTH CAROLINA ENVIRONMENTAL MANAGEMENT COMMISSION

Original Signed By
RICK SHIVER
FOR

A. Preston Howard, Jr., P.E., REGIONAL SUPERVISOR
Division of Environmental Management
By Authority of the Environmental Management Commission

PERMIT NO. 66-0268-WM-0280

PH/RSS/CDR/lfc
cc: ATEC Associates, Inc. ✓
Perry Nelson
WiRO-GWS

DEPARTMENT OF ENVIRONMENT, HEALTH, & NATURAL RESOURCES
APPLICATION FOR PERMIT TO CONSTRUCT A MONITORING WELL SYSTEM

Date: 5/18, 19 92 County Onslow

In accordance with the provisions of Article 7, Chapter 87, General Statutes of North Carolina and regulations pursuant thereto, application is hereby made for a permit to monitoring wells.

- 1. Name of Applicant: United States Marine Corps (Telephone: (919)451-5872)
Applicant's Mailing Address: Commanding General, ACS-EMD Building 1, Marine Corps Base
Camp Lejeune, NC 28542-5001
2. Name of Property Owner (if different from applicant) _____
Owner's Mailing Address: _____
3. Contact Person: Tom Morris (Telephone: (919)451-5872)
4. Location of Property: Building AS 527
5. Reason for Monitoring Well(s): Environmental Assessment
(ex: nondischarge permit requirements, suspected contamination, environmental assessment, etc.)
6. Type of facility or site for which the monitoring well(s) is needed: Fuel Pipeline
(ex: nondischarge facility, waste disposal site, landfill, underground storage tank, etc.)
7. Type of contamination being monitored (if applicable): Petroleum Products
(ex: nutrients, organics, heavy metals, etc.)
8. Are any existing recovery wells associated with the monitoring well(s)? No If yes, how many? _____
Recovery Well Construction Permit No. _____
9. Distance to a known waste or pollution source: _____ feet
10. Are any water supply wells located less than 500 feet from the proposed monitoring wells? No
If yes, give distance: _____ feet
11. Well Driller: ATEC Associates, Inc.
12. Registration #: 696
13. Driller's Address: 6814 Davis Circle, Raleigh, NC 27613

PROPOSED MONITORING WELL CONSTRUCTION INFORMATION

- 10 - Hydropunches
1. Total Number of Wells to be constructed: 9 - MW; (A) Number to be completed in bedrock? None
10 - Hydropunches
(B) Number to be completed in unconsolidated material? 9 - MW
2. Estimated depth of well(s): 15 to 30 feet
3. Gravel or sand pack interval (if appropriate)
From 5 feet To 30 feet
4. Type of casing used: PVC
(ex: PVC, stainless steel, galvanized steel, etc.)
5. Diameter of casing: 2 inches

FOR OFFICE USE ONLY	
___	PERMITTED ACTIVITY
___	U.S.T. LEAK DETECTION
___	GROUNDWATER QUALITY STANDARDS
___	VIOLATIONS SUSPECTED FROM UNPERMITTED
___	ACTIVITIES
___	NOTICE OF NON-COMPLIANCE AT
___	UNPERMITTED FACILITIES
PERMIT NO. _____	ISSUED _____ 19 _____
INCIDENT # _____	

6. Thickness of casing: Sch. 40 Inches
7. How will the well(s) be secured? Steel Protective Casings with Locks
8. Estimated beginning construction date: 06/15/92
- Estimated completion date: 07/03/92

ADDITIONAL INFORMATION

1. ATTACH A SITE MAP SHOWING THE LOCATIONS OF THE FOLLOWING:
 - 1 - PROPOSED MONITORING WELL(S)
 - 2 - ALL EXISTING MONITORING AND RECOVERY WELLS OR TEST BORINGS WITH THE PROPERTY BOUNDARY
 - 3 - ALL WATER SUPPLY WELLS WITHIN 500 FEET OF THE WASTE SOURCES
 - 4 - AT LEAST TWO REFERENCE POINTS (NUMBERED ROADS, INTERSECTIONS, STREAMS, ETC.)
 2. PROVIDE A WELL CONSTRUCTION DIAGRAM OF EACH WELL SHOWING DIAMETER, ESTIMATED DEPTH, SCREEN INTERVALS, SAND/GRAVEL PACKS, TYPE OF CASING MATERIAL, CASING WALL THICKNESS, WELL HEAD COMPLETION DETAILS, ETC.)
-

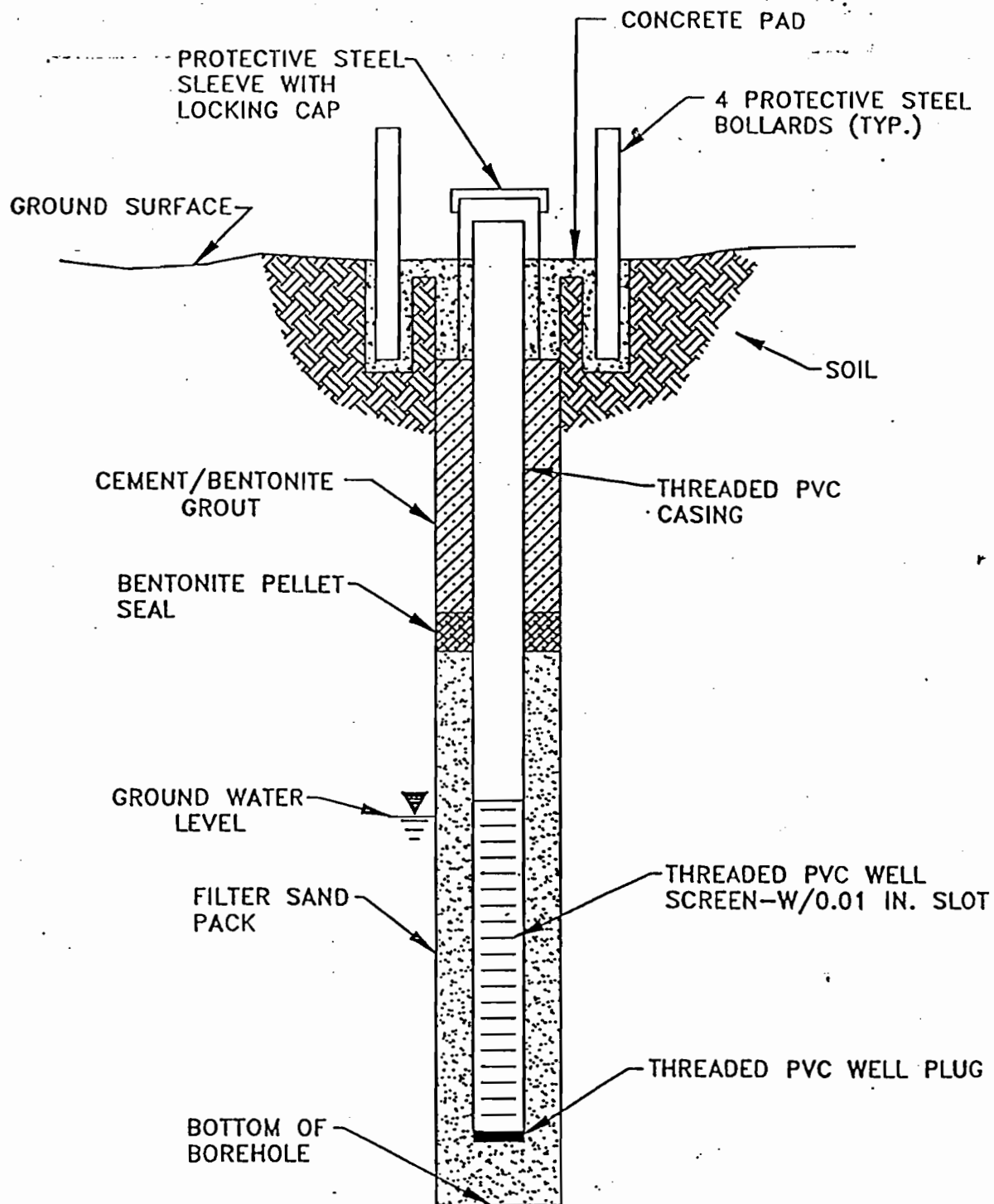
The Applicant hereby agrees the proposed well(s) will be constructed in accordance with approved specifications and conditions of the Well Construction Permit as regulated under the Well Construction Standards (Title 15A North Carolina Administrative Code, Subchapter 2C) and accepts full responsibility for compliance with these rules.

David J. Mammie
Signature of Applicant or Agent

SENIOR ENGINEER
Title (if applicable)

If the property is owned by someone other than the applicant, the property owner hereby consents to allow the applicant to construct monitoring wells as outlined in this application and that it shall be the responsibility of the applicant to ensure that these monitoring wells conform to the Well Construction Standards (Title 15A North Carolina Administrative Code, Subchapter 2C).

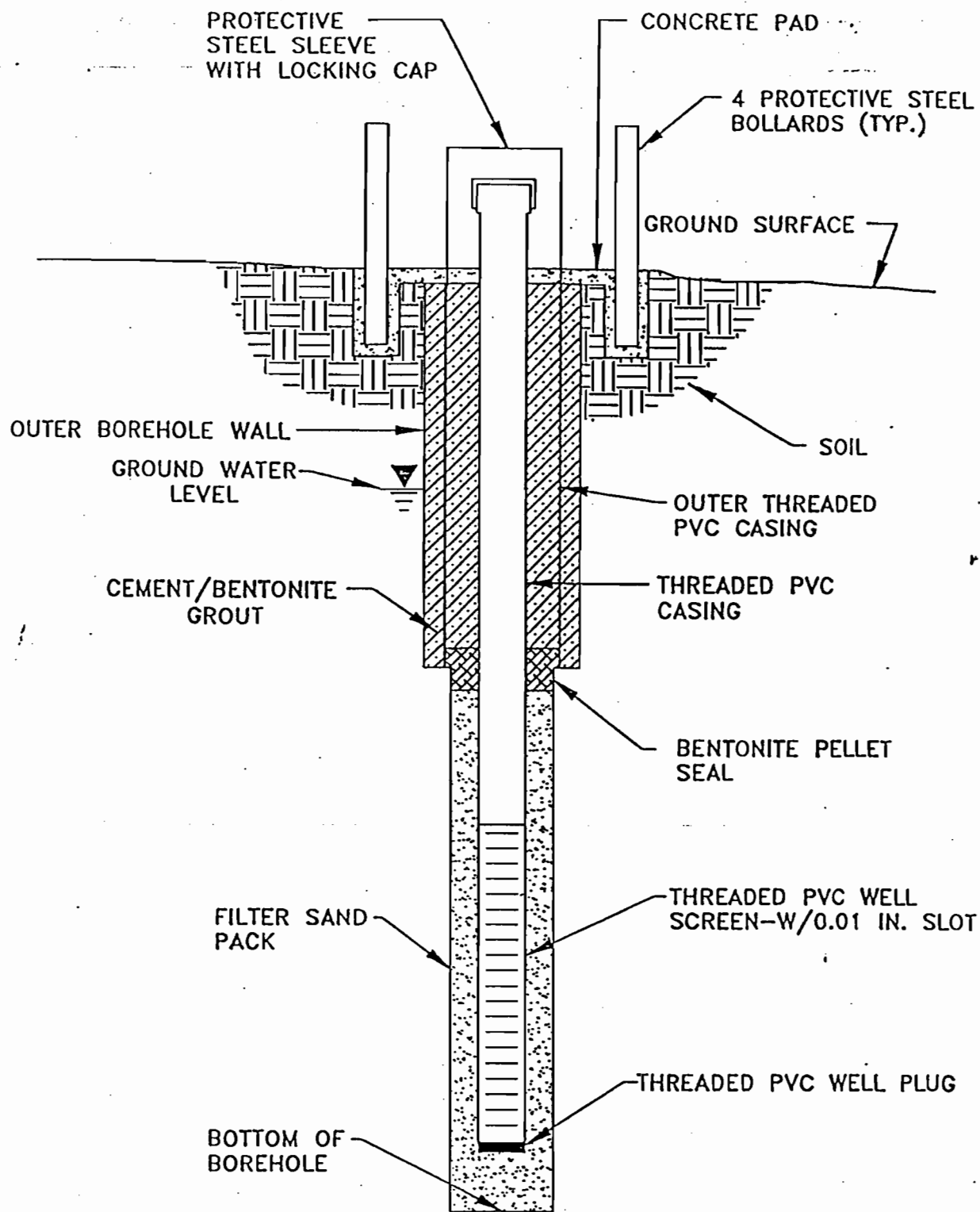
Robert R. W.
Signature of Property Owner (if different from applicant)



N.T.S.

Baker
Baker Environmental, Inc.

FIGURE 11
TYPICAL TYPE II GROUNDWATER
MONITORING WELL CONSTRUCTION DIAGRAM



N.T.S.

Baker
Baker Environmental, Inc.

FIGURE 12
TYPICAL TYPE III GROUNDWATER
MONITORING WELL CONSTRUCTION DIAGRAM

A/C
PARKING
APRON

A/C
PARKING
APRON

X - hydroponic
o - well location

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AS 599
AS 600

Emergency
Shower

AS 511
A/C DIRECT REFUELER

SAS 3601

INSTRUMENT
RUNWAY 1/3-23

TAXIWAY

TAXIWAY
D 545560

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ATTACHMENT A-3
HYDROPUNCH FIELD USER'S GUIDE

HOW THE HYDROPUNCH II® WORKS

The HydroPunch II is designed to be pushed or driven to the desired sample depth, either from the ground surface (in soft soils) or from the bottom of a drilled borehole (similar to a split barrel sampler). Typically this is accomplished by using a drill rig or a cone penetrometer rig. The tool utilizes an air-tight and water-tight sealed intake screen and sample chamber which is isolated from the surrounding environment as the tool is advanced.

The surface of the HydroPunch is designed to prevent the downward transport of contamination as the tool is advanced; it cleans itself as the soil particles are displaced to the side. A very tight annular seal is produced around the tool as the soil is displaced and compacts into the walls of the hole. The tight seal enables the HydroPunch II to collect a very discrete sample from a specific depth by sealing off ground water from above and below the zone to be sampled.

When the desired depth for collection of a sample is reached, the HydroPunch II is opened by pulling back on the body of the tool. Soil friction holds the drive cone in place as the body is pulled back. Once the HP-II is open and the O-ring seal between the drive cone and the body of the tool is broken, the tool fills from the bottom with no aeration and minimal agitation of the sample.

THE HYDROPUNCH II IS USED IN THE WATER SAMPLING MODE:

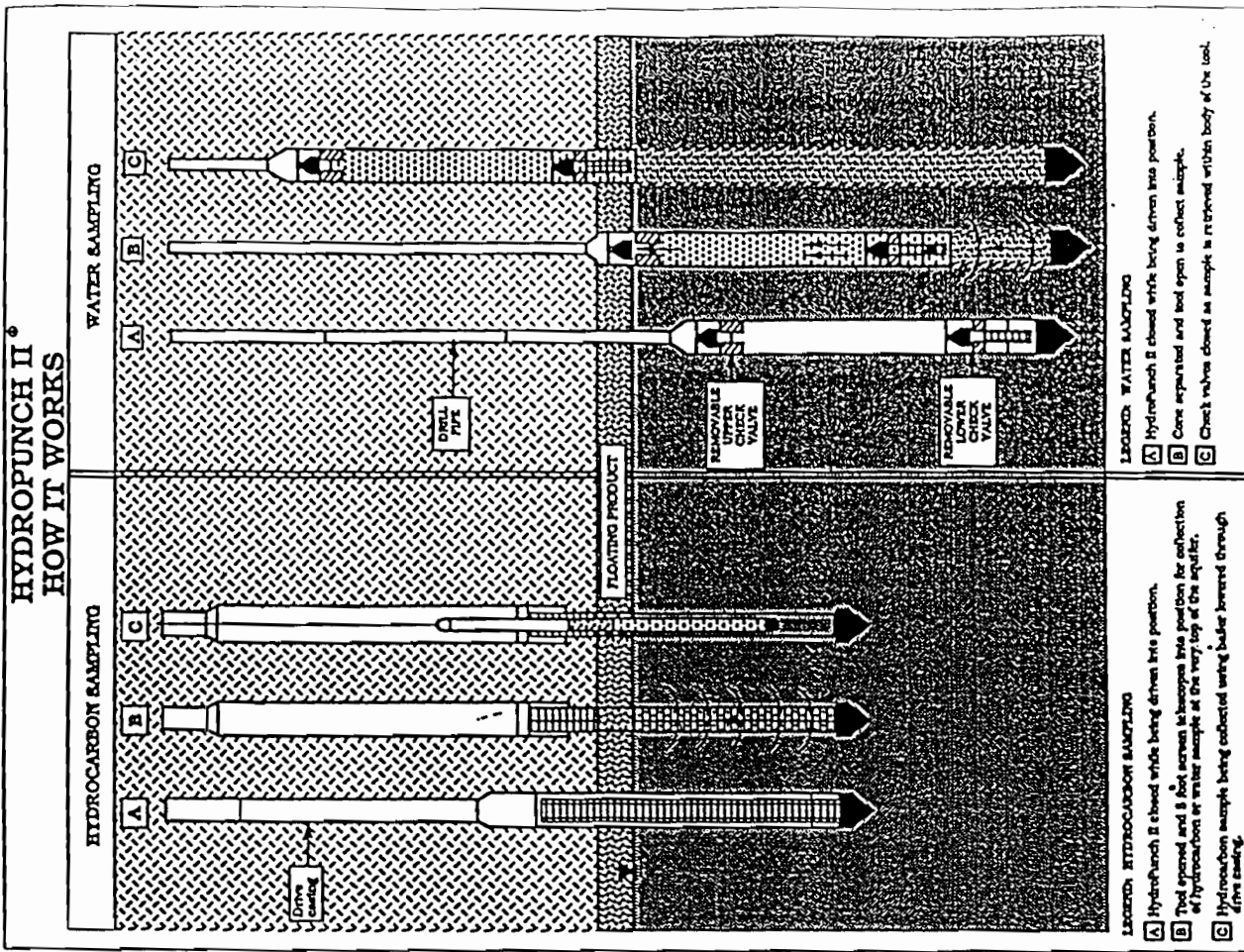
- If the sample can be collected from 5 feet or more below the top of the water table, and
- If 1.2 liters of sample volume is adequate.

When the tool is used in the water sampling mode, the sample is collected and transported to the surface within the body of the tool. As the tool is pulled upward, increased hydrostatic head closes a lower and upper check valve which retains the sample within the body of the HydroPunch. Once at the surface, the HydroPunch is inverted and the sample is decanted through a top discharge valve and tubing.

THE HYDROPUNCH II IS USED IN THE HYDROCARBON SAMPLING MODE:

- primarily, if a sample of floating product is needed;
- in special cases: if a ground water sample must come from the uppermost portion of the aquifer; if the water bearing strata are very thin; or if a large volume of sample is required.

When the HP-II is used in the hydrocarbon sampling mode the tool is connected to the surface using a hollow drive pipe of large enough inside diameter to permit the passage of a thin bailer. The sample is collected by lowering the bailer from the surface through the drive pipe and retrieving the sample. This configuration permits sampling of floating contaminants and also allows an unlimited quantity of sample to be collected. However, in this mode the sample is exposed to potential debris and water leakage from the entire length of drive pipe above it, making the procedure less suitable for low-level, sensitive sampling.



HYDROPUNCH II®—BASIC OPERATING SEQUENCE

WATER SAMPLING MODE		
STEP	PROCEDURE	COMMENTS
1	Drill to a point just above the desired sample depth.	If site conditions permit pushing the tool from the surface to the sample point, go to Step #3.
2	Attach assembled HP-II to the drive rod or downhole hammer.	Be sure to use the rubber retainer sleeve to hold the cone onto the drive shoe if the tool is lowered downhole.
3	Lower the tool to the bottom of the borehole.	Once on the bottom of the hole, DO NOT PICK UP THE TOOL. (Driller's Rule 1)
4	Drive or push the HP-II a minimum of one foot past the bottom of the borehole to the final sample point.	1. If pushing or driving the HP-II from the surface, advance the tool directly to the selected sample depth. 2. Remember that when sampling in the water mode, the bottom of the HP-II must be at least 5 feet below the water table to collect a full sample. 3. WHEN DRIVING OR PUSHING, CAREFULLY COUNT AND MARK THE ROD OR CABLE SO YOU KNOW EXACTLY WHERE THE END OF THE TOOL IS.
5	When the final depth has been achieved, pull back on the drive rods or hammer to pull the cone out of the body of the tool, permitting ground water to enter the HP-II.	DO NOT PULL THE TOOL BACK FURTHER THAN IT HAS BEEN DRIVEN (Driller's Rule 3). For example, if the tool is driven or pushed 2-1/2 feet, do not pull the tool back more than 2 feet. A minimum of 6 inches of the body of the tool needs to be in the driven hole to provide a good annular seal.
6	Clamp the drive casing at the surface.	This prevents the body of the HP-II from sliding back down to the bottom of the hole and plugging with soil.
7(a)	If hollow drive rods are used to advance the tool, a water level indicator can be lowered down the rods to determine when the tool is full.	The rods must be watertight.
7(b)	If hollow drive rods are not used, wait approximately 20 minutes for the first sample.	Adjust the fill time based on the quantity of sample and the estimated permeability of the formation.
8	Pull the HP-II to the surface, unthread the upper subassembly and replace it with the thread retainer cap.	
9	Unthread the upper check valve and replace it with the teflon stopcock and tubing.	Flush or wipe away external water or soil.
10	Invert the tool, open the stopcock and decant the sample.	
11	Disassemble the HP-II while it is wet.	Water lubricates the parts which reduces the potential for galling.
12	Decontaminate the tool according to your cleaning protocol.	

HYDROCARBON SAMPLING MODE*		
STEP	PROCEDURE	COMMENTS
1	Drill to a point just above the desired sample depth. If sampling floating product, be sure to stop drilling above the top of the aquifer.	If site conditions permit pushing the tool from the surface to the sample point, go to Step #3.
2	Attach assembled HP-II to the drive casing.	Be sure to use the rubber retainer sleeve to hold the cone onto the drive shoe if the tool is lowered downhole.
3	Lower the tool to the bottom of the borehole.	Once on the bottom of the hole, DO NOT PICK UP THE TOOL. (Driller's Rule 1)
4	Drive or push the HP-II a minimum of one foot (3 to 5 feet is better) past the bottom of the borehole to the final sample point.	1. If pushing or driving the HP-II from the surface, advance the tool directly to the selected sample depth. 2. When driving or pushing, carefully count and mark the casing so you know exactly where the end of the tool is.
5	When the final depth has been achieved, pull back on the drive casing to pull the cone and screen out of the body of the tool, permitting ground water to enter the HP-II.	1. DO NOT PULL THE TOOL BACK FURTHER THAN IT HAS BEEN DRIVEN (Driller's Rule 3). For example, if the tool is driven or pushed 3-1/2 feet, do not pull the tool back more than 3 feet. 2. A minimum of 6 inches of the body of the tool needs to be in the driven hole to provide a good annular seal. 3. Additionally, since the screen is 5 feet long, the tool cannot be pulled back more than 5 feet without separating the screen from the body.
6	Clamp the drive casing at the surface.	This prevents the body of the HP-II from sliding back down over the exposed screen.
7	Disconnect the drive casing from the hammer (or push adapter) and check to see if tool is filling.	A mirror to reflect light down the casing or a water level indicator can be used.
8	When an adequate volume of water has filled the tool, lower a small diameter bailer through the drive casing to collect the sample.	There is no need for development or purging prior to sample collection.
9	After completing sample collection, pull the drive casing and the HP-II to the surface. The cone and screen will normally stay downhole.	Should the screen be recovered, do not attempt to reuse it. It cannot be decontaminated and, if reused, will likely affect the integrity of subsequent samples.
10	Disassemble the HP-II while it is still wet.	Water lubricates the parts which reduces the potential for galling.
11	Decontaminate the tool according to your cleaning protocol.	In the Hydrocarbon mode, the drive pipe as well as the tool and bailer need to be thoroughly decontaminated.

*Prior to using HP-II in the hydrocarbon mode, be sure the drive casing is thoroughly decontaminated. In this mode, the casing contacts the sampling bailer and is in communication with the sample chamber.

HYDROPUNCH II[®] TIP SHEET

First Boring

Because the HydroPunch must be pushed into undisturbed material in the zone to be sampled, the drilling procedure must stop somewhere above the sample point. Consequently, it is very helpful to have some idea of the depth at which the sample is to be collected. If little is known of the site hydrogeology, it is often a very good idea to use the initial boring as a pilot boring to determine: 1) exactly where the water bearing zones are, 2) the permeability of the sample zone, 3) the density of the soil, and 4) other relevant factors

TIP 2: Flowing Sand

If the HydroPunch is used in a sand formation and the material has a tendency to flow into the augers, always sound the interior prior to lowering the tool into the augers. Driving the HydroPunch through a sand plug in the bottom of the augers is almost impossible. As the tool is driven the sand is compressed into the space between the HydroPunch and the inside wall of the augers, greatly increasing the resistance to driving. This sometimes results in damage to the tool and will occasionally lock the HydroPunch inside of the augers.

Solutions to this problem include: 1) the use of one way sand catchers or trap valves in the bottom of the augers, 2) filling the augers with drilling mud, and 3) drilling using mud rotary drilling techniques. A simple method that can be used at most sites is to drill to just above the sample zone with the augers and then back the augers out to a point where the sand is no longer inside. The HydroPunch can often be easily driven or pushed through the zone disturbed by the drilling process and then an additional distance into the undisturbed formation to the sample point. HydroPunches have been pushed through as much as 35 feet of collapsed sand in a borehole to collect a sample from the undisturbed material below the drilled portion.

TIP 3: Cone Separation, Loose Formation

If the aquifer material is very loose and does not pull the cone from the drive shoe during retraction, it is helpful to use the drive hammer to backhammer for the initial pull back. The upward snap on the tool during the backhammering process is often enough to separate the cone and pull the screen from the body.

TIP 4: Pushing the HydroPunch

Where soil conditions permit, it is preferable to push, rather than drive, the tool into position. Pushing allows very accurate control of the depth the tool is advanced and retracted, is easier on the driller, and is frequently quicker than driving. If the tool is to be pushed into position, it is best to make sure that the driller has an adapter which will enable him to push and retract the drive pipe before he gets into the field.

Pushing the HydroPunch from the Surface

If soils are soft enough to enable the HP-II to be pushed from the surface into the sample zone, a considerable amount of time can be saved. When the HP-II is used in this manner, no drill cuttings are generated and there is no handling of the augers, etc. The only major activity is to add casing as the tool is being rapidly pushed into the ground. If pushed from the surface, sampling time can often be cut in half.

TIP 5: Drilling Past Drive Cones & Screens

Prior to drilling through the polypropylene screen and drive cone left from the previous sample, pull the cutter head of the auger to a point above the top of the screen, then lower the center bit into position and drill through the screen and cone. This procedure ensures that the screen and cone are drilled to the side, carried up the flights of the augers, and do not become jammed in the hollow stem of the lead auger.

TIP 6: Drive Casing

It is very helpful to have lengths of the drive pipe in 2 foot and 3 foot sections, as well as standard 5 foot sections. The short sections enable the driller to have a manageable casing height above the top of the augers after the tool has been driven into place and opened.

TIP 7: Monitoring Filling

When used in the hydrocarbon sampling mode, the filling process of the HydroPunch can be closely monitored. At shallow depths this can be done using a bright flashlight or a mirror to shine light down into the casing. At greater depths an electronic water level indicator can be used.

TIP 8: Disassembly

Always attempt to disassemble the HydroPunch while it is still wet. The water serves as a lubricant and prevents damage to the stainless steel parts. For decontamination, saw horses or some similar supports help make cleaning easier. Also, a plastic bucket and a mesh basket, such as a fry basket, can retain small parts during steam cleaning and prevent them from flying all over when subjected to the high pressure steam.

TIP 9: Cone Separation — Hydrocarbon Mode

With HP-II there is rarely a problem with the cone detaching and the screen not being exposed to the formation. Should the tool be used in a formation where there is a problem, it is helpful to measure the internal length of the casing and the tool just prior to pull back and then immediately after pull back is completed. The distance measured inside the tool should increase by whatever the distance pulled back. Example: Distance to cone from top of drive casing as measured inside the casing with tape prior to pull back is 13.5 feet. Pull back three feet. Distance to cone immediately after pull back is 16.5 feet from top of drive casing, indicating cone has telescoped out of the HydroPunch body three feet.

HYDROPUNCH II® TROUBLESHOOTING GUIDE

MECHANICAL PROBLEMS

PROBLEM	CAUSE	SOLUTION
Drive Cone Does Not Separate from Body	1) Very fine sand has worked its way between cone and drive shoe as tool is being driven.	a) Make sure the rubber exterior sleeve is used over the cone and drive shoe. b) Make sure tool is not lifted or accidentally backhammered as it is being advanced.
	2) In very loose formations there may not be enough soil friction to separate the cone as it is pulled back.	a) Initiate pull back by a sharp backhammer. The sudden shock and upward motion will cause separation.
	3) Utilizing a "homemade" sleeve instead of the sleeve provided with the HydroPunch.	a) Use the sleeves provided with the tool.
Drive Cone Separates Too Soon	1) Tool is pulled back prematurely or was picked up after being placed on bottom of borehole.	a) Driller's Rule #1 (Sheet 4-B).
	2) Rubber friction sleeve was not used.	a) Always use rubber sleeves provided with the tool.
Leaking Check Valve	1) Sediment clogs on check valve.	a) Retrieve tool and decant sample as rapidly as possible.

HYDROGEOLOGY RELATED PROBLEMS

PROBLEM	CAUSE	SOLUTIONS
No Sample Due to Low Permeability Conditions	In some fine-grained silts and clays, or formations with very thin water bearing zones, the compression of soil particles may lower permeability of the saturated zone, causing the collection of ground water samples to take a longer period of time than "normal" (>1 hour). In some low permeability conditions, sample collection may not be possible.	Many low permeability conditions occur in fine-grained cohesive soils. Often these soils will "stand open" after the drilling tools are removed. If the HydroPunch hole stands open, it is possible to use the tool in the HydroCarbon mode without a screen attached to the cone. This permits the open area to be as long as possible—not limited to the 5-foot screen length. The long open hole provides a greater intake area and a collection sump for the sample. The increased intake reduces the time required for the tool to fill.
Intrusion of Drilling Mud or Outside Ground Water	If the HydroPunch is used in the water sampling mode in a mud filled hole, or is retrieved through a zone with a higher head than the sample zone, the foreign fluid will displace the sample in the HydroPunch.	1. Vent tubing can be run from the top check valve of the HydroPunch to the surface. The tubing vents the tool while filling. After the tool is filled, gas pressure is applied to the tube which seats the check valves. This prevents outside fluid from entering as the tool is withdrawn. 2. Use the tool in the HydroCarbon mode and collect the sample before the tool is withdrawn through the fluid.

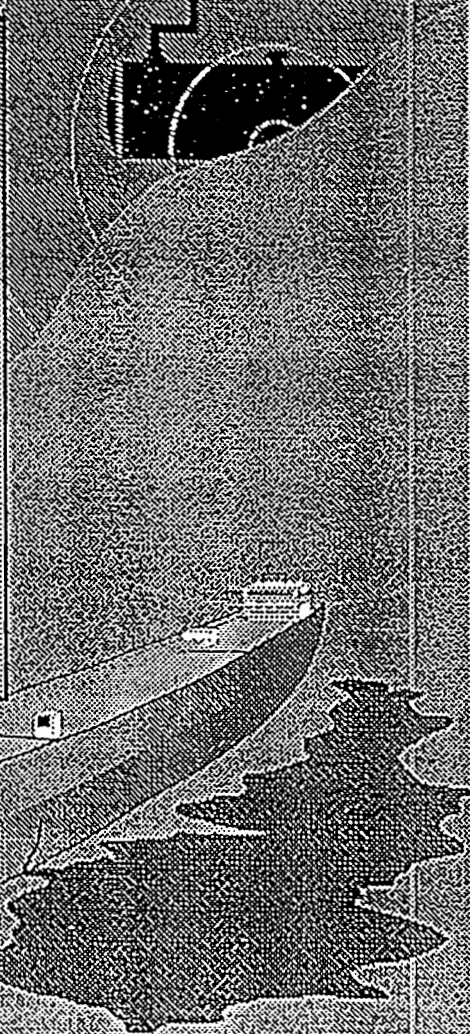
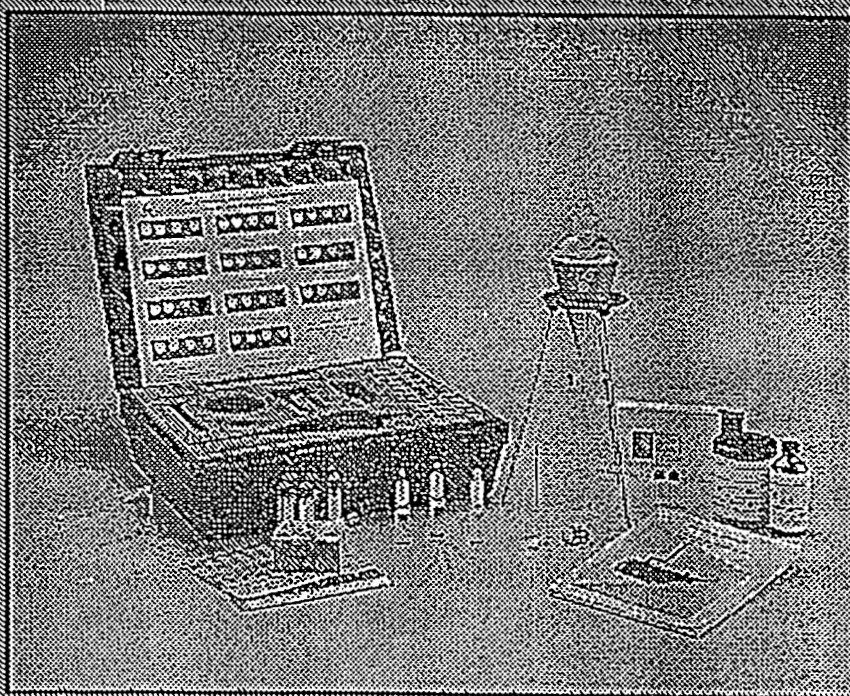
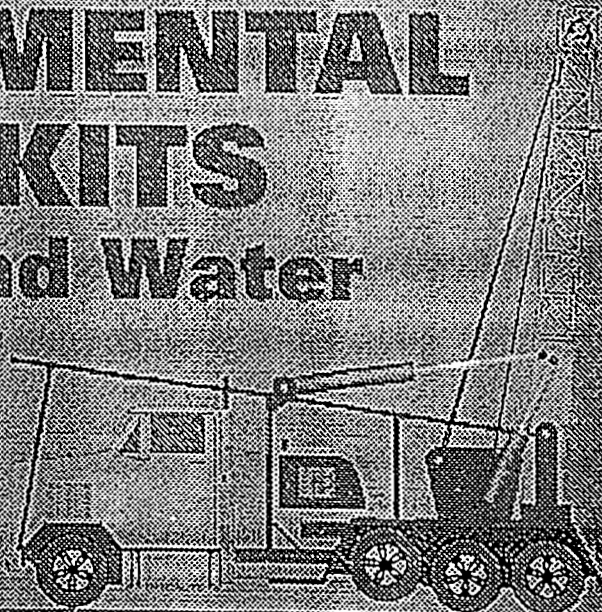


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In California 415/930-7610

ATTACHMENT A-4
hnu-hanby FIELD TESTING PROCEDURES

ENVIRONMENTAL TEST KITS for Soil and Water

Oil, Gasoline, Diesel
Chlorinated Hydrocarbons
DDT, PCBs



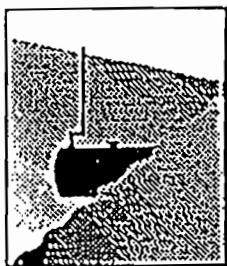
hnu - hanby

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New Product News

Brochure ☐

Handbook ☒

Video ☐

Other ☐

A new guide to field measurements. . .

Field Measures: Dependable Data When You Need It

Field measurements are essential to our LUST investigations.

Peter Zack, Connecticut LUST Unit

Field measurements are critical to making timely corrective action decisions and are standard procedures for our investigators. They enable us to identify emergencies quickly.

Tito Madrid, New Mexico UST Bureau

In many situations, field measurement techniques can be used instead of laboratory analyses to provide quicker corrective action decisions, hence better protection of public health. *Field Measures: Dependable Data When You Need It* describes several commonly used field measurement techniques and explains how you can use them to make decisions.

The guide contains:

- ☐ An overview comparing common field measurement procedures
- ☐ Descriptions of several procedures, including
 - Headspace methods
 - Polyethylene bag sampling systems
 - Draeger liquid extraction method
 - * —Hanby method
 - Soil vapor surveying
- ☐ Descriptions of the field instruments used with these procedures
- ☐ A list of manufacturers and distributors
- ☐ A glossary of terms

Field Measures: Dependable Data When You Need It is intended for State regulators and field personnel who are interested in using field measurement techniques in their programs. Consultants and contractors who perform site assessments will also find the guide of interest.

Copies of the guide are available from the U.S. Government Printing Office. Ordering information is as follows:

Field Measures: Dependable Data When You Need It

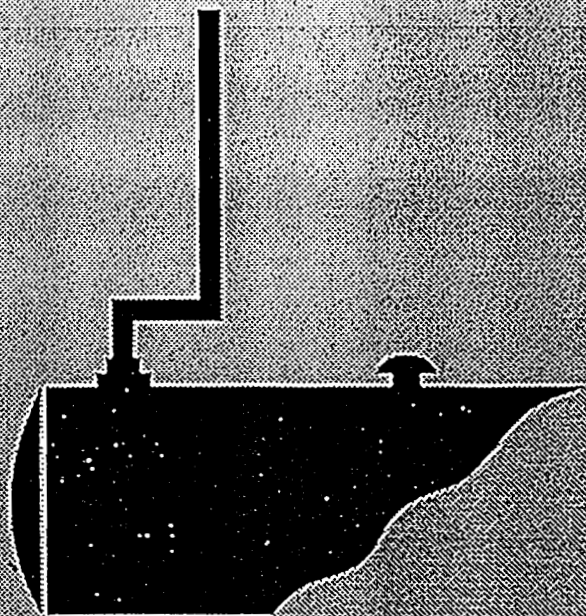
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Hanby Method Kits

for

- Oil & Gasoline
- Chlorinated Hydrocarbons
in Soil and Water

NEW

US PATENT

4992379

Granted February 12, 1991

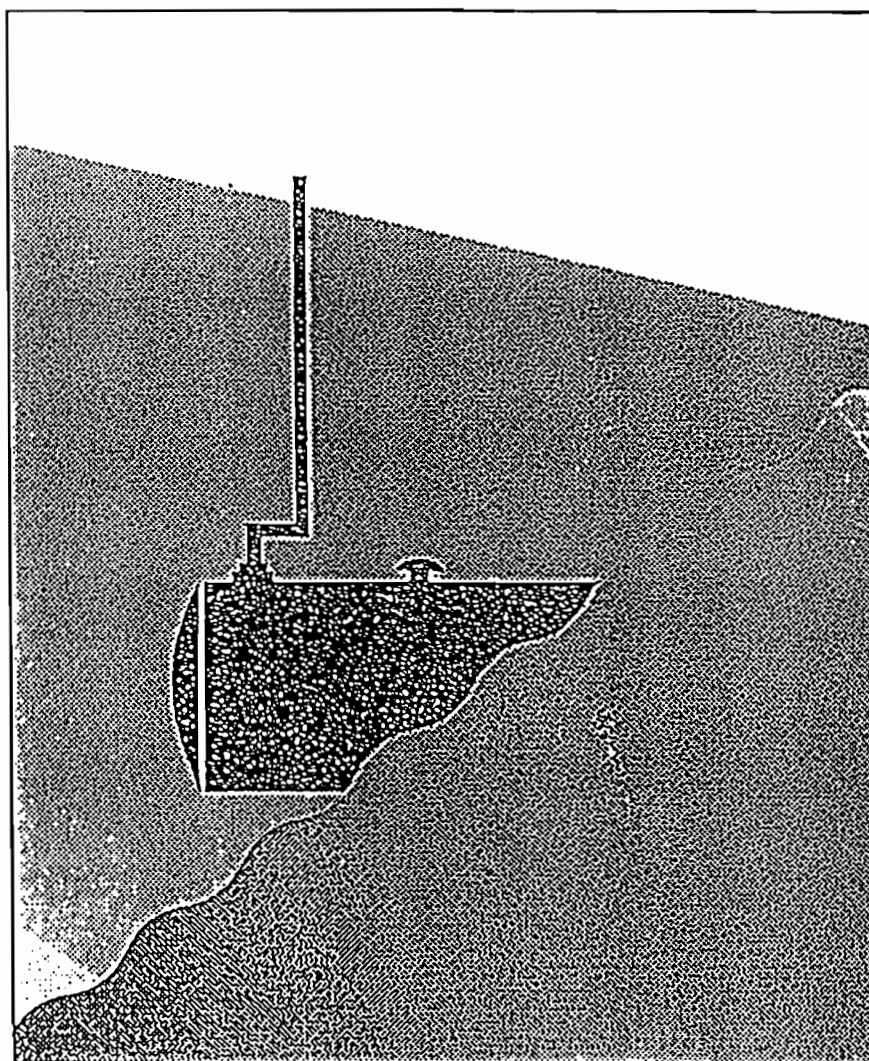
h-nu[®]-hanby

Environmental Kits



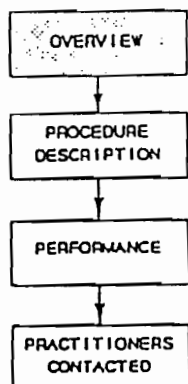
Field Measurements

Dependable Data When
You Need It



Hanby Procedure for Soil and Water Analysis

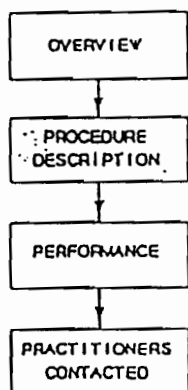
Overview



The Hanby Field Test Kit is a procedure for analysis of petroleum aromatic hydrocarbons over a wide range of concentrations in water and soil. The Hanby procedure provides a colorimetric indication of the presence of aromatic compounds (BTEX, gasoline, diesel, etc.). The soil procedure requires two extraction steps; whereas the water procedure involves one extraction step. Figures 8 and 9 show the process of sample preparation and analysis for soil and water, respectively.

This field procedure is being used by investigators to assess the presence of contamination during tank removals and to quantify levels of contamination to determine the extent of contaminant plumes. As noted in Table 1, this procedure can be used in other applications, including selecting locations for installation of ground-water monitoring wells, determining limits of soil excavation, and measuring progress of ground-water remediation.

Procedure Description



SAMPLE COLLECTION - Soil and Water

1. Samples may be collected by a number of conventional methods. Soil samples can be obtained using a trowel, backhoe, auger, or split spoon sampler. Water samples may be obtained using pumps, bailers, or sample bottles.
2. Minimize mixing, aerating, heating, or otherwise disturbing the sample to prevent loss of any volatile organic compounds.
3. Decontaminate sampling and testing equipment between each sample analysis to prevent cross-contamination. This can be accomplished using clean water to thoroughly rinse all apparatus.

Analytic technique measures aromatics in soil and water

By Kimberly A. Roy

The simplicity of a colorful new field technique for detecting aromatic compounds in soil and water belies its accuracy, asserts inventor John Hanby.

The technique traces its roots to a chemical reaction discovered in 1877 by Charles Friedel, a Frenchman, and James Mason Crafts, an American. Known as Friedel-Crafts alkylation chemistry, the reaction is an organic synthesis process that has been harnessed for the production of high-octane gasoline, synthetic rubber, plastics and synthetic detergents. "It certainly is one of the most important reactions ever discovered," says Hanby, president of Houston-based Hanby Analytical Laboratories Inc. (HAL). "It has resulted in more chemical products than any other reaction."

More than a century later, Hanby used the same chemistry as the basis for an analytical technique that quantifies contamination caused by products of the Friedel-Crafts reaction. The "discovery," which Hanby describes as "serendipitous," occurred March 6, 1986.

"It (the realization) really was a matter of minutes," Hanby recalls. "I ran out to the lab, conducted a test, and it was obviously a huge success." That success led to the development of a field test kit. Hanby filed patents on the kit and its use Feb. 7, 1987, and received a notice of allowance Aug. 20. "This, for the first time, gives researchers the field capability to do quantitative analysis of soil samples," he says. "We're looking for this to have an extremely significant impact."

The test. Once a sample is collected, the entire analytic procedure takes five to seven minutes for water and four to five minutes for soil using the direct-extraction method. Soil also can be washed first in a TCLP-like fashion, Hanby says, but this method takes about 80 minutes and is no more accurate than direct extraction.

Water analysis basically involves three steps. First, 500 milliliters (ml) of water are placed in a separatory funnel, and 5 ml of proprietary alkyl halide

reagent are added. The reagent, which is heavier than water, sinks. A sample size of 500 ml is preferred, but tests have been conducted successfully with as little as 40 ml, Hanby relates.

The sample then is agitated vigorously for two minutes. During this time, the reagent extracts contaminants from the water. The sample then sits for five minutes, allowing the extraction phase to sink to the bottom.

Once a sample is collected, the entire analytic procedure takes five to seven minutes for water and four to five minutes for soil using the direct-extraction method.

After phase separation is complete, the extraction phase is drained into a test tube, where it is mixed with a catalyst — a white, powdered Lewis acid. (A Lewis acid is one that readily accepts a pair of electrons.) The user must be sure not to drain water into the test tube, Hanby cautions, because it will consume the catalyst.

The catalyst is pre-measured to work best with 4.2 ml of the extraction phase. According to an EPA report, "Because the method is calibrated to draining exactly 4.2 ml, the amount drained in the first analysis step must be measured and corrected (if not 4.2 ml) by using the worksheet with the kit. If this correction is not made, the contamination may be overstated by as much as 16 percent." According to Hanby, this applies to water samples and wash-water extraction for soil, where turbidity can cause an emulsion during extraction that inhibits phase separation. EPA's report, *Field Measurements: Dependable Data When*

You Need It, was published in June by the Agency's Office of Underground Storage Tanks (OUST). It describes several alternatives to fixed-facility laboratories and is based on interviews with users of the various techniques discussed.

The test tube is shaken for two minutes to ensure good dispersal of the catalyst and uniform color, Hanby explains. The alkyl halide reagent, Lewis-acid catalyst and aromatic compounds undergo several chemical substitutions that produce large, intensely colored molecules. (Color, Hanby says, results from the electrons shifting orbits during reactions.) Reaction products are prone to photochemical oxidation and should be kept out of direct sunlight to prevent degradation, he adds.

Hue and color intensity of the catalyst are compared to a chart of standards to determine contaminant concentrations. At press time, standards were available for "all types of fuels, some pure PNAs . . . (the pesticide) DDT, most of the simple aromatics and PCBs, including two Aroclor mixtures," Hanby relates.

"The colors depend on the aromatics you're looking at," Hanby explains. For example, he continues, water containing between 5 ppm and 10 ppm benzene will turn the catalyst "a nice yellow color," while toluene shows up as orange.

Colors and concentrations for various classes of compounds are:

- Benzene: yellow (1 ppm) to orange (10 ppm);
- Toluene, ethylbenzene and xylenes: orange-yellow (1 ppm) to burnt orange (10 ppm);
- Gasoline: beige (5 ppm) to rust, red-brown (20 ppm);
- Diesel: beige (5 ppm) to green (20 ppm);
- PCBs: light pink (0.05 ppm) to coral (0.2 ppm); and
- Naphthalene: light violet (0.2 ppm) to violet (2 ppm).

Soil samples are extracted directly or washed. Washing is more effective for fresh gasoline and requires 100 grams of soil, Hanby relates. Once the soil is

Analytic technique measures aromatics in soil and water

By Kimberly A. Roy

Reprinted from the December 1990 Issue of Hazmat World.
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in the parts-per-billion range, and the Hanby test is only accurate down to parts per million.

"It definitely has a place in the market," Lewis continues. "It's cheaper than having a mobile gas chromatograph onsite." Potential applications, he says, include use as a preliminary screening device to determine whether contamination exists and for establishing the location of an upgradient well. "But if you're really trying to find the outer bounds of a contaminant plume," he says, "it's not sensitive enough."

According to Hanby, size of the newly formed molecules dictates the test's sensitivity; the larger they are, the more sensitive the technique. The test, he says, results in a noticeable coloration for PNA concentrations as low as 2 ppm, while "with gasoline in soil, you really can't get below 1 ppm." Also, he notes, detection limits for soil are 10 times higher, or less sensitive, than for water samples. Soil tests show the same sensitivity for both the wash water and direct-extraction methods, he adds.

"The accuracy of the method has been proven to far exceed that of direct injection gas chromatography," which, according to EPA, has a 10 percent mar-

gin of error, states company literature. "The only interference for the ... test we've encountered," Hanby says, "is from humic material in soil samples. These naturally occurring aromatics sometimes cause slight interference." According to EPA's report, users generally agree with Hanby's assessment but some also said they experienced "moderate interference from high-clay-content soils." They also said moderate skills are needed to perform the test.

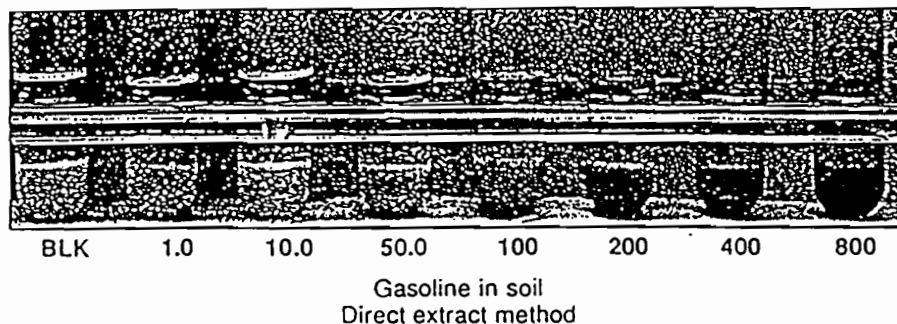
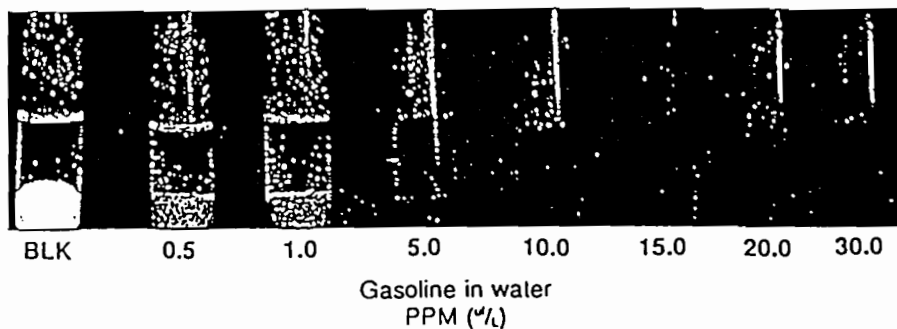
Accuracy is somewhat subjective, Hanby concedes, because each user must exercise judgment when matching test results to the standard color chart. "You have to train your eye," he says. "An obvious development that is just around the corner is a colorimeter, which will eliminate the subjectivity." Conventional colorimeters, Hanby says, are inadequate, because they rely on transmitting light through a substance, which is impossible with an opaque catalyst. An appropriate instrument, which would measure reflected light bounced off the catalyst, is under development, he adds.

In March 1987, Hanby demonstrated the technique at EPA's Environmental Monitoring Systems Laboratory in Las Vegas, Nev. The results, based on 40-

ml samples were "extremely impressive," Hanby asserts, and "launched us into EPA's good graces." Since then, he says, he has given demonstrations for about 30 state agencies, and has received "the same reaction" from state officials.

Because of the test's warm reception from the regulatory community, HAL expects to "do quite well," Hanby says. EPA, he continues, estimates there are more than 3 million USTs in the United States. Based on this figure and the "good opinions" of several marketing experts, HAL estimates the potential market for the field kits has a value between \$5 million and \$10 million, Hanby says.

Besides a large domestic market, Hanby says he expects to see some international interest as well, and has sent kits to "at least a dozen foreign countries," including Holland, Canada and England. To date, HAL has relied on word of mouth, personal contact (the company employs about eight people) and a smattering of advertisements to spread the word about its innovation. However, the company is "just about to launch a big concerted marketing effort," Hanby says. ▼



Hanby Analytical Laboratories Inc.

washed, the resulting water undergoes the same procedures as for other water samples. This method, he says, "is more time-consuming than direct extraction, which is used more frequently, especially with UST work, to speed up tank removal." Also, he notes, direct extraction "gives a more quantitative extraction and, therefore, a more quantitative analysis."

Direct extraction is more effective for older gasoline contamination and for diesel and other fuel oils, where the components are fairly insoluble, Hanby explains. In this method, 5 grams of soil and 10 ml of extraction reagent are mixed, and the soil is "chopped" until its particles are smaller than 3 millimeters. The soil and extraction agent then are stirred for five minutes. Next, 4.2 ml are measured into a test tube, and the catalyst is added. The two are mixed for one minute.

The converse chemical reaction — using an aromatic reagent to extract alkyl halides — also works but has more limitations, Hanby says. It yields the same color results, but "there are a number of negative interferences that exist and limit its applicability."

Applications. According to Hanby, numerous applications exist, including:

- Determining whether contamination exists;
- Estimating degree of contamination;
- Determining lateral and vertical extent of a contamination plume;
- Isolating the source of a leak;
- Monitoring groundwater contamination;
- Monitoring the effectiveness of biological treatment systems;

One purchaser said he was going to use the kit to prospect for oil, Hanby relates.

- Selecting remedial technologies for site cleanup; and
- Monitoring the toxicity of spills on marine and other life.

One purchaser said he was going to use the kit to prospect for oil, Hanby relates, "but I haven't got the full story on (the results) of that yet."

The test kits "have been called in on most of the more recent major oil spills," Hanby says, including the collapse of an Ashland Chemical Co. tank near Pittsburgh, the Megaborg incident off the Texas coast and the Exxon Valdez spill in Alaska's Prince William Sound.

Recently, Hanby relates, an accident caused a barge carrying about 1 million gallons of oil to dump part of its load into the warm waters (about 90 degrees Fahrenheit) of Galveston Bay. Hanby transported HAL's mobile lab to the scene and analyzed about 40 samples over a three-day period. "The area looked fairly clean," he recalls, but tests revealed "the levels of dissolved oil were 10 to 20 times the toxic level for fish." A typical lethal level for marine life is 20 to 30 ppm, he continues, but "we were finding levels greater than 100 ppm. The real significance in this case was the toxicity. . . . Oil spills are

generally bad . . . for marine life in the short term, but the human impact was huge," because fishing and shrimp operations were shut down.

In Alaska, Hanby performed a similar task — sampling water near several of the area's fish hatcheries.

Of all possible applications, Hanby says, the "biggest immediate and ongoing market is for UST work." In these situations, he continues, the kit not only saves time, which is money, but costs less to perform.

Conventional tests to determine concentrations of total petroleum hydrocarbons and simple aromatics cost, on average, \$175 per sample, Hanby says. Each UST site typically requires six samples, bringing total analytical costs to more than \$1,000. This, he notes, does not include the cost of down time while the crew waits for lab results. HAL's field kits for soil analysis cost \$800 and come with enough reagent for 30 tests, which works out to about \$27 per sample. After the initial expenditure, users can purchase enough reagent for 30 more samples for \$350, or about \$12 per sample. These costs, however, will increase in 1991, Hanby says.

Field techniques for UST work are important, because lab analysis often is expensive and can delay projects for up to two months, agrees Kimberly Green, an environmental protection specialist with OUST. For this reason, OUST decided to publish its first manual on field techniques, she relates. It contains "a lot of (scientific) data gaps, but we felt it was such an important issue that we wanted to get out the information we have," she explains. The manual does not endorse the techniques' validity, but the Agency hopes it will help convince regulators that viable options exist, she says. "Regulators," she says, "have depended on lab analysis from the beginning" and often erroneously view the results as incontrovertible.

Evaluation. According to users interviewed by EPA for its report, the field test kit is "highly suitable" for confirming contamination, quantifying contamination level, determining limits for soil excavation and measuring the progress of groundwater remediation. Users classified it as "moderately suitable" for tracing the source of highest concentration and determining the placement of monitoring wells.

According to Scott Lewis, a staff engineer with Inberg-Miller Engineers (Riverton, Wyo.), his company uses the field test kit when time is a factor. "Otherwise, we still use traditional labs, because the Hanby technique is not sensitive enough. Some wells still are considered contaminated with concentrations

hnu[®]-hanby

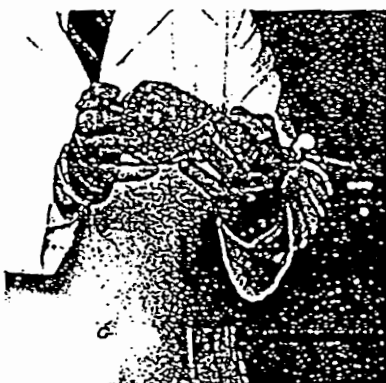
FIELD TEST FOR AROMATICS IN WATER



Step 1: Pour 500 ml. sample into separatory funnel.



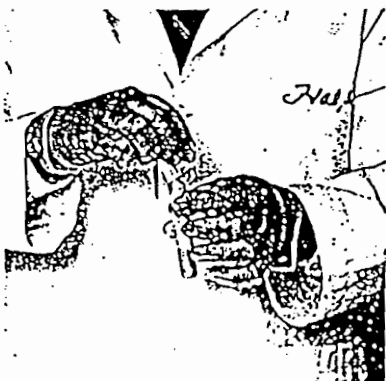
Step 2:
Pour the extractant reagent from one of the 5 ml. ampules into the separatory funnel.



Step 3: Extract sample for two minutes.



Step 4: After sample has settled for 2-3 minutes drain extractant layer into test tube. *Don't allow water into test tube.*



Step 5: Empty contents of one catalyst vial into test tube.



Step 6: Shake test tube for 30 seconds and compare to color chart.

DIRECT EXTRACTION METHOD

CAUTION: WEAR GLOVES, SAFETY GLASSES AVOID FUMES. KEEP WORK AREA CLEAN, BELOW BREATHING ZONE AND VERY WELL VENTILATED. CAUTION:

1. Place beaker on balance and tare.
2. Quickly add 5 grams of soil sample (about 2 ml) to beaker.
3. Hold 10 ml ampoule upright firmly with one hand on a flat surface and with the other hand quickly snap off the top of the ampoule and pour into beaker covering soil. AVOID FUMES KEEP DOWN AT ARMS LENGTH.
4. Chop sample with clean spatula or knife blade until soil is very small (<3mm) pieces. (Note 1)
5. Stir soil in extraction reagent for three minutes. (Note 2)
6. Pour Solvent from the beaker into one of the screw top test tubes up to the black line on the tube.
7. CAUTION: AVOID CONTACT WITH SKIN, EYES AND WATER! Add one catalyst vial to the tube, firmly screw on the cap and shake well for two minutes.
8. Compare color of catalyst at bottom of tube to photograph of standard results, e.g. gasoline in soil, diesel in soil, etc.
9. Pour excess solvent from beaker into waste solvent bottle (if not needed for dilution in the case of high concentration samples.)
10. Beakers can be placed in a hood or in an open outside (unoccupied) area until solvent has evaporated, or the soil can be cleaned from the beaker into a waste soil container.
11. Place screw cap tubes into original foam container and ship back to HAL, Inc. for disposal/recycling.

Note 1. While doing this procedure keep the beakers well below breathing zone level (i.e. at waist level while standing. The solvent fumes having a vapor density of 5.5, will sink.)

Note 2. Samples in beakers should be covered with aluminum foil while doing multiple analyses to keep solvent vapor exposure minimized.

APPENDIX B
SITE HEALTH AND SAFETY PLAN

DRAFT

HEALTH AND SAFETY PLAN

BUILDING AS-527
AIRCRAFT DIRECT REFUELING AREA
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONTRACT TASK ORDER 0124

Prepared For:

NAVAL FACILITIES
ENGINEERING COMMAND
ATLANTIC DIVISION
Norfolk, Virginia

Under:

Contract N62470-89-D-4814

Prepared By:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

JUNE 3, 1992

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1.0 INTRODUCTION

1.1 Background

Baker Environmental, Inc. (Baker) will perform a site characterization study to investigate potentially contaminated soil and/or groundwater associated with the underground storage tank (UST) system located at Building AS-527, the aircraft direct refueling area, located at the Marine Corps Base (MCB), Camp Lejeune, North Carolina. The objectives of the study are to: (1) investigate the geology and the hydrogeology in the area of concern; (2) study the extent/severity of potential subsurface fuel migration; (3) suggest practical methods of abatement and cleanup; and (4) execute applicable sections of Title 15A, Subchapter 2N, Section 0600 of the North Carolina Administrative Code (NCAC - effective January 1, 1991). This study will include soil borings, monitoring well installations, and both soil and groundwater sampling and analysis (refer to Figure 1 for identification of site location).

1.2 Policy

It is the policy of Baker that all on-site hazardous waste management activities be performed in conformance with a Site-Specific Health and Safety Plan (HASP). The Site Health and Safety Officer (SHSO) or person temporarily designated as SHSO will be responsible for continually evaluating safety at the site and ensuring adherence to the HASP. The SHSO or designee, in addition to the Site Manager, is directly responsible for safety issues relevant to the site, and the SHSO has the immediate authority to modify the existing HASP as site conditions warrant. Modifications are to be documented and changes made to the HASP after review with the Project Manager and the Navy's Engineer-in-Charge (EIC). The SHSO, or designee, will be responsible for the preparation of a daily report which includes all relevant health and safety events; recordkeeping of all personnel and site monitoring information; accident investigation and reporting; daily safety talks and inspections; and any other relevant health and safety issues. The HASP may be modified/updated with the approval of the Project HSO (PHSO) and Project Manager. Proper notification will be given to the Navy EIC when such changes to the plan are implemented.

1.3 Medical Surveillance Requirements

An essential requirement of the site-specific HASP is to provide that project personnel, who may be exposed to materials having potentially adverse and deleterious health effects, will be

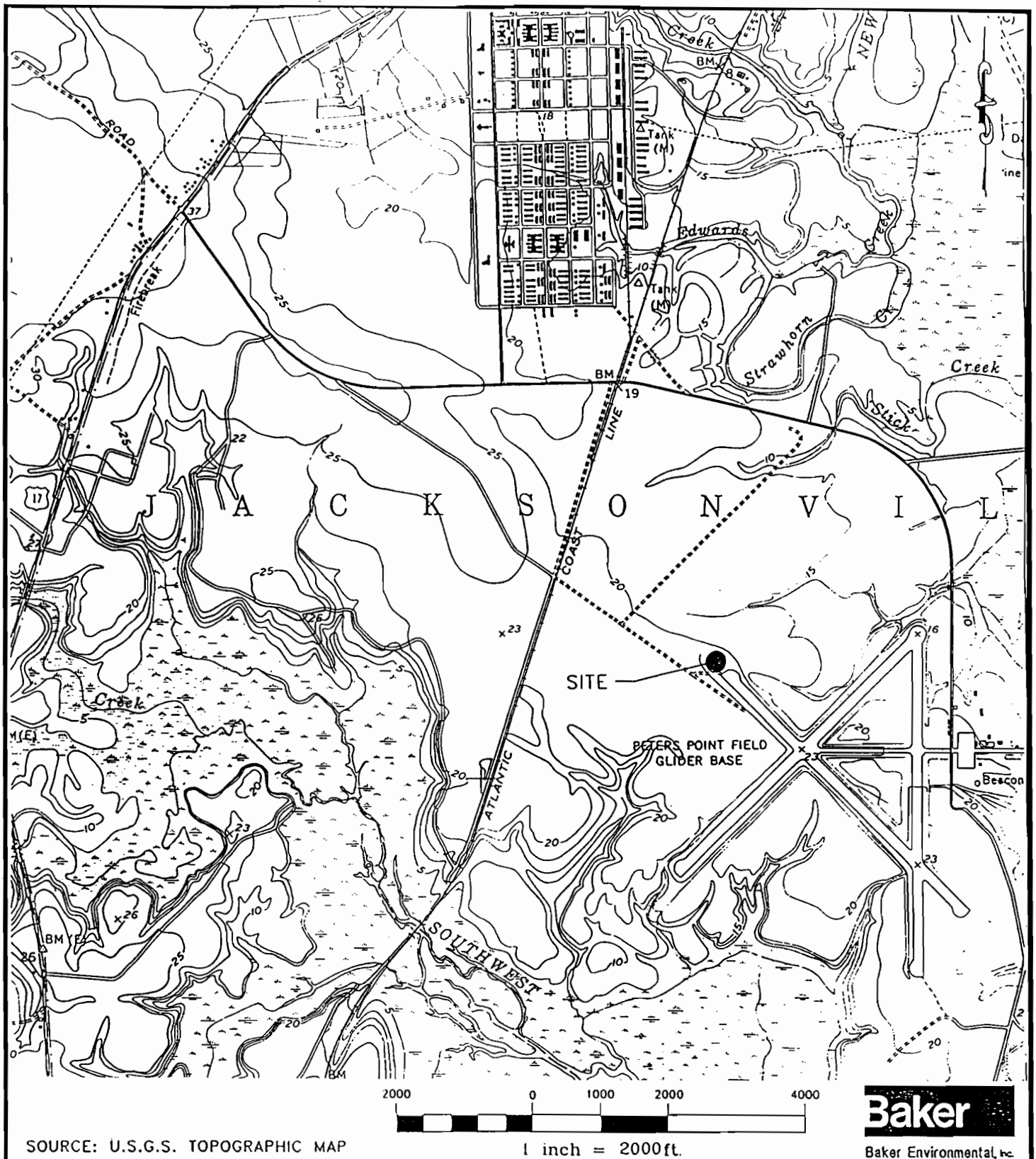


FIGURE 1
AIRCRAFT REFUELING AREA - BUILDING AS-527
SITE LOCATION MAP

NEW RIVER MARINE CORPS AIR STATION
CAMP LEJEUNE RESERVATION
JACKSONVILLE, NORTH CAROLINA

Baker's corporate medical surveillance program has been developed to establish a medical baseline and to monitor for symptoms of overexposure for individuals who participate in Preliminary Assessments, Site Inspections, Remedial Investigations, Feasibility Studies, and construction-phase services at sites covered by the Department of Labor, Occupational Safety and Health Administration (OSHA), Hazardous Waste Operations and Emergency Response Standard, 29 CFR 1910.120. Additionally, the program is intended to determine the individual's capability for performing on-site work, including wearing respiratory protective equipment.

All individuals engaged in site activities covered by the 1910.120 standard receive a physical examination by a licensed physician prior to entry onto the site. A complete medical exam is given which includes parameters such as height, weight, vision, temperature, and blood pressure, including a complete review of occupational and medical histories. Other information obtained to satisfy the protocols for OSHA Standard 1910.120 include chest x-rays, electrocardiogram, pulmonary function test, urinalysis, and blood tests. Attachment A describes the medical surveillance testing parameters performed annually on Baker employees.

Subcontractor personnel are required, at a minimum, to meet all applicable medical monitoring requirements identified in OSHA's General Industry Standards (29 CFR 1910) and Construction Standards (29 CFR 1926), including the requirements previously mentioned in 29 CFR 1910.120.

1.4 Training Requirements

Baker assures that personnel who work on site will be initially trained at a health and safety training course, meeting the requirements outlined in 29CFR 1910.120. These requirements state: "General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three day actual field experience under the direct supervision of a trained, experienced supervisor." These are generally 5-day (40-hour) courses. Key points of the 40-hour training include field demonstrations, respiratory fit testing and training, risk assessment, toxicology, chemical reactivity, use of monitoring equipment, downrange work procedures, site safety procedures, levels of protection, protective clothing, decontamination, and practical field exercises (which

include donning, doffing, and working in personal protective ensembles for personal protection Levels A, B, and C).

In addition to the initial 40-hour training program, OSHA requires site workers to receive an annual 8-hour refresher training course on the items specified by the 1910.120 standard. OSHA also requires that personnel involved with on-site management and supervisors directly responsible for, or who supervise employees engaged in hazardous waste operations, shall receive (in addition to 40 hours initial training and three days of supervised field experience) at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques. The general purpose of the 8-hour refresher is to ensure that personnel retain the knowledge necessary to be adequately protected, and stay current with proper site health and safety procedures; the 8-hour supervisory training is required to ensure that supervisors have the knowledge necessary to understand and use the various Health and Safety Programs, and to implement the elements of the HASP. Attachment B provides the appropriate "OSHA" Health and Safety Training History for Baker Project Personnel.

1.5 Pre-Entry Requirements

During the initiation of site activities (site set-up), the SHSO will perform a reconnaissance of the on-site and offsite sampling areas, after which the SHSO will call a meeting with Baker on-site personnel and the subcontractor's personnel. Site-specific safety and health hazards, data obtained from the site reconnaissance, and appropriate safety and health related procedures/protocols will be reviewed by the SHSO. Prior to each phase of site operation (new sampling task), the safety and health hazards will be reviewed by the SHSO with the site workers involved. The SHSO will be available to address potential emergencies, unforeseen circumstances, and implement appropriate changes to the HASP.

Subcontractors working on the project and involved with site activities are required to comply with all applicable health and safety regulations for hazardous waste site operations. All Baker employees and subcontractor personnel will be responsible for familiarity with the requirements and provisions of the HASP including modifications. Any and all modifications will be clearly posted to alert all site personnel.

Baker believes that the development of a HASP is necessary to ensure adequate protection for on-site personnel. The following HASP has been based on an outline developed by the U.S. Coast Guard for responding to hazardous chemical releases (U.S.C.G. Pollution Response COMDTINST-ML6456-30) and by NIOSH, OSHA, USCG, and EPA's recommended health and safety procedures (Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities). This plan, at a minimum, meets the requirements under OSHA Standard 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response). This plan has been designed as a Site-Specific HASP for Building AS-527, Marine Corps Base, Camp Lejeune, North Carolina.

2.0 SITE DESCRIPTION

S.O.# 19124-40-SRN

Submittal Date: June 3, 1992

Location: Marine Corps Base

Camp Lejeune, North Carolina

Hazards:

- Potentially contaminated soil (petroleum hydrocarbons, waste soils).
- Potentially contaminated groundwater (as above).
- Potential hazards associated with drilling around utilities in a public area (i.e., traffic hazards).
- Site-specific hazards to be addressed at pre-entry briefing.

Area affected:

- Building AS-527 (see Figure 2 in the Preliminary Well Location and Work Plan).

Surrounding population:

- Military and aircraft operations.

Topography:

- Generally flat with low relief.

Anticipated weather conditions:

- Warm 60° to 85°F.

Additional information:

Building AS-527 is associated with the JP-5 aviation fuel pipeline and two 10,000 gallon USTs located at the aircraft refueling station.

3.0 SITE ENTRY OBJECTIVES

The objective of the initial entry to the contaminated area is to characterize the degree, type, and extent (vertical and areal) of soil and groundwater contamination in the vicinity of Building AS-527. The exact tasks to be performed are identified in Section 7.1 with more detail provided in the Preliminary Well Location and Work Plan.

4.0 SITE ORGANIZATION AND COORDINATION

The following personnel are designated to carry out the stated job functions for both on- and off-site activities. (Note: One person may carry out more than one job function.)

PROJECT MANAGER	<u>Richard F. Bonelli</u>
PROJECT HEALTH AND SAFETY OFFICER	<u>Barbara Cummings</u>
SITE MANAGER	<u>Ken Tua</u>
SITE HEALTH AND SAFETY OFFICER	<u>Ken Tua</u>
FIELD TEAM LEADER	<u>Ken Tua</u>

FIELD TEAM MEMBERS

<u>James Culp</u>

NAVFACENGCOM REPRESENTATIVES

<u>Mr. Trueman Seamans</u>	<u>(804) 445-2935</u>

ACTIVITY/BASE REPRESENTATIVES

<u>Mr. Thomas Morris</u>	<u>(919) 451-5093</u>

FEDERAL/STATE/LOCAL REPRESENTATIVES

<u>(Not Applicable)</u>

CONTRACTOR(S)

Driller:	<u>(To be Determined)</u>
Surveyor:	<u>(To be Determined)</u>
Geophysics:	<u>(Not Applicable)</u>

All personnel arriving or departing the site will be documented in the field log. All activities on site must be cleared through the Site Manager.

5.0 SITE CONTROL

5.1 General Requirements

The Site Manager is designated to coordinate access control and security on site. Perimeters have been established according to the site boundary procedures identified in Section 5.3. Site security will be established by the Site Manager according to local conditions and Marine Corps Activity requirements on a daily basis.

Unauthorized personnel are not permitted within this area.

5.2 Site Conditions

The prevailing wind conditions are moderate and easterly.

The on-site Command Post has been established at Baker Field Vehicle.

This location is upwind from the "Exclusion Zone."

5.3 Site Boundaries

Control boundaries between the Exclusion Zone (the contaminated or sampling area) and the Contamination Reduction Zone (CRZ), referred to as the hotline, and the Support Zone (clean area) are designated as follows:

- Exclusion Zone - A radius of at least 25 feet (barring obstructions) from Site Investigative Activities.
- Hotline - The boundary between the Exclusion Zone and CRZ.*
- CRZ* - The area between the Exclusion Zone and the Support Zone (located upwind of the Site Investigative Activities).
- Contamination Control Line - The boundary between the CRZ and the Support Zone.
- Support Zone - The outermost area next to the CRZ and upwind of the Site Investigative Activities.

* Note: A CRZ is required for activities in Level D+ protection and higher protection levels. Refer to Figure 2 for a "Typical Contamination Reduction Zone Layout."

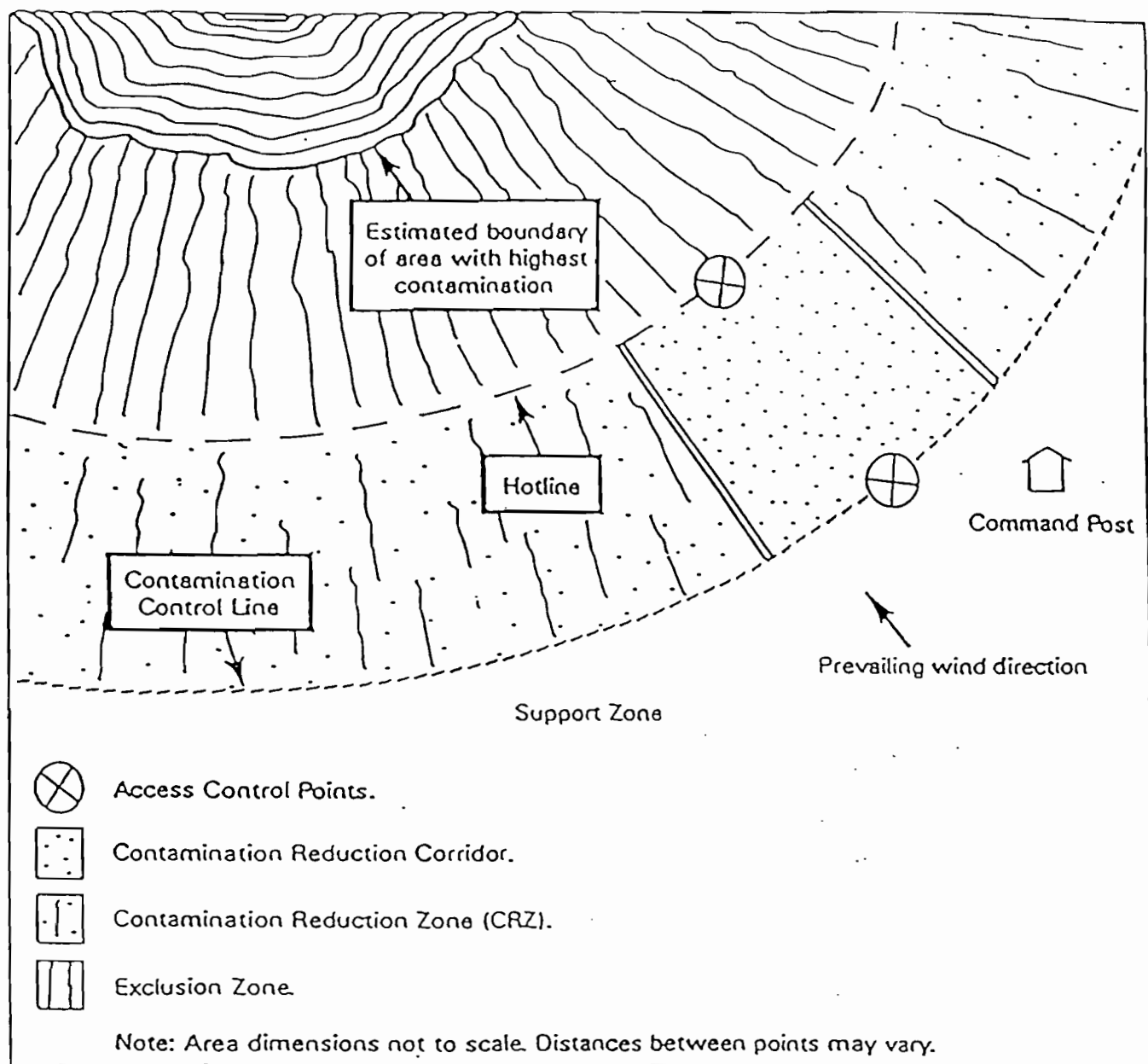


FIGURE 2
TYPICAL CONTAMINATION
REDUCTION ZONE LAYOUT

These boundaries will be demarcated using:

- Colored Boundary Tape Cones for the Hotline.
- Colored Boundary Tape or Cones for the Decontamination Corridor of the CRZ.
- Colored Boundary Tape for the Contamination Control Line including posted signs indicating "Work Area", or "Authorized Personnel Only".

As site investigation locations vary throughout the project, adjustments will be made accordingly.

5.4 Sanitation/Site Precautions

Provisions for sanitation procedures and precautions to be followed on site can be found in Attachment D - Baker Safety SOPs. Responsibility for compliance with these provisions lies with Site Manager.

6.0 HAZARD EVALUATION

6.1 Preliminary Evaluation

Research into the history of the site under investigation indicates potential site hazards. An assessment of the potential chemical, physical, and radiological hazards at this site can be found in Sections 6.2, 6.3, and 6.4 respectively.

6.2 Chemical Hazard Analysis

The toxicological properties of chemicals/substances associated with Building AS-527 are identified in Table 1.

Chemical Safety Data Sheets for these substances have been included as Attachment C.

6.3 Physical Hazard Analysis

6.3.1 Confined Space Entry

It is not anticipated that there will be a need for a confined space entry procedure during the remedial investigation activities. However, should this condition occur, procedures for entering a confined space are outlined in Attachment D - Baker Safety SOPs.

6.3.2 Heat Stress

Provisions for monitoring for heat stress will be determined by the Site HSO.

For personnel wearing semipermeable or impermeable protective outerwear when there is an ambient air temperature greater than 70°F, heat stress monitoring is required and the following procedures will be implemented:

1. Increased awareness of heat stress symptoms and buddy monitoring.
2. Fluid intake discipline.
3. Work-rest intervals.
4. Self monitoring of urine output quantities to prevent dehydration.

TABLE 1
TOXICOLOGICAL PROPERTIES OF CHEMICALS/SUBSTANCES DETECTED ON SITE

Chemical/Substance	Source	Exposure Limit (EL)(a)	Odor Threshold(b)	Vapor Pressure(c)	Specific Gravity(d)	Routes of Exposure	Ionization Potential
JP-5 Aviation Fuel	Soil/Water	200 ppm	1.0 ppm	NA	0.82	Skin/Eye Contact/ Skin Absorption/Inhalation	NA

(a) EL - Exposure Limit = A time-weighted average concentration for a normal eight-hour work day and 40-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. The EL represents published Exposure Levels according to the following hierarchical order: (1) OSHA PELs; (2) NIOSH RELs; (3) ACGIH TLVs; and, (4) other recognized sources.

(b) Odor Threshold - Concentration at which odor can be detected in air.

(c) Vapor Pressure = Expressed as mm/Hg at 68°F (unless otherwise mentioned).

(d) Specific Gravity = At 68°F (unless otherwise mentioned).

NA - Not Available

The following heat stress causes and symptoms are provided for buddy monitoring purposes. Site personnel must realize that monitoring the physical condition of fellow personnel in Level B and C protective ensembles will be difficult.

1. Heat rash results from continuous exposure to heat or humid air.
2. Heat cramps are caused by heavy sweating and inadequate fluid intake. Symptoms include muscle spasms and pain in the hands, feet, and abdomen.
3. Heat exhaustion occurs when body organs attempt to keep the body cool, due to inadequate fluid intake and personnel not acclimated to the environment. Symptoms include pale, cool, moist skin; heavy sweating; and dizziness.
4. Heat stroke is the most serious form of heat stress. It is a **MEDICAL EMERGENCY**. Symptoms are red, hot, dry skin; lack of perspiration; nausea; dizziness and confusion; strong, rapid pulse rate; and coma.

The need to seek medical attention and the urgency in seeking medical attention depends on the symptoms and the severity of the symptoms displayed by the affected individual. If heat stroke is noted or suspected, medical attention must be sought **IMMEDIATELY**. Efforts should be taken to cool the body to prevent serious injury or death. Excessive cooling can cause hypothermia and should be avoided.

Fluid intake should be increased during rest schedules to prevent dehydration. Drinking cool water is best; however, diluted electrolyte solutions (i.e., Gatorade or equivalent) can be substituted for water. Each individual should monitor their urine output and adjust his fluid intake to ensure that urine output and urine color are close to normal.

6.3.3 Explosion and Fire

In general, the following items present potential physical hazards and will be monitored closely:

- Explosion and fire resulting from heavy equipment malfunction.
- Explosion and fire resulting from penetration into underground utility lines (gas, electric).
- Explosion and fire resulting from ignition of trapped flammable vapors.
- Explosion and fire resulting from vehicular accidents.

As additional concerns are identified, provisions for making changes to the HASP will be presented by the SHSO, as needed.

6.3.4 Site-Specific Safety Hazards

It is expected that the following additional safety hazards may be present at Building AS-527:

1. Underground Utilities
2. Vehicular Traffic
3. Aircraft Traffic

Provisions for the monitoring of hazards particular to the specific site activities (such as slippery ground, uneven terrain, overhead equipment, electrical lines, etc.) shall be addressed at the pre-entry briefing by the SHSO or qualified designee. All personnel are expected to adhere to all applicable compliance regulations such as, but not limited to, OSHA standards 29 CFR 1910 and 1926.

6.4 Radiation Hazard Analysis

Given the background information provided by LANTDIV, radiation monitoring will not be required.

7.0 PERSONAL PROTECTIVE EQUIPMENT

7.1 Levels of Protection

Based on an evaluation of potential hazards, the following levels of personal protection have been designated for the applicable work areas or tasks. Upgrading or downgrading the level of protection will be based on real time monitoring (as outlined in Section 11.3), and working conditions. Changes in Level of Protection will be the responsibility of the SHSO.

Location	Job Task	Level of Protection				
		B	C	D+	D	Other
Building AS-527	Surveying				X	
Building AS-527	Monitoring Well Installation				X	
Building AS-527	Groundwater Sampling				X	
Building AS-527	Soil Boring - Sampling				X	

Continuous monitoring in the breathing zone with a PID and intermittent monitoring with Colorimetric (Dräger) Tubes as outlined in Section 11.3.1 (Table 2) will be conducted to evaluate this level of protection, to include the likelihood of protection upgrades.

CHANGES TO THE SPECIFIED LEVELS OF PROTECTION SHALL ONLY BE MADE WITH THE APPROVAL OF THE SITE HEALTH AND SAFETY OFFICER AND THE SITE MANAGER.

Specific protective equipment for each level of protection is as follows:

Level C

Chemical Resistant Clothing/Coveralls
Full-face or half-face cartridge respirator
Chemical Resistant Gloves (Inner - Disposable)
Chemical Resistant Gloves (Outer)
Hearing Protection (Optional)*
Safety Shoes/Boots
Boots (Chemical Resistant - Overboots)
Hard Hat
Safety Glasses/Goggles (for use with half-face respirator)

Level D

Normal Work Clothes or Coveralls
Safety Shoes/Boots
Hard Hat
Gloves (Outer)
Hearing Protection
Safety Glasses/Goggles

7.2 Respiratory Protection

If Level C protection is required, an air-purifying cartridge respirator with an organic vapor cartridge (and a dust/mist prefilter for drilling Activities) is the appropriate cartridge for use with the known hazardous materials and corresponding concentrations. Cartridge changeover frequency will be determined by the user and the SHSO. Changeover frequency is based on contaminant concentrations, exposure duration, breathing resistance, odor breakthrough, and other warning properties. Criteria for using this type of respiratory protection has been determined by qualified Baker personnel in compliance with Attachment D - Baker Safety SOPs.

7.3 Care and Cleaning of Personal Protective Equipment

Provisions for the care and cleaning of personal protective equipment used on site can be found in Attachment D - Baker Safety SOPs. Responsibility for compliance with these provisions lies with the Site Manager.

8.0 SITE WORK PLANS/PROJECT PERSONNEL

Work Plans detailing the tasks to be performed at each site can be found immediately attached to the HASP. The name and corresponding function of personnel to be present on site can be found in the table below.

Work party(s) consisting of two or more persons will perform the following functions:

Name*	Function
Ken Tua	Site Manager/SHSO
James Culp	Project Geologist
Drilling Contractor (to be determined)	Drilling Activities
Survey Contractor (to be determined)	Site Survey Activities

*Note: At the time of the HASP Publication, specific site personnel and contractors had not been fully determined. Personnel identified are subject to change.

9.0 COMMUNICATION PROCEDURES

The "Buddy System" will be employed during all site activities. Personnel in the Exclusion Zone should remain in constant communication or within sight of the Site Manager, or his/her representative. Any failure of communication requires an evaluation of whether personnel should leave the Exclusion Zone.

Air horns will be used for communication during emergency evacuation of site personnel. One long air horn blast is the emergency signal to indicate that all personnel should evacuate the Exclusion Zone.

The following standard hand signals will be used in case of failure of radio communications or when radio communications are not available:

Hand gripping throat	- Out of air, can't breathe
Grip partner's wrist or both hands around waist ...	- Leave area immediately
Hands on top of head	- Need assistance
Thumbs up	- OK, I am all right, I understand
Thumbs down	- No, negative

The following audible signals, using a hand-held air horn, will be implemented in the event of radio communications failure, when verbal or hand signals are not feasible, or if immediate notification of project personnel is needed:

- 1-long = Evacuate or All's Clear(1)
- 1-short = Attention Getter(2)
- 2-short = Fire
- 3-short = Emergency or Need Help

- (1) Long = 3-second blast
- (2) Short = 1-second blast intervals

Coordination between Baker and Contractor Personnel is the responsibility of the Site Manager. The best means for securing the lines of communication will be determined prior to start-up by on-site project personnel.

Telephone communication at the Command Post should be established as soon as practicable.

10.0 DECONTAMINATION PROCEDURES

10.1 Site Decontamination

Personnel and equipment leaving the Exclusion Zone shall be thoroughly decontaminated. The following protocol shall be used for the decontamination stations according to levels of protection:

Level C	Level D
1. Equipment drop	1. Equipment drop
2. Outer boot and glove wash	2. Boot and glove gross contamination removal
3. Outer boot and glove rinse	3. Boot and glove wash*
4. Outer boot and glove removal	4. Boot and glove rinse*
5. Coverall removal/disposal	5. Boot and glove removal*
6. Respirator removal	6. Coverall removal*
7. Inner glove removal/disposal	7. Hand/Face wash
8. Hand/face wash	8. Equipment wipe down
9. Respirator cleaning/sanitizing	
10. Equipment cleaning	

* Optional - depends on degree of contamination and type of PPE used.

The following decontamination equipment is required for Level D+ and higher protection levels and recommended for Level D protection:

- Four small tubs (two sets of wash and rinse water)
- Scrub brush
- Towels
- Contaminated clothing disposal bag or drum
- Respiratory cleaning solution (when applicable)

Non-phosphate detergent (Alconox) and water should be sufficient for use as the decontamination solution. The decontamination liquids and clothing will be contained and disposed according to policy defined in the Work Plan.

10.2 Emergency Decontamination

Emergency decontamination will include the following stations*:

Level C	Level D
1, 4, 5, 6, and 7 as referenced above	1, 4, 5, and 6 as referenced above

- * If circumstances dictate that contaminated clothing cannot be readily removed, then remove gross contamination, wrap injured personnel with clean garments/blankets, to avoid contaminating other personnel or transporting equipment.

All emergency personnel are to be immediately informed of the injured person's condition, potential contaminants, and provided with all pertinent chemical data.

10.3 Equipment Decontamination

Provisions for the decontamination of equipment will be based on the size and type of equipment used. Specific decontamination procedures for Building AS-527 can be found in the Work Plan.

11.0 SITE SAFETY AND HEALTH

11.1 Responsibilities

The SHSO, as identified in Section 4.0, is directly responsible for safety requirements on site.

11.2 Emergency Medical Care

The nearest hospital is the Naval Base Hospital located in Building NH 100, telephone no.: (919) 451-4551 or 911. See Section 11.2.3 for directions and map of route to hospital.

Local ambulance service is available from the Base Ambulance Service, and can be reached at telephone no.: 911. Contact should be made with emergency personnel prior to the start of activities.

Emergency and first aid equipment is available on site at the following locations:

Fire Extinguisher:	<u>Contractor field vehicle</u>
Air Horn:	<u>Baker field vehicle</u>
First aid kit:	<u>Baker field vehicle</u>
Emergency eye wash bottle:	<u>Baker field vehicle</u>
Emergency shower:	<u>(Not applicable)</u>

11.2.1 Medical Training

The Site Manager is responsible for providing or obtaining immediate medical attention. Instances requiring "First Aid" and/or CPR treatment will be addressed on site by certified personnel. Instances requiring treatment beyond "First Aid" will be handled off site at appropriate facilities and reported to the Project Manager and PHSO within 24 hours. Any injury occurring on the site will be recorded on the SHSO's incident report. Refer to Sections 11.2.2 and 11.2.3 for a list of emergency phone numbers and directions and route to the nearest hospital.

11.2.2 Emergency Phone Numbers

List of emergency phone numbers:

Agency/Facility	Phone Number	Contact
Security (Police)	911 or (919) 451-4555	Base Police
Fire	911	Base Fire Department
Ambulance (On-Base)	911	Base Hospital
Ambulance (Off-Base)	(919) 455-9119	Jacksonville
Hospital (On-Base)	911 or (919) 451-4551	Base Naval Hospital
Hospital (Off-Base)	(919) 577-2240	Onslow County Memorial
Emergency	911	Base Dispatch

11.2.3 Directions and Hospital Route

The following are directions to the Onslow County Memorial Hospital from Site AS-527:

1. Leave Base through "Main Gate".
2. Take Highway 17N to Western Boulevard and turn right (south).
3. Continue on Western Boulevard approximately one-half mile and Onslow County Memorial Hospital will be located on the right.

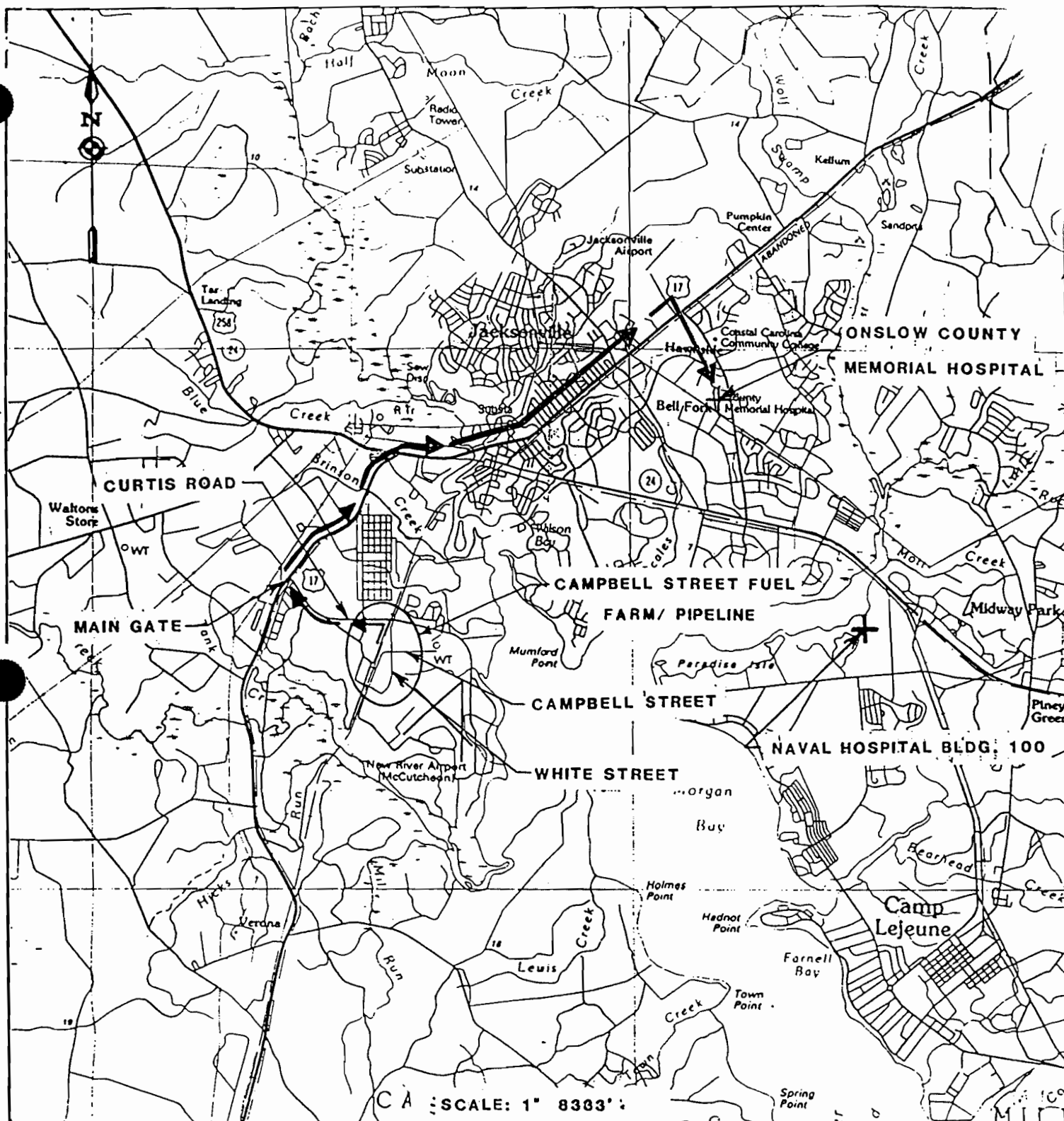


Figure 3
 EMERGENCY HOSPITAL ROUTE
 CAMPBELL STREET FUEL FARM/PIPELINE AREA
 NEW RIVER MARINE CORPS AIR STATION
 JACKSONVILLE, NORTH CAROLINA

11.2.4 Substance-Specific Information

A summary of emergency medical information for known substances on site are provided in the table below. Chemical Safety Data Sheets can be found in Attachment C for additional information.

Substance	Exposure Symptoms	First Aid Instructions
Aviation fuel (JP-5)	Eye and skin and throat irritation; headache, nausea, vomiting; coughing	Inhalation: Remove to fresh air. Eyes: Hold eyelids open and flush with large amounts of water. Skin: Flush affected area with large amounts of water and wash with soap and water. Ingestion: Seek immediate medical attention.

11.3 Environmental Monitoring

The following environmental monitoring instruments shall be used on site at the specified intervals.

11.3.1 Point Source

Point source monitoring is defined as monitoring performed at the source of the activity or within the breathing zone (bz) of the work party personnel; therefore, the tasks being performed at each site along with the type and frequency of monitoring required have been outlined in Table 2. The action levels to be followed, given the concentration measured, are as follows:

*PID/FID

- Background to 1 ppm - Level D protection
- > 1 ppm to 5 ppm for greater than 5 continuous minutes = Level C plus benzene monitoring
- > 5 ppm for up to 15 continuous minutes = Stop Work
- Instantaneous concentrations > 50 ppm = Stop Work

*PID with 10.2 eV ultraviolet lamp.

TABLE 2
MONITORING EQUIPMENT AND FREQUENCY FOR BUILDING AS-527

Job Task	PID	Dräger Colorimetric Tubes	Combustible Gas Meter
		(67 28561) Benzene	
Surveying	I	I&P	
Monitoring Well Installation	C	I&P	I&P
Groundwater Sampling	I	I&P	
Soil Boring-Sampling	C	I&P	I&P

I = Initially - At start of job task to confirm level of respiratory protection
 P = Periodically - When site condition or set-up changes, or when a new area is entered
 C = Continuously - Monitor levels continuously

Note: As air concentrations are measured, they should be documented. In the case of continuous monitoring, every 15 to 30 minutes.

PID - Photoionization Detector

Benzene Dräger Tube

- Below limits of detection (BLD) to less than 1 ppm - Level D
- ≥ 1 ppm to 5 ppm = Level C
- > 5 ppm = Stop Work

Combustible Gas Meter*

- $< 10\%$ of the Lower Explosive Limit (LEL) = continue work
- 10% to 20% of the LEL = continue work with extreme caution and use non-sparking tools (if applicable)
- $> 20\%$ of the LEL = stop work immediately and pursue alternative measures

* Used to evaluate physical safety in conjunction with PID/Dräger tubes.

11.3.2 Perimeter Monitoring

Perimeter monitoring is defined as monitoring performed at borders beyond the Support Zone and often at the "fence line." Releases occurring during these types of investigative activities are expected to be minimal. Therefore, it is anticipated that the type and frequency of monitoring required for each site will be as follows:

- The PID will be used periodically to scan the perimeter as a means of documenting any volatile releases that may extend past the work zone, when volatiles are detected at the point source.
- Dräger Colorimetric Tubes will be used periodically to measure any potential releases of suspect chemicals when contamination is found at the point source. Refer to Table 2 to determine the specific tubes required for each task.

It is not anticipated that there will be a need for any additional monitoring. However, as work progresses, additions to the scope of monitoring will be investigated by the SHSO.

11.4 Personal Monitoring

The following personal monitoring will be in effect on site:

- Personal exposure monitoring, as outlined in Section 11.3, should be sufficient according to the work activities and hazards already presented. However, as work progresses, additions to the scope of monitoring may be extended based on monitoring

results, odor detection, changing work conditions and signs or symptoms of exposure. Any or all of these conditions will be immediately investigated and acted upon by the SHSO.

See Attachment A for annual medical surveillance program requirements.

11.5 Equipment Maintenance and Calibration

Procedures for the return of equipment to inventory and for maintenance of the equipment shall be followed in order to assure that the optimum level of operation is maintained for the item. Personnel using equipment shall complete a field equipment usage form which will be reviewed by the PHSO. Equipment calibration by the SHSO will be completed daily and entered into the equipment calibration log. Procedures for equipment maintenance and calibration can be found in Baker's Standard Operating Procedures for Administrative, Field, and Technical Activities Manual.

12.0 EMERGENCY PROCEDURES

The SHSO shall be notified of any on-site emergencies and be responsible for ensuring that the appropriate procedures are followed. The following standard emergency procedures will be used by on-site personnel.

If there is an emergency on-site and immediate evacuation of project personnel is needed, use a hand-held air horn and initiate one long blast for a minimum of 3 seconds. Continue long blasts for as long as necessary.

Personnel Injury in the Exclusion Zone: Upon notification of an injury in the Exclusion Zone, the designated emergency signal (verbal) warning or three short airhorn blasts shall be sounded. All site personnel shall assemble at the decontamination control line (for Level D) or the CRZ (for Level D+ or higher). The rescue team will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The SHSO and/or Field Team Leader will evaluate the nature of the injury, and assure that the affected person is decontaminated according to Section 10.2. If required, contact will be made with an ambulance, and/or with the designated medical facility. No persons shall reenter the Exclusion Zone until an accident investigation is performed by the SHSO and/or the Site Manager.

Personnel Injury in the Support Zone: Upon notification of any injury in the Support Zone, the Field Team Leader and SHSO will assess the nature of the injury. If the cause of the injury or loss of the injured person does not affect the performance of other site personnel, operations may continue. If the injury increases the risk to others, the designated emergency signal (verbal) warning or three short airhorn blasts shall be sounded and all remaining site personnel will move to the support zone for further instructions. Activities on site will stop until the added risk is mitigated.

Fire/Explosion: Upon notification of a fire or explosion on site, the designated emergency signal (verbal) warning or two short airhorn blasts shall be sounded and all site personnel will assemble at the contamination control line (for Level D) or the CRZ (for Level D+ or higher). The fire and police/security departments will be alerted and all personnel will move to a safe distance from the involved area for further instructions. Activities will stop until the added risk is mitigated.

Personal Protective Equipment Failure: If any site worker experiences difficulty, failure or alteration of protective equipment that affects the protection factor, that person and his/her buddy shall immediately cease work activities, leave the Exclusion Zone, and repair or replace the defective equipment. Reentry will not be permitted until the equipment has been repaired or replaced.

Other Equipment Failure: If any other equipment on site fails to operate properly, the Site Manager and/or Field Team Leader and SHSO shall be notified to determine the effect of this failure on continuing operations on site. If the failure affects the safety of site personnel, work with the equipment will cease until the situation is evaluated and appropriate actions taken.

Accident/injury reports will be completed for any accidents no matter how minor the injury. All injuries resulting in treatment other than first aid will be reported to the Project Manager and PHSO within 24 hours. Records on equipment failure will also be completed.

In all situations, when an on-site emergency results in evacuation of the Exclusion Zone, personnel shall not reenter until:

1. The conditions resulting in the emergency have been corrected.
2. The hazards have been reassessed.
3. The HASP has been reviewed and, if appropriate, modified.
4. Site personnel have been briefed on any changes in the HASP.

A list of emergency phone numbers and contacts can be found in Sections 11.2.2 and 11.2.3 and will be posted at the Baker command post.

13.0 WASTE HANDLING PROCEDURES

The protocols outlined in the Work Plan for the handling, packaging, storage, and disposal of contaminated materials must be followed to: (1) minimize the risk of off-site exposures that could endanger public health; and (2) limit the potential for liabilities associated with handling, containment, storage, and transportation of contaminated materials.

14.0 SPILL CONTAINMENT PROCEDURES

In the event that a spill of hazardous substances (gasoline, oil, etc.) occurs during the implementation of field activities, spill containment will be utilized to prevent the additional migration of contaminants through the site area. Specific spill containment procedures will be dependent on the type of materials spilled and the type of environment affected. Potential spill containment procedures may include diking with absorbent/adsorbent material/pads, then removal or containment of the contaminated materials. Spill containment materials will be located close to the storage area of hazardous substances in a manner such that, the pathway remains accessible and free of obstructions. Appropriate Marine Corps Activity Personnel will be notified as soon as possible in the event of a spill.

15.0 DECLARATION OF HASP REVIEW

All site personnel have read the above plan and are familiar with its provisions.

	Name*	Signature
Site Manager/Site Health and Safety Officer	Ken Tua	
Project Geologist	James Culp	
Drilling Contractor		
Survey Contractor		

*Contractor personnel are yet to be determined.

The work party(s) were briefed on the contents of this plan on _____ at _____ a.m./p.m.

Attachment A
Medical Surveillance Testing Parameters

ATTACHMENT A

MEDICAL SURVEILLANCE TESTING PARAMETERS*

Group I - Individuals Rarely in the Field (<10 days/year)

- Medical History and Physical
- Eye Exam
- EKG (for individuals over 30 yrs.)
- CBC with differential

Group II - Individuals Occasionally in the Field (10-30 days/year)

- Medical History and Physical
- Eye Exam
- EKG (for individuals over 30 yrs.)
- Chest X-ray (biannual)
- Pulmonary Function (spirometry)
- CBC with differential
- SMA 20 or 24 (liver enzyme scan)

Group III - Individuals Frequently in the Field (>30 days/year)

- Medical History and Physical
- Eye Exam
- EKG (for individuals over 30 years)
- Audiogram
- Chest X-ray (biannual)
- Pulmonary Function (spirometry)
- CBC with differential
- SMA 20 or 24 (liver enzyme scan)
- Urinalysis (glucose scan)
- Specific Blood and Urine Tests (dependent on field exposure)
 - ▶ Lead ▶ Zinc
 - ▶ Mercury ▶ Chromium
 - ▶ Arsenic ▶ Volatile organics**
 - ▶ Cadmium ▶ Extractable organics**
 - ▶ Nickel ▶ Phenols**

Group III with Asbestos - Individuals frequently in the Field and also associated with asbestos

- Group III testing with the Asbestos Medical Questionnaire

Group IV - Individuals associated with Asbestos

- Medical history and physical
- Chest X-ray
- Pulmonary Function (spirometry)
- Urinalysis
- Asbestos Medical Questionnaire

* All tests annual except as indicated. The attending physician has the right to expand the medical monitoring as he/she deems necessary.

** Rare and expensive - to be performed only for individuals identified by the attending physician as being chronically exposed to organic compounds.

Attachment B
OSHA Training History of Project Personnel

ATTACHMENT B

OSHA TRAINING HISTORY OF PROJECT PERSONNEL

Personnel	Anticipated Site Activities Phase I	Training Status
Richard Bonelli	• Project Manager	• 40-hr. training completed: 3/89 • Supervisory training: Yes • 8-hr. refresher completed: 4/92 • First Aid/CPR Training: 11/91 • Medical surveillance participant
Barbara Cummings	• Project Health and Safety Officer	• 40-hr. training completed: 10/91 • Supervisory training: Yes • 8-hr. refresher completed: NA • First Aid/CPR Training: 11/91 • Medical surveillance participant
Ken Tua	• Site Manager/Site Health and Safety Officer	• 40-hr. training completed: 11/90 • Supervisory training: Yes • 8-hr. refresher completed: 4/92 • First Aid/CPR Training: No • Medical surveillance participant
James Culp	• Project Geologist	• 40-hr. training completed: 8/89 • Supervisory training: Yes • 8-hr. refresher completed: 11/91 • First Aid/CPR Training: 8/89 • Medical surveillance participant

Attachment C
Chemical Safety Data Sheets

JET FUELS: JP-5

JPV

Common Synonyms Kerosene, heavy	Liquid Colorless Fuel oil odor Floats on water.
Stop discharge if possible Call fire department Avoid contact with liquid Isolate and remove discharged material Notify local health and pollution control agencies	
Fire	Combustible. Extinguish with dry chemical foam or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.
Exposure	CALL FOR MEDICAL AID LIQUID Irritating to skin and eyes. Harmful if swallowed. Remove contaminated clothing and shoes. Flush affected areas with plenty of water. IF IN EYES, hold eyelids open and flush with plenty of water. IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk. DO NOT INDUCE VOMITING.
Water Pollution	Dangerous to aquatic life in high concentrations. Fouling to shoreline. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Mechanical containment Should be removed Chemical and physical treatment	2. LABEL 2.1 Category: None 2.2 Class: Not pertinent
3. CHEMICAL DESIGNATIONS 3.1 CQ Compatibility Class: Miscellaneous Hydrocarbon Mixtures 3.2 Formula: Not pertinent 3.3 IMO/UN Designation: 3.3/2781 3.4 DOT ID No.: 2781 3.5 CAS Registry No.: Data not available	4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless to light brown 4.3 Odor: Like fuel oil
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective gloves; goggles or face shield. 5.2 Symptoms Following Exposure: Vapor causes slight irritation of eyes and nose. Liquid irritates stomach; if taken into lungs, causes coughing, distress, and rapidly developing pulmonary edema. 5.3 Treatment of Exposure: ASPIRATION: enforce bed rest; administer oxygen; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water. 5.4 Threshold Limit Value: 200 ppm 5.5 Short Term Inhalation Limit: 2500 mg/m ³ for 60 min. 5.6 Toxicity by Ingestion: Grade 2; LD ₅₀ = 0.5 to 5 g/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary. 5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin. 5.10 Odor Threshold: 1 ppm 5.11 IDLH Value: Data not available	

6. FIRE HAZARDS 6.1 Flash Point: 140°F (min.) C.C. 6.2 Flammable Limits in Air: 0.6%-4.6% 6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide 6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective 6.5 Special Hazards of Combustion Products: Not pertinent 6.6 Behavior in Fire: Not pertinent 6.7 Ignition Temperature: 475°F 6.8 Electrical Hazard: Not pertinent 6.9 Burning Rate: 4 mm/min. 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available	10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-T-U																																				
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity With Common Materials: No reaction 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Bases: Not pertinent 7.5 Polymerization: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Molar Ratio (Reactant to Product): Data not available 7.8 Reactivity Group: 33	11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Combustible liquid 11.2 NAB Hazard Rating for Bulk Water Transportation: <table> <tr> <th>Category</th><th>Rating</th></tr> <tr> <td>Fire.....</td><td>1-2</td></tr> <tr> <td>Health.....</td><td></td></tr> <tr> <td>Vapor Irritant.....</td><td>1</td></tr> <tr> <td>Liquid or Solid Irritant.....</td><td>1</td></tr> <tr> <td>Poisons.....</td><td>1</td></tr> <tr> <td>Water Pollution.....</td><td></td></tr> <tr> <td>Human Toxicity.....</td><td>1</td></tr> <tr> <td>Aquatic Toxicity.....</td><td>1</td></tr> <tr> <td>Aesthetic Effect.....</td><td>3</td></tr> <tr> <td>Reactivity.....</td><td></td></tr> <tr> <td>Other Chemicals.....</td><td>0</td></tr> <tr> <td>Water.....</td><td>0</td></tr> <tr> <td>Self Reaction.....</td><td>0</td></tr> </table> 11.3 NFPA Hazard Classification: <table> <tr> <th>Category</th><th>Classification</th></tr> <tr> <td>Health Hazard (Blue).....</td><td>0</td></tr> <tr> <td>Flammability (Red).....</td><td>2</td></tr> <tr> <td>Reactivity (Yellow).....</td><td>0</td></tr> </table>	Category	Rating	Fire.....	1-2	Health.....		Vapor Irritant.....	1	Liquid or Solid Irritant.....	1	Poisons.....	1	Water Pollution.....		Human Toxicity.....	1	Aquatic Toxicity.....	1	Aesthetic Effect.....	3	Reactivity.....		Other Chemicals.....	0	Water.....	0	Self Reaction.....	0	Category	Classification	Health Hazard (Blue).....	0	Flammability (Red).....	2	Reactivity (Yellow).....	0
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Reactivity (Yellow).....	0																																				
8. WATER POLLUTION 8.1 Aquatic Toxicity: 500 ppm/*salmon fingerling/lethal/fresh water *Time period not specified 8.2 Waterfowl Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): 53%, 5 days 8.4 Food Chain Concentration Potential: None	12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: Not pertinent 12.3 Boiling Point at 1 atm: 349-349°F = 176-287°C = 449-560°K 12.4 Freezing Point: <-54°F = <-48°C = <-225°K 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 0.82 at 15°C (liquid) 12.8 Liquid Surface Tension: (est.) 25 dynes/cm = 0.025 N/m at 20°C 12.9 Liquid Water Interfacial Tension: (est.) 50 dynes/cm = 0.05 N/m at 20°C 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: 140 Btu/lb = 76 cal/g = 3.3 X 10 ⁴ J/kg 12.13 Heat of Combustion: -16,540 Btu/lb = -10,300 cal/g = -431.24 X 10 ⁴ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.25 Heat of Fusion: Data not available 12.26 Limiting Value: Data not available 12.27 Reid Vapor Pressure: Data not available																																				
9. SHIPPING INFORMATION 9.1 Grades of Purity: 100% 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open (flame arrester)	NOTES																																				

JET FUELS: JP-5

12.17 SATURATED LIQUID DENSITY		12.18 LIQUID HEAT CAPACITY		12.19 LIQUID THERMAL CONDUCTIVITY		12.20 LIQUID VISCOSITY	
Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F	Temperature (degrees F)	British thermal unit-inch per hour- square foot-F	Temperature (degrees F)	Centipoise
34	52.370	0	.444	0	.926	-35	10.600
36	52.300	10	.449	10	.924	-30	9.614
38	52.230	20	.454	20	.921	-25	8.739
40	52.160	30	.459	30	.919	-20	7.960
42	52.090	40	.464	40	.917	-15	7.266
44	52.020	50	.469	50	.915	-10	6.646
46	51.950	60	.474	60	.913	-5	6.090
48	51.880	70	.479	70	.911	0	5.592
50	51.810	80	.484	80	.909	5	5.144
52	51.740	90	.489	90	.907	10	4.740
54	51.670	100	.494	100	.905	15	4.376
56	51.600	110	.499	110	.903	20	4.046
58	51.530	120	.504	120	.901	25	3.747
60	51.460	130	.509	130	.899	30	3.476
62	51.390	140	.514	140	.897	35	3.229
64	51.330	150	.519	150	.895	40	3.004
66	51.260	160	.524	160	.893	45	2.799
68	51.190	170	.529	170	.891	50	2.612
70	51.120	180	.534	180	.889	55	2.440
72	51.050	190	.539	190	.887	60	2.282
74	50.980	200	.544	200	.885	65	2.138
76	50.910	210	.549	210	.883	70	2.005
78	50.840					75	1.883
80	50.770						
82	50.700						
84	50.630						

12.21 SOLUBILITY IN WATER		12.22 SATURATED VAPOR PRESSURE		12.23 SATURATED VAPOR DENSITY		12.24 IDEAL GAS HEAT CAPACITY	
Temperature (degrees F)	Pounds per 100 pounds of water	Temperature (degrees F)	Pounds per square inch	Temperature (degrees F)	Pounds per cubic foot	Temperature (degrees F)	British thermal unit per pound-F
	I	130	.101		N		D
	N	140	.130		O		A
	S	150	.166		T		T
	O	160	.210				A
	L	170	.264		P		
	U	180	.330		E		N
	B	190	.409		R		O
	L	200	.504		T		T
	E	210	.616		I		
		220	.750		N		A
		230	.907		E		V
		240	1.091		N		A
		250	1.306		T		I
		260	1.555				L
		270	1.843				A
		280	2.174				B
		290	2.553				L
		300	2.986				E

Attachment D
Baker Environmental, Inc.
Safety Standard Operating Procedures

ATTACHMENT D

**BAKER ENVIRONMENTAL, INC.
SAFETY STANDARD OPERATING PROCEDURES**

TABLE OF CONTENTS

- 1.0 Confined Space Entry Program
- 2.0 Respiratory Protection Program
- 3.0 Care and Cleaning of Personal Protective Equipment
- 4.0 Sanitation/Site Precautions

1.0 - CONFINED SPACE ENTRY PROGRAM

1.1 INTRODUCTION

All confined space entries shall be performed in accordance with the following program based on the "Criteria Document for a Recommended Standard for Working in Confined Spaces," issued by NIOSH. A confined space refers to a space, which by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants; and which is not intended for continuous employee occupancy.

Confined spaces include, but are not limited to, storage tanks, compartments of ships, process vessels, pits, silos, degreasers, reaction vessels, boilers, ventilation and exhaust ducts, sewers, tunnels, underground utility vaults, and pipelines. If there is a question as to whether or not an area should be considered as a confined space, appropriate safety personnel should be consulted prior to entry.

1.2 HAZARD IDENTIFICATION

Identify and evaluate each hazard of the permit spaces. Hazardous substances should be identified through the use of Dräger tubes and/or direct reading instruments such as HNu or OVA meters. Oxygen and explosive levels will be monitored using a Lower Explosive Level/Oxygen (LEL/O₂) meter.

1.3 HAZARD CONTROL

Establish and implement the means, procedures, and practices by which the permit spaces can be entered safely. Ventilation and area cleaning should be considered in addition to personal protective equipment.

1.4 PERMIT SYSTEM

The Health and Safety Officer (HSO) or designee will complete the confined space entry permit, as attached. This form must be posted at the point of entry and is valid for eight consecutive hours. After eight hours, or sooner if there is reason to believe that conditions

may have changed, additional environmental testing and a new permit must be completed. Completed, expired permits must be returned to the HSO, or designee.

1.5 EMPLOYEE INFORMATION

Signs shall be posted near permit confined spaces to notify employees as to hazards that may be present and that only authorized personnel may enter.

1.6 EMPLOYEE TRAINING

All employees entering or directly involved in the confined space activities must complete a 40-hour health and safety training course in accordance with 29 CFR 1910.120. Additionally, site-specific training must be conducted regarding the hazards associated with each confined space and confirmed space entry procedures including the following subjects:

- Oxygen Deficiency
- Explosivity
- Toxics
- Ventilation
- Personal Protective Equipment/Procedures
- Respiratory Protection
- Initial Entry and Monitoring
- Emergency Procedures and Egress

1.7 EQUIPMENT

All equipment must be inspected and maintained to ensure the proper use of the equipment, necessary for safe entry. Respirators and emergency equipment, lanyard, harness, etc. must be thoroughly inspected prior to the confined space entry. Records of the inspection shall be kept in the project file. The equipment shall be adequately decontaminated following each entry.

1.8 RESCUE

Ensure that procedures and equipment necessary to rescue entrants from permit spaces are implemented and provided. The buddy system shall be used for all entries. The attached table provides a list of requirements with respect to each entry classification. The following items describe the three confined space entry classifications.

I CLASS A

- Immediate Danger to Life and Health (IDLH) condition exists
- Should only be entered under emergency conditions (Level A or B protection ensembles)
- Efforts should be made to reduce IDLH levels such as ventilation, cleaning, etc.
- IDLH conditions may include:
 - ▶ Oxygen levels below 19.5% or greater than 22%
 - ▶ LEL levels 20% or greater
 - ▶ Contaminant Concentration > PEL

II CLASS B

- Dangerous, but not IDLH conditions
- Levels of protection can range from C to A
- Range of conditions:
 - ▶ Oxygen from 19.5% to 21.5%
 - ▶ LEL levels from 10% to 19%
 - ▶ Contaminant Concentration $\geq$ the PEL

III CLASS C

- Low Hazard Potential
- Requires no modification of work procedures but constant monitoring
- Range of conditions:
 - ▶ Oxygen levels from 19.5% to 22%
 - ▶ LEL levels less or equal to 10%
 - ▶ Contaminant Concentrations < the PEL

CONFINED SPACE ENTRY

ITEM	CLASS A	CLASS B	CLASS C
1. Permit	X	X	X
2. Atmospheric Testing	X	X	X
3. Monitoring	X	O	O
4. Medical Surveillance	X	X	O
5. Training of Personnel	X	X	X
6. Labeling and Posting	X	X	X
7. Preparation Isolate/Lockout/Tag	X	X	X
Purge and Ventilate	X	X	O
Cleaning Procedures	O	O	O
Requirements for Special Equipment/Tools	X	X	O
8. Procedures Initial Plan	X	X	X
Standby	X	X	O
Communication/Observation	X	X	X
Rescue	X	X	X
Work	X	X	X
9. Safety Requirement and Clothing Head Protection	O	O	O
Hearing Protection	O	O	O
Hand Protection	X	O	O
Foot Protection	X	O	O
Body Protection	X	O	O
Respiratory Protection	X	X	O
Safety Belts	X	X	X
Life Lines, Harness	X	X	X
10. Rescue Equipment	X	X	X
11. Recordkeeping/Exposure	X	X	X

X - Indicates requirements

O - Indicates determination by the qualified individual

ALL COPIES OF PERMIT
WILL REMAIN AT JOB SITE
UNTIL JOB IS COMPLETED

- ☐ CONFINED SPACE ENTRY PERMIT
☐ HAZARDOUS AREA ENTRY PERMIT

LOCATION and DESCRIPTION

of Confined Space _____ Date _____

PURPOSE of Entry _____ Time _____ M

JOB/SITE _____ Expiration _____ M

PERSON in Charge of Work _____

SAFETY REQUIREMENTS	Yes	No		Yes	No
Lock Out - De-Energize			Escape Harness		
Lines Broken - Capped or Blanked			Tripod Emergency Escape Unit		
Purge - Flush and Vent			Lifelines		
Ventilation			Fire Extinguishers		
Secure Area			Lighting		
SAR or SCBA			Protective Clothing		
Resuscitator - Inhalator			Respirator (half mask or full face)		

TEST(S) TO BE TAKEN Valid for One 8-Hour Entry	Yes	No	CONCENTRATION	INSTRUMENT USED AND DATE CALIBRATED
Oxygen				
% of L.E.L.*				
Carbon Monoxide				
Aromatic Hydrocarbon				
Hydrocyanic Acid				
Hydrogen Sulfide				
Sulfur Dioxide				
Ammonia				
Other:				
Other:				

*L.E.L. = Lower Explosion Level

*Permit Issued By: _____
print Name Signature

Note: Continuous/periodic tests shall be established before beginning job. Any questions pertaining to test requirements contact the On-Site Health and Safety Officer.

SAFETY STANDBY PERSON(S)	Name	Check No.

AMBULANCE: _____ FIRE: _____

*Health and Safety Officer or Qualified Designee



2.0 - RESPIRATORY PROTECTION PROGRAM

2.1 INTRODUCTION

In accordance with OSHA requirements (29 CFR 1910.134), this document represents Baker Environmental, Inc.'s (Baker's) program governing the selection and use of respiratory protection for its employees. It is Baker's policy to provide its employees with the proper protective equipment, training, and medical surveillance necessary to protect individuals from any potential hazards which may be present during the tasks performed throughout the course of each individual's employment. This program specifically describes the procedures which have been established and implemented for the use of respiratory protection equipment. The effectiveness of this program shall be reevaluated on an annual basis and appropriate changes shall be made if deemed necessary.

2.2 EMPLOYER RESPONSIBILITY

Baker shall provide its employees the respiratory protection equipment which is appropriate and suitable for the purpose intended, when such equipment is necessary to protect the health of the employee.

2.3 EMPLOYEE RESPONSIBILITY

The employee shall use the respiratory protection provided in accordance with instructions and training received, and shall report any malfunction of the equipment to a responsible person. The employee shall not wear contact lenses in atmospheres where respiratory protection is required. Corrective lens inserts will be provided, at Baker's expense, for employees who require corrective lenses.

2.4 HAZARD ASSESSMENT

The key elements of a respiratory protection program must start with an assessment of the inhalation and ingestion hazards present in the work area. Because Baker's services involve a variety of environmental and industrial hygiene studies, it is not practical to identify all

possible hazards to which all employees could be exposed within the scope of this document. Therefore, it is essential that a task specific assessment be conducted prior to the initiation of any activities on a given project. This task specific assessment may be part of the site-specific Health and Safety Plan.

After a task-specific assessment is completed and it is determined that airborne exposure concentrations exceed or may exceed the recommended limits, engineering and administrative controls should be implemented, whenever feasible.

If the exposure cannot be reduced, or it is not feasible to reduce the airborne exposure below the recommended limits, respirators will be selected by the Site Health and Safety Officer on the basis of:

- Toxicity
- Maximum Expected Concentration
- Oxygen Levels
- Warning properties of the substance(s) involved
- Sorbent Limitations
- Facepiece Fit
- Mobility Requirements
- Type of Use (routine, escape, or emergency entry)
- Possibility of Ingestion of Toxic Materials
- Respirator Attributes

2.5 TRAINING

Each respirator wearer shall be given training, by a qualified individual, which will include explanations and discussions of:

- Opportunity to wear respiratory protection in an uncontaminated environment.
- Respirator Kit Testing (qualitative)
- The respiratory hazard(s) and what may occur if the respirator is not used properly.
- The reasons for selecting a particular type of respirator.
- The function, capabilities, and limitations of the selected respirator.
- The method of donning the respirator and checking its fit and operation.
- The proper wearing of the respirator.

- Respirator maintenance, repair, and cleaning.
- Recognizing and handling emergency situations.

Respirator training will be conducted on an annual basis, at a minimum. Records of the training and fit-testing will be maintained for a minimum of 30 years following termination of employment for each employee.

2.6 TYPES OF RESPIRATORS

Baker provides employees with half-face and full-face air purifying respirators, positive pressure 30-minute Self-Contained Breathing Apparatus (SCBAs), positive pressure supplied airline respirators, and 5-minute escape SCBAs. Only respiratory equipment certified by the appropriate approval agencies (e.g., NIOSH, MSHA) according to Title 30, Part II of the Code of Federal Regulations, will be distributed to Baker employees. All Baker employees who regularly perform tasks requiring respiratory protection will be issued their own half-face or full-face respirator, provided the employee can achieve a proper fit and is medically capable of wearing the equipment.

Because 30-minute SCBAs, positive pressure supplied airline respirators, and 5-minute escape SCBAs are used less frequently, this equipment will be distributed on an as-needed basis.

2.7 CLEANING AND MAINTENANCE

Respirator maintenance will be performed by each trained individual on a regular basis. The maintenance shall be carried out on a schedule which ensures that each respirator wearer is provided with a respirator that is clean and in good operating condition.

Respiratory equipment that is used on an as-needed basis shall be maintained by qualified personnel. This equipment shall be cleaned/sanitized, then rinsed and air-dried, after each use. Inspections shall be conducted before and after each use.

Respiratory equipment that has been issued to an employee shall be cleaned/sanitized then rinsed and air-dried by the wearer on a schedule (specified by OSHA in 29 CFR 1910.134) which ensures that it will be maintained in clean and good operating condition. Inspections shall be conducted on a regular basis during usage and prior to each project requiring the potential usage of the equipment.

All respirators shall be stored in a plastic bag within a cool/dry location, in a manner that will protect them against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. They shall be stored to prevent distortion of rubber or other elastomer parts.

Parts replacement and repairs shall be performed only by appropriate personnel. Equipment requiring repairs shall be reported to appropriate Baker personnel. Examples of inspection forms are included at the end of this text.

2.8 FIT-TESTING

Each respirator wearer shall be provided with a respirator that can properly form a secure face to mask seal. Each wearer shall be fit-tested prior to issuance of the respirator using either an irritant smoke or odorous vapor, or other suitable test agent. Retesting shall be performed, at a minimum, on an annual basis or if a different model respirator, other than the model he/she was previously fit-tested for, is to be used by the wearer. Respirators fit-tested qualitatively will be assigned a protection factor of 10 ($APF = 10$).

Facial hair, which interferes with the normally effective face to mask seal, is prohibited. Each respirator wearer shall be required to check the seal of the respirator by appropriate means prior to entering a harmful atmosphere.

2.9 MEDICAL SURVEILLANCE

Personnel who are or may be assigned to tasks requiring use of respirators shall participate in a medical surveillance program on an annual basis. The medical surveillance program shall include, but may not be limited to, a physical and a pulmonary function test conducted by the company's physician and at the expense of the company. Test parameters included in Baker's medical surveillance program is included as Attachment A in each site-specific Health and Safety Plan.

[illegible]

[illegible]

3.0 - CARE AND CLEANING OF PERSONAL PROTECTIVE EQUIPMENT

3.1 INTRODUCTION

The following procedures cover the care and cleaning of Level D and C personal protective equipment. Note: These are general procedures that apply to most situations and are not all inclusive. Procedures are subject to change at the direction of the on-site HSO.

3.2 EQUIPMENT CARE

3.2.1 Chemical Resistant Suit (Level C)

- Before donning, inspect suit for holes or tears; check to see that zippers are operable; and look for signs of suit degradation.
- When wearing, avoid contact with contaminated material where possible; be aware of sharp objects that can tear suit; periodically look over suit to check for major rips or tears.
- While decontaminating, remove gross excess of material from suit; remove suit so that material does not contact inner suit; place clothing in properly labeled disposal containers.

3.2.2 Gloves (inner/outer)

- Look for rips, tears, or degradation of material. Replace as necessary or at the direction of the on-site HSO.

3.2.3 Chemically Resistant Boots

Non-disposable boots are to be examined on a daily basis before and after use. Disposable boots should be examined prior to donning and while in use. Dispose of according to site procedures.

3.2.4 Hard Hats

Should be visually inspected before donning for fit, cracks, and overall condition.

3.2.5 Respirators

Procedures for care of respiratory protective equipment are covered in Attachment C - Baker SOPs.

3.3 EQUIPMENT CLEANING

General procedures for cleaning of equipment are listed below. Site-specific concerns will be addressed by the on-site HSO prior to start-up. Cleaning of respiratory equipment is covered under Attachment C - Baker SOPs.

3.3.1 Gross Physical Removal

Large amounts of contaminated soil is scraped off with a tongue depressor, or wiped off using a disposable wipe.

3.3.2 Physical/Chemical Removal

The residual contamination will be scrubbed with a soft-bristled, long-handled brush using a detergent solution.

3.3.3 Rinsing/Dilution

The detergent solution and residual contaminants will be rinsed with tap water using a pressurized sprayer.



4.0 - SANITATION/SITE PRECAUTIONS

4.1 SANITATION

- A supply of clearly marked potable water, tightly closed, and equipped with a tap.
- Single service cups/disposal for used cups.
- Outlets for non-potable water, clearly marked, for fire fighting or other purposes. Cross-contamination of the potable supply shall be prevented.
- One toilet facility which is either chemical, recirculating, combustion, or flush, depending on local code requirements.
- A place for food handling facility must meet all applicable laws, otherwise this activity may be restricted by on site management. In the event, suitable alternatives to such facilities will be provided (i.e., nearby restaurants, food wagons, etc.).
- Clean wash water will be available in the decontamination zone.

4.2 SITE PRECAUTIONS

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material, is prohibited in any area designated as contaminated.
- No smoking will be allowed on-site.
- Hands and face must be thoroughly washed upon leaving the work area.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- No work garments are to be worn off site.
- Contact lenses are not permitted to be worn on site.
- No facial hair which interferes with a satisfactory fit of the mask-to-face seal, is allowed on personnel required to wear respirators.
- Contact with contaminated or suspected contaminated surfaces should be avoided. Wherever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, sit or place equipment on drums/containers.
- Medicine and alcohol can potentiate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel where the potential for absorption, inhalation, or ingestion of toxic substances exist unless specifically approved by a qualified physician. Alcoholic beverage intake should be minimized or avoided during after-hour operations.
- Alcoholic beverages are prohibited on site.
- Personal radios, TVs, and tape players are prohibited on site.
- Firearms are prohibited on site.
- All personnel will observe any posted sign, warning, fence, or barrier posted around contaminated areas.

APPENDIX C
FIELD TEST BORING RECORDS

TEST BORING LOG LEGEND

SOIL DESCRIPTION			ROCK DESCRIPTIONS		
GRAIN SIZE IDENTIFICATION			HARDNESS		
NAME	SIZE LIMITS		Very Soft -	Easily gouged by knife, easily scratched by fingernail, easily broken by hand	
Boulder	12" OR MORE		Soft -	Gouged by knife, scratched by fingernail, difficult to break by hand, powders with hammer	
Cobbles	3" - 12"		Medium Hard -	Easily scratched by knife, easily broken with hammer	
Coarse Gravel	3/4" - 3"		Hard -	Difficult to scratch, breaks with hammer	
Fine Gravel	4.76 mm (#4) - 3/4"		Very Hard -	Difficult to break, rings when struck	
Coarse Sand	2 mm (#10) - 4.76 mm (#4)		WEATHERING		
Medium Sand	0.42 mm (#40) - 2 mm (#10)		Decomposed	Soft to Very soft, bedding and fractures indistinct, no cementation.	
Fine Sand	0.074 mm (#200)-0.42 mm (#40)		Highly Weathered	Very soft to soft, with medium hard relict rock fragments; little to moderate cementation. Vugs, openings in bedding and fractures (may be filled).	
Silt	0.002 mm-0.074 mm (#200)		Weathered	Soft to medium hard. Good cementation, bedding and fractures are pronounced. Uniformly stained.	
Clay	Less than 0.002 mm		Slightly Weathered	Medium hard. Fractures pronounced, non-uniform staining, bedding distinct.	
RELATIVE DENSITY			Fresh	Medium hard to hard. No staining. Fractures may be present. Bedding may or may not be indistinct.	
NONCOHESIVE SOIL			BEDDING AND FRACTURES:		
TERM	SPT (Blows/ft)		SPACING	BEDDING	FRACTURES
Very Loose	Below 4		LESS THAN 1/2" (1 cm)	Indistinct	Fissile
Loose	4-10		1/2" to 1" (1cm-3cm)	Laminated	Very Close
Medium Dense	10-30		1" TO 4" (3cm-10cm)	Very Thin	Close
Dense	30-50		4" TO 1' (10cm-30cm)	Thin	Moderate
Very Dense	OVER 50		1' TO 3' (30 cm-1m)	Moderate	Wide
COHESIVE SOILS			3' TO 10' (1m-3m)	Thick	Very Wide
TERM	SPT (Blows/ft)				
Very Soft	BELOW 2				
Soft	2-4				
Medium Stiff	4-8				
Stiff	8-15				
Very Stiff	15-30				
Hard	OVER 30				
MOISTURE					
DESCRIPTIVE TERMS					
Dry	Trace	0-10%			
Damp	Little	10-20%			
Moist	Some	20-35%			
Wet	with = And	35-50%			
CONTACTS:			SAMPLE TYPE		
_____ = DEFINITE			ABBREVIATIONS		
_____ = INDEFINITE			S = Split Spoon	HS = Hollow Stem	
..... = GRADATIONAL			T = Shelby Tube	NP = Non Plastic	
			R = Air Rotary	-PL = Below the Plastic Limit	
			D = Denison	PL = At the Plastic Limit	
			A = Auger	+ PL = Above the Plastic Limit	
			W = Wash (Roller Bit)	+ LL = Above the Liquid Limit	
			C = Core	SPT = Standard Penetration Test	
			P = Piston	RQD = Rock Quality Designation	
			N = No Sample Taken		

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORD

PROJECT: Aircraft Refueling Area

S.O. NO.: 19124

COORDINATES: EAST: _____

ELEVATION: SURFACE: 23.65

BORING NO.: MW-8

NORTH: _____

TOP OF PVC CASING: 23.54

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-18-92</u>	<u>14'</u>	<u>Hot</u>		
LENGTH	<u>2.0</u>		<u>5.0</u>						
TYPE	<u>STD</u>	<u>SCH 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140#</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: Samples collected 2' intervals to end of boring. Monitoring well installed

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type - No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
1	S1	S	1.5/2.0	3			2" Topsoil	black	Loose	Dry		23.6
2			75%	7			4" sand - fine → medium	brown		Dry		
3	S2	S	1.6/2.0	7			12" silt trace sand - fine	black		Dry		
4			80%	5			Silt and sand - fine	brown	medium dense	Damp - mottled gray		
5	S3	S	1.8/2.0	3			10" sand - medium	yellow	Loose	Damp		18.6
6			90%	3			12" clay	yellow	medium stiff	Damp		17.6
7	S4	S	1.5/2.0	2			sand - fine trace silt	lt. gray	Loose	moist		
8			75%	3			WATER					15.6
9	S5	S	2.0/2.0	3			4" sand - fine some silt	lt. brown	Loose	wet		
10			100%	4			20" sand - medium → coarse	white		wet		

DRILLING CO.: ATEC

DRILLER: Sanford Sweeping

BAKER REP.: K. Tue

BORING NO.: MW-8

SHEET 1 OF 2

FIELD TEST BORING RECORD

Baker Environmental, Inc.

PROJECT: Aircraft Refueling Area

S.O. NO.: 19124

BORING NO.: MW-8

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11	S6	S	2.0/20	2		200	Sand - medium to coarse	white	very loose	wet - odor	
12			100%	2							
13	S7	S	2.0/20	3		18	Sand - medium to coarse trace silt	white	loose	wet - slight odor	
14			100%	3							
15				1			End of Boring 14'				
16				2							
17				3							
18				4							
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

9.6

DRILLING CO.: ATEC

DRILLER: Sanford Sweeting

BAKER REP.: K. Tua

BORING NO.: MW-8

SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: Aircraft Refueling AreaS.O. NO.: 19124BORING NO.: MW-9

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 22.33TOP OF PVC CASING: 22.25

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-18-92</u>	<u>14'</u>	<u>Hot</u>		
LENGTH	<u>2.0</u>		<u>5.0</u>						
TYPE	<u>STD</u>	<u>SCH 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: samples collected 2' intervals to end of boring. Monitoring well installed

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type - No. (N = No Samp.)		RQD (FL & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
1	S1	S	1.5/2.0	2			4" Topsoil	brown	stiff	Dry		22.3
2			75%	4			14" clay and sand - fine	brown		Dry		
3	S2	S	1.7/2.0	3			2" clay and sand - fine	brown	stiff	Dry		
4			85%	4			2" sand - fine trace clay	black		Damp		
5	S3	S	1.4/2.0	3			17" clay some sand - fine	brown		Dry		
6			70%	4			3" sand - fine trace clay	black	medium	Wet		
7	S4	S	1.6/2.0	3			14" clay	lt. brown	stiff	Dry		16.3
8			80%	1			WATER					
9	S5	S	2.9/2.0	2			8" clay some sand - fine	gray	soft	wet		
10			100%	1			11" clay and sand - medium	yellow		wet		14.3
							sand - medium some clay	yellow	very loose	wet		

DRILLING CO.: ARECBAKER REP.: K. TuoDRILLER: Sanford SweetingBORING NO.: MW-9SHEET 1 OF 2

FIELD TEST BORING RECORD

PROJECT: Aircraft Refueling Area
S.O. NO.: 19124

BORING NO.: MW-9

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
11	S6	S	2.0% 2.0	1 1		0	18" silt and sand - fine	lt. brown	very loose	wet		8.3
12			100%	2 5			6" sand - medium	white		wet		
13	S7	S	2.0% 2.0	5 9		0	8" silt with sand - fine	lt. brown	medium dense	wet		
14			100%	13 16			16" sand - medium	white		wet		
15							End of Boring 14'					
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: ATEC

BAKER REP.: K. Tua

DRILLER: Sanford Sweeting

BORING NO.: MW-9

SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: MW 10

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 22.56TOP OF PVC CASING: 22.68

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-18-92</u>	<u>14'</u>	<u>Hot</u>		
LENGTH	<u>2.0</u>		<u>5.0'</u>						
TYPE	<u>STD</u>	<u>SCN 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: SAMPLES COLLECTED EVERY 2' TO END OF BORING. MONITORING WELL INSTALLED.

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL ELEVATION
	ROCK	Type - No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
1	S1	S	1.5	6		0	1" Top Soil	Dark Yellow	Med DENSE	Dry	22.6
2			75%	7			17" SAND-MEDIUM				
3	S2	S	2	3		0	SAND-MEDIUM	Dark Yellow	Loose	DAMP	19.2
4			100%	3			4" CLAY TRACE SAND-FINE	Yellow	Loose	DAMP	18.9
5	S3	S	1.5	1		0	5" SAND-FINE TO MEDIUM	Yellow	Loose	DAMP	18.1
6			75%	4			CLAY	Gray	Med STIFF	DAMP MOTTLED ORANGE	16.6
7	S4	S	0	3		600	SAND FINE AND CLAY	Yellow	Loose	WET STRONG ODOR	
8			100%	3			10" SAND-M TO CHARGE TRACE SILT	Gray		WET	
9	S5	S	1.9	2		400	SAND-MEDIUM	Gray	Very Loose	WET	
10			96%	2				Yellow			

DRILLING CO.: ATECBAKER REP.: KENNETH A. TUADRILLER: SANFORD SWEETINGBORING NO.: MW 10SHEET 1 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: MW 10

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
11	56	5	$\frac{2}{2}$	2			SAND - COARSE	10" yellow	AEO DENSE	WET ODR		8.6
				4				14" GRAY				
12			100%	6		700						
13	57	5	$\frac{1.6}{2}$	8			SAND - MEDIUM	10" yellow	MD DENSE	WET ODR		
				12				10" GRAY				
14			83%	14		600	END OF BORING 14'					
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: ATECDRILLER: SANTOARD SWEETINGBAKER REP.: KENNETH A. TUABORING NO.: MW 10SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: Aircraft Refueling AreaS.O. NO.: 19124BORING NO.: MW-11

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 23.85TOP OF PVC CASING: 23.59

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-21-92</u>	<u>12'</u>	<u>Hot</u>		
LENGTH	<u>2.0</u>		<u>5.0</u>						
TYPE	<u>STD</u>	<u>SCH 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140#</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: 6" concrete. 0.5-6.0' hand augered. Samples collected 2' intervals 6.0' to end of boring.
Monitoring well installed.

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL ELEVATION
	ROCK	Type- No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	
1	S1	S	--	Hand Auger		NR	<u>6" concrete</u>				23.8
2							<u>18" sand - medium and gravel - fine</u>	<u>orange</u>		<u>Damp</u>	
3	S2	S	--	Hand Auger		NR	<u>12" sand - medium → fine</u>	<u>orange</u>		<u>Damp</u>	20.8
4							<u>12" clay and sand - medium</u>	<u>orange</u>		<u>wet</u>	19.8
5	S3	S	--	Hand Auger		NR	<u>clay</u>	<u>orange gray</u>		<u>wet</u>	
6											
7	S4	S	<u>2.0/2.0</u>	<u>100%</u>		45	<u>clay and sand - fine → medium</u>	<u>brown</u>	<u>very soft</u>	<u>wet</u>	
8											
9	S5	S	<u>1.3/2.0</u>	<u>65%</u>		9	<u>clay trace sand - fine</u>	<u>brown</u>	<u>very soft</u>	<u>wet.</u>	
10											

DRILLING CO.: ATECDRILLER: Sanford SweetingBAKER REP.: K. TuaBORING NO.: MW-11SHEET 1 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: Aircraft Refueling AreaS.O. NO.: 19124BORING NO.: MW-11

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class..		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
11	56	5	20/20 100%	2 1 2 2		10	6" clay some sand-fine 8" clay trace sand-fine 10" clay and gravel-fine	green brown brown	soft	wet wet wet		11.8
12							End of Boring 12'					
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												

DRILLING CO.: ATECDRILLER: Sanford SweetingBAKER REP.: K. TugBORING NO.: MW-11SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: Aircraft Refueling AreaS.O. NO.: 19124BORING NO.: MW-12

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 22.50TOP OF PVC CASING: 22.40

RIG: B-61					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	1 3/8" ID	2"	6 1/4" ID		6-18-92	14'	Hot & Sunny		
LENGTH	2.0		5.0						
TYPE	STD	SCH 40 PVC	HSA						
HAMMER WT.	140#								
FALL	30"								
STICK UP									

REMARKS: Samples collected every 2' to end of boring. Monitoring well installed

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec. (Ft. & %)	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
1	S1	S	1 1/2	3			7" Top Soil	BLACK		DRY	
2			60%	11			8" SILT TRACE SAND-FINE	BLACK			
3	S2	S	1 1/2	11			SILT SOME SAND-FINE	BLACK		DAMP	
4			80%	9			5" SILT AND SAND-FINE			DAMP	
5	S3	S	1 1/2	6			SILT SOME CLAY	BLACK		DAMP MOTTLED	
6			90%	5			13" CLAY	YELLOW		MOTTLED	
7	S4	S	1 1/2	4			SAND-MEDIUM → COARSE	LT. BROWN		WET	
8			80%	4							
9	S5	S	2 1/2	4			3" SILT AND TRACE SAND-FINE	BROWN		WET	
10			100%	4			SAND-MED-COARSE TRACE SILT	YELLOW		WET	

DRILLING CO.: ATECBAKER REP.: K. TuaDRILLER: SANFORD SWEETINGBORING NO.: MW-12SHEET 1 OF 2

FIELD TEST BORING RECORD

PROJECT: Aircraft Refueling Area
S.O. NO.: 19124

BORING NO.: MW-12

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11	S6	S	3/2	2		0	SAND - MEDIUM TO COARSE	yellow	LOOSE	WET	
12			100%	4							
13	S7	S	2/2	6		0	SAND - COARSE	yellow	MED DENSE	WET	
14			100%	8							
15				11			END OF BORING 14'				
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

8.5

DRILLING CO.: ATEC

DRILLER: SANBORN SWEETING

BAKER REP.: K. Tua

BORING NO.: MW-12

SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: MW-13

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 23.03TOP OF PVC CASING: 22.69

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-18-92</u>	<u>14'</u>	<u>WARR</u>		
LENGTH	<u>20</u>		<u>5.0</u>						
TYPE	<u>STD</u>	<u>50N40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: SAMPLES COLLECTED EVERY 2' TO END OF BORING, MONITORING WELL INSTALLED.

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
1	S1	S	<u>1.58</u> <u>2</u>	<u>2</u>			TOP SOIL	BLACK	LOOSE	DAMP		23.0
2			<u>79%</u>	<u>4</u>			6" SAND-FINE	LT. BLACK	LOOSE	DAMP		
3	S2	S	<u>2</u> <u>2</u>	<u>3</u>			SAND-FINE AND SILT	BLACK		MOIST		19.5
4			<u>100%</u>	<u>2</u>			4" CLAY	YELLOW	SOFT	MOIST MOTTLED		19.0
5	S3	S	<u>1.41</u> <u>2</u>	<u>2</u>			SILT AND SAND-FINE	BLACK	LOOSE	MOIST		17.8
6			<u>71%</u>	<u>4</u>			10" CLAY AND SAND-FINE	GRAY		MOIST		
7	S4	S	<u>1.41</u> <u>2</u>	<u>1</u>			CLAY AND SAND-FINE	GRAY	VERY SOFT	WET		17.0
8			<u>71%</u>	<u>1</u>				LT. BROWN	LOOSE	WET		
9	S5	S	<u>2</u> <u>2</u>	<u>3</u>			SAND-MEDIUM	GREEN				
10			<u>100%</u>	<u>1</u>								

DRILLING CO.: ATECDRILLER: SANFORD SWEETINGBAKER REP.: KENNETH A. TUABORING NO.: MW13SHEET 1 OF 2

FIELD TEST BORING RECORD

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 19124

BORING NO.: MW-13

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11	56	5	2 2	2 2 7 6		0	CLAY SOME SAND-MEDIUM	LT. GRAY	STIFF	WET	
12							10" CLAY SOME SAND-FINE	BROWN	MED STIFF	WET	
13	57	5	2 2	3 3 2 2		0	14" SAND-MED TO COARSE	WHITE	MED STIFF	WET	
14											
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

10.2

9.0

DRILLING CO.: ATEC

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: MW-13

SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: MW-14

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 23.41TOP OF PVC CASING: 23.33

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>6 1/4" ID</u>		<u>6-17-92</u>	<u>14'</u>	<u>WARM & SUNNY</u>		
LENGTH	<u>2.0</u>		<u>5.0</u>						
TYPE	<u>STD</u>	<u>SEN 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: SAMPLES COLLECTED 2' INTERVALS TO END OF BORING. MONITORING WELL INSTALLED

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)		RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
1	<u>S1</u>	<u>S</u>	<u>1/2</u>	<u>3</u>		<u>NR</u>	<u>SAND - FINE</u>	<u>DR. BROWN</u>	<u>LOOSE</u>	<u>DRY - NO OGR</u>	<u>23.4</u>
2			<u>56%</u>	<u>6</u>							
3	<u>S2</u>	<u>S</u>	<u>1.9/2</u>	<u>8</u>		<u>NR</u>	<u>SAND - FINE</u>	<u>LT. GRAY BROWN</u>	<u>MED DENSE</u>	<u>DRY - NO OGR</u>	
4			<u>96%</u>	<u>7</u>							
5	<u>S3</u>	<u>S</u>	<u>3/2</u>	<u>3</u>		<u>NR</u>	<u>12" SAND - FINE - MEDIUM</u>	<u>BROWN</u>	<u>LOOSE</u>	<u>DRY</u>	<u>18.4</u>
6			<u>100%</u>	<u>6</u>			<u>12" CLAY</u>			<u>DAMP</u>	
7	<u>S4</u>	<u>S</u>	<u>1.33/2</u>	<u>2</u>		<u>NR</u>	<u>WATER 7" SAND - FINE</u>	<u>BROWN</u>		<u>WET</u>	<u>16.9</u>
8			<u>67%</u>	<u>4</u>			<u>9" SAND - MEDIUM</u>	<u>GRAY</u>	<u>STIFF</u>	<u>WET</u>	
9	<u>S5</u>	<u>S</u>	<u>2/2</u>	<u>3</u>		<u>NR</u>	<u>SAND - MEDIUM</u>	<u>WHITE</u>	<u>LOOSE</u>	<u>WET</u>	
10			<u>100%</u>	<u>6</u>							

DRILLING CO.: ATECBAKER REP.: KENNETH A. TUADRILLER: SANFORD SWEETINGBORING NO.: MW-14SHEET 1 OF 2

FIELD TEST BORING RECORD

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 19124

BORING NO.: MW-14

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11	56	5	$\frac{2}{2}$	3		NR	SAND - MEDIUM	white		WET - NO ODOR	
12			100%	3							
13	57	5	$\frac{1.66}{2}$	2		NR	8" SAND - MEDIUM	Brown		WET - NO ODOR	
14			83%	1			12" SAND - MEDIUM	white			
15							END OF BORING 14'				
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											
26											
27											
28											
29											
30											

9.4

DRILLING CO.: ATEC

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: MW-14

SHEET 2 OF 2

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: DW-5

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 23.40TOP OF PVC CASING: 22.89

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>3/8" ID</u>	<u>24" O.F.C. 4" I.D.</u>	<u>8 1/4" ID</u>		<u>6-21-92</u>	<u>34'</u>	<u>WARM</u>		
LENGTH	<u>2.0</u>		<u>5.0</u>		<u>6-22-92</u>	<u>44'</u>	<u>WARM</u>		
TYPE	<u>STD</u>	<u>5CH 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: SAMPLES + LOG RETRIEVED USING 4 1/4" HSA AS PILOT HOLE. SAMPLES COLLECTED CONTINUOUS TO WATER TABLE THEN EVERY 5'.

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
1	S1	S	<u>6.75/2</u>	3			<u>12" TOP SOIL</u>	<u>BLACK BROWN</u>	<u>LOOSE</u>	<u>DRY</u>	
2			<u>87%</u>	5			<u>SAND - FINE</u>				
3	S2	S	<u>1.08/2</u>	6			<u>SAND - FINE</u>	<u>BROWN</u>	<u>MED DENSE</u>	<u>DRY</u>	
4			<u>54%</u>	5							
5	S3	S	<u>8/2</u>	3			<u>CLAY</u>	<u>BROWN</u>	<u>MED STIFF</u>	<u>DAMP</u>	
6			<u>100%</u>	3							
7	S4	S	<u>2/2</u>	4			<u>4" CLAY</u>	<u>BROWN</u>		<u>DAMP</u>	
8			<u>100%</u>	3			<u>WATER</u>				
9	S5	S	<u>8/2</u>	2			<u>SAND-FINE SOME SILT</u>	<u>BROWN</u>	<u>LOOSE</u>	<u>WET - STRONG ODR</u>	
10			<u>100%</u>	11			<u>SAND-FINE AND SILT</u>	<u>LT GRAY</u>		<u>WET - ODR.</u>	

DRILLING CO.: ATECDRILLER: SANFORD SWEETINGBAKER REP.: KENNETH A. TUABORING NO.: DW-5SHEET 1 OF 3

Baker Environmental, Inc.

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 19124

BORING NO.: DW-5

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	RQD (FL & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11											
12											
13											
14											
15											
16	56	5	$\frac{1.8}{2}$ 92%	3 3 4 8		4	3" SAND - COARSE SAND - MEDIUM	WHITE GREEN/ GRAY	LOOSE	WET	
17											
18											
19											
20											
21	57	5	$\frac{25}{2}$ 38%	6 5 7 8		0	SAND - FINE	GRAY	MED DENSE	WET	
22											
23											
24											
25											
26	58	5	$\frac{1.58}{2}$ 79%	4 4 6 10		0	SAND - MEDIUM	GRAY	LOOSE	WET	
27											
28											
29											
30											

DRILLING CO.: ATEL

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: DW-5

SHEET 2 OF 3

Baker Environmental, Inc.

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 17124

BORING NO.: DN-5

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type - No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
31	59	S	1.66 2	2 3 2 6		0	SAND - FINE - DRY	GRAY	LOOSE	WET	
32			83%				1" SAND - COARSE	WHITE		WET	
33											
34											
35											-11.6
36	510	S	2 2	11 12 13 14		0	GRAVEL - FINE	WHITE	MED DENSE	WET	
37			100%								
38											
39											
40											
41											
42											
43	511	S	2 2	10 15 18 30		0	GRAVEL - FINE	WHITE	DENSE	WET	
44			100%								-20.6
45							END OF BORING 44'				
46											
47											
48											
49											
50											

DRILLING CO.: ATEL

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: DN-5

SHEET 3 OF 3

Baker Environmental, Inc.

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 17124

BORING NO.: DW-6

DRILL RECORD							VISUAL DESCRIPTION					
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL	ELEVATION
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK	
31	58	S	1.25 2	4 7 11 9		0	SAND - FINE → MEDIUM	WHITE	MED DENSE	WET		
32			63%									
33												
34												
35												-13.7
36	59	S	2 2	12 13 19 21		0	12" GRAVEL - FINE	GRAY	DENSE	WET		-14.7
37			100%				12" SAND - MED → COARSE	GRAY		WET		
38												
39												
40												-18.7
41	510	S	2 2	7 8 14 21		0	12" GRAVEL - FINE	GRAY	MED DENSE	WET		-19.7
42			100%				12" SAND - MED - COARSE	GRAY		WET		
43												
44												
45												-23.7
46	511		2 2	7 10 15 28		0	10" GRAVEL - FINE	WHITE	MED DENSE	WET		-24.7
47			100%				4" SAND - FINE TRACE SILT	GREEN		WET		-25.7
48							END OF BORING					
49												
50												

DRILLING CO.: ATEC

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: DW-6

SHEET 3 OF 3

Baker

Baker Environmental, Inc.

FIELD TEST BORING RECORDPROJECT: AIRCRAFT REFUELING AREAS.O. NO.: 19124BORING NO.: DW-6

COORDINATES: EAST: _____

NORTH: _____

ELEVATION: SURFACE: 21.33TOP OF PVC CASING: 21.21

RIG: <u>B-61</u>					DATE	PROGRESS (FT)	WEATHER	TOP OF CASING WATER DEPTH (FT)	TIME
	SPLIT SPOON	CASING	AUGERS	CORE BARREL					
SIZE (DIAM.)	<u>1 3/8" ID</u>	<u>2"</u>	<u>8 1/4" ID</u>		<u>6-19-92</u>	<u>37'</u>	<u>Hot</u>		
LENGTH	<u>2.0</u>	<u>37' OF 6"</u> <u>47' OF 2"</u>	<u>5.0</u>		<u>6-20-92</u>	<u>47'</u>			
TYPE	<u>STD</u>	<u>50# 40 PVC</u>	<u>HSA</u>						
HAMMER WT.	<u>140 #</u>								
FALL	<u>30"</u>								
STICK UP									

REMARKS: SAMPLES + LOG RECORDED USING 4 1/4" PILOT HOLE SAMPLES COLLECTED CONTINUOUS TO WATER TABLE THEN AT 5' INTERVALS, DEEP WELL INSTALLED

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	SPT Blows Per 0.5'	Lab. Class.	Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations		SOIL	ELEVATION
	ROCK	Type - No. (N = No Samp.)		Pen. Rate	PID (ppm)		Hardness	Weathering, Bedding, Fracturing, and Other Observations		ROCK	
1	<u>S1</u>	<u>S</u>	<u>7</u>			<u>6" Top Soil</u>	<u>Black</u>	<u>Stiff</u>	<u>Dry</u>		<u>21.3</u>
2			<u>8</u>			<u>10" Clay</u>	<u>Brown</u>				
3	<u>S2</u>	<u>S</u>	<u>5</u>			<u>CLAY some SAND - FINE</u>	<u>LT. Brown</u>	<u>STIFF</u>	<u>Dry</u>		
4			<u>7</u>								
5	<u>S3</u>	<u>S</u>	<u>9</u>			<u>CLAY</u>	<u>LT. Brown</u>	<u>STIFF</u>	<u>Damp</u>		
6			<u>8</u>								
7			<u>5</u>			<u>3" SAND-FINE TRACT CLAY</u>	<u>Black</u>		<u>WET</u>		<u>15.8</u>
8			<u>4</u>			<u>WATER</u>					<u>15.3</u>
9			<u>7</u>								
10			<u>6</u>								

DRILLING CO.: ATECBAKER REP.: KENNETH A. TUADRILLER: SANFORD SWEETINGBORING NO.: DW-6SHEET 1 OF 3

Baker Environmental, Inc.

PROJECT: AIRCRAFT REFUELING AREA

S.O. NO.: 17124

BORING NO.: DW-6

DRILL RECORD							VISUAL DESCRIPTION				
DEPTH	SOIL	Sample ID	Samp. Rec.	SPT Blows Per 0.5'	Lab. Class.		Classification (Grain Size, Principal Constituents, Etc.)	Color	Consist. or Density	Moisture Content, Organic Content, Plasticity, and Other Observations	SOIL
	ROCK	Type-No. (N = No Samp.)	(Ft. & %)	RQD (Ft. & %)	Pen. Rate	PID (ppm)	Classification (Name, Grain Size, Principal Constituents, Etc.)	Color	Hardness	Weathering, Bedding, Fracturing, and Other Observations	ROCK
11	54	S	$\frac{2}{2}$	4		0	12" SILT AND SAND-FINE			WET	
12			100%	11			SAND-FINE → MEDIUM				
13											
14											
15			$\frac{1.16}{2}$	5			SAND-FINE → MEDIUM				
16	55	S	58%	9		0				WET	
17				16							
18											
19											
20			$\frac{2}{2}$	6			SAND-FINE → MEDIUM				
21	56	S	100%	7		0				WET	
22				12							
23											
24											
25			$\frac{1.25}{2}$	7			SAND-FINE → MEDIUM				
26	57	S	63%	8		0				WET	
27				7							
28											
29											
30											

DRILLING CO.: ATEC

DRILLER: SANFORD SWEETING

BAKER REP.: KENNETH A. TUA

BORING NO.: DW-6

SHEET 2 OF 3

APPENDIX D
CHAIN-OF-CUSTODY FORMS

SOLUTIONS LOG #

06191992-004

COMPANY NAME:

BAKER ENV

SOLUTIONS LABORATORIES, INC.

814-B Greenbrier Circle

Chesapeake, VA 23320

(804) 420-0467/Fax 420-4204

CHAIN-OF-CUSTODY RECORD
AND ANALYSIS REQUEST

ANALYSIS REQUEST

PROJECT MANAGER:

KEN TUA

Phone:

412-269-6000

Address (Office): ADD Bldg 3

JACKSONVILLE ARS (ARMED STATION)

432 ROYCE RD. COMBATS PA. 15405

Project Number:

17124-641-502

Project Name:

AKS

KENNETH A. TUA

I attest that the proper field sampling procedures were used during the collection of these samples.

Kenneth A. Tua

Sampler name

Field Sample ID	Source of Sample	SOLN'S LAB # (Lab use only)	# containers	MATRIX					METHOD PRESERVED					SAMPLING		
				water	soil	air	sludge	other	HCl	HNO3	H2SO4	ICE	NONE	other	DATE	TIME
AKS-01 HP-21	Hydrophobic	01 A1 A2	2	X					X			X			6-18-92	0900
AKS-02 HP-22	"	02 A1 A2	2	X						X			X			6-18-92 1140
AKS-03 HP-23	"	03 A1 A2	2	X						X			X			6-18-92 / 840
AKS-04 HP-24	"	04 A1 A2	2	X						X			X			6-18-92 / 335
AKS-05 HP-25	"	05 A1 A2	2	X						X			X			6-17-92 1000
AKS-06 HP-26	"	06 A1 A2	2	X						X			X			6-17-92 1140
AKS-07 HP-27	"	07 A1 A2	2	X						X			X			6-17-92 1050

Relinquished by Sampler:

Kenneth A. Tua

Relinquished by:

J. J. Ex

Relinquished by:

J. J. Ex

Date

6-18-92

Time

1400

Date

6-19-92

Time

1100

Received by:

Received by:

Received by Laboratory:

John J. Exline

REMARKS:

RECEIVED 14 JUN 1992

SAMPLES PACKED ON 201

AND SHIPPED TO LAB VIA

FEDEX

CUSTODY RECORD

EPA 601 8010

EPA 602 8020

EPA 608 8080

EPA 610 8310

EPTOX METALS PEST HERB

TCLP METALS VOA SEMI-VOA

EPA METALS SPAS PCRA

HRSD AG METALS

LEAD FLAME FURNACE

CORR FLASH REACT

OTHER

SPECIAL HANDLING

EXPEDITED (48) (24) (24)

THREE DAYS

SEVEN DAYS

PURCHASE ORDER #

FAX

SPECIAL DETECTION LIMITS (Specify)

REGULAR

SPECIAL REPORTING REQUIREMENTS:

COMBINE SOIL & WATER FOR FINAL

ANALYSIS

CONTAINERS:

GLASS

AMBER

PLASTIC

WHIRLPAK

other

40 ML

500 ML

1 Liter

other

SOLUTIONS LOG #

06191992-004

COMPANY NAME:

BAKER ENVIRONMENTAL

SOLUTIONS LABORATORIES, INC.

814-B Greenbrier Circle
Chesapeake, VA 23320
(804) 420-0467/Fax 420-4204CHAIN-OF-CUSTODY RECORD
AND ANALYSIS REQUEST

ANALYSIS REQUEST

PROJECT MANAGER:

KEN TUN

Phone:

410 269-6000

Address (Office):

New York, NY

Site Location:

New River Rd, Chesapeake, PA 15049

Project Number:

19124-64-502

Project Name:

ARS

I attest that the proper field sampling procedures were used during the collection of these samples.

Kenneth A. Tun

Sampler name

Field Sample ID	Source of Sample	SOLN'S LAB # (Lab use only)	# containers	MATRIX					METHOD PRESERVED					SAMPLING		
				water	soil	air	sludge	other	HCl	HNO3	H2SO4	ICF	NONE	other	DATE	TIME
ARS-W-HP-30	HP	08.11.12	2	X					X			X			6-16-92	1114
ARS-W-HP-31	LAC	09.11.12	1	X					X			X			6-15-92	1500
SP6-W-HP-32	HP	08.11.12	2	X					X			X			6-15-92	1110
SP6-W-HP-33	HP	08.11.12	2	X					X			X			6-16-92	0955
SP6-W-HP-34	HP	08.11.12	2	X					X			X			6-17-92	1110
SP6-W-HP-35	HP	08.11.12	2	X					X			X			6-17-92	0955
SP6-W-HP-36	HP	08.11.12	2	X					X			X			6-17-92	1130
SP6-W-HP-37	HP	08.11.12	2	X					X			X			6-17-92	1130

Relinquished by Sampler:

Kenneth A. Tun

Date

6-14-92

Received by:

1100

Relinquished by:

Jed E.

Date

6-19-92

Received by:

1100

Relinquished by:

Jed E.

Date

6-19-92

Received by Laboratory:

Jed E.

REMARKS:

14 DAY TURN AROUND

SAMPLES PICKED UP ON 6/15

8 SAMPLES 100/100

CUSTODY RECORD

SPECIAL HANDLING

EXPEDITED (48) ☐ (24) ☐THREE DAYS ☐SEVEN DAYS ☐ QUOTE #

PURCHASE ORDER #

FAX

SPECIAL DETECTION LIMITS (Specify)

REG/100

SPECIAL REPORTING REQUIREMENTS:

Analytical for Lead, Cadmium, and Water

CONTAINERS:

GLASS ☒AMBER ☐PLASTIC ☐WHIRLPAK ☐

other

40 ML ☒500 ML ☐1 Liter ☐

other

OTHER

SOLUTIONS LOG #
06231992-003

SOLUTIONS LABORATORIES, INC.
814-B Greenbrier Circle
Chesapeake, VA 23320
(804) 420-0457/Fax 420-4204

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

[illegible]

SOLUTIONS LOG #
06231992-003

COMPANY NAME:

Baker Environmental, Inc

SOLUTIONS LABORATORIES, INC.
814-B Greenbrier Circle
Chesapeake, VA 23320
(804) 420-0467/Fax 420-4204

CHAIN-OF-CUSTODY RECORD
AND ANALYSIS REQUEST

ANALYSIS REQUEST

PROJECT MANAGER:

KENNETH A. TUNA

Phone:

(410) 267-6000

Address (Office):

AOR Bldg. 3

Site Location:

NC

120 Rousier Rd. Charlottesville VA 22908

Project Number:

19124-64-502

Project Name:

(ARS)

ARMAMENT REFINING SIMULAN

I attest that the proper field sampling procedures were used during the collection of these samples.

Sampler name

KENNETH A. TUNA

Field Sample ID	Source of Sample	SOLN'S LAB # (Lab use only)	# containers	MATRIX					METHOD PRESERVED						SAMPLING	
				water	soil	air	sludge	other	HCl	HNO3	H2SO4	ICE	NONE	other	DATE	TIME
RS-5-MW11-02	BORINE	08-A17A4	4		X							X			6-21-92	1135
RS-5-MW12-01	"	09-A17A4	4		X							X			6-18-92	1504
RS-5-MW12-02	"	10-A17A2	2		X							X			6-18-92	1509
RS-5-MW13-01	"	11-A17A2	2		X							X			6-18-92	0942
RS-5-MW13-02	"	12-A17A4	4		X							X			6-18-92	0944
RS-5-MW14-01	"	13-A17A4	4		X							X			6-17-92	1442
RS-5-MW14-02	"	14-A17A2	2		X							X			6-17-92	1444

Relinquished by Sampler:

Kenneth A. Tuna

Date

6-22-90

Time

0700

Relinquished by:

Date

Time

Received by:

Received by Laboratory:

Time

1325

REMARKS:

SAMPLES KEPT ON ICE AND SHIPPED via FED EX.

CUSTODY RECORD

SPECIAL HANDLING

EXPEDITED (48) ☐ (24) ☐

THREE DAYS ☐

SEVEN DAYS ☐

QUOTE # _____

PURCHASE ORDER # _____ FAX _____

SPECIAL DETECTION LIMITS (Specify)

REGULAR

SPECIAL REPORTING REQUIREMENTS:

COMBINE SOIL & WATER RESULTS INTO 1 FINAL REPORT

CONTAINERS:

GLASS ☒

AMBER ☐

PLASTIC ☐

WHIRLPAK ☐

other _____

40 ML ☒

500 ML ☐

1 Liter ☐

other _____

SOLUTIONS LOG #
06231992-003

COMPANY NAME:

BAKER ENVIRONMENTAL, INC

SOLUTIONS LABORATORIES, INC.

814-B Greenbrier Circle
Chesapeake, VA 23320
(804) 420-0467/Fax 420-4204CHAIN-OF-CUSTODY RECORD
AND ANALYSIS REQUEST

PROJECT MANAGER:

KENNETH A. TUA

Phone:

(412) 369-6000

Address (Office): AOP Bldg. 3

4120 ROUSSEAU RD. CARROLLS Pt. 15108 CAMP LEJUNE, NC

Site Location:

Project Number:

19124-64-5VZ

Project Name:

(ARS)

MILITARY RESERVE STATION

I attest that the proper field sampling procedures were used during the collection of these samples.

KENNETH A. TUA

Sampler name

Field Sample ID	Source of Sample	SOLN'S LAB # (Lab use only)	# containers	MATRIX				METHOD PRESERVED				SAMPLING				
				water	soil	air	sludge	other	HCl	HNO3	H2SO4	ICE	NONE	other	DATE	TIME
ARS-5-MN15-01	Boxing	15-A1, A2	2	X								X			6-18-92	1100
ARS-5-MN16-01	"	16-A1, A2	2	X								X			6-18-92	0831
ARS-5-DW5-01	"	17-A1, A2	2	X								X			6-21-92	1405
ARS-5-DW5-02	"	18-A1, A2	4	X								X			6-21-92	0916
ARS-5-DW6-01	"	19-A1, A2	4	X								X			6-19-92	1003
ARS-5-DW6-02	"	20-A1, A2	2	X								X			6-19-92	1006
Compas-T	Drop Box	21-A1, A2	6	X								X			6-17-92	1600

Relinquished by Sampler:

Kenneth A. Tua

Date

6-22-92

Received by:

Time

0700

Relinquished by:

Date

Time

Received by:

Time

Relinquished by:

Date

Time

Received by Laboratory:

Time

1325

REMARKS:

SAMPLES KEPT ON ICE
AND SHIPPED WITH RED EX

CUSTODY RECORD

SPECIAL HANDLING

EXPEDITED (48) ☐ (24) ☐THREE DAYS ☐SEVEN DAYS ☐ QUOTE # _____

PURCHASE ORDER # _____ FAX _____

SPECIAL DETECTION LIMITS (Specify)

REGULAR

SPECIAL REPORTING REQUIREMENTS:

COMBINE SOIL & WATER RESULTS INTO

1 FINAL REPORT.

CONTAINERS:

GLASS ☒AMBER ☐PLASTIC ☐WHIRLPAK ☐

other _____

40 ML ☒500 ML ☐1 Liter ☐other ☒ 400 JARS.

ANALYSIS REQUEST

OTHER

TCLP METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

EPA METALS

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EPA METALS

EPA METALS

EPA METALS

EPA METALS

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST

SOLUTIONS LABORATORIE
814-B Greenbrier Circle
Chesapeake, VA 23320
(804) 420-0467/Fax 420-4204

Chesapeake, VA 23320
(804) 420-0467/Fax 420-4204

Phone: (412) 267-6000

Site Location: *Carroll LA FENCE NE*

Project Name: WHAFT REFUELING STATION (ACS)

Sampler name

Relinquished by Sampler: <i>James H. C. - 1/11/92</i>	Date	Time	Received by:
	6-24-92	0600	
Relinquished by:	Date	Time	Received by:
Relinquished by: <i>J. D. E.</i>	Date	Time	Received by Laboratory:
	6-25-92	1205	

REMARKS:
ALCATEA IS NOT ANY FORMER INMATES
- CAPTURED WITHIN OUR LEE
+ SHOT BY FID FX

**CUSTODY
RECORD**

SPECIAL DETECTION LIMITS (Specify)

MF 6-11-78

SPECIAL REPORTING REQUIREMENTS:
COMBINE Soil & WATER RESULTS
INTO 1. FINAL REPORT

CONTAINERS:

GLASS ☒ AMBER ☐
PLASTIC ☐ WHIRLPAK ☐
other _____

[illegible]

APPENDIX E
LABORATORY ANALYSES REPORTS

SAMPLE DATA SUMMARY PACKAGE

Table of Contents

1. Narrative
2. Chain-Of-Custody Reports
3. Results of Analysis
 - a. Soils-Physical
 - b. Soils-Organic-3550/8015 & 5030/8015
 - c. Waters-Organic-602
 - d. Waters-Organic-625
4. Appendix A- QC Report
5. Appendix B- Glossary of Report and Data Information

1. Narrative

NARRATIVE

Laboratory: Solutions Laboratories, Inc.

Date Samples received by Solutions: 06/19/92, 06/23/92, 06/25/92 AND 06/26/92

Project Name: Baker Environmental, Camp Lejeune-ARS

Contract Number: 19001-43-SRN-3
Navy CLEAN Program

Results of the Following samples are included in this data package:

Sample ID	Lab No.	Matrix	Analysis
ARSW-HP21 Thru ARSW-HP30	06191992-004-01		
	Thru 09	Water	602
ARSS-MW801 Thru ARSS-DW602	06231992-003-01		
COMPOSIT	Thru 06231992-003-21	Water, soil	TPH 3550/5030 pH, Flash Point 602, 625, TCLP Metals, PCBs, VOL 8240/8270, 602, 625
ARSW-MW801 Thru ARSW-HP31	06251992-001-01		
ARSS Grain Size, Curb side	Thru 06251992-001-16A1		TPH 3550/5030 Grain Size
Right thru Right Wall			
ARSW-MW11, ARSW-DW5, Trip B1	06261992-005-01	Thru 03	602

Inorganics

The samples were analyzed following Method 1010 for Flash Point, Method 9045 for pH, and Grain Size by ASTM D-422.

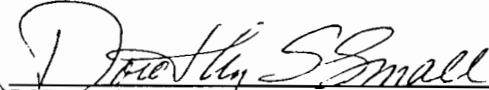
Holding times were met for all analyses.

Organics

All samples were analyzed following 3550/5030 Total Petroleum Hydrocarbons, EPA 602 and EPA 625 for waters. Results for soil disposal (PCBs, VOC 8240/8270) are reported in a separate report.

Official holding times were met for all analyses.

RELEASE OF THE DATA CONTAINED IN THIS HARDCOPY DATA PACKAGE HAS BEEN AUTHORIZED BY THE LABORATORY MANAGER OR HIS DESIGNEE, AS VERIFIED BY THE FOLLOWING SIGNATURE:


DOROTHY S. SMALL

DATE:


July 20, 1992

NARRATIVE

Laboratory Name: Maryland Spectral Services, Inc. (MSS)

Date Samples Delivered to MSS Laboratory: 26 June 1992

Project: Baker Environmental--Aircraft Refueling Station
Camp LeJeune, NC
(For Solutions Laboratories, Inc., Chesapeake, VA)

Results for the following samples are included in this data package:

Field ID	SL Log ID	MSS#	Matrix	Analysis
ARS-W-MW8	06251992-001-01	920626-04	Water	EPA 625
ARS-W-MW10	06251992-001-03	920626-05	Water	EPA 625
ARS-W-MW12	06251992-001-04	920626-06	Water	EPA 625

The samples were analyzed for the portion of the Priority Pollutant List established by 40 CFR Part 136 as Semivolatile Organic Priority Pollutants.

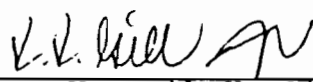
The samples were extracted by EPA Method 3510 (Separatory Funnel Liquid-Liquid Extraction) and analyzed by EPA Method 625/8270, using capillary chromatography.

Results appear in tabular format in Section 3 of this report.

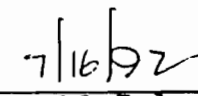
Surrogate recoveries are presented in Section 4 of this report. All extractions and analyses were performed within required holding time limitations.

Chromatograms of sample and Method Blank analyses are presented in Section 9 of this report and are labeled for target compounds found (if any), together with Internal Standards (IS) and Surrogate Spiking Compounds (SS).

RELEASE OF THE DATA CONTAINED IN THIS HARDCOPY DATA PACKAGE HAS BEEN AUTHORIZED BY THE LABORATORY MANAGER OR HIS DESIGNEE, AS VERIFIED BY THE FOLLOWING SIGNATURE:



Kenneth K. Gill, Jr.

DATE: 

16 July 1992

2. Chain-of-Custody Reports

SOLUTIONS LABORATORIES, INC.

814 B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

CHAIN-OF-CUSTODY REPORT

SOLUTIONS LOG #: 06191992-004

COMPANY NAME: BAKER ENVIRONMENTAL

PROJECT MANAGER: KEN TUA

BILLING ADDRESS: AIRPORT OFFICE PARK, BLDG 3

420 ROUSER ROAD

CORAOPOLIS, PA 15108

TELEPHONE #: (412) 269-6000

FAX #: (412) 269-2002

P.O.#:

DATE/TIME RECEIVED: 6/19/92, 1100

SAMPLER: KENNETH A TUA

SAMPLE ID	FIELD SAMPLE ID	SAMPLED DATE	SAMPLED TIME	# OF CONT.	CONTAINER	LOCATION	PRESERV.	MATRIX
01A1,A2	ARS-W-HP-21	6/17/92	0900	2	40 ML VOA	ARS	ICE, HCL	WATER
02A1,A2	ARS-W-HP-22	6/16/92	1140	2	40 ML VOA	ARS	ICE, HCL	WATER
03A1,A2	ARS-W-HP-23	6/16/92	1240	2	40 ML VOA	ARS	ICE, HCL	WATER
04A1,A2	ARS-W-HP-24	6/16/92	1335	2	40 ML VOA	ARS	ICE, HCL	WATER
05A1,A2	ARS-W-HP-25	6/17/92	1000	2	40 ML VOA	ARS	ICE, HCL	WATER
06A1,A2	ARS-W-HP-26	6/17/92	1140	2	40 ML VOA	ARS	ICE, HCL	WATER
07A1,A2	ARS-W-HP-27	6/17/92	1050	2	40 ML VOA	ARS	ICE, HCL	WATER
08A1,A2	ARS-W-HP-30	6/16/92	1114	2	40 ML VOA	ARS	ICE, HCL	WATER
09A1	TRIP BLANK	6/15/92	1500	1	40 ML VOA	ARS	ICE, HCL	WATER

SAMPLE ID	ANALYSIS TO BE PERFORMED	DUE DATE
01A1,A2 THRU 08A1,A2	EPA 602	7/3/92
09A1 (TRIP BLANK)	EPA 602	

CONDITION OF SAMPLE: GOOD

RECEIVED BY: J FEROLINO

RELINQUISHED BY: FED EX

SOLUTIONS LABORATORIES, INC.

814 B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

CHAIN-OF-CUSTODY REPORT

SOLUTIONS LOG #: 06231992-003

COMPANY NAME: BAKER ENVIRONMENTAL
PROJECT MANAGER: KEN TUA
BILLING ADDRESS: AIRPORT OFFICE PARK, BLDG 3
420 ROUSER ROAD
CORAOPOLIS, PA 15108
TELEPHONE #: (412) 269-6000
FAX #: (412) 269-2002
P.O.#:

DATE/TIME RECEIVED: 6/23/92, 1325
SAMPLER: KENNETH A TUA

SAMPLE ID	FIELD SAMPLE ID	SAMPLED DATE	SAMPLED TIME	# OF CONT.	CONTAINER	LOCATION	PRESERV.	MATRIX
01A1>A4	ARS-S-MW8-01	6/18/92	1047	4	40 ML VOA	ARS	ICE	SOIL
02A1,A2	ARS-S-MW8-02	6/18/92	1049	2	40 ML VOA	ARS	ICE	SOIL
03A1>A4	ARS-S-MW9-01	6/18/92	0823	4	40 ML VOA	ARS	ICE	SOIL
04A1,A2	ARS-S-MW9-02	6/18/92	0825	2	40 ML VOA	ARS	ICE	SOIL
05A1,A2	ARS-S-MW10-01	6/18/92	1612	2	40 ML VOA	ARS	ICE	SOIL
06A1>A4	ARS-S-MW10-02	6/18/92	1614	4	40 ML VOA	ARS	ICE	SOIL
07A1,A2	ARS-S-MW11-01	6/21/92	1130	2	40 ML VOA	ARS	ICE	SOIL
08A1>A4	ARS-S-MW11-02	6/21/92	1135	4	40 ML VOA	ARS	ICE	SOIL
09A1>A4	ARS-S-MW12-01	6/18/92	1504	4	40 ML VOA	ARS	ICE	SOIL
10A1,A2	ARS-S-MW12-02	6/18/92	1509	2	40 ML VOA	ARS	ICE	SOIL
11A1,A2	ARS-S-MW13-01	6/18/92	0942	2	40 ML VOA	ARS	ICE	SOIL
12A1>A4	ARS-S-MW13-02	6/18/92	0944	4	40 ML VOA	ARS	ICE	SOIL
13A1>A4	ARS-S-MW14-01	6/17/92	1442	4	40 ML VOA	ARS	ICE	SOIL
14A1,A2	ARS-S-MW14-02	6/17/92	1444	2	40 ML VOA	ARS	ICE	SOIL
15A1,A2	ARS-S-MW15-01	6/18/92	1100	2	40 ML VOA	ARS	ICE	SOIL
16A1,A2	ARS-S-MW16-01	6/18/92	0831	2	40 ML VOA	ARS	ICE	SOIL
17A1,A2	ARS-S-DW5-01	6/21/92	1405	2	40 ML VOA	ARS	ICE	SOIL
18A1>A4	ARS-S-DW5-02	6/21/92	0916	4	40 ML VOA	ARS	ICE	SOIL
19A1>A4	ARS-S-DW6-01	6/19/92	1003	4	40 ML VOA	ARS	ICE	SOIL
20A1,A2	ARS-S-DW6-02	6/19/92	1006	2	40 ML VOA	ARS	ICE	SOIL
21A1>A6	COMPOSITE	6/17/92	1600	6	4 oz. JARS	ARS DROP BOX	ICE	WATER

SAMPLE ID	ANALYSIS TO BE PERFORMED	DUE DATE
01A1>A4 THRU 19A1>A4	pH; FLASHPOINT; TPH 5030/3550	6/30/92
02A1,A2 THRU 20A1,A2	TPH 5030/3550	6/30/92
21A1>A6	TCLP METALS; PCB'S 8080; VOL. ORGANICS & 8270	6/30/92

CONDITION OF SAMPLE: GOOD

RECEIVED BY: J FEROLINO

RELINQUISHED BY: FED EX

SOLUTIONS LABORATORIES, INC.

814 B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

CHAIN-OF-CUSTODY REPORT

SOLUTIONS LOG #: 06251992-001

COMPANY NAME: BAKER ENVIRONMENTAL

PROJECT MANAGER: KEN TUA

BILLING ADDRESS: AIRPORT OFFICE PARK, BLDG 3

420 ROUSER ROAD

CORAOPOLIS, PA 15108

TELEPHONE #: (412) 269-6000

FAX #: (412) 269-2002

P.O.#:

DATE/TIME RECEIVED: 6/25/92, 1005

SAMPLER: KENNETH A TUA

SAMPLE ID	FIELD SAMPLE ID	SAMPLED DATE	SAMPLED TIME	# OF CONT.	CONTAINER	LOCATION	PRESERV.	MATRIX
01A1>A3	ARS-W-MW8	6/23/92	1512	3	40 ML VOA	ARS	ICE,HCL	WATER
02A1,A2	ARS-W-MW9	6/23/92	1232	2	40 ML VOA	ARS	ICE,HCL	WATER
03A1>A3	ARS-W-MW10	6/23/92	0940	3	40 ML VOA	ARS	ICE,HCL	WATER
04A1>A3	ARS-W-MW12	6/23/92	1030	3	40 ML VOA	ARS	ICE,HCL	WATER
05A1,A2	ARS-W-MW13	6/23/92	1140	2	40 ML VOA	ARS	ICE,HCL	WATER
06A1,A2	ARS-W-MW14	6/23/92	1425	2	40 ML VOA	ARS	ICE,HCL	WATER
07A1,A2	ARS-W-MW15	6/23/92	1300	2	40 ML VOA	ARS	ICE,HCL	WATER
08A1,A2	ARS-W-DW6	6/23/92	1625	2	40 ML VOA	ARS	ICE,HCL	WATER
09A1,A2	ARS-W-HP28	6/22/92	1415	2	40 ML VOA	ARS	ICE,HCL	WATER
10A1,A2	ARS-W-HP29	6/22/92	1345	2	40 ML VOA	ARS	ICE,HCL	WATER
11A1,A2	ARS-W-HP31	6/22/92	1700	2	40 ML VOA	ARS	ICE,HCL	WATER
12A1	ARS-S-GRAIN SIZE	6/20/92	1500	1	40 ML VOA	ARS	ICE	SOIL
13A1	CURB SIDE RIGHT	6/17/92	UNKNOWN	1	40 ML VOA	ARS	ICE	SOIL
14A1	CURB SIDE LEFT	6/17/92	UNKNOWN	1	40 ML VOA	ARS	ICE	SOIL
15A1	BOTTOM RIGHT	6/17/92	UNKNOWN	1	40 ML VOA	ARS	ICE	SOIL
16A1	RIGHT WALL	6/17/92	UNKNOWN	1	40 ML VOA	ARS	ICE	SOIL

SAMPLE ID	ANALYSIS TO BE PERFORMED	DUE DATE
01A1>A3, 03A1>A3, 04A1>A3	EPA 602; 625	7/02/92
02A1,A2 THRU 11A1,A2	EPA 602	7/02/92
12A1	GRAIN SIZE - NO PARTICAL COUNT!	7/02/92
13A1 THRU 16A1	TPH 5030/3550	7/02/92

CONDITION OF SAMPLE: GOOD

RECEIVED BY: J FEROLINO

RELINQUISHED BY: FED EX

SOLUTIONS LABORATORIES, INC.

814 B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

CHAIN-OF-CUSTODY REPORT

SOLUTIONS LOG #: 06261992-006

COMPANY NAME: BAKER ENVIRONMENTAL
PROJECT MANAGER: KEN TUA
BILLING ADDRESS: AIRPORT OFFICE PARK, BLDG 3
420 ROUSER ROAD
CORAOPOLIS, PA 15108
TELEPHONE #: (412) 269-6000
FAX #: (412) 269-2002
P.O.#:

DATE/TIME RECEIVED: 6/26/92, 1315
SAMPLER: UNKNOWN

SAMPLE ID	FIELD SAMPLE ID	SAMPLED DATE	SAMPLED TIME	# OF CONT.	CONTAINER	LOCATION	PRESERV.	MATRIX
01A1,A2	*ARS-W-MW11-01	6/24/92	UNK.	2	40 ML VOA	AS527	ICE	WATER
02A1,A2	*ARS-W-DW05-01	6/24/92	UNK.	2	40 ML VOA	AS527	ICE	WATER
03A1	TRIP BLANK	UNK.	UNK.	2	40 ML VOA		ICE, HCL	WATER

SAMPLE ID	ANALYSIS TO BE PERFORMED	DUE DATE
01A1,A2 02A1,A2 AND 03A1	EPA 602	7/6/92

CONDITION OF SAMPLE: GOOD-NOTE: SAMPLES ARS-W-MW11-01 AND ARS-W-DW05-01 WERE RECEIVED WITH SAMPLE ID AS SPG-W-MW11-01 AND SPG-W-DW5-01. REVIEW WITH SAMPLER IDENTIFIED THE SAMPLES AS LABELED ABOVE.

RECEIVED BY: J FEROLINO

RELINQUISHED BY: FED EX

3. Results of Analysis

3.a. Soils-Physical

SOLUTIONS LABORATORIES, INC.

SAMPLE OF: SOIL

LOCATION: ARS-CAMP LEJEUNE, NC

PROJECT NUMBER: 19124-64-SVZ

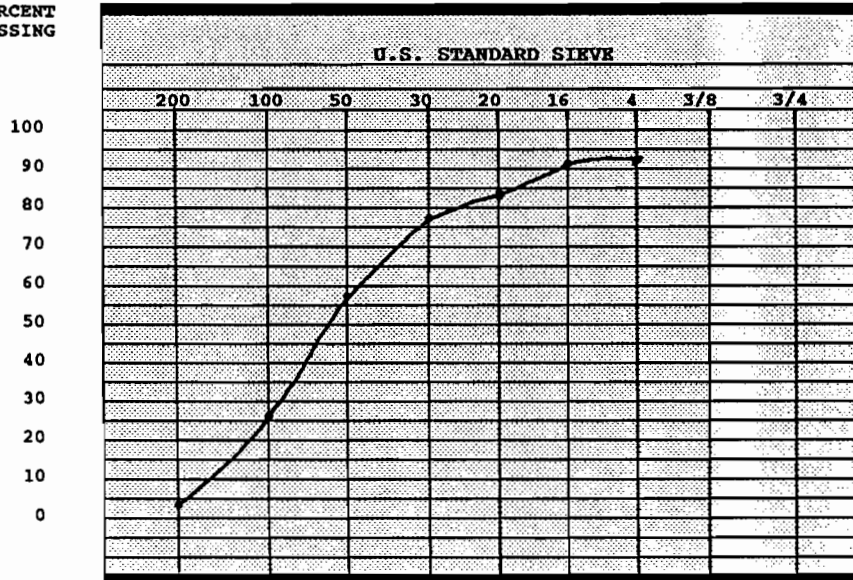
SOL LOG ID: 06251992-001-12A1

FIELD ID: ARS GRAIN SIZE

SIEVE ANALYSIS

ASTM D-422

PERCENT
PASSING



SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003

MATRIX: SOIL

DATE/TIME RECEIVED: 06/23/92; 1325

SAMPLE ID	FIELD ID	ANALYSIS PERFORMED	RESULT	UNITS	METHOD/DATE/TIME/ANALYST
01A3	ARSS-MW801	ph	3.69	STD UNITS	9045/06-25-92/2200/MD
03A3	ARSS-MW901	ph	3.74	STD UNITS	9045/06-25-92/2203/MD
06A3	ARSS-MW1002	ph	3.94	STD UNITS	9045/06-25-92/2205/MD
08A3	ARSS-MW1102	ph	7.16	STD UNITS	9045/06-25-92/2209/MD
09A3	ARSS-MW1201	ph	5.92	STD UNITS	9045/06-25-92/2212/MD
12A3	ARSS-MW1302	ph	4.39	STD UNITS	9045/06-25-92/2215/MD
13A3	ARSS-MW1401	ph	4.55	STD UNITS	9045/06-25-92/2220/MD
18A3	ARSS-DW502	ph	3.95	STD UNITS	9045/06-25-92/2222/MD
19A3	ARSS-DW601	ph	4.26	STD UNITS	9045/06-25-92/2225/MD
01A3	ARSS-MW801	FLASH POINT	> 220	oF	1010/06-25-92/1917/MD
03A3	ARSS-MW901	FLASH POINT	> 220	oF	1010/06-25-92/1918/MD
06A3	ARSS-MW1002	FLASH POINT	> 220	oF	1010/06-25-92/1920/MD
08A3	ARSS-MW1102	FLASH POINT	> 220	oF	1010/06-25-92/1923/MD
09A3	ARSS-MW1201	FLASH POINT	> 220	oF	1010/06-25-92/1925/MD
12A3	ARSS-MW1302	FLASH POINT	> 220	oF	1010/06-25-92/1926/MD
13A3	ARSS-MW1401	FLASH POINT	> 220	oF	1010/06-25-92/1927/MD
18A3	ARSS-DW502	FLASH POINT	> 220	oF	1010/06-25-92/1929/MD
19A3	ARSS-DW601	FLASH POINT	> 220	oF	1010/06-25-92/1930/MD

3.b. Soils-Organic-3550/8015 & 5030/8015

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 3550 MODIFIED 8015

CLIENT NO:	ARSS-MW801	ARSS-MW802	ARSS-MW901	ARSS-MW902	ARSS-MW1001
LAB NO:	01A2	02A2	03A2	04A2	05A2
SAMPLE DATE:	06/18/92	06/18/92	06/18/92	06/18/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	06/30/92	06/30/92	06/30/92	06/30/92	06/30/92
ANALYSIS DATE:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID	HP/FID
DILUTION FACTOR:	0.05	0.05	0.05	0.05	0.05
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.53	0.53	0.53	0.53	0.53

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.53 U	0.53 U	0.53 U	0.53 U	0.53 U
TYPE	N/A	N/A	N/A	N/A	N/A

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 3550 MODIFIED 8015

CLIENT NO:	ARSS-MW1002	ARSS-MW1101	ARSS-MW1102	ARSS-MW1201	ARSS-MW1202
LAB NO:	06A2	07A2	08A2	09A2	10A2
SAMPLE DATE:	06/18/92	06/21/92	06/21/92	06/18/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	06/30/92	06/30/92	06/30/92	07/01/92	07/01/92
ANALYSIS DATE:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID	HP/FID
DILUTION FACTOR:	0.50	0.05	0.05	0.05	0.05
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	5.38	0.53	0.53	0.53	0.53

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	2577	0.40 J	0.53 U	0.53 U	0.53 U
TYPE	JET FUEL	NOT DIST.	N/A	N/A	N/A

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003

MATRIX: SOIL

DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 3550 MODIFIED 8015

CLIENT NO:	ARSS-MW1301	ARSS-MW1302	ARSS-MW1401	ARSS-MW1402	ARSS-MW1501
LAB NO:	11A2	12A2	13A2	14A2	15A2
SAMPLE DATE:	06/18/92	06/18/92	06/17/92	06/17/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
ANALYSIS DATE:	07/02/92	07/02/92	07/02/92	07/02/92	07/02/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID	HP/FID
DILUTION FACTOR:	0.05	0.05	0.05	0.05	0.05
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.53	0.53	0.53	0.53	0.53

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.53 U	0.53 U	0.31 J	0.53 U	1.53
TYPE	N/A	N/A	NOT DIST.	N/A	JET FUEL

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 3550 MODIFIED 8015

CLIENT NO:	ARSS-MW1601	ARSS-DW501	ARSS-DW502	ARSS-DW601	ARSS-DW602
LAB NO:	16A2	17A2	18A2	19A2	20A2
SAMPLE DATE:	06/18/92	06/21/92	06/21/92	06/19/92	06/19/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
ANALYSIS DATE:	07/02/92	07/02/92	07/02/92	07/02/92	07/03/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID	HP/FID
DILUTION FACTOR:	0.05	0.05	0.05	0.05	0.05
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.53	0.53	0.53	0.53	0.53

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.53 U	0.04 J	0.53 U	0.53 U	0.53 U
TYPE	N/A	NOT DIST.	N/A	N/A	N/A

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 3550 MODIFIED 8015

CLIENT NO:	COMPOSIT
LAB NO:	21A2
SAMPLE DATE:	06/18/92
RECEIVED DATE:	06/23/92
DATE EXTRACTED:	07/01/92
ANALYSIS DATE:	07/02/92
INSTRUMENT ID:	HP/FID
DILUTION FACTOR:	5.0
UNITS:	mg/KG
DET. LMT.	53.8

ANALYSIS

TOTAL PETROLEUM
HYDROCARBONS 11569

TYPE JET FUEL

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS -CAMP LEJEUNE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06251992-001

MATRIX: SOIL

DATE/TIME RECEIVED: 06/25/92; 1005

METHOD 3550 MODIFIED 8015

CLIENT NO:	CURB RIGHT	CURB LEFT	BOTT RIGHT	RIGHT WALL
LAB NO:	13A1	14A1	15A1	16A1
SAMPLE DATE:	06/17/92	06/17/92	06/17/92	06/17/92
RECEIVED DATE:	06/25/92	06/25/92	06/25/92	06/25/92
DATE EXTRACTED:	07/01/92	07/01/92	07/01/92	07/01/92
ANALYSIS DATE:	07/11/92	07/11/92	07/11/92	07/11/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID
MATRIX:	SOIL	SOIL	SOIL	SOIL
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	5.38 U	1715	8.08	4833
TYPE	N/A	JET FUEL	JET FUEL	JET FUEL

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003

MATRIX: SOIL

DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 5030 MODIFIED 8015

CLIENT NO:	ARSS-MW801	ARSS-MW802	ARSS-MW901	ARSS-MW902	ARSS-MW1001
LAB NO:	01A2	02A2	03A2	04A2	05A2
SAMPLE DATE:	06/18/92	06/18/92	06/18/92	06/18/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	N/A	N/A	N/A	N/A	N/A
ANALYSIS DATE:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
INSTRUMENT ID:	P&T/FID	P&T/FID	P&T/FID	P&T/FID	P&T/FID
DILUTION FACTOR:	1	1	1	1	1
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.50	0.50	0.50	0.50	0.50

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.50 U	3.36	0.29 J	0.53 U	0.12 J
TYPE	N/A	JET FUEL	NOT DIST.	N/A	NOT DIST.

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003

MATRIX: SOIL

DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 5030 MODIFIED 8015

CLIENT NO:	ARSS-MW1002	ARSS-MW1101	ARSS-MW1102	ARSS-MW1201	ARSS-MW1202
LAB NO:	06A2	07A2	08A2	09A2	10A2
SAMPLE DATE:	06/18/92	06/21/92	06/21/92	06/18/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	N/A	N/A	N/A	N/A	N/A
ANALYSIS DATE:	07/01/92	07/04/92	07/04/92	07/04/92	07/04/92
INSTRUMENT ID:	P&T/FID	P&T/FID	P&T/FID	P&T/FID	P&T/FID
DILUTION FACTOR:	1	1	1	1	1
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.50	0.50	0.50	0.50	0.50

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.65	0.50 U	0.50 U	0.50 U	0.50 U
TYPE	JET FUEL	N/A	N/A	N/A	N/A

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 5030 MODIFIED 8015

CLIENT NO:	ARSS-MW1301	ARSS-MW1302	ARSS-MW1401	ARSS-MW1402	ARSS-MW1501
LAB NO:	11A2	12A2	13A2	14A2	15A2
SAMPLE DATE:	06/18/92	06/18/92	06/17/92	06/17/92	06/18/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	N/A	N/A	N/A	N/A	N/A
ANALYSIS DATE:	07/01/92	07/01/92	07/01/92	07/01/92	07/01/92
INSTRUMENT ID:	P&T/FID	P&T/FID	P&T/FID	P&T/FID	P&T/FID
DILUTION FACTOR:	1	1	1	1	1
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.50	0.50	0.50	0.50	0.50

ANALYSIS

TOTAL PETROLEUM					
HYDROCARBONS	0.14 J	0.19 J	0.14 J	0.53 U	0.12 J
TYPE	N/A	N/A	NOT DIST.	N/A	JET FUEL

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003

MATRIX: SOIL

DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 5030 MODIFIED 8015

CLIENT NO:	ARSS-MW1601	ARSS-DW501	ARSS-DW502	ARSS-DW601	ARSS-DW602
LAB NO:	16A2	17A2	18A2	19A2	20A2
SAMPLE DATE:	06/18/92	06/21/92	06/21/92	06/19/92	06/19/92
RECEIVED DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
DATE EXTRACTED:	N/A	N/A	N/A	N/A	N/A
ANALYSIS DATE:	07/01/92	07/04/92	07/04/92	07/01/92	07/01/92
INSTRUMENT ID:	P&T/FID	P&T/FID	P&T/FID	P&T/FID	P&T/FID
DILUTION FACTOR:	1	1	1	1	1
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG	mg/KG
DET. LMT.	0.50	0.50	0.50	0.50	0.50

ANALYSIS

TOTAL PETROLEUM HYDROCARBONS	0.50 U	0.50 U	6.08	0.50 U	0.09 J
TYPE	N/A	N/A	JET FUEL	N/A	N/A

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: CAMP LEJEUNE, NC-ARS
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06231992-003
MATRIX: SOIL
DATE/TIME RECEIVED: 06/23/92; 1325

METHOD 5030 MODIFIED 8015

CLIENT NO:	COMPOSIT
LAB NO:	21A2
SAMPLE DATE:	06/18/92
RECEIVED DATE:	06/23/92
DATE EXTRACTED:	N/A
ANALYSIS DATE:	07/02/92
INSTRUMENT ID:	P&T/FID
DILUTION FACTOR:	1000
UNITS:	mg/KG
DET. LMT.	50

ANALYSIS

TOTAL PETROLEUM
HYDROCARBONS 11773

TYPE JET FUEL

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS -CAMP LEJEUNE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06251992-001

MATRIX: SOIL

DATE/TIME RECEIVED: 06/25/92; 1005

METHOD 5030 MODIFIED 8015

CLIENT NO:	CURB RIGHT	CURB LEFT	BOTT RIGHT	RIGHT WALL
LAB NO:	13A1	14A1	15A1	16A1
SAMPLE DATE:	06/17/92	06/17/92	06/17/92	06/17/92
RECEIVED DATE:	06/25/92	06/25/92	06/25/92	06/25/92
DATE EXTRACTED:	07/01/92	07/01/92	07/01/92	07/01/92
ANALYSIS DATE:	07/11/92	07/11/92	07/11/92	07/11/92
INSTRUMENT ID:	HP/FID	HP/FID	HP/FID	HP/FID
MATRIX:	SOIL	SOIL	SOIL	SOIL
UNITS:	mg/KG	mg/KG	mg/KG	mg/KG

ANALYSIS

TOTAL PETROLEUM				
HYDROCARBONS	0.03 J	64.1	1.78	419
TYPE	NOT DIST.	JET FUEL	JET FUEL	JET FUEL

3.c. Waters-Organic-602

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS JACKSONVILLE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06191992-004
MATRIX: WATER
DATE/TIME RECEIVED: 06/19/92; 1315

METHOD 602

CLIENT NO:	ARSW-HP21	ARSW-HP22	ARSW-HP23	ARSW-HP24	ARSW-HP25
LAB NO:	01A1	02A1	03A1	04A1	05A1
SAMPLE DATE:	06/17/92	06/16/92	06/16/92	06/16/92	06/17/92
RECEIVED DATE:	06/19/92	06/19/92	06/19/92	06/19/92	06/19/92
ANALYSIS DATE:	06/28/92	06/28/92	06/28/92	06/28/92	06/28/92
INSTRUMENT ID:	HP/P&T	HP/P&T	HP/P&T	HP/P&T	HP/P&T
DIL. FACTOR:	1000	1	1	1	1
UNITS:	ug/L	ug/L	ug/L	ug/L	ug/L

COMPOUNDS

MTBE	200 U	0.23 J	0.18 J	0.23 J	0.34 J
BENZENE	200 U	0.09 J	0.71 J	0.09 J	0.26 J
TOLUENE/EDB	484	0.07 J	2.0 U	2.0 U	0.24 J
CHLOROBENZENE	200 U	2.0 U	2.0 U	2.0 U	2.0 U
ETHYL BENZENE	65 J	2.0 U	2.0 U	2.0 U	3.77
M & P XYLENE	168 J	2.0 U	2.0 U	2.0 U	2.0 U
O XYLENE	238	2.0 U	2.0 U	2.0 U	2.0 U
1,3					
DICHLOROBENZENE	74 J	2.0 U	2.0 U	2.0 U	2.25
1,4					
DICHLOROBENZENE	93 J	2.0 U	2.0 U	2.0 U	0.74 J
1,2					
DICHLOROBENZENE	906	1.28 J	2.0 U	2.0 U	1.20 J

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS JACKSONVILLE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06191992-004
MATRIX: WATER
DATE/TIME RECEIVED: 06/19/92; 1315

METHOD 602

CLIENT NO:	ARSW-HP26	ARSW-HP27	ARSW-HP30	TRIP BLANK
LAB NO:	06A1	07A1	08A1	09A1
SAMPLE DATE:	06/17/92	06/17/92	06/16/92	06/15/92
RECEIVED DATE:	06/19/92	06/19/92	06/19/92	06/19/92
ANALYSIS DATE:	06/28/92	06/28/92	06/28/92	06/24/92
INSTRUMENT ID:	HP/P&T	HP/P&T	HP/P&T	HP/P&T
DIL. FACTOR:	1	1	1	1
UNITS:	ug/L	ug/L	ug/L	ug/L

COMPOUNDS

MTBE	0.55 J	0.52 J	0.22 J	0.2 U
BENZENE	2.0 U	0.42 J	2.0 U	0.2 U
TOLUENE/EDB	0.01 J	2.0 U	2.0 U	0.2 U
CHLOROBENZENE	2.0 U	2.0 U	2.0 U	0.2 U
ETHYL BENZENE	2.0 U	2.0 U	2.0 U	0.2 U
M & P XYLENE	2.0 U	2.0 U	2.0 U	0.2 U
O XYLENE	2.0 U	2.0 U	2.0 U	0.2 U
1,3				
DICHLOROBENZENE	2.0 U	2.0 U	2.0 U	0.2 U
1,4				
DICHLOROBENZENE	2.0 U	2.0 U	2.0 U	0.2 U
1,2				
DICHLOROBENZENE	2.0 U	2.0 U	2.0 U	0.2 U

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
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REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS -CAMP LEJEUNE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06251992-001

MATRIX: WATER

DATE/TIME RECEIVED: 06/25/92; 1005

METHOD 602

CLIENT NO:	ARSW-MW8	ARSW-MW9	ARSW-MW10	ARSW-MW12	ARSW-MW13
LAB NO:	01A1	02A1	03A1	04A1	05A1
SAMPLE DATE:	06/23/92	06/23/92	06/23/92	06/23/92	06/23/92
RECEIVED DATE:	06/25/92	06/25/92	06/25/92	06/25/92	06/25/92
ANALYSIS DATE:	07/06/92	07/01/92	07/06/92	07/01/92	07/01/92
INSTRUMENT ID:	HP/P&T	HP/P&T	HP/P&T	HP/P&T	HP/P&T
DIL. FACTOR:	50	1	100	1	1
UNITS:	ug/L	ug/L	ug/L	ug/L	ug/L

COMPOUNDS

MTBE	10 U	2.0 U	20 U	2.0 U	2.0 U
BENZENE	3.8 J	2.0 U	20 U	2.0 U	2.0 U
TOLUENE/EDB	36.2	2.0 U	20 U	0.2 J	0.86 J
CHLOROBENZENE	10 U	2.0 U	20 U	2.0 U	2.0 U
ETHYL BENZENE	18.0	2.0 U	22	2.0 U	0.33 J
M & P XYLENE	41.7	2.0 U	25	2.0 U	2.0 U
O XYLENE	45.7	0.02 J	48	0.07 J	0.49 J
1,3 DICHLOROBENZENE	10 U	2.0 U	20 U	2.0 U	2.14
1,4 DICHLOROBENZENE	93.8	2.0 U	64.2	2.0 U	1.79 J
1,2 DICHLOROBENZENE	17.1	2.0 U	4.8 J	2.0 U	12.48 J

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS -CAMP LEJEUNE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06251992-001

MATRIX: WATER

DATE/TIME RECEIVED: 06/25/92; 1005

METHOD 602

CLIENT NO:	ARSW-MW14	ARSW-MW15	ARSW-DW6	ARSW-HP28	ARSW-HP29
LAB NO:	06A1	07A1	08A1	09A1	10A1
SAMPLE DATE:	06/23/92	06/23/92	06/23/92	06/22/92	06/22/92
RECEIVED DATE:	06/25/92	06/25/92	06/25/92	06/25/92	06/25/92
ANALYSIS DATE:	07/01/92	07/07/92	07/01/92	07/06/92	07/06/92
INSTRUMENT ID:	HP/P&T	HP/P&T	HP/P&T	HP/P&T	HP/P&T
DIL. FACTOR:	1	1000	1	1	1
UNITS:	ug/L	ug/L	ug/L	ug/L	ug/L

COMPOUNDS

MTBE	2.0 U	200 U	2.0 U	2.0 U	2.0 U
BENZENE	2.0 U	200 U	2.0 U	2.0 U	2.0 U
TOLUENE/EDB	0.17 J	200 U	0.84 J	0.14 J	0.62 J
CHLOROBENZENE	2.0 U	200 U	2.0 U	2.0 U	2.0 U
ETHYL BENZENE	2.0 U	50 J	0.09 J	2.0 U	2.0 U
M & P XYLENE	2.0 U	100 J	2.0 U	2.0 U	10.92
O XYLENE	0.05 J	271	2.0 U	0.11 J	0.52 J
1,3					
DICHLOROBENZENE	2.0 U	363	2.0 U	0.38 J	7.35
1,4					
DICHLOROBENZENE	2.0 U	200 U	2.0 U	0.03 J	1.29 J
1,2					
DICHLOROBENZENE	2.0 U	296	2.0 U	2.0 U	7.95

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL, INC.
AIRPORT OFFICE PARK BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: ARS -CAMP LEJEUNE NC
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06251992-001
MATRIX: WATER
DATE/TIME RECEIVED: 06/25/92; 1005

METHOD 602

CLIENT NO: ARSW-HP31
LAB NO: 11A1
SAMPLE DATE: 06/22/92
RECEIVED DATE: 06/25/92
ANALYSIS DATE: 07/06/92
INSTRUMENT ID: HP/P&T
DIL. FACTOR: 1
UNITS: ug/L

COMPOUNDS

MTBE	2.0 U
BENZENE	2.0 U
TOLUENE/EDB	0.55 J
CHLOROBENZENE	2.0 U
ETHYL BENZENE	2.0 U
M & P XYLENE	10.73
O XYLENE	0.52 J
1,3	
DICHLOROBENZENE	7.51
1,4	
DICHLOROBENZENE	1.28 J
1,2	
DICHLOROBENZENE	8.28

SOLUTIONS LABORATORIES, INC.

814-B GREENBRIER CIRCLE
CHESAPEAKE, VA 23320
(T) (804) 420-0467
(F) (804) 420-4204

REPORT OF ANALYSIS

DATE: JULY 20, 1992

BAKER ENVIRONMENTAL INC.
AIRPORT OFFICE PARK, BLDG.
420 ROUSER ROAD
COROAPOLIS, PA 15108

PROJECT NAME: AS527 RR5
PROJECT NUMBER: 19124-64-SVZ

SOL LOG: 06261992-006
MATRIX: WATER
DATE/TIME RECEIVED: 06/26/92; 1315

METHOD 602

CLIENT NO:	ARSW-MW1101	ARSW-DW501	TRIP BLANK
LAB NO:	01A1	02A1	03A1
SAMPLE DATE:	06/24/92	06/24/92	06/19/92
RECEIVED DATE:	06/26/92	06/26/92	06/26/92
ANALYSIS DATE:	06/29/92	06/29/92	06/29/92
INSTRUMENT ID:	HP/P&T	HP/P&T	HP/P&T
DIL. FACTOR:	20	1	1
UNITS:	ug/L	ug/L	ug/L

COMPOUNDS

MTBE	2.0 U	2.0 U	0.2 U
BENZENE	2.0 U	2.0 U	0.2 U
TOLUENE/EDB	2.0 U	0.48 J	0.2 U
CHLOROBENZENE	2.0 U	2.0 U	0.2 U
ETHYL BENZENE	6.4	0.66 J	0.2 U
M & P XYLENE	2.0 U	0.12 J	0.2 U
O XYLENE	2.0 U	0.04 J	0.2 U
1,3			
DICHLOROBENZENE	18.6	2.0 U	0.2 U
1,4			
DICHLOROBENZENE	18.7	0.19 J	0.2 U
1,2			
DICHLOROBENZENE	42.2	0.35 J	0.2 U

3.d. Waters-Organic-625

MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

SEMIVOLATILE ORGANICS BY EPA GC/MS METHOD 625

CLIENT SAMPLE ID:	ARS-W-MW8	ARS-W-MW10	ARS-W-MW12	SWBLK0629
	062592-001-01	062592-001-03	062592-001-04	
LAB SAMPLE ID:	92062604	92062605	92062606	METHOD BLANK
SAMPLE DATE:	06/23/92	06/23/92	06/23/92	
RECEIVED DATE:	06/26/92	06/26/92	06/26/92	
EXTRACTION DATE:	06/29/92	06/29/92	06/29/92	06/29/92
ANALYSIS DATE:	06/30/92	06/30/92	06/30/92	06/30/92
FILE NAME:	S062604	S062605	S062606	SWBLK0629
INSTRUMENT ID:	MSC	MSC	MSC	MSC
MATRIX:	WATER	WATER	WATER	WATER
UNITS:	UG/L	UG/L	UG/L	UG/L

SEMIVOLATILE COMPOUNDS

Acenaphthene	10 U	6.6 J	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U
Benidine	50 U	50 U	50 U	50 U
Benzo(a)Anthracene	10 U	10 U	10 U	10 U
Benzo(a)Pyrene	10 U	10 U	10 U	10 U
Benzo(b+k)fluoranthenes	10 U	10 U	10 U	10 U
Benzo(g,h,i)Perylene	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U
4-Chloro-3-Methylphenol	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)Methane	10 U	10 U	10 U	10 U
bis(2-Chloroethyl)Ether	10 U	10 U	10 U	10 U
bis(2-Chloroisopropyl)Ether	10 U	10 U	10 U	10 U
2-Chloronaphthalene	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U
Chrysene	10 U	10 U	10 U	10 U
Di-n-Butylphthalate	10 U	10 U	10 U	10 U
Di-n-Octyl Phthalate	10 U	10 U	10 U	10 U
Dibenz(a,h)Anthracene	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20 U	20 U	20 U	20 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U
Dimethyl Phthalate	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	10 U	10 U
4,6-Dinitro-2-Methylphenol	50 U	50 U	50 U	50 U
2,4-Dinitrophenol	50 U	50 U	50 U	50 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U
1,2-Diphenylhydrazine	10 U	10 U	10 U	10 U
bis(2-Ethylhexyl)Phthalate	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U

MARYLAND SPECTRAL SERVICES, INC.
1500 Caton Center Drive Baltimore, MD 21227

SEMIVOLATILE ORGANICS BY EPA GC/MS METHOD 625

CLIENT SAMPLE ID:	ARS-W-MW8	ARS-W-MW10	ARS-W-MW12	SWBLK0629
	062592-001-01	062592-001-03	062592-001-04	
LAB SAMPLE ID:	92062604	92062605	92062606	METHOD BLANK
SAMPLE DATE:	06/23/92	06/23/92	06/23/92	
RECEIVED DATE:	06/26/92	06/26/92	06/26/92	
EXTRACTION DATE:	06/29/92	06/29/92	06/29/92	06/29/92
ANALYSIS DATE:	06/30/92	06/30/92	06/30/92	06/30/92
FILE NAME:	S062604	S062605	S062606	SWBLK0629
INSTRUMENT ID:	MSC	MSC	MSC	MSC
MATRIX:	WATER	WATER	WATER	WATER
UNITS:	UG/L	UG/L	UG/L	UG/L

SEMIVOLATILE COMPOUNDS

Fluorene	10 U	<u>4.1</u> J	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)Pyrene	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U
N-Nitroso-Di-n-Propylamine	10 U	10 U	10 U	10 U
N-Nitrosodimethylamine	10 U	10 U	10 U	10 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U
Naphthalene	10 U	<u>19</u>	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U
4-Nitrophenol	50 U	50 U	50 U	50 U
2-Nitrophenol	10 U	10 U	10 U	10 U
Pentachlorophenol	50 U	50 U	50 U	50 U
Phenanthrene	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U

4. Appendix A- QC Report

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 06-24-92

TIME ANALYZED: 1108

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
TRIP BLANK	06191992-004-09A1	06191992-004	1203

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 06-28-92

TIME ANALYZED: 0824

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
ARS-W-HP-21	06191992-004-01A1	06191992-004	1620
ARS-W-HP-22	06191992-004-02A1	06191992-004	0929
ARS-W-HP-23	06191992-004-03A1	06191992-004	1010
ARS-W-HP-24	06191992-004-04A1	06191992-004	1100
ARS-W-HP-25	06191992-004-05A1	06191992-004	1157
ARS-W-HP-26	06191992-004-06A1	06191992-004	1344
ARS-W-HP-27	06191992-004-07A1	06191992-004	1430
ARS-W-HP-30	06191992-004-08A1	06191992-004	1522

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 07-01-92

TIME ANALYZED: 0740

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
ARS-W-MW9	06251992-001-02A1	06251992-001	0829
ARS-W-MW12	06251992-001-04A1	06251992-001	0910
ARS-W-MW13	06251992-001-05A1	06251992-001	0947
ARS-W-MW14	06251992-001-06A1	06251992-001	1121
ARS-W-DW6	06251992-001-08A1	06251992-001	1212

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 07-06-92

TIME ANALYZED: 0803

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
ARS-W-MW1	06251992-001-01A1	06251992-001	1317
ARS-W-MW10	06251992-001-03A1	06251992-001	1517
ARS-W-MW13	06251992-001-05A1	06251992-001	0947
ARS-W-HP28	06251992-001-09A1	06251992-001	0851
ARS-W-HP29	06251992-001-10A1	06251992-001	1007
ARS-W-HP31	06251992-001-11A1	06251992-001	1135

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 07-07-92

TIME ANALYZED: 2222

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
ARS-W-MW15	06251992-001-07A1	06251992-001	2314

4A

VOLATILES METHOD BLANK SUMMARY

LAB NAME: SOLUTIONS LABORATORIES, INC

LAB CODES: SOL

DATE ANALYZED: 06-29-92

TIME ANALYZED: 1832

MATRIX: WATER

INSTRUMENT: H.P/P&T

<u>SAMPLE ID</u>	<u>LAB ID</u>	<u>LAB FILE ID</u>	<u>TIME ANALYZED</u>
ARS-W-MW1101	06261992-006-01A1	06261992-006	1922
ARS-W-DW501	06261992-006-02A1	06261992-006	2045
TRIP BLANK	06261992-006-03A1	06261992-006	2136

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

LAB NAME: SOLUTIONS LABORATORIES, INC.

SAMPLE NUMBER: 06261992-006-03A3

LAB CODE: SOL

MATRIX SPIKE SAMPLE NO: 011292-64-2

UNITS: ug/L

COMPOUND	SPIKE ADDED	SAMPLE CON	MS CON	MS % REC	QC LIMIT
BENZENE	2.0	0.2 U	2.26	113.0	66-142
TOLUENE	2.0	0.2 U	2.13	106.5	59-139
ETHYL BENZENE	2.0	0.2 U	2.22	111.0	66-142

COMPOUND	SPIKE ADDED	MSD CON	MSD % REC	% RPD	QC LIMIT
BENZENE	2.0	1.95	97.5	15.8 21	66-142
TOLUENE	2.0	2.16	108.0	1.5 21	59-139
ETHYL BENZENE	2.0	2.35	117.5	6.5 21	70-120

3B

SOIL VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

LAB NAME: SOLUTIONS LABORATORIES, INC.

SAMPLE NUMBER: 06191992-004-09A1

LAB CODE: SOL

MATRIX SPIKE SAMPLE NO: 011292-64-2

UNITS: ug/L

COMPOUND	SPIKE ADDED	SAMPLE CON	MS CON	MS % REC	QC LIMIT
BENZENE	2.0	0.2 U	2.21	110.5	66-142
TOLUENE	2.0	0.2 U	2.13	105.0	59-139
ETHYL BENZENE	2.0	0.2 U	2.10	105.0	66-142

COMPOUND	SPIKE ADDED	MSD CON	MSD % REC	% RPD	QC LIMIT
BENZENE	2.0	1.86	93.0	17.5 21	66-142
TOLUENE	2.0	2.05	102.5	2.5 21	59-139
ETHYL BENZENE	2.0	2.25	112.5	7.5 21	70-120

2C
WATER SEMIVOLATILE SURROGATE RECOVERY

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS

Case No.: SL0626

SAS No.:

SDG No.:

	EPA SAMPLE NO.	S1 (NBZ) #	S2 (FBP) #	S3 (TPH) #	S4 (PHL) #	S5 (2FP) #	S6 (TBP) #	OTHER	TOT OUT
01	ARS-W-MW10	106	61	42	23	37	61		0
02	ARS-W-MW12	72	57	39	22	42	52		0
03	ARS-W-MW8	64	68	54	26	45	76		0
04	SWBLK0629	58	63	70	22	39	65		0

		QC LIMITS
S1 (NBZ)	= Nitrobenzene-d5	(35-114)
S2 (FBP)	= 2-Fluorobiphenyl	(43-116)
S3 (TPH)	= Terphenyl	(33-141)
S4 (PHL)	= Phenol-d5	(10-94)
S5 (2FP)	= 2-Fluorophenol	(21-100)
S6 (TBP)	= 2,4,6-Tribromophenol	(10-123)

Column to be used to flag recovery values
 * Values outside of contract required QC limits
 D Surrogates diluted out

4B
SEMIVOLATILE METHOD BLANK SUMMARY

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Lab File ID: SWBLK0629 Lab Sample ID: METHOD_BLANK

Date Extracted: 06/29/92 Extraction: (SepF/Cont/Sonc)

Date Analyzed: 06/30/92 Time Analyzed: 1447

Matrix: (soil/water) WATER Level: (low/med)

Instrument ID: MSC

THIS METHOD BLANK APPLIES TO THE FOLLOWING SAMPLES, MS AND MSD:

	EPA SAMPLE NO. =====	LAB SAMPLE ID =====	LAB FILE ID =====	DATE ANALYZED =====
01	ARS-W-MW10	92062605	S062605	06/30/92
02	ARS-W-MW12	92062606	S062606	06/30/92
03	ARS-W-MW8	92062604	S062604	06/30/92

COMMENTS: SWBLK0629 BNA SEP FUNNEL EXTRACTIN BLANK 062992, 1.0UL
CAP COLUMN MSC

5B
SEMIVOLATILE ORGANIC GC/MS TUNING AND MASS
CALIBRATION - DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Lab File ID: 0622DFTC1 DFTPP Injection Date: 06/22/92

Instrument ID: MSC DFTPP Injection Time: 0908

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	35.8
68	Less than 2.0% of mass 69	0.8 (1.8)1
69	Mass 69 relative abundance	43.7
70	Less than 2.0% of mass 69	0.0 (0.1)1
127	40.0 - 60.0% of mass 198	40.2
197	Less than 1.0% of mass 198	0.0
198	Base peak, 100% relative abundance	100.0
199	5.0 to 9.0% of mass 198	7.0
275	10.0 - 30.0% of mass 198	17.6
365	Greater than 1.00% of mass 198	1.74
441	Present, but less than mass 443	7.7
442	Greater than 40.0% of mass 198	58.2
443	17.0 - 23.0% of mass 442	10.3 (17.7)2

1-Value is % mass 69

2-Value is % mass 442

THIS TUNE APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	SSTD160	160PPM_BNA	0622S5C1	06/22/92	1104
02	SSTD120	120PPM_BNA	0622S4C1	06/22/92	1148
03	SSTD080	80PPM_BNA	0622S3C1	06/22/92	1237
04	SSTD020	20PPM_BNA	0622S1C1	06/22/92	1511
05	SSTD050	50PPM_BNA	0622S2C3	06/22/92	1705

5B
SEMIVOLATILE ORGANIC GC/MS TUNING AND MASS
CALIBRATION - DECAFLUOROTRIPHENYLPHOSPHINE (DFTPP)

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Lab File ID: 0630DFTC1 DFTPP Injection Date: 06/30/92

Instrument ID: MSC DFTPP Injection Time: 1119

m/e	ION ABUNDANCE CRITERIA	% RELATIVE ABUNDANCE
51	30.0 - 60.0% of mass 198	56.6
68	Less than 2.0% of mass 69	0.0 (0.0)1
69	Mass 69 relative abundance	67.4
70	Less than 2.0% of mass 69	0.0 (0.0)1
127	40.0 - 60.0% of mass 198	44.6
197	Less than 1.0% of mass 198	0.0
198	Base peak, 100% relative abundance	100.0
199	5.0 to 9.0% of mass 198	6.6
275	10.0 - 30.0% of mass 198	16.5
365	Greater than 1.00% of mass 198	1.40
441	Present, but less than mass 443	6.7
442	Greater than 40.0% of mass 198	43.6
443	17.0 - 23.0% of mass 442	7.9 (18.2)2

1-Value is % mass 69

2-Value is % mass 442

THIS TUNE APPLIES TO THE FOLLOWING SAMPLES, MS, MSD, BLANKS, AND STANDARDS:

	EPA SAMPLE NO.	LAB SAMPLE ID	LAB FILE ID	DATE ANALYZED	TIME ANALYZED
01	SSTD050	50PPM_BNA	0630S2C2	06/30/92	1324
02	SWBLK0629	METHOD BLANK	SWBLK0629	06/30/92	1447
03	ARS-W-MW8	92062604	S062604	06/30/92	1553
04	ARS-W-MW10	92062605	S062605	06/30/92	1641
05	ARS-W-MW12	92062606	S062606	06/30/92	1727

6B
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Instrument ID: MSC Calibration Date(s): 06/22/92 06/22/92

Min $\overline{RRF}$ for SPCC(#) = 0.050 Max %RSD for CCC(*) = 30.0%

LAB FILE ID: RRF20 = 0622S1C1 RRF50 = 0622S2C3
RRF80 = 0622S3C1 RRF120 = 0622S4C1 RRF160 = 0622S5C1

COMPOUND	RRF20	RRF50	RRF80	RRF120	RRF160	$\overline{RRF}$	% RSD
Phenol *	1.508	1.839	1.958	1.551	1.610	1.693	11.6*
bis(2-Chloroethyl) Ether	1.885	1.865	2.037	1.700	1.550	1.807	10.4
2-Chlorophenol	1.211	1.206	1.401	1.214	1.307	1.268	6.7
1,3-Dichlorobenzene	1.529	1.457	1.639	1.392	1.511	1.506	6.1
1,4-Dichlorobenzene *	1.625	1.471	1.720	1.394	1.528	1.548	8.3*
Benzyl Alcohol	0.561	0.726	0.796	0.679	0.670	0.686	12.6
1,2-Dichlorobenzene	1.594	1.432	1.644	1.287	1.457	1.483	9.5
2-Methylphenol	1.102	1.151	1.223	1.021	1.090	1.117	6.7
bis(2-Chloroisopropyl) Ether	2.906	2.689	2.919	2.272	1.960	2.549	16.5
4-Methylphenol	1.099	1.149	1.261	1.023	1.057	1.118	8.3
N-Nitroso-Di-n-Propylamine #	1.013	1.118	1.224	0.972	0.883	1.042	12.7#
Hexachloroethane	0.703	0.658	0.707	0.583	0.618	0.654	8.2
Nitrobenzene	0.428	0.424	0.421	0.360	0.310	0.389	13.4
Sophorone	0.882	0.888	0.899	0.786	0.686	0.828	11.1
2-Nitrophenol *	0.142	0.167	0.166	0.151	0.160	0.157	6.8*
2,4-Dimethylphenol	0.350	0.376	0.380	0.337	0.277	0.344	12.1
Benzoic Acid		0.095	0.119	0.124	0.108	0.112	11.5
bis(2-Chloroethoxy)Methane	0.564	0.543	0.565	0.487	0.429	0.518	11.4
2,4-Dichlorophenol *	0.236	0.263	0.271	0.252	0.253	0.255	5.2*
1,2,4-Trichlorobenzene	0.323	0.298	0.305	0.285	0.294	0.301	4.7
Naphthalene	1.025	0.915	0.894	0.767	0.710	0.862	14.5
4-Chloroaniline	0.188	0.145	0.172	0.176	0.122	0.161	16.6
Hexachlorobutadiene *	0.166	0.158	0.160	0.150	0.164	0.160	3.9*
4-Chloro-3-Methylphenol *	0.245	0.302	0.312	0.302	0.227	0.278	13.9*
2-Methylnaphthalene	0.622	0.596	0.585	0.518	0.489	0.562	10.0
Hexachlorocyclopentadiene #	0.120	0.151	0.174	0.185	0.202	0.166	19.2#
2,4,6-Trichlorophenol *	0.271	0.315	0.327	0.348	0.358	0.324	10.5*
2,4,5-Trichlorophenol		0.306	0.339	0.360	0.360	0.341	7.5
2-Chloronaphthalene	1.196	1.068	1.102	1.076	0.986	1.086	6.9
2-Nitroaniline		0.338	0.369	0.372	0.301	0.345	9.6
Dimethyl Phthalate	1.162	1.183	1.246	1.232	1.128	1.190	4.1
Acenaphthylene	1.687	1.550	1.630	1.502	1.340	1.542	8.7
2,6-Dinitrotoluene	0.194	0.240	0.271	0.269	0.265	0.248	13.1
3-Nitroaniline		0.032	0.008	0.031	0.031	0.026	44.9
Acenaphthene *	1.195	1.041	1.055	1.019	0.950	1.052	8.5*
2,4-Dinitrophenol #		0.061	0.069	0.082	0.103	0.079	23.2#
4-Nitrophenol #		0.079	0.098	0.100	0.081	0.090	12.3#

6C
SEMIVOLATILE ORGANICS INITIAL CALIBRATION DATA

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Instrument ID: MSC Calibration Date(s): 06/22/92 06/22/92

Min RRF for SPCC(%) = 0.050 Max %RSD for CCC(*) = 30.0%

LAB FILE ID:		RRF20 = 0622S1C1		RRF50 = 0622S2C3			
RRF80 = 0622S3C1		RRF120= 0622S4C1		RRF160= 0622S5C1			
COMPOUND	RRF20	RRF50	RRF80	RRF120	RRF160	RRF	% RSD
Dibenzofuran	1.406	1.382	1.413	1.356	1.264	1.364	4.4
2,4-Dinitrotoluene	0.235	0.300	0.339	0.346	0.339	0.312	14.9
Diethylphthalate	1.196	1.190	1.280	1.210	1.108	1.197	5.1
4-Chlorophenyl-phenylether	0.446	0.449	0.465	0.474	0.492	0.465	4.1
Fluorene	1.065	1.074	1.087	1.054	1.002	1.056	3.1
4-Nitroaniline		0.053	0.064	0.067	0.055	0.060	11.3
4,6-Dinitro-2-Methylphenol		0.087	0.096	0.106	0.114	0.101	11.6
N-Nitrosodiphenylamine	* 0.480	0.419	0.428	0.416	0.359	0.420	10.2*
4-Bromophenyl-phenylether	0.159	0.165	0.177	0.189	0.179	0.174	6.8
Hexachlorobenzene	0.223	0.213	0.229	0.236	0.238	0.228	4.5
Pentachlorophenol	*	0.072	0.087	0.099	0.104	0.091	15.7*
Phenanthrene	0.971	0.958	1.006	0.986	0.920	0.968	3.3
Anthracene	0.899	0.915	0.933	0.945	0.863	0.911	3.5
Di-n-Butylphthalate	1.157	1.280	1.285	1.242	1.097	1.212	6.8
Fluoranthene	* 0.638	0.704	0.706	0.728	0.769	0.709	6.7*
Pyrene	2.035	1.870	2.014	1.880	1.641	1.888	8.3
Butylbenzylphthalate	0.989	0.987	1.052	1.018	0.800	0.969	10.1
3,3'-Dichlorobenzidine	0.100	0.060	0.075	0.082	0.070	0.077	19.4
Benzo(a)Anthracene	0.895	0.898	0.932	1.012	0.914	0.930	5.2
Chrysene	1.138	0.886	0.941	0.993	0.852	0.962	11.7
bis(2-Ethylhexyl)Phthalate	1.326	1.327	1.407	1.295	1.060	1.283	10.2
Di-n-Octyl Phthalate	* 4.228	3.958	5.128	4.543	3.517	4.275	14.2*
Benzo(b)fluoranthene	1.623	1.402	1.705	1.787	1.581	1.620	9.0
Benzo(k)fluoranthene	1.594	1.451	1.776	1.625	1.563	1.602	7.3
Benzo(a)Pyrene	* 1.191	1.170	1.537	1.284	1.273	1.291	11.3*
Indeno(1,2,3-cd)Pyrene	0.661	0.914	0.991	0.943	1.009	0.904	15.6
Dibenz(a,h)Anthracene	0.405	0.652	0.728	0.735	0.795	0.663	23.1
Benzo(g,h,i)Perylene	0.661	0.791	0.955	0.927	0.900	0.847	14.3
Nitrobenzene-d5	0.380	0.407	0.408	0.362	0.308	0.373	11.0
2-Fluorobiphenyl	1.261	1.074	1.111	1.098	1.024	1.114	8.0
Terphenyl-d14	1.046	1.082	1.136	1.145	0.988	1.079	6.0
Phenol-d5	1.504	1.550	1.695	1.416	1.352	1.503	8.8
2-Fluorophenol	1.166	1.167	1.388	1.204	1.254	1.236	7.5
2,4,6-Tribromophenol	0.073	0.096	0.097	0.111	0.122	0.100	18.4

(1) Cannot be separated from Diphenylamine

7B
SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Instrument ID: MSC Calibration date: 06/30/92 Time: 1324

Lab File ID: 0630S2C2 Init. Calib. Date(s): 06/22/92 06/22/92

Min RRF50 for SPCC(#) = 0.050 Max %D for CCC(*) = 25.0%

COMPOUND	RRF	RRF50	%D
Phenol	* 1.693	1.898	-12.1 *
bis(2-Chloroethyl) Ether	1.807	1.762	2.5
2-Chlorophenol	1.268	1.203	5.1
1,3-Dichlorobenzene	1.506	1.365	9.4
1,4-Dichlorobenzene	* 1.548	1.427	7.8 *
Benzyl Alcohol	0.686	0.714	-4.1
1,2-Dichlorobenzene	1.483	1.349	9.0
2-Methylphenol	1.117	1.102	1.3
bis(2-Chloroisopropyl) Ether	2.549	2.733	-7.2
4-Methylphenol	1.118	1.133	-1.3
N-Nitroso-Di-n-Propylamine	# 1.042	1.127	-8.2 #
Hexachloroethane	0.654	0.593	9.3
Nitrobenzene	0.389	0.446	-14.7
Isophorone	0.828	1.014	-22.5
2-Nitrophenol	* 0.157	0.177	-12.7 *
2,4-Dimethylphenol	0.344	0.392	-14.0
Benzoic Acid	0.112	0.118	-5.4
bis(2-Chloroethoxy) Methane	0.518	0.602	-16.2
2,4-Dichlorophenol	* 0.255	0.266	-4.3 *
1,2,4-Trichlorobenzene	0.301	0.298	1.0
Naphthalene	0.862	0.950	-10.2
4-Chloroaniline	0.161	0.275	-70.8
Hexachlorobutadiene	* 0.160	0.150	6.3 *
4-Chloro-3-Methylphenol	* 0.278	0.313	-12.6 *
2-Methylnaphthalene	0.562	0.603	-7.3
Hexachlorocyclopentadiene	# 0.166	0.153	7.8 #
2,4,6-Trichlorophenol	* 0.324	0.318	1.9 *
2,4,5-Trichlorophenol	0.341	0.323	5.3
2-Chloronaphthalene	1.086	1.090	-0.4
2-Nitroaniline	0.345	0.471	-36.5
Dimethyl Phthalate	1.190	1.188	0.2
Acenaphthylene	1.542	1.607	-4.2
2,6-Dinitrotoluene	0.248	0.248	0.0
3-Nitroaniline	0.026	0.023	11.5
Acenaphthene	* 1.052	1.058	-0.6 *
2,4-Dinitrophenol	# 0.079	0.087	-10.1 #
4-Nitrophenol	# 0.090	0.110	-22.2 #

7C
SEMIVOLATILE CONTINUING CALIBRATION CHECK

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Instrument ID: MSC Calibration date: 06/30/92 Time: 1324

Lab File ID: 0630S2C2 Init. Calib. Date(s): 06/22/92 06/22/92

Min RRF50 for SPCC(#) = 0.050

Max %D for CCC(*) = 25.0%

COMPOUND	RRF	RRF50	%D
Dibenzofuran	1.364	1.413	-3.6
2,4-Dinitrotoluene	0.312	0.324	-3.8
Diethylphthalate	1.197	1.262	-5.4
4-Chlorophenyl-phenylether	0.465	0.463	0.4
Fluorene	1.056	1.080	-2.3
4-Nitroaniline	0.060	0.150	-99.9
4,6-Dinitro-2-Methylphenol	0.101	0.098	3.0
N-Nitrosodiphenylamine	* 0.420	0.488	-16.2 *
4-Bromophenyl-phenylether	0.174	0.151	13.2
Hexachlorobenzene	0.228	0.203	11.0
Pentachlorophenol	* 0.091	0.072	20.9 *
Phenanthrene	0.968	1.005	-3.8
Anthracene	0.911	0.935	-2.6
Di-n-Butylphthalate	1.212	1.327	-9.5
Fluoranthene	* 0.709	0.753	-6.2 *
Pyrene	1.888	1.726	8.6
Butylbenzylphthalate	0.969	1.091	-12.6
3,3'-Dichlorobenzidine	0.077	0.145	-88.3
Benzo(a)Anthracene	0.930	0.945	-1.6
Chrysene	0.962	0.945	1.8
bis(2-Ethylhexyl)Phthalate	1.283	1.467	-14.3
Di-n-Octyl Phthalate	* 4.275	4.720	-10.4 *
Benzo(b)fluoranthene	1.620	1.669	-3.0
Benzo(k)fluoranthene	1.602	1.710	-6.7
Benzo(a)Pyrene	* 1.291	1.418	-9.8 *
Indeno(1,2,3-cd)Pyrene	0.904	1.220	-35.0
Dibenz(a,h)Anthracene	0.663	0.930	-40.3
Benzo(g,h,i)Perylene	0.847	0.973	-14.9
Nitrobenzene-d5	0.373	0.444	-19.0
2-Fluorobiphenyl	1.114	1.118	-0.4
Terphenyl-d14	1.079	1.011	6.3
Phenol-d5	1.503	1.593	-6.0
2-Flourophenol	1.236	1.196	3.2
2,4,6-Tribromophenol	0.100	0.082	18.0

(1) Cannot be separated from Diphenylamine

8B
SEMIVOLATILE INTERNAL STANDARD AREA SUMMARY

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Lab File ID (Standard): 0630S2C2

Date Analyzed: 06/30/92

Instrument ID: MSC

Time Analyzed: 1324

	IS1 (DCB) AREA #	RT	IS2 (NPT) AREA #	RT	IS3 (ANT) AREA #	RT
=====	=====	=====	=====	=====	=====	=====
12 HOUR STD	20300	7.83	63800	10.37	32200	14.19
=====	=====	=====	=====	=====	=====	=====
UPPER LIMIT	40600		127600		64400	
=====	=====	=====	=====	=====	=====	=====
LOWER LIMIT	10150		31900		16100	
=====	=====	=====	=====	=====	=====	=====
EPA SAMPLE NO.						
=====	=====	=====	=====	=====	=====	=====
01 ARS-W-MW10	14100	7.83	52100	10.42	29800	14.20
02 ARS-W-MW12	19100	7.82	65500	10.37	34700	14.19
03 ARS-W-MW8	22900	7.82	85600	10.37	41300	14.17
04 SWBLK0629	20300	7.82	68200	10.37	31900	14.17

IS1 (DCB) = 1,4-Dichlorobenzene-d4
IS2 (NPT) = Naphthalene-d8
IS3 (ANT) = Acenaphthene-d10

UPPER LIMIT = + 100%
of internal standard area.
LOWER LIMIT = - 50%
of internal standard area.

Column used to flag internal standard area values with an asterisk

8C
SEMIVOLATILE INTERNAL STANDARD AREA SUMMARY

Lab Name: MD. SPECTRAL SERVICES, INC. Contract: BAKER

Lab Code: MSS Case No.: SL0626 SAS No.: SDG No.:

Lab File ID (Standard): 0630S2C2 Date Analyzed: 06/30/92

Instrument ID: MSC Time Analyzed: 1324

	IS4(PHN) AREA #	RT	IS5(CRY) AREA #	RT	IS6(PRY) AREA #	RT
=====	=====	=====	=====	=====	=====	=====
12 HOUR STD	40900	17.42	16900	23.34	7510	26.47
=====	=====	=====	=====	=====	=====	=====
UPPER LIMIT	81800		33800		15020	
=====	=====	=====	=====	=====	=====	=====
LOWER LIMIT	20450		8450		3755	
=====	=====	=====	=====	=====	=====	=====
EPA SAMPLE NO.						
=====	=====	=====	=====	=====	=====	=====
01 ARS-W-MW10	38000	17.40	13600	23.34	6670	26.47
02 ARS-W-MW12	42400	17.42	14100	23.34	6590	26.46
03 ARS-W-MW8	49600	17.40	16000	23.34	7140	26.46
04 SWBLK0629	43900	17.40	18700	23.34	8770	26.46

IS4 (PHN) = Phenanthrene-d10
IS5 (CRY) = Chrysene-d12
IS6 (PRY) = Perylene-d12

UPPER LIMIT = + 100%
of internal standard area.
LOWER LIMIT = - 50%
of internal standard area.

Column used to flag internal standard area values with an asterisk

5. Appendix B- Glossary of Report and Data Information

GLOSSARY OF SYMBOLS AND ABBREVIATIONS

1. < - "Less than". The number following the sign is the smallest amount which can be detected using this specific test.
2. > - "Greater than". The number following the sign is the highest amount which can be detected using this specific test.
3. °C and °F - "degrees of temperature", Celsius and Fahrenheit respectively.
4. % - "percent of part per hundred". When followed by the designation "by weight" it means grams per hundred grams. If followed by the designation "by volume" it refers to volume per unit volume, eg, milliliters per hundred milliliters.
5. g - "gram(s)". The unit weight used in the metric system. One gram equals about 1/28th of an ounce.
6. kg - "kilogram(s)". One kilogram is 1000 grams.
7. L - "liter(s)". The unit of volume used in the metric system.
8. lb - pound(s).
9. m³ - "cubic meter(s)". Usually used as a volume unit in air analyses.
10. MF - "Membrane Filtration". Method used for certain bacteriological tests in which results indicate colony counts after sample has been filtered through a 0.45 um filter.
11. mg - "milligram(s)". One milligram is 1/1000 of a gram.
12. mg/L - "milligrams per liter". Equals "parts per million" for aqueous liquids.
13. ml - "milliliter(s)". One milliliter is 1/1000 of a liter.
14. MPN - "Most Probable Number". Analytical method used for certain bacteriological tests in which bacteria are calculated from a statistical formula related to the bacterial count observed in a series of dilutions of the sample.
15. ND - "none detected". Usually used when the limits of detection of the method have not been definitely established.
16. NTU - "Nephelometric Turbidity Units".
17. ppb - "parts per Billion". One ppm is 1/1000 of a ppm.
18. ppm - "parts per million". One ppm is equivalent to one microgram per gram (ug/g), or one gram per million grams (g/kg). For aqueous liquids ppm equates to milligrams per liter (mg/L), because one liter of water has a weight very close to a kilogram. For gases or vapors, one ppm is equivalent to one microliter of gas per liter of gas (ul/L).
19. TNTC - "Too numerous to count". Indicates in certain bacteriological tests that the test has run "off scale".
20. ug - "microgram(s)". One-millionth of a gram.
21. ug/g - "microgram per gram". Equals "parts per million" (ppm) for solids and sludges.

GLOSSARY OF SYMBOLS AND ABBREVIATIONS-continued

22. ul - "microliter(s)". One microliter is 1/1000 of a milliliter or one-millionth of a liter.
23. ul/L - "Microliter of gas per liter". Equals "part per million" (ppm) for gases or vapors.
24. umhos/cm - "micromhos/cm". Used in reporting specific conduction of solutions.
25. N/R - "Not requested".
26. MGD - "Million gallons per year".

DATA QUALIFIERS

INORGANIC CHEMICAL DATA

B	Reported value is <CRDL, but >IDL
U	Compound was analyzed for, but not detected
E	Value is estimated due to matrix interferences
M	Duplicate injection precision criteria not met
N	Spiked sample recovery not within control limits
S	Reported value was determined by the Method of Standard Additions (MSA)
W	Post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is <50% of spike absorbance
*	Duplicate analysis was not within control limits
+	Correction coefficient for MSA was <0.995

ORGANIC CHEMICAL DATA

U	Compound was analyzed for, but not detected
J	Value is estimated, either for a tentatively identified compound (TIC) or when a compound is present (spectral identification criteria are met, but the value is <CRQL)
C	Pesticide results were confirmed by GC/MS
B	Analyte found in associated blank as well as in sample
E	Concentration exceeds calibration range of GC/MS instrument
D	Compound identified in an analysis at a secondary dilution factor
A	The TIC is a suspected aldol-condensation product
X	Additional flags defined separately

APPENDIX F
HYDRAULIC CONDUCTIVITY DATA

Time	Observed	Calculated	Residual	Weight
0.0833	0.646	0.57142	0.074575	1
0.1	0.576	0.57104	0.0049594	1
0.1166	0.562	0.57066	-0.00866	1

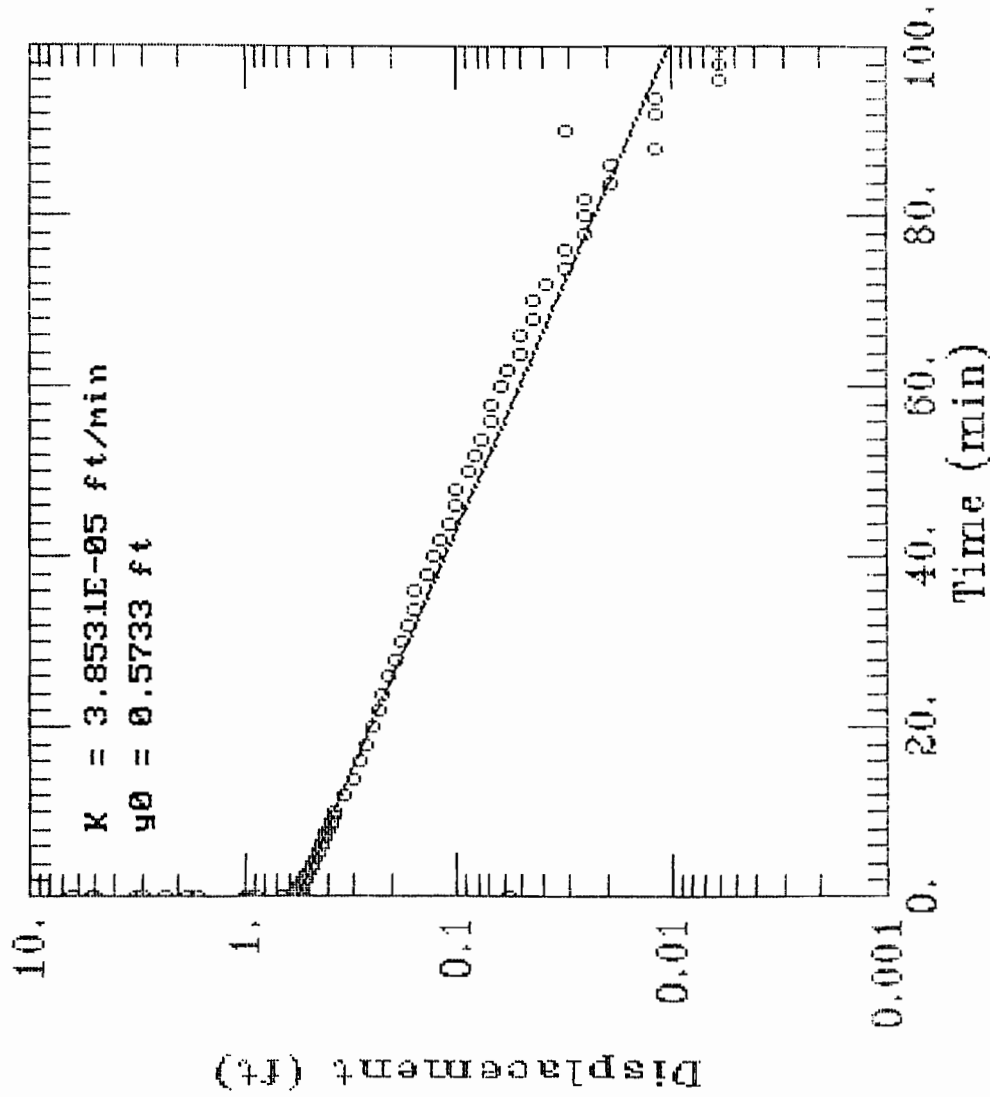
0.15	0.589	0.56989	0.019108	1
0.1666	0.589	0.56951	0.019489	1
0.1833	0.582	0.56913	0.012872	1
0.2	0.582	0.56875	0.013255	1
0.2166	0.582	0.56836	0.013635	1
0.2333	0.582	0.56798	0.014017	1
0.25	0.582	0.5676	0.014399	1
0.2666	0.582	0.56722	0.014779	1
0.2833	0.582	0.56684	0.01516	1
0.3	0.576	0.56646	0.0095412	1
0.3166	0.576	0.56608	0.0099199	1
0.3333	0.576	0.5657	0.010301	1
0.4166	0.576	0.5638	0.012195	1
0.5	0.57	0.56191	0.0080863	1
0.5833	0.57	0.56003	0.0099686	1
0.6666	0.563	0.55816	0.0048445	1
0.75	0.557	0.55628	0.00071642	1
0.8333	0.557	0.55442	0.0025798	1
0.9166	0.551	0.55256	-0.001563	1
1	0.551	0.55071	0.00029013	1
1.0833	0.544	0.54887	-0.0048651	1
1.1666	0.544	0.54703	-0.0030266	1
1.25	0.538	0.54519	-0.007192	1
1.3333	0.538	0.54337	-0.0053658	1
1.4166	0.532	0.54155	-0.0095457	1
1.5	0.532	0.53973	-0.0077295	1
1.5833	0.525	0.53792	-0.012922	1
1.6666	0.525	0.53612	-0.01112	1
1.75	0.525	0.53432	-0.0093216	1
1.8333	0.519	0.53253	-0.013532	1
1.9166	0.519	0.53075	-0.011748	1
2	0.513	0.52897	-0.015968	1
2.5	0.506	0.51842	-0.012421	1
3	0.487	0.50808	-0.021084	1
3.5	0.481	0.49795	-0.016954	1
4	0.468	0.48803	-0.020025	1
4.5	0.456	0.47829	-0.022295	1
5	0.449	0.46876	-0.019758	1
5.5	0.443	0.45941	-0.016412	1
6	0.43	0.45025	-0.020252	1
6.5	0.424	0.44127	-0.017274	1
7	0.411	0.43248	-0.021476	1
7.5	0.411	0.42385	-0.012853	1
8	0.399	0.4154	-0.016402	1
8.5	0.392	0.40712	-0.015119	1
9	0.386	0.399	-0.013002	1
9.5	0.38	0.39105	-0.011046	1
10	0.373	0.38325	-0.010249	1
12	0.335	0.35359	-0.018585	1
14	0.304	0.32622	-0.022218	1
16	0.285	0.30097	-0.015968	1
18	0.266	0.27767	-0.011673	1
20	0.247	0.25618	-0.0091807	1
22	0.234	0.23635	-0.0023521	1
24	0.221	0.21806	0.0029418	1
26	0.209	0.20118	0.0078197	1
28	0.196	0.18561	0.010391	1
30	0.183	0.17124	0.011758	1
32	0.171	0.15799	0.013012	1
34	0.158	0.14576	0.01224	1
36	0.158	0.13448	0.023522	1
38	0.139	0.12407	0.014931	1
40	0.126	0.11447	0.011534	1
42	0.12	0.10561	0.014394	1
44	0.107	0.097639	0.0095478	1

=====

VISUAL MATCH PARAMETER ESTIMATES

[illegible]

MW-13 FALLING



AQTESOLV

GERAGHTY
& MILLER, INC.

Modeling Group

A Q T E S O L V R E S U L T S

Version 1.10

07/17/91

09:26:55

TEST DESCRIPTION

Data set..... B:124MW13R.DAT

Data set title..... MW-13 RISING

Knowns and Constants:

No. of data points..... 103

Radius of well casing..... 0.08333

Radius of well..... 0.25

Aquifer saturated thickness..... 8.30

Well screen length..... 9.78

Static height of water in well..... 8.38

Log(Re/Rw)..... 2.694

A, B, C..... 0.000, 0.000, 2.267

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

Estimate	Std. Error

$$K = 2.2241E-006 \pm 3.2503E-007$$

$y_0 = 5.8538E+000 \pm 6.1942E-002$

ANALYSIS OF MODEL RESIDUALS

residual = calculated - observed

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals..... 98

Number of estimated parameters.... 2

Degrees of freedom..... 96

Residual mean..... 0.0002602

Residual standard deviation..... 0.4792

Residual variance..... 0.2296

Model Residuals:

Time	Observed	Calculated	Residual	Weight
4.62	7.09	5.8535	1.2365	1
0.0233	7.678	5.8535	1.8245	1
0.0244	7.578	5.8535	1.7245	1

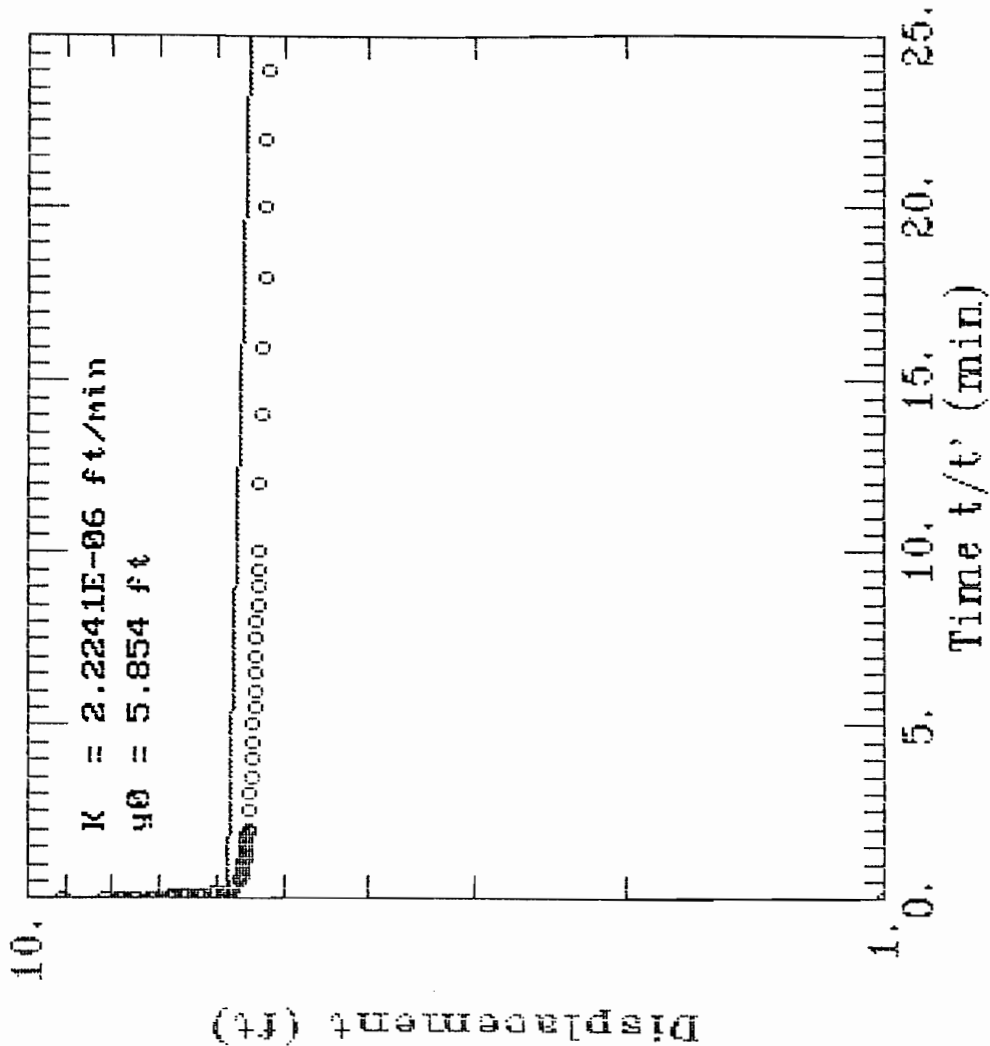
0.0333	7.431	5.8533	1.5777	1
0.05	7.109	5.8531	1.2559	1
0.0666	6.969	5.8529	1.1161	1
0.0833	6.792	5.8526	0.93936	1
0.1	6.621	5.8524	0.76858	1
0.1166	6.457	5.8522	0.60481	1
0.1333	6.311	5.852	0.45904	1
0.15	6.185	5.8517	0.33326	1
0.1666	6.077	5.8515	0.22549	1
0.1833	5.988	5.8513	0.13672	1
0.2	5.919	5.8511	0.067945	1
0.2166	5.868	5.8508	0.017171	1
0.2333	5.837	5.8506	-0.013602	1
0.25	5.805	5.8504	-0.045375	1
0.2666	5.786	5.8501	-0.064149	1
0.2833	5.767	5.8499	-0.082922	1
0.3	5.748	5.8497	-0.10169	1
0.3166	5.735	5.8495	-0.11447	1
0.3333	5.723	5.8492	-0.12624	1
0.4166	5.685	5.8481	-0.16311	1
0.5	5.659	5.847	-0.18797	1
0.5833	5.64	5.8458	-0.20584	1
0.6666	5.621	5.8447	-0.22371	1
0.75	5.609	5.8436	-0.23458	1
0.8333	5.602	5.8424	-0.24045	1
0.9166	5.59	5.8413	-0.25131	1
1	5.583	5.8402	-0.25718	1
1.0833	5.577	5.8391	-0.26205	1
1.1666	5.571	5.8379	-0.26692	1
1.25	5.564	5.8368	-0.27279	1
1.3333	5.558	5.8357	-0.27766	1
1.4166	5.552	5.8345	-0.28253	1
1.5	5.545	5.8334	-0.2884	1
1.5833	5.545	5.8323	-0.28727	1
1.6666	5.539	5.8311	-0.29214	1
1.75	5.533	5.83	-0.29701	1
1.8333	5.533	5.8289	-0.29588	1
1.9166	5.526	5.8277	-0.30175	1
2	5.526	5.8266	-0.30062	1
2.5	5.501	5.8198	-0.31885	1
3	5.488	5.8131	-0.32509	1
3.5	5.476	5.8063	-0.33033	1
4	5.463	5.7996	-0.33659	1
4.5	5.45	5.7928	-0.34285	1
5	5.444	5.7861	-0.34212	1
5.5	5.431	5.7794	-0.34839	1
6	5.425	5.7727	-0.34768	1
6.5	5.412	5.766	-0.35397	1
7	5.406	5.7593	-0.35327	1
7.5	5.4	5.7526	-0.35258	1
8	5.387	5.7459	-0.3589	1
8.5	5.381	5.7392	-0.35822	1
9	5.374	5.7326	-0.35855	1
9.5	5.368	5.7259	-0.35789	1
10	5.362	5.7192	-0.35724	1
12	5.349	5.6927	-0.34371	1
14	5.33	5.6663	-0.3363	1
16	5.305	5.64	-0.33501	1
18	5.292	5.6138	-0.32184	1
20	5.273	5.5878	-0.3146	1
22	5.26	5.5619	-0.30187	1
24	5.241	5.5361	-0.29507	1
26	5.235	5.5104	-0.27538	1
28	5.222	5.4848	-0.26282	1
30	5.21	5.4594	-0.24877	1

[illegible]

VISUAL MATCH PARAMETER ESTIMATES

[illegible]

MW--13 RISING



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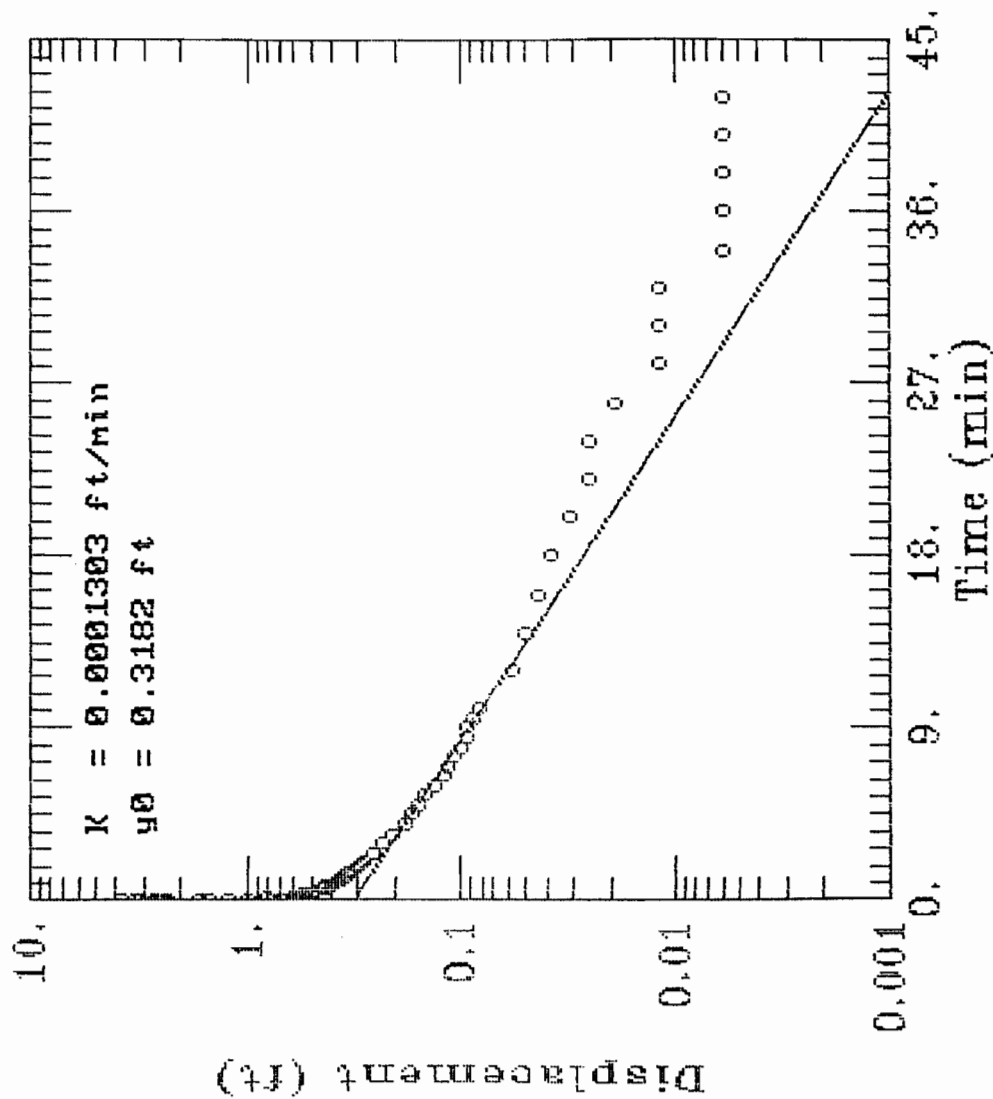
Time	Observed	Calculated	Residual	Weight
3	0.228	0.21135	0.016648	1
3.5	0.209	0.19742	0.011576	1
4	0.183	0.18441	-0.001411	1

3	0.138	0.16091	-0.0029063	1
5.5	0.145	0.1503	-0.0053021	1
6	0.133	0.1404	-0.0073987	1
6.5	0.12	0.13115	-0.011146	1
7	0.114	0.1225	-0.0085002	1
7.5	0.107	0.11443	-0.007427	1
8	0.101	0.10689	-0.0058858	1
8.5	0.095001	0.099844	-0.0048424	1
9	0.095001	0.093264	0.0017376	1
9.5	0.088001	0.087117	0.00088404	1
10	0.082001	0.081376	0.00062471	1
12	0.056999	0.061953	-0.0049541	1
14	0.049999	0.047166	0.0028328	1
16	0.043999	0.035909	0.0080899	1
18	0.038002	0.027338	0.010664	1
20	0.031002	0.020813	0.010189	1
22	0.025002	0.015845	0.009156	1
24	0.025002	0.012064	0.012938	1
26	0.019001	0.0091842	0.0098168	1
28	0.012001	0.0069921	0.0050089	1
30	0.012001	0.0053233	0.0066777	1
32	0.012001	0.0040527	0.0079483	1
34	0.0060005	0.0030854	0.0029151	1
36	0.0060005	0.002349	0.0036515	1
38	0.0060005	0.0017883	0.0042122	1
40	0.0060005	0.0013615	0.004639	1
42	0.0060005	0.0010365	0.004964	1
46	0.0060005			

MW-14 FALLING

$K = 0.0001303 \text{ ft/min}$

$y_0 = 0.3182 \text{ ft}$



AQTESOLV

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& MILLER, INC.

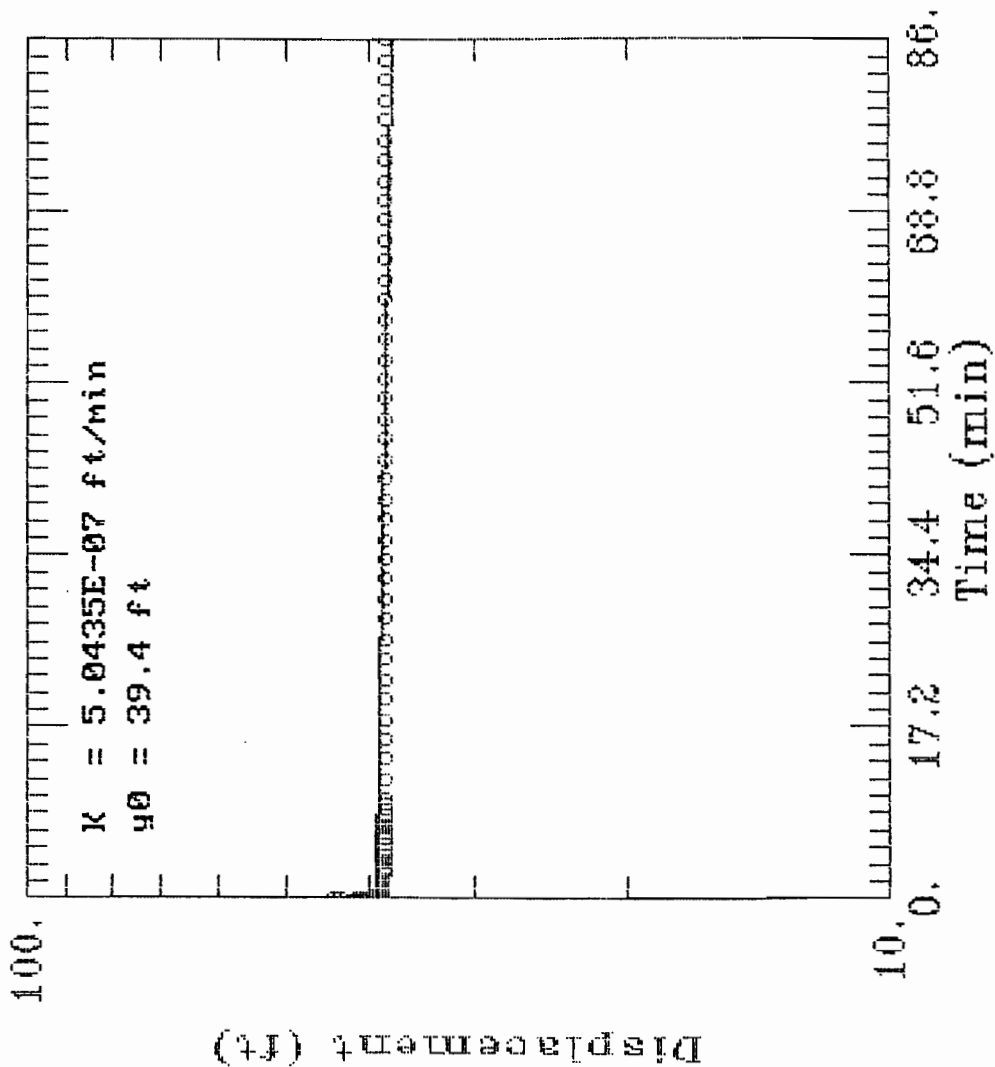
Modeling Group

Time	Observed	Calculated	Residual	Weight
0.0033	43.165	39.396	3.7691	1
0.0066	43.965	39.396	4.5692	1
0.01	40.569	39.396	1.1737	1

0.0166	41.448	39.396	2.0524	1
0.02	41.372	39.396	1.9765	1
0.0233	41.416	39.395	2.0206	1
0.0266	41.315	39.395	1.9196	1
0.03	41.347	39.395	1.9517	1
0.0333	41.284	39.395	1.8888	1
0.05	41.068	39.395	1.6731	1
0.0666	40.936	39.395	1.5415	1
0.0833	40.708	39.394	1.3138	1
0.1	40.55	39.394	1.1561	1
0.1166	40.385	39.394	0.99149	1
0.1333	40.297	39.393	0.90384	1
0.15	40.183	39.393	0.79019	1
0.1666	40.088	39.392	0.69553	1
0.1833	39.993	39.392	0.60688	1
0.2	39.904	39.392	0.51223	1
0.2166	39.816	39.391	0.42457	1
0.2333	39.74	39.391	0.34892	1
0.25	39.664	39.391	0.27327	1
0.2666	39.594	39.39	0.20361	1
0.2833	39.531	39.39	0.14096	1
0.3	39.468	39.39	0.078306	1
0.3166	39.411	39.389	0.021651	1
0.3333	39.354	39.389	-0.035001	1
0.4166	39.1	39.387	-0.28727	1
0.5	38.904	39.386	-0.48154	1
0.5833	38.752	39.384	-0.6318	1
0.6666	38.67	39.382	-0.71207	1
0.75	38.632	39.38	-0.74834	1
0.8333	38.613	39.379	-0.76561	1
0.9166	38.6	39.377	-0.77688	1
1	38.594	39.375	-0.78114	1
1.0833	38.581	39.373	-0.79241	1
1.1666	38.569	39.372	-0.80268	1
1.25	38.556	39.37	-0.81395	1
1.3333	38.55	39.368	-0.81822	1
1.4166	38.537	39.366	-0.82949	1
1.5	38.531	39.365	-0.83375	1
1.5833	38.518	39.363	-0.84502	1
1.6666	38.518	39.361	-0.84329	1
1.75	38.505	39.36	-0.85456	1
1.8333	38.499	39.358	-0.85883	1
1.9166	38.486	39.356	-0.8701	1
2	38.486	39.354	-0.86837	1
2.5	38.455	39.344	-0.88898	1
3	38.417	39.334	-0.9166	1
3.5	38.404	39.323	-0.91922	1
4	38.385	39.313	-0.92784	1
4.5	38.366	39.302	-0.93647	1
5	38.353	39.292	-0.9391	1
5.5	38.341	39.282	-0.94073	1
6	38.328	39.271	-0.94337	1
6.5	38.322	39.261	-0.939	1
7	38.315	39.251	-0.93564	1
7.5	38.309	39.24	-0.93129	1
8	38.303	39.23	-0.92693	1
8.5	38.296	39.22	-0.92358	1
9	38.296	39.209	-0.91323	1
9.5	38.29	39.199	-0.90889	1
10	38.284	39.189	-0.90454	1
12	38.29	39.147	-0.8572	1
14	38.277	39.106	-0.82889	1
16	38.277	39.065	-0.78763	1
18	38.271	39.023	-0.75242	1
20	38.265	39.022	-0.71795	1

24	38.238	38.7	-0.04203	1
26	38.265	38.859	-0.59399	1
28	38.258	38.816	-0.55999	1
30	38.258	38.777	-0.51904	1
32	38.265	38.736	-0.47112	1
34	38.258	38.695	-0.43726	1
36	38.252	38.654	-0.40243	1
38	38.252	38.614	-0.36165	1
40	38.258	38.573	-0.31491	1
42	38.258	38.532	-0.27421	1
44	38.258	38.492	-0.23356	1
46	38.258	38.451	-0.19294	1
48	38.258	38.41	-0.15238	1
50	38.258	38.37	-0.11185	1
52	38.258	38.329	-0.071369	1
54	38.258	38.289	-0.030929	1
56	38.258	38.249	0.0094685	1
58	38.258	38.208	0.049823	1
60	38.258	38.168	0.090135	1
62	38.258	38.126	0.1304	1
64	38.258	38.087	0.17063	1
66	38.252	38.047	0.20482	1
68	38.252	38.007	0.24496	1
70	38.265	37.967	0.29806	1
72	38.258	37.927	0.33112	1
74	38.258	37.887	0.37113	1
76	38.258	37.847	0.4111	1
78	38.252	37.807	0.44504	1
80	38.258	37.767	0.49092	1
82	38.265	37.727	0.53777	1
84	38.258	37.68		

MW-14 RISING



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& MILLER, INC.

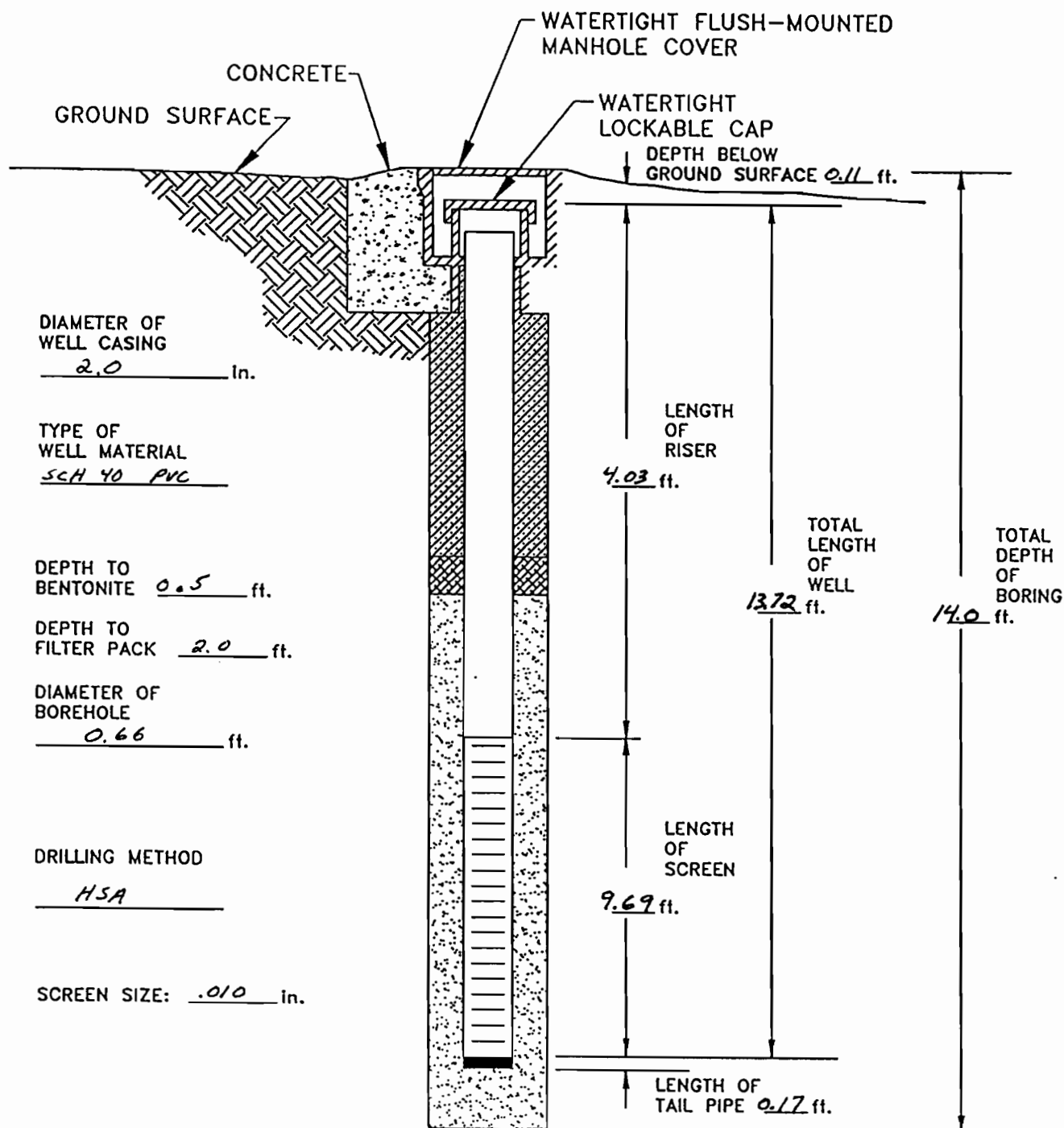
Modeling Group

APPENDIX G
WELL CONSTRUCTION RECORDS

BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASS27 (ARA)
 WELL No.: MW-8
 DRILLING CO.: ATEL

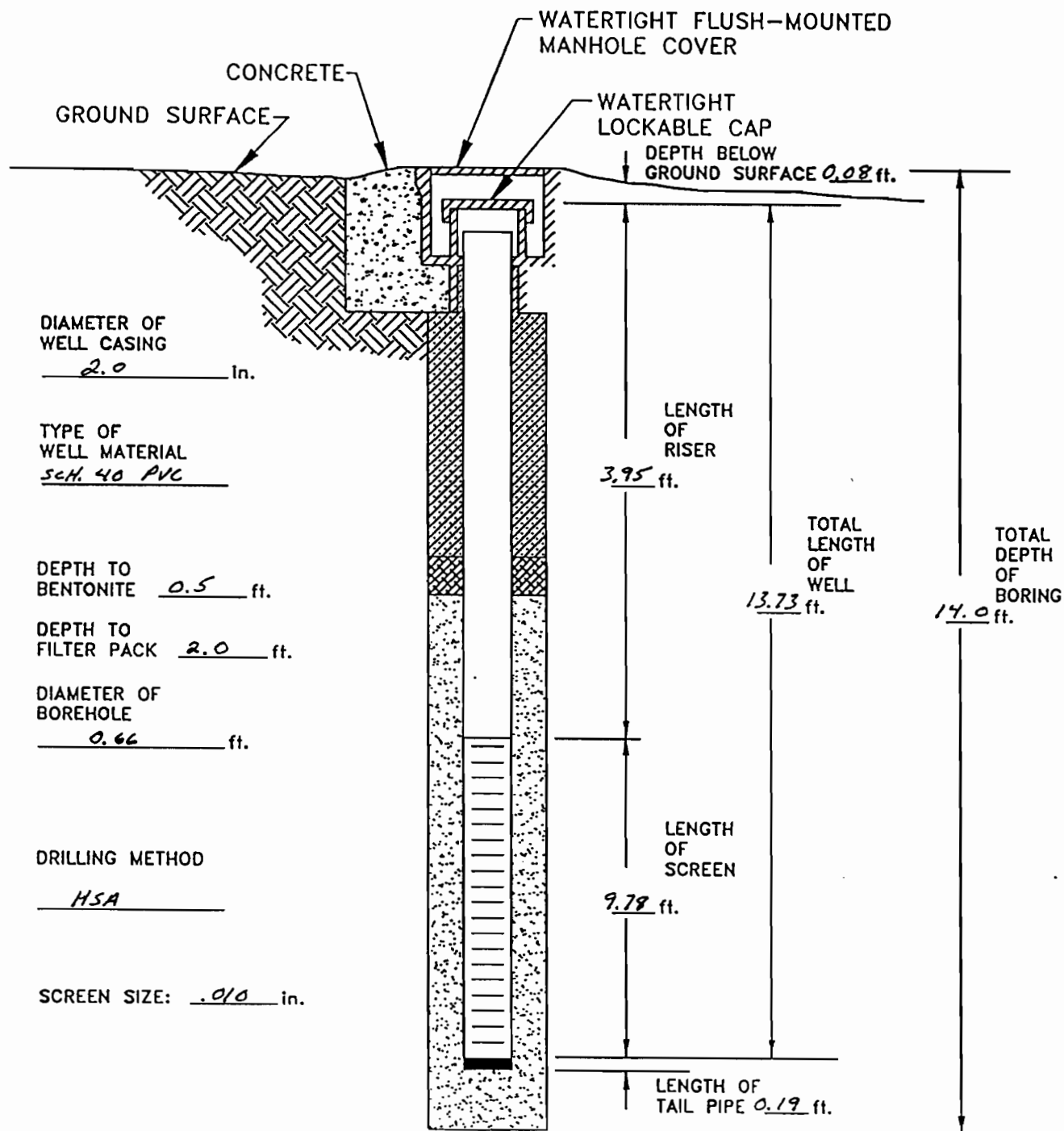
DATE STARTED: 6-18-92
 DATE COMPLETED: 6-18-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: PUMP



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASS27 (AEA)
 WELL No.: MN-9
 DRILLING CO.: ATEC

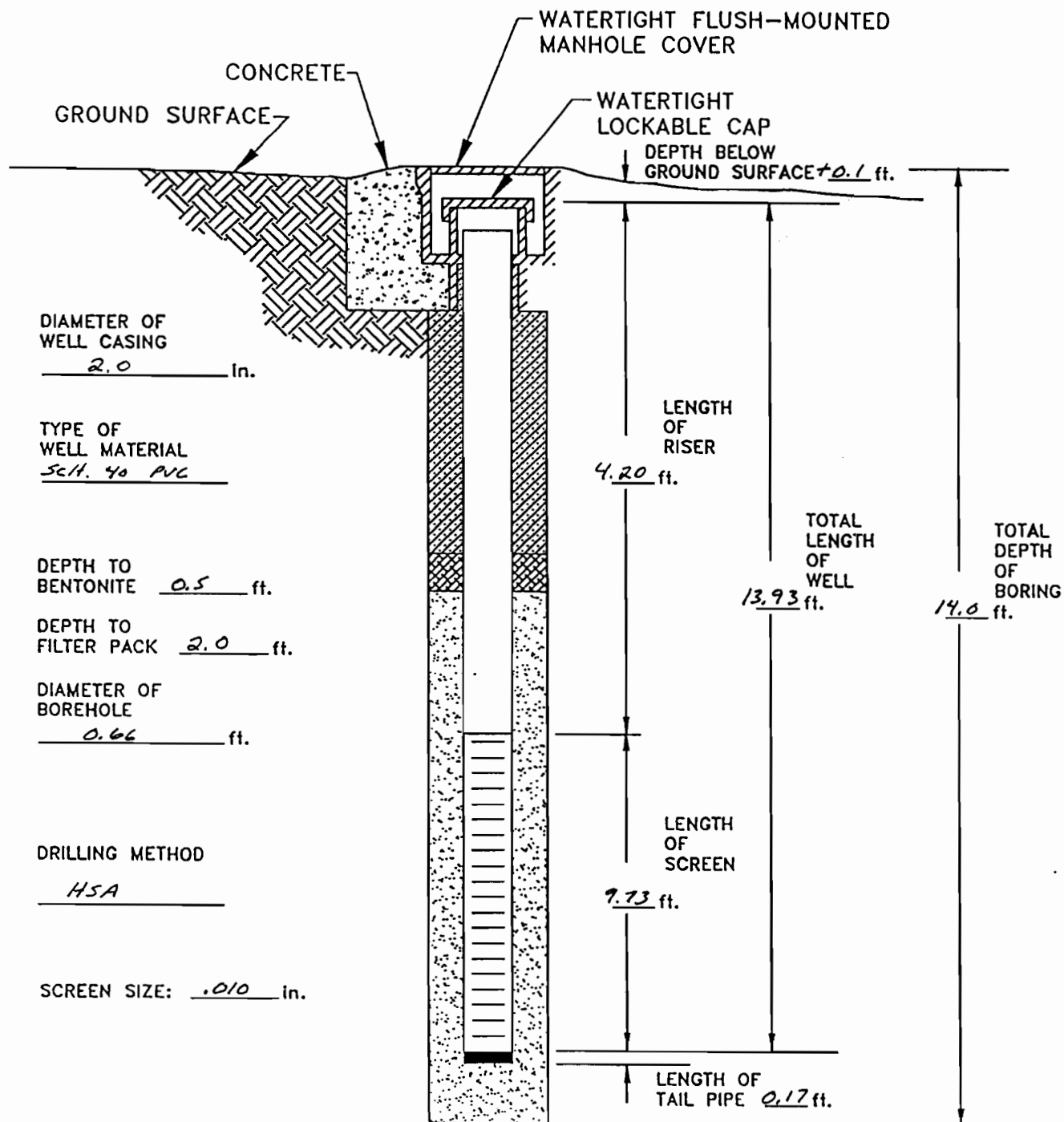
DATE STARTED: 6-18-92
 DATE COMPLETED: 6-18-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: PUMP



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: A5527 (AEA)
 WELL No.: MW-10
 DRILLING CO.: ATEL

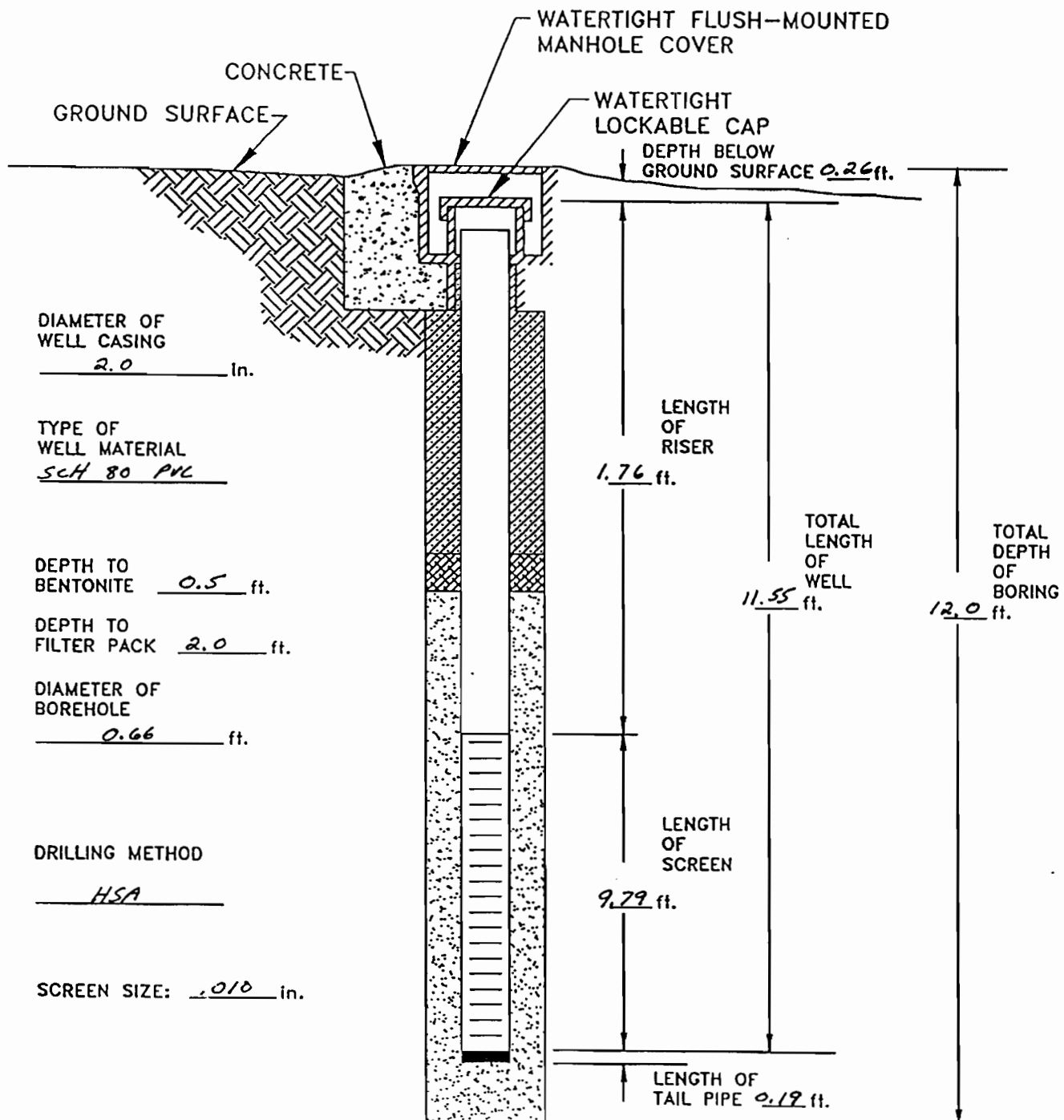
DATE STARTED: 6-18-92
 DATE COMPLETED: 6-18-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: Pump



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASS27 (ARA)
 WELL No.: MW-11
 DRILLING CO.: ATEL

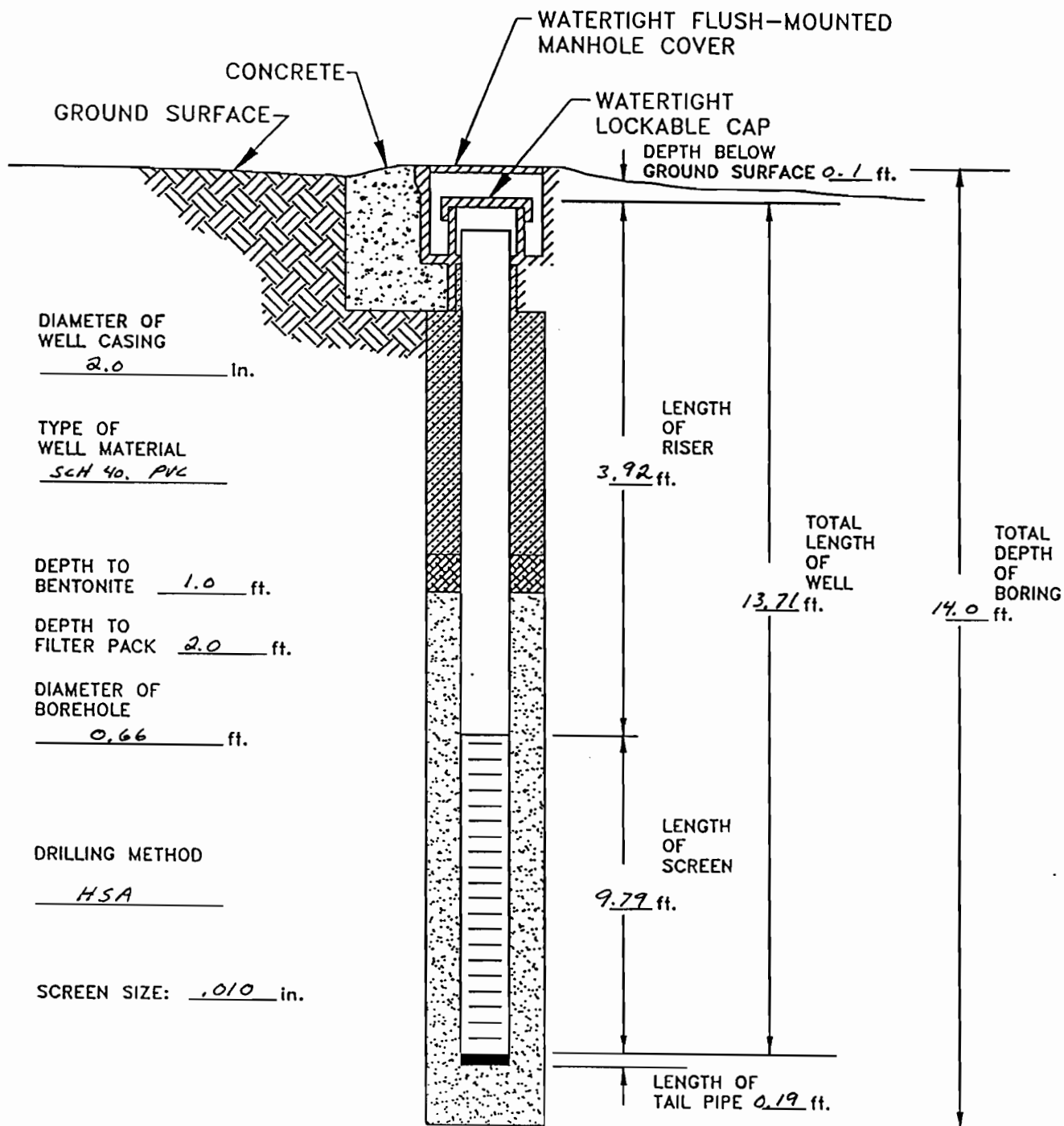
DATE STARTED: 6-21-92
 DATE COMPLETED: 6-22-92
 DATE DEVELOPED: 6-23-92
 DEVELOPMENT METHOD: PUMP



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASS27 (ARA)
 WELL No.: 17W-12
 DRILLING CO.: ATEC

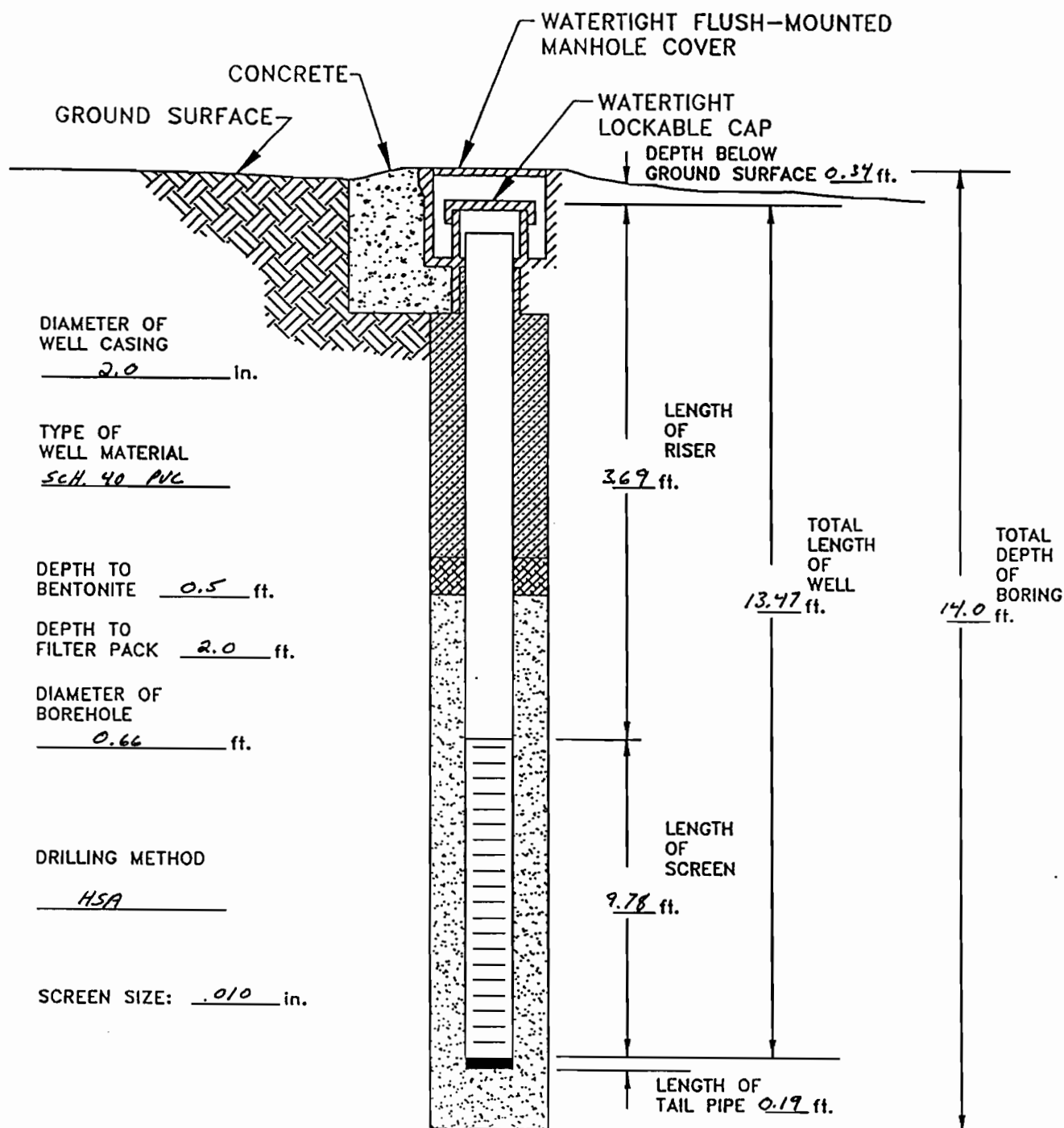
DATE STARTED: 6-18-92
 DATE COMPLETED: 6-18-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: Pump



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASS27 (ARQ)
 WELL No.: MW-13
 DRILLING CO.: ATEC

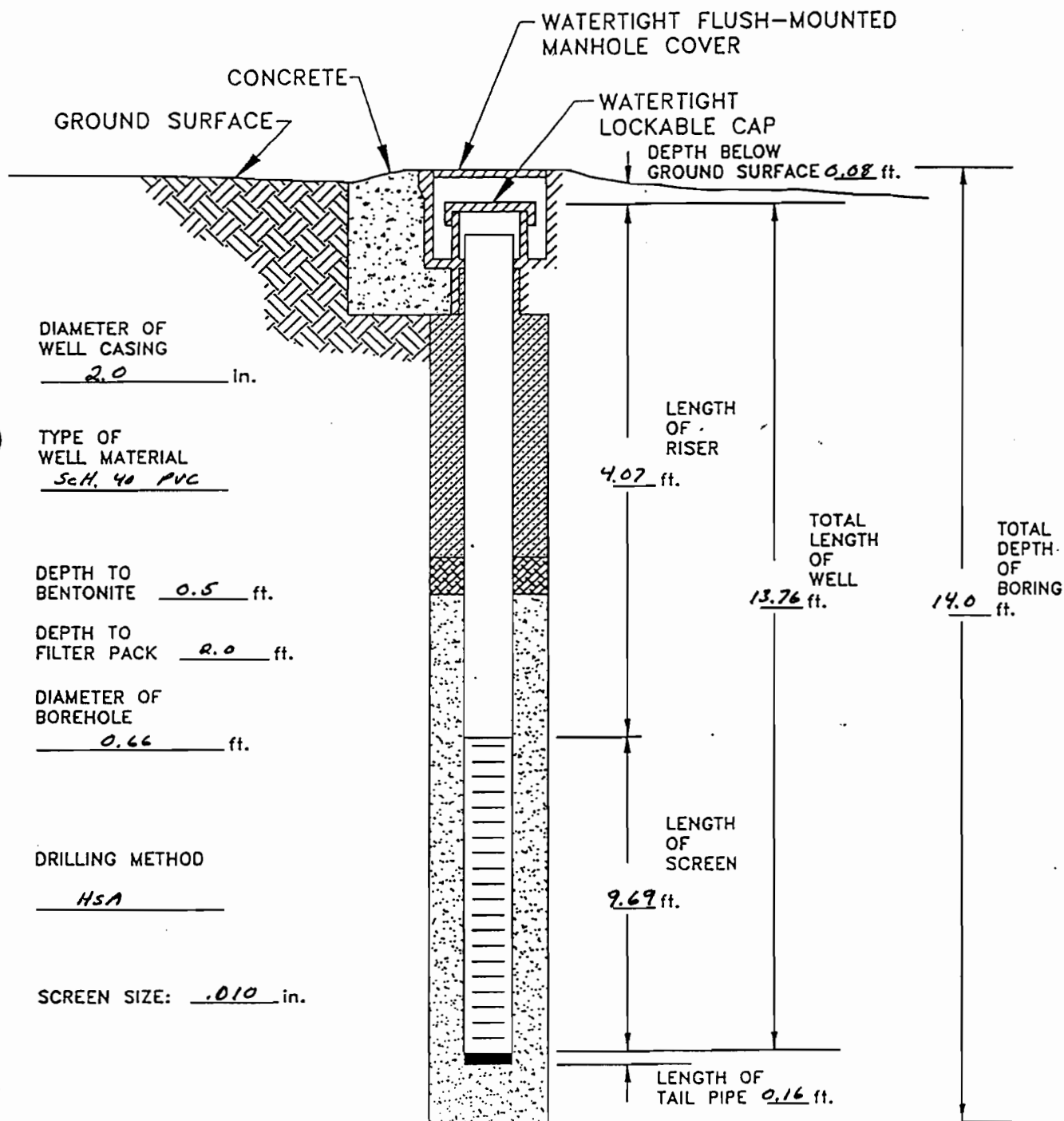
DATE STARTED: 6-18-92
 DATE COMPLETED: 6-18-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: PUMP



BELOW GRADE TYPE II MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: ASSR7 (AR)
 WELL No.: MW-14
 DRILLING CO.: ATEC

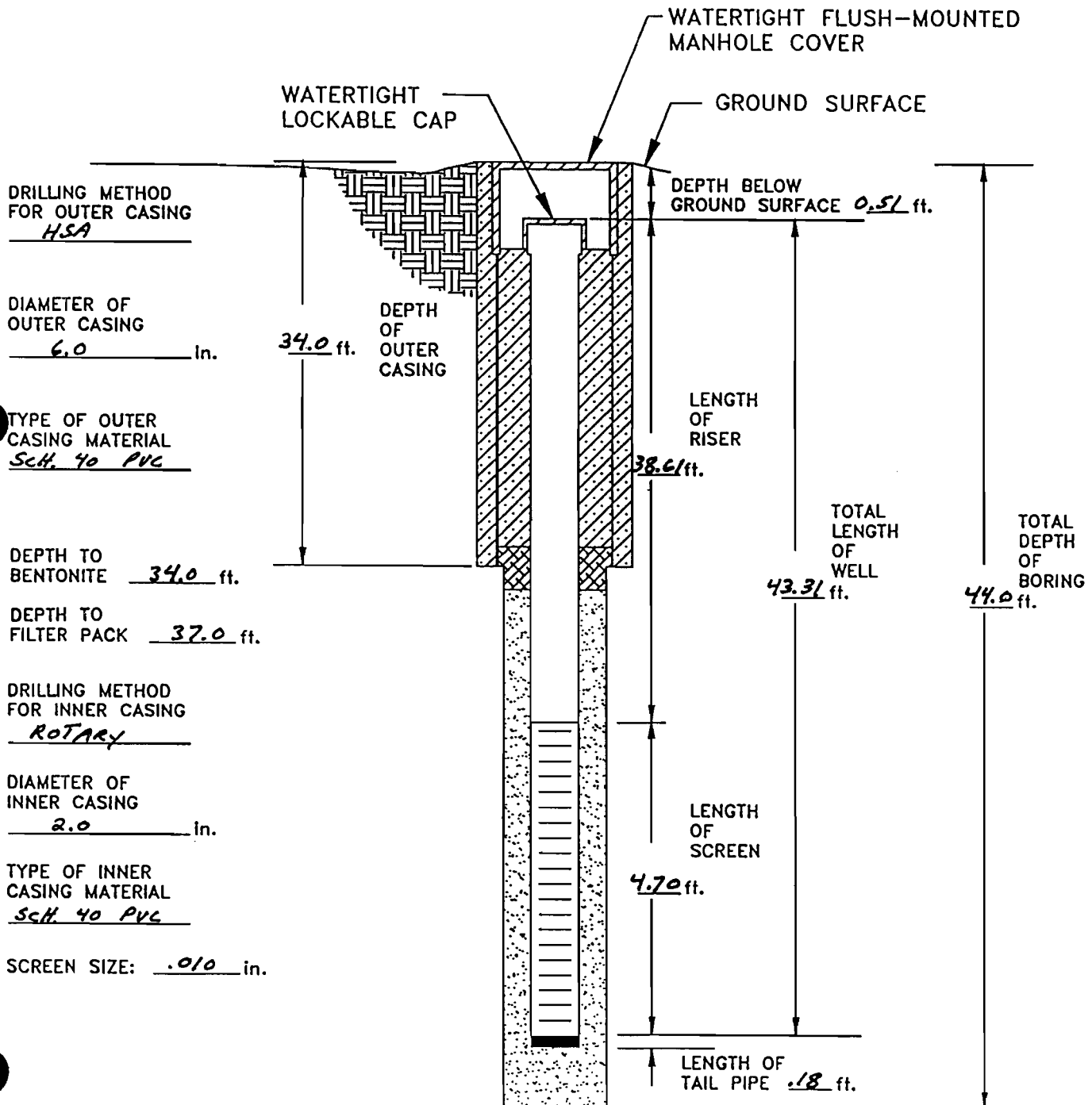
DATE STARTED: 6-17-92
 DATE COMPLETED: 6-17-92
 DATE DEVELOPED: 6-22-92
 DEVELOPMENT METHOD: PUMP



BELOW GRADE TYPE III MONITORING WELL

PROJECT No.: 19124
 PROJECT NAME: AS-527 (ARA)
 WELL No.: DW-5
 DRILLING CO.: ATEC

DATE STARTED: 6-20-92
 DATE COMPLETED: 6-22-92
 DATE DEVELOPED: 6-23-92
 DEVELOPMENT METHOD: PUMP



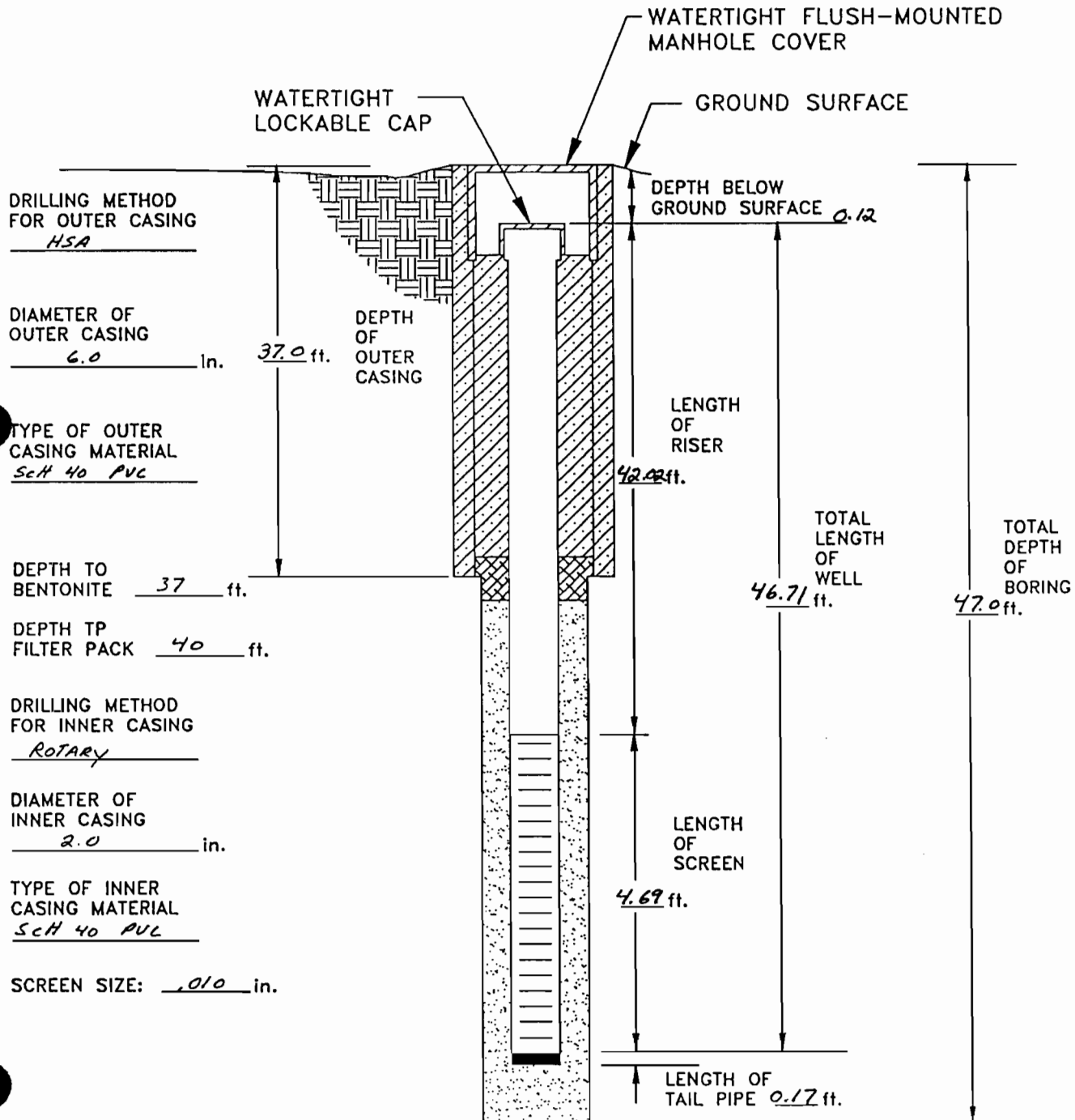
Baker

Baker Environmental, Inc.

BELOW GRADE TYPE III MONITORING WELL

PROJECT No.: 19124
PROJECT NAME: AS-527 (ARA)
WELL No.: DW 6
DRILLING CO.: ATEC

DATE STARTED: 6-19-92
DATE COMPLETED: 6-20-92
DATE DEVELOPED: 6-22-92
DEVELOPMENT METHOD: PUMP

BAKER ENVIRONMENTAL REPRESENTATIVE: KENNETH A. TUA

APPENDIX H
PENETROMETER RECORDS

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>K. Tug</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-21</u>	Elevation: Surface	
Date	<u>6-17-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>x</u>	Pushed	<u></u> Hammered
Sampling Mode:	<u>x</u>	Hydrocarbon	<u></u> Groundwater
Time Installed	<u>0900</u>		

SAMPLING

Amount of Sample Collected	<u>1 Liter</u>	
Visual Appearance	<u>slightly cloudy</u>	
Odor Detected	<u></u> Yes <u>x</u> No	
Product Detected	<u></u> Yes <u>x</u> No	
Time Sampled	<u>0915</u>	

HANBY RESULTS

Color of Precipitate	<u>Red</u>
Concentration (PPM)	<u>20</u>
Type of Hydrocarbon Source	<u>JP-5</u>

COMMENTS

Fifteen minute recovery of 1 Liter plus

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>K. Tug</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-22</u>	Elevation: Surface	<u></u>
Date	<u>6-16-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>X</u>	Pushed	<u></u> Hammered
Sampling Mode:	<u>X</u>	Hydrocarbon	<u></u> Groundwater
Time Installed	<u>1120</u>		

SAMPLING

Amount of Sample Collected	<u>1 Liter</u>		
Visual Appearance	<u>slightly cloudy</u>		
Odor Detected	<u></u> Yes	<u>X</u> No	
Product Detected	<u></u> Yes	<u>X</u> No	
Time Sampled	<u>1140</u>		

HANBY RESULTS

Color of Precipitate	<u>white</u>
Concentration (PPM)	<u>0</u>
Type of Hydrocarbon Source	<u>JP-5 (suspected)</u>

COMMENTS

Twenty minute recovery of 1 Liter plus

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>J. Culp</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-23</u>	Elevation: Surface	<u></u>
Date	<u>6-16-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>x</u>	Pushed	<u></u> Hammered
Sampling Mode:	<u>x</u>	Hydrocarbon	<u></u> Groundwater
Time Installed	<u>1230</u>		

SAMPLING

Amount of Sample Collected	<u>500 ml</u>		
Visual Appearance	<u>cloudy</u>		
Odor Detected	<u>Yes</u>	<u>x</u>	No
Product Detected	<u>Yes</u>	<u>x</u>	No
Time Sampled	<u>1240</u>		

HANBY RESULTS

Color of Precipitate	<u>white</u>
Concentration (PPM)	<u>0</u>
Type of Hydrocarbon Source	<u>JP-5 (suspected)</u>

COMMENTS

Ten minute recovery of 500 ml.

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>J. Culp</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-24</u>	Elevation: Surface	
Date	<u>6-16-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>x</u>	Pushed	<u> </u> Hammered
Sampling Mode:	<u>x</u>	Hydrocarbon	<u> </u> Groundwater
Time Installed	<u>1325</u>		

SAMPLING

Amount of Sample Collected	<u>500 ml</u>		
Visual Appearance	<u>cloudy</u>		
Odor Detected	<u> </u> Yes	<u>ix</u> No	
Product Detected	<u> </u> Yes	<u>x</u> No	
Time Sampled	<u>1335</u>		

HANBY RESULTS

Color of Precipitate	<u>white</u>		
Concentration (PPM)	<u>0</u>		
Type of Hydrocarbon Source	<u>JP-5 (suspected)</u>		

COMMENTS

Ten minute recovery of 500 ml.

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>K. Tuq</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-25</u>	Elevation: Surface	
Date	<u>6-17-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>x</u>	Pushed	<u> </u> Hammered
Sampling Mode:	<u>x</u>	Hydrocarbon	<u> </u> Groundwater
Time Installed	<u>0946</u>		

SAMPLING

Amount of Sample Collected	<u>1 Liter</u>		
Visual Appearance	<u>black - cloudy</u>		
Odor Detected	<u> </u> Yes	<u> </u> <u>x</u> No	
Product Detected	<u> </u> Yes	<u> </u> <u>x</u> No	
Time Sampled	<u>1000</u>		

HANBY RESULTS

Color of Precipitate	<u>pink</u>		
Concentration (PPM)	<u>5</u>		
Type of Hydrocarbon Source	<u>JP-5</u>		

COMMENTS

Fourteen minute recovery of 1 Liter plus

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>K. Tua</u>
Project Name	<u>ARS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-26</u>	Elevation: Surface	
Date	<u>6-17-82</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>x</u>	Pushed	<u> </u> Hammered
Sampling Mode:	<u>x</u>	Hydrocarbon	<u> </u> Groundwater
Time Installed	<u>1125</u>		

SAMPLING

Amount of Sample Collected	<u>1 Liter</u>
Visual Appearance	<u>black - cloudy</u>
Odor Detected	<u> </u> Yes <u> </u> <u>x</u> No
Product Detected	<u> </u> Yes <u> </u> <u>x</u> No
Time Sampled	<u>1140</u>

HANBY RESULTS

Color of Precipitate	<u>white</u>
Concentration (PPM)	<u>0</u>
Type of Hydrocarbon Source	<u>JP-5 (suspected)</u>

COMMENTS

Fifteen minute recovery of 1 liter plus

PENETROMETER RECORD

Project No.	<u>19124</u>	Baker Representative	<u>K. Tuq</u>
Project Name	<u>APS</u>	Total Depth of Probe	<u>15'</u>
Hydropunch No.	<u>HP-27</u>	Elevation: Surface	<u></u>
Date	<u>6-17-92</u>		

INSTALLATION

Drilling Co.	<u>ATEC</u>		
Type of Rig	<u>B-61</u>		
Method:	<u>X</u>	Pushed	<u></u> Hammered
Sampling Mode:	<u>X</u>	Hydrocarbon	<u></u> Groundwater
Time Installed	<u>1030</u>		

SAMPLING

Amount of Sample Collected	<u>1 Liter</u>	
Visual Appearance	<u>black - cloudy</u>	
Odor Detected	<u>Yes</u>	<u>X</u> No
Product Detected	<u>Yes</u>	<u>X</u> No
Time Sampled	<u>1050</u>	

HANBY RESULTS

Color of Precipitate	<u>white</u>
Concentration (PPM)	<u>0</u>
Type of Hydrocarbon Source	<u>JP-5 (suspected)</u>

COMMENTS

Twenty minute recovery of 1 liter plus