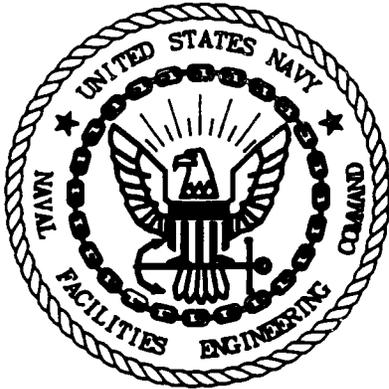


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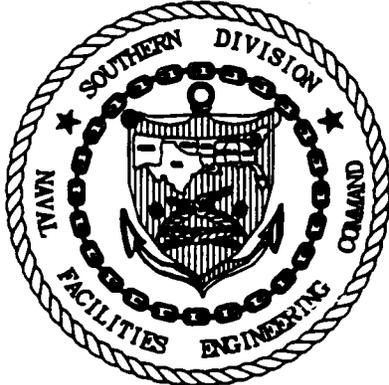
**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
NAVAL AIR STATION MEMPHIS
MILLINGTON, TENNESSEE**

**FINAL ENVIRONMENTAL ASSESSMENT REPORT
FLYING CLUB UST SITE
FACILITY I.D. #0-790479**

Prepared for

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

**SOUTH DIV CONTRACT NUMBER:
N62467-89-D-0318**

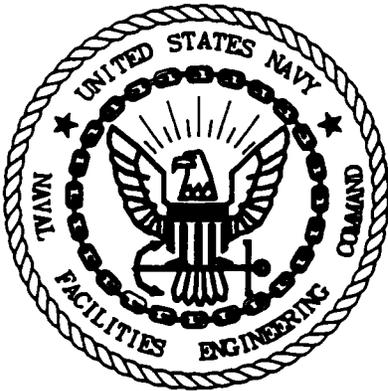


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OCTOBER 13, 1993

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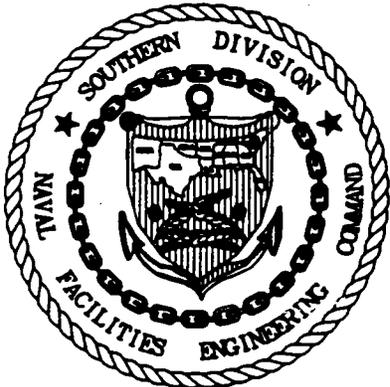
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ACRONYMS AND SYMBOLS

TITLE	DEFINITION
ACGIH	American Council of Governmental and Industrial Hygienists
ADI	Average Daily Intake
ARAR	Applicable or Relevant and Appropriate Requirements
ASTM	American Society of Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and Total Xylenes
BW	Body Weight
CAG	Carcinogenic Assessment Group
CAP	Corrective Action Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator (Explosimeter)
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	USEPA Contract Laboratory Program
CPC	Chemical-Protective Clothing
CPR	Cardiopulmonary Resuscitation
CSEP	Confined Space Entry Permit
CV	Coefficient of Variation
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
DP	Duplicate (sample)
DQO	Data Quality Objective
DRO	Diesel Range Organics
E/A&H	EnSafe/Allen & Hoshall
EFD	Engineering Field Division
EIC	Engineer-in-Charge
EP	Extraction Procedure/Exposure Period
EPA	United States Environmental Protection Agency
FB	Field Blank
FID	Flame Ionization Detector
GC	Gas Chromatography
GRO	Gasoline Range Organics
GW	Groundwater (sample)
HASP	Health and Safety Plan
HSWA	Hazardous and Solid Waste Amendments of 1984
IDLH	Immediately Dangerous to Life and Health
IR	Average Soil Ingestion Rate
LEL	Lower Expositive Limit
LQAC	Laboratory Quality Assurance Coordinator
mg/kg	Milligrams/Kilogram
mg/L	Milligrams/Liter
MS	Matrix Spike
MSD	Matrix Spike Duplicate

MSA	Mine Safety Administration
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
MW	Monitoring Well
NAS	Naval Air Station
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Contingency Plan
NCR	NEESA Contract Representative
NEESA	Naval Energy and Environmental Support Activity
NFA	No Further Action
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PEL	Permissible Exposure Limit
PID	Photoionization Detector
ppb	Parts per Billion
PPE	Personal Protective Equipment
ppm	Parts per Million
PVC	Poly Vinyl Chloride
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan (QAP)
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
R	Acceptable Incremental Lifetime Cancer Risk
RB	Rinsate Blank
RCRA	Resource Conservation and Recovery Act
SB	Soil Boring
SCBA	Self Contained Breathing Apparatus
SG	Soil Gas
SOP	Standard Operating Procedure
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual (USEPA Region IV Environmental Compliance Branch)
SOUTHDIV	Southern Division, Naval Facilities Engineering Command
SOW	Statement of Work
SVOC	Semivolatile Organic Compounds
TB	Trip Blank
TCLP	Toxicity Characteristic Leaching Procedure
TDEC	Tennessee Department of Environment and Conservation
TDS	Total Dissolved Solids
TLV	Threshold Limit Value
TPH	Total Petroleum Hydrocarbons
UEL	Upper Explosive Limit
ug/L	Micrograms/liter
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WBGTT	Wet Globe Bulb Temperature Index

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EXECUTIVE SUMMARY

The Department of the Navy's Engineering Field Division, Southern Division Naval Facilities Engineering Command (SOUTHDIV) is providing engineering support and contract services to the Naval Air Station (NAS) Memphis, Millington, Tennessee in support of their compliance with the Tennessee Department of Environment and Conservation (TDEC) Underground Storage Tank Division regulations.

This Environmental Assessment Report (EAR) presents the findings of the assessment of petroleum hydrocarbon contamination associated with the underground storage tank (UST) located at the former Flying Club facility, NAS Memphis.

The following conclusions and recommendations are based on information gathered during the assessment.

Conclusions:

- A petroleum release has occurred from Tanks 1205N and 1205S at the Flying Club UST site. However, these tanks have been removed from the site.
- Permeabilities of soil samples collected in native soil outside the tank pit exhibited average hydraulic conductivities ranging from 1.1×10^{-6} cm/sec to 3.5×10^{-6} cm/sec, which are typical permeabilities for clay. TDEC has established that cleanup levels for soil in a "non-drinking water aquifer" within this permeability range are 500 ppm (parts per million) for BTX (Benzene, Toluene, & Xylenes) and 1000 ppm for TPH. Groundwater clean-up levels for the "non-drinking water" classification are 0.070 ppm for benzene and 1.0 ppm for TPH (Total Petroleum Hydrocarbons).
- BTX and TPH concentrations in soil did not exceed the TDEC cleanup level for a non-drinking water aquifer in any of the analyzed soil samples.

- TPH and benzene concentrations in groundwater exceeded the TDEC cleanup levels for a non-drinking water aquifer in three monitoring wells. Contamination has apparently migrated approximately 120 ft. southwest of the tank pit. Petroleum hydrocarbons were not detected in the other three wells.
- The groundwater flow direction beneath the site is in a southwesterly direction and has a calculated hydraulic gradient ranging from 0.025 to 0.055 ft/ft.
- Depth to the static water table beneath the site ranges from 10.5 to 12.5 feet below grade.
- Free product was not detected in any monitoring wells.
- The aquifer can be classified as non-drinking water based on a water use survey in the vicinity of the site and water samples collected near the site which did not meet several primary and secondary drinking water standards.

Recommendations:

- EnSafe/Allen & Hoshall (E/A&H) recommends the development of a Corrective Action Plan to determine the best course of action to remediate groundwater contamination at the site.
- The release detection wells for the former tanks are still present at the site and should be abandoned in accordance with TDEC UST Guidance to protect the surficial aquifer from surface water runoff.

1.0 INTRODUCTION

On March 3, 1993, E/A&H was tasked by the Department of the Navy to conduct an Environmental Assessment at the Flying Club UST facility located on Eniwetok Street at the Naval Air Station in Millington, Tennessee. The purpose of this investigation was to measure the nature and extent of petroleum hydrocarbon contamination in the site subsurface. The source of the release was reportedly two leaking tanks, Tank Nos. 1205N and 1205S. The quantity of the suspected release is not known. This investigation has been completed in accordance with the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract.

1.1 Objectives and Scope

The objectives of the Environmental Assessment were in accordance with the TDEC's UST Division Environmental Assessment Guidelines (1/92).

Objectives:

- Determine whether soil and/or groundwater were contaminated.
- Determine the horizontal and vertical extent of contamination, if any.
- Determine the extent and thickness of free phase product, if any.
- Describe the geology and hydrogeology beneath the site and their relationship to the contamination.
- Collect adequate information in order for corrective action measures (if needed) to be developed.

The scope of work in this investigation included the following:

- Completion of a soil screening survey over the site using a KVA soil sampler and a portable infrared spectrophotometer to determine optimum monitoring well and soil boring locations.
- Installation of eight soil borings and five monitoring wells into the surficial aquifer to determine site-specific geologic and hydrogeologic characteristics.

- Determination of the groundwater classification (drinking or non-drinking) through a water use survey in the site vicinity and water quality analyses.
- Laboratory analysis of select soil and water samples for benzene, toluene, ethylbenzene, and xylene (BTEX), and Total Petroleum Hydrocarbons (TPH) subdivided into Gasoline Range Organics (GRO) and Diesel Range Organics (DRO).
- Laboratory analysis of select soil and water samples for various parameters to aid in the design of remedial alternatives, if necessary. These are included as Appendix A.
- Identification of potential contamination pathways and receptors.

1.2 Background Information/Previous Work

In March 1992, National Salvage and Services Corporation was contracted to remove and provide proper closure documentation for USTs 1205N and 1205S. After excavation and removal of the tanks, soil samples taken from the bottom of the pit at each corner of each tank indicated the presence of both DRO and GRO. Table 1-1 lists the sample locations and analytical results.

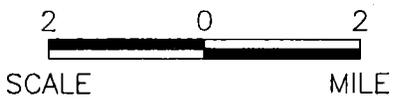
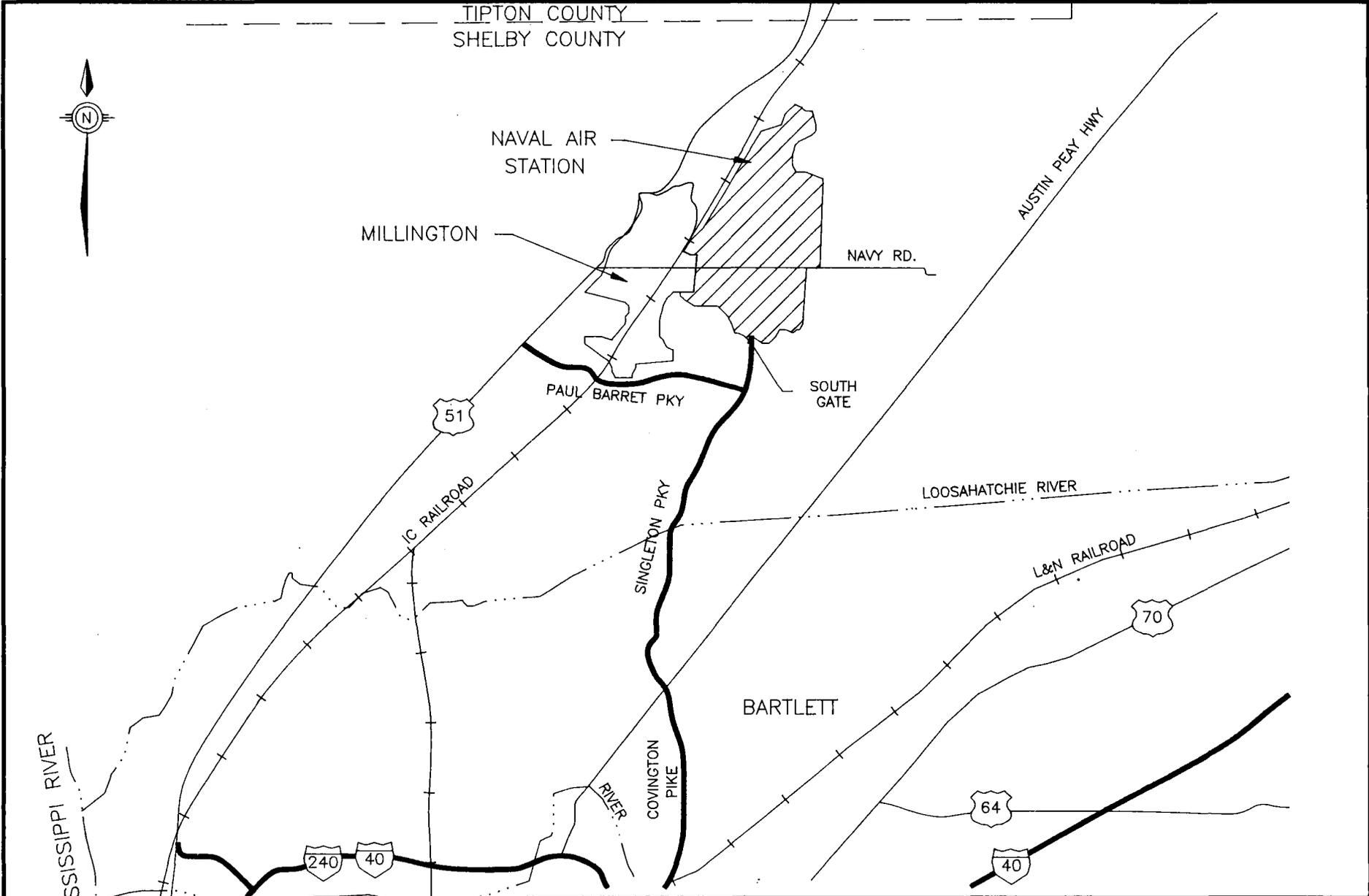
Table 1-1 Previous Analytical Results Flying Club USTs (ppm)			
Sample Location	TPH, Diesel Range Organics (Hi Boil Hydrocarbons)	TPH, Gasoline Range Organics (Lo Boil Hydrocarbons)	BTEX (Total)
UST #1205N NW Corner	175	< 5.0	< 1.0
UST #1205N NE Corner	< 5.0	25.0	< 1.0
UST #1205N SE Corner	< 5.0	450	40.65
UST #1205N SW Corner	< 5.0	245	26.74
UST #1205S NW Corner	< 5.0	120	3.94
UST #1205S NE Corner	< 5.0	310	4.83
UST #1205S SE Corner	< 5.0	400	21.1
UST #1205S SW Corner	< 5.0	370	20.7

2.0 SITE DESCRIPTION/LOCATION

The NAS Memphis Flying Club USTs are located on the east end of Eniwetok Street at the Naval Air Station in Millington, Shelby County, Tennessee (See Figures 2-1 and 2-2). The Flying Club UST site was formerly used as an aviation fuel storage and dispensing facility located east of the former Flying Club building. Tank 1205N was a 1,000-gallon steel UST and Tank 1205S was a 2,000-gallon steel UST. The former location of the tanks is a grassy area adjacent to an asphalt and concrete landing strip. Four release detection wells were previously installed on the perimeter of the tank pit to monitor any releases that may have occurred. Only two of the wells were located during field activities because the concrete pads had been broken and/or removed from the site. The release detection wells still present are considered unserviceable.

2.1 Site Topography

The site is located in a relatively flat grassy area adjacent to a concrete/asphalt taxi-way used to stage out of service aircraft. Drainage across the site is toward the south into a low-lying grassy area which appears to drain to the east. Approximately 4 feet of relief exists between the northern and southern portions of the property (See Figure 2-3). The site is completely covered with grass and bordered on the north and east by either concrete or asphalt.



ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS

FIGURE 2-1
VICINITY MAP
NAS MEMPHIS

DWG DATE: 09/28/93 | DWG NAME: 067MEMHS

3.0 SOIL INVESTIGATION

3.1 Soil Screening Survey

E/A & H personnel were onsite May 5, 1993 to conduct a soil screening survey. The screening was conducted with a KVA Rotary Hefty System. The KVA system is a hand-held electric rotary hammer used to advance a stainless steel soil probe to the desired depth. Samples were collected from discrete intervals in a Teflon sleeve located in the end of the soil sampler. Soil samples were analyzed onsite by E/A & H personnel utilizing a General Analytical Corporation (GAC) portable infrared spectrophotometer (TPH Plus Analyzer) to screen the soil samples for TPH using EPA Method 418.1. The GAC measures both the aliphatic and aromatic components associated with petroleum products and enables the user to identify the lighter weight hydrocarbons found in aviation gasoline.

A sample grid was established in a radial pattern in the former tank pit area. Figure 3-1 shows the sampling grid pattern and the sample locations. The soil probe was to be advanced to the bottom of the tank pit or until groundwater was encountered. During the sampling, groundwater was encountered at approximately 8.0 feet below land surface. Samples taken from soils immediately above the saturated zone indicated the presence of a small contaminant plume migrating in a southwesterly direction. In all, 15 samples were collected and analyzed during the screening event. The results are displayed in Table 3-1.

The results of the screening survey indicated the presence of a small plume extending approximately 20 feet to the southwest of the former tank pit. However, during monitoring well installation, the groundwater encountered at 8.0 feet was found to be a perched moisture zone. The screening did identify the direction of migration but did not adequately identify the extent of the plume. Further soil screening was conducted in conjunction with the monitoring well installation activities.

**Table 3-1
 Soil Screening Survey
 Flying Club USTs**

DATE	SAMPLE #	TIME	SAMPLE WEIGHT (g)	SOLVENT VOLUME (ml)	AROMATIC HYDROCARBONS (GAC READING)	ALIPHATIC HYDROCARBONS (GAC READING)	AROMATIC HYDROCARBONS (ACTUAL)	ALIPHATIC HYDROCARBONS (ACTUAL)
5/5/93	FCS-1	1215	20.0	20.0	21	321	21	321
5/5/93	FCS-4	1340	19.7	20.0	0	16	0	16.2
5/5/93	FCS-3	1445	25.7	20.0	0	28	0	22
5/5/93	FCS-2	1515	20.5	20.0	2	15	2	15
5/5/93	FCS-5	1625	20.0	20.0	0	9	0	9
5/5/93	FCS-6	1702	21.0	20.0	0	65	0	62
5/6/93	FCS-7	0939	19.4	20.0	0	14	0	14.4
5/6/93	FCS-8	1035	21.2	20.0	0	9	0	8
5/6/93	FCS-1D	1125	20.0	20.0	0	8	0	8
5/6/93	FCS-9	1340	20.0	20.0	0	11	0	11
5/6/93	FCS-10	1425	21.0	20.0	0	14	0	13
5/6/93	FCS-11	1520	19.6	20.0	0	6	0	6
5/7/93	FCS-12	1030	20.5	20.0	0	6	0	6
5/7/93	FCS-12D	1130	20.6	20.0	0	6	0	6
5/7/93	FCS-13	1240	20.6	20.0	0	6	0	6
5/7/93	FCS-14	1410	22.2	20.0	0	38	0	34.2
5/7/93	FCS-15	1500	23.9	20.0	0	30	0	25

3.2 Regional and Site Specific Geology

The site is located within the central Mississippi Embayment geologic province consisting of a 200-mile wide trough or syncline that plunges southward along an axis which approximates the Mississippi River. The Embayment is filled with several thousand feet of sediment dating from the Quaternary to Cretaceous Periods (0 to 140 million years ago). The geology and hydrogeology consist of a thick sequence of unconsolidated Quaternary and Tertiary sediments. This sequence comprises the Wilcox Group, Claiborne Group and terrace deposits and the surficial loess deposits (in ascending order). Two major aquifer systems are included in this sequence, the Fort Pillow Formation (Wilcox Group) and the Memphis Sand Formation (Lower Claiborne Group.) These aquifers, principally the Memphis Sand, provide approximately 95 percent of the municipal and industrial water supplies for the Memphis and Shelby County areas. These aquifers are overlain by the Jackson-Upper Claiborne confining unit (Jackson Clay, Cockfield, and Cook Mountain Formations). The Jackson Clay formation pinches out to the east and has "holes" due to facies changes, resulting in sand lenses in the clay. However, this significant confining unit retards the downward migration of shallow groundwater to the subordinate aquifers in the NAS Memphis area.

Due to the confining nature of the Jackson-Upper Claiborne unit, and the limited (shallow) extent of the fuel release at the facility, impact on the lower aquifer systems is not likely at the NAS Memphis Flying Club UST site.

The terrace deposits and the surficial loess deposits are stratigraphically above the Jackson Clay. The terrace deposits consist of Pleistocene and Pliocene age sand, gravel, some clay with thin layers of a ferruginous sandstone and conglomerates at the base. This unit ranges in thickness from 0 to 100 feet. Typically, wells completed in these deposits produce small quantities of groundwater and are limited to a groundwater source for agricultural applications.

The surficial loess deposits are windblown sediments comprised of silt, silty clay, clay and minor amounts of sand. Loess is typically 0 to 65 feet thick in the Memphis area. Water-bearing zones are present in this unit; however, yield is low and water quality is poor.

Site Stratigraphy

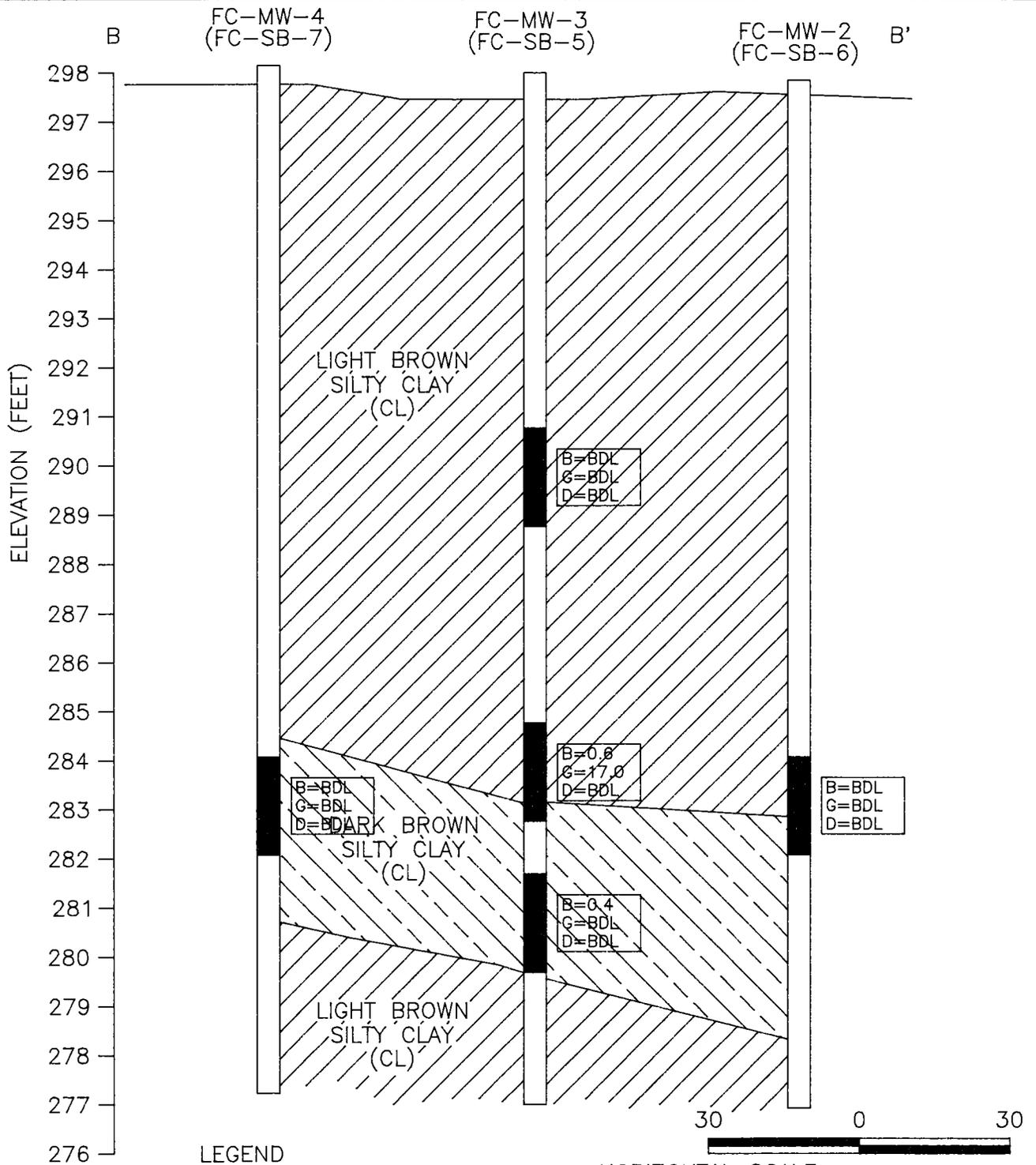
Soil types encountered during boring activities consist of clayey silts and silty clays from the surface to the terminating depth of the boring. A layer of soft gray clay was encountered in boring FC-SB-2 at a depth of 11.0 feet below grade. The maximum depth penetrated was 20 feet below grade in borings FC-SB-2 through FC-SB-5, all of which terminated in a medium brown, soft silty clay. Lithologic cross sections generated from boring log data can be found in Figures 3-2, 3-3, and 3-4. Boring logs are included in Appendix B.

Shelby tube samples collected from boring FC-SB-8 at depth intervals of 8 to 10 feet and 13 to 15 feet indicated average permeabilities of 1.1×10^{-6} cm/sec and 3.5×10^{-6} cm/sec. Shelby tube samples were analyzed in accordance with Method 9100 of Test Methods for Evaluation of Solid Waste, Third Edition (SW-846), and in general accordance with ASTM D-5084-90. The samples were collected from the zone suspected of having the highest permeability (8 to 10 feet) and from the soil-water interface (13 to 15 feet). Results of the permeability analyses are presented in Appendix C.

On the basis of the "non-drinking water" classification of the aquifer (Section 4.9) and the low permeabilities of the site soils, the soil cleanup levels should be 500 and 1000 ppm for BTX and TPH, respectively (as specified under TDEC UST Regulations 1200-1-15 Appendix III).

3.3 Soil Borings

Eight soil borings were initially drilled to define the extent of soil contamination and to characterize the geology/surficial sediments beneath the site. Borings were advanced and sampled using hollow-stem auger techniques. Samples were collected continuously using a 5-foot long,



ANALYTICAL SOIL SAMPLE LOCATION

SOIL ANALYTICAL RESULTS

B= CONCENTRATION BTEX (ppm)
G= GASOLINE RANGE ORGANICS (ppm)
D= DIESEL RANGE ORGANICS (ppm)
BDL - BELOW DETECTION LIMITS



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FIGURE 3-4
B-B' CROSS SECTION
NAS MEMPHIS
FLYING CLUB

2-inch inner diameter (ID) split barrel sampler through the hollow-stem augers to the terminating depth of the boring. Monitoring wells were installed in 6 of the 9 soil borings and the 3 remaining borings were properly abandoned by grouting to the surface.

To prevent possible cross contamination between boreholes, all down-hole equipment was completely disassembled and cleaned between each sample collection. The cleaning procedure consisted of steam cleaning to remove any gross contamination, a wash in a laboratory-grade detergent and a tap water rinse. The samplers were then further decontaminated using a triple rinse consisting of deionized water. New disposable latex gloves were worn by field personnel at all times during sampling and decontamination procedures.

Soil Vapor Screening

Soil retrieved from the sampler was analyzed in place using a HNu Model GP101 Photoionization Detector (PID) to determine the interval exhibiting the highest concentration of volatile organic compounds (VOCs). The interval exhibiting the highest PID reading was sampled for VOCs in accordance with the SOUTHDIV-approved Environmental Assessment Plan (EAP). Samples collected were placed immediately into two 60-milliliter precleaned glass volatile organic analysis (VOA) container and one 125-milliliter precleaned glass container for laboratory analysis.

Two to three soil samples were collected for laboratory analysis in soil borings with elevated PID readings. The intervals sampled and retained for laboratory analysis were selected based on the following criteria: (1) the sample exhibiting the most elevated PID reading, (2) the deepest sample with a PID reading, and/or (3) the soil sample above the soil-water interface or the bottom of the boring (whichever was first encountered). In boreholes with no measurable PID readings, soil samples were retained from the boring's terminal depth or at the soil-water interface, whichever was first encountered. Results of the organic vapor analysis are shown in Table 3-2. Soil samples were shipped to the laboratory by overnight express courier for

analysis, and were analyzed for BTEX and GRO, in series, using the Modified 8015/TN GRO.8020, and for DRO using the DRO-TPH Modified 8015/TN DRO Method.

Soil borings FC-SB-1 and FC-SB-8 were drilled to a depth of 15 feet and borings FC-SB-2 through FC-SB-7 were drilled to a depth of 20 feet. Placement of the initial borings was based on the information obtained from the soil screening survey.

Upon receipt of the analytical data from the initial eight borings, an additional boring was added downgradient of the site. Soil boring FC-SB-9 was drilled on July 15, 1993. It was advanced to 20 feet and completed as a monitoring well (FC-MW-6). The boring was drilled in the same manner as the previous borings with samples continuously collected to the terminating depth. Samples were collected from 10 to 15 feet and 15 to 20 feet. Headspace analysis results indicated the presence of background levels of VOCs.

3.4 Soil Analytical Results

Discrete soil samples were collected from each boring (except FC-SB-8) and submitted to International Technologies Analytical Services in Knoxville, Tennessee for BTEX/GRO and DRO analyses. Samples from FC-SB-8 were submitted for permeability testing only. GRO concentrations of 300 ppm were detected at a depth of 13 to 15 feet below land surface in the vicinity of FC-SB-2 (adjacent to the SW corner of the former tank pit.) . BTEX concentrations of 4.4 ppm were found at this depth as well. The remaining soil samples were also either below the TDEC Cleanup levels or below the method detection limits. Figure 3-5 depicts soil boring locations and the highest measured BTEX and TPH concentrations at each location. Soil analytical results are summarized in Table 3-3. Laboratory reports for the soil analyses are included in Appendix D.

Table 3-2 Organic Vapor Analysis Headspace Readings Flying Club USTs (ppm)									
Interval (ft. bls)	FC-SB-1	FC-SB-2	FC-SB-3	FC-SB-4	FC-SB-5	FC-SB-6	FC-SB-7	FC-SB-8	FC-SB-9
0 - 1	0	0	0	0	0	0	0	N/S	0
1 - 2	0	0	0	0	0	0	0	N/S	0
2 - 3	0	0	0	0	0	0	0	N/S	0
3 - 4	0	0	0	N/R	0	0	0	N/S	0
4 - 5	0	0	0	N/R	0	0	0	N/S	0
5 - 6	0	0	0	0	0	0	0	N/S	0
6 - 7	0	0	0	0	0	0	0	N/S	0
7 - 8	0	0	0	0	0	0	0	N/S	0
8 - 9	0	0	0	N/R	0	0	0	100	0
9 - 10	0	0	0	N/R	0	0	0	100	0
10 - 11	0	0	0	0	0	0	0	N/S	0
11 - 12	0	20	1	1	0	0	0	N/S	0
12 - 13	0	50	3	3	0	0	0	N/S	0
13 - 14	0	100	5	5	0	0	0	108	0
14 - 15	0	270	N/R	6	0.1	0	0	108	0
15 - 16	-	100	5	5	0	0	0	-	0
16 - 17	-	70	8	1	0	0	0	-	0
17 - 18	-	5	3	0	4	0	0	-	0
18 - 19	-	15	3	0	0	0	0	-	0
19 - 20	-	0	0	0	0	N/R	0	-	0

Notes:

N/R - Insufficient Recovery
 N/S - Interval not Sampled

Table 3-3 Soil Analytical Results Flying Club USTs					
Sample No.	Sampling Date	Depth (feet)	BTEX (ppm)	Gasoline Range Organics (GRO) (ppm)	Diesel Range Organics (DRO) (ppm)
FC-SB-1-8	5/11/93	6 - 8	BDL	BDL	BDL
FC-SB-2-9	5/11/93	7 - 9	BDL	12	BDL
FC-SB-2-15	5/11/93	13 - 15	57.7	300	BDL
FC-SB-2-19	5/11/93	17 - 19	BDL	BDL	BDL
FC-SB-3-15	5/11/93	13 - 15	4.4	77	BDL
FC-SB-3-15DUP	5/11/93	13 - 15	2.0	46	BDL
FC-SB-3-20	5/11/93	18 - 20	0.1	BDL	BDL
FC-SB-4-10	5/11/93	8 - 10	BDL	BDL	BDL
FC-SB-4-15	5/11/93	13 - 15	2.6	81	BDL
FC-SB-4-20	5/11/93	18 - 20	BDL	BDL	BDL
FC-SB-5-9	5/12/93	7 - 9	BDL	BDL	BDL
FC-SB-5-15	5/12/93	13 - 15	BDL	BDL	BDL
FC-SB-5-15DUP	5/12/93	13 - 15	0.6	17	BDL
FC-SB-5-18	5/12/93	16 - 18	0.4	BDL	BDL
FC-SB-6-16	5/12/93	14 - 16	BDL	BDL	BDL
FC-SB-7-16	5/12/93	14 - 16	BDL	BDL	BDL
FC-SB-9-15	7/15/93	10-15	BDL	BDL	BDL
FC-SB-9-20	7/15/93	15-20	BDL	BDL	BDL

Notes:

BDL = Below Detection Limit
 ppm = parts per million

Detection Limits:

GRO = 10 ppm
 BTEX = 0.1 ppm
 DRO = 10 ppm

Headspace analyses performed on soil samples indicate organic vapor concentrations above background levels in borings FC-SB-2, FC-SB-3, FC-SB-4, FC-SB-5, and FC-SB-8. The highest measured organic vapor concentration in FC-SB-3 was 8 ppm at the 16 to 17-foot interval. Green staining and a petroleum odor were noted in soil samples collected from this depth. Laboratory results from this same depth interval did not detect BTEX constituents in the sample. Boring FC-SB-2 had the highest measurable organic vapor concentration of 270 ppm at the depth interval of 14 to 15 feet. As mentioned previously, this soil sample also exhibited the most elevated BTEX and TPH concentrations. However, the analytical results are well below the 500 and 1000 ppm BTX and TPH soil cleanup levels.

In addition to the BTEX, GRO, and DRO analyses, samples were analyzed for several remedial design parameters to aid in the development of a Corrective Action Plan. These parameters and their results are presented in Appendix A.

4.0 GROUNDWATER INVESTIGATION

A groundwater investigation was completed to assess the extent of groundwater contamination beneath the site and to allow characterization of the surficial aquifer. Before monitoring wells were installed, a soil screening survey using onsite TPH analysis was conducted to facilitate monitoring well/soil boring placement. A total of five wells (FC-MW-1 thru 5) were installed on May 11-12, 1993. To aid in the characterization of the surficial aquifer, slug tests were performed on each well installed during the initial field investigation. An additional well (FC-MW-6) was installed hydrologically downgradient on July 15, 1993. The location of the monitoring wells are shown in Figure 4-1. Release detection wells present at the site were assessed prior to the beginning of the field activities and found to be unservicable and were, therefore, not utilized during this investigation.

4.1 Hydrogeology

Groundwater Flow Direction

Static water level measurements at each well were collected on 6/3/93 and 7/20/93. Using these water level measurements, piezometric surface diagrams (Figures 4-7 and 4-8 in Section 4.8) were constructed to show groundwater flow direction. As the flow arrows on both diagrams indicate, groundwater flow is directed to the southwest.

Groundwater Gradient

The highest and lowest horizontal hydraulic gradients were calculated using the piezometric surface diagrams. The lowest gradient was calculated from Figure 4-7 (6/3/93) by using the following relationship:

$$\text{Lowest gradient} = 1 \text{ ft. head change} / 40 \text{ ft. distance} = 0.025 \text{ ft./ft.}$$

The highest gradient was calculated from Figure 4-8 (7/20/93) with the following relationship:

$$\text{Highest gradient} = 2 \text{ ft. head change} / 36.5 \text{ ft. distance} = 0.055 \text{ ft./ft.}$$

Groundwater Flow Velocity

The lowest and highest estimated groundwater flow velocities were calculated using the following formula:

$$V = Ki/n_e$$

Where:

V	=	groundwater velocity
K	=	horizontal hydraulic conductivity
i	=	horizontal hydraulic gradient
n_e	=	effective porosity

For the velocity calculations, an average hydraulic conductivity of 0.102 feet/day was used. This value was obtained by averaging the hydraulic conductivity results from the slug tests presented below. To estimate the potential range of groundwater velocity, separate calculations were made with both the highest and lowest gradients previously derived. The effective porosity was obtained from the Tri-State Testing Services, Inc. laboratory reports (See Appendix C). An average of the four reported porosity values for FC-SB-8 was used in the velocity calculations.

Lowest estimated groundwater velocity = $(0.102 \text{ ft./day})(0.025)/(0.427) = 0.006 \text{ ft./day}$

Highest estimated groundwater velocity = $(0.102 \text{ ft./day})(0.055)/(0.427) = 0.013 \text{ ft./day}$

Slug Tests Results

Rising and falling head slug tests were conducted during the field investigation to enhance estimates of aquifer characteristics. Before a slug test was started, the static water level in the well was measured using an electronic water level indicator. A stainless steel "slug" was then instantaneously introduced into the well, at which time the water level and the time (T_0) were recorded. Periodically, water level/elapsed time measurements were recorded as the head fell back to the original level. Similarly, each rising head slug test was performed by removing the slug and recording water level/elapsed time measurements as the head rose back to normal. The

time required for a slug test to be completed is a function of the water level rate of change and the hydraulic conductivity of the aquifer.

An in-situ pressure transducer and a two-channel Hermit 1000C data logger were used to measure and record water levels in the wells. To facilitate graphing of the data, the Hermit was programmed to record water level measurements on a logarithmic time scale. The slug used during most of the tests was a 5-foot long, 1.5-inch diameter stainless steel cylinder with a steel ring welded on one end. A Teflon-coated cable tethered to the cylinder served to suspend the slug in the well just above or below the water level. At the beginning of each test, the data logger was activated as soon as the slug was either lowered into or removed from the water.

Because FC-MW-1 had less than 6 feet of water in it, the stainless steel slug could not be used. Alternately, one gallon of DI water was instantaneously poured into the well to serve as the slug. Consequently a rising head test could not be conducted, and therefore falling head data is all that is reported.

Data from the slug tests were compiled using the computer program AQTESOLV (Aquifer Test Solver) by the Geraghty and Miller Modeling Group (1989). AQTESOLV has several widely published and accepted analytical solutions for many different kinds of aquifer tests. Rising and falling head slug test data were plotted using the unconfined aquifer solution. For this solution, time (elapsed) versus displacement (change in water level) is plotted on semi-logarithmic graph paper. In computing the hydraulic conductivity (K), the steep portion of the graph was disregarded because the sand pack is not representative of the surrounding aquifer conditions. Hydraulic conductivity was computed by the program using an equation developed by Bouwer and Rice (1976) for unconfined aquifers. The AQTESOLV graphs are presented in Appendix E.

The hydraulic conductivities calculated from the rising and falling head slug tests are presented in Table 4-1. Injecting the slug produces falling head data and rising heads result from

withdrawal of the slug. As mentioned previously, a rising head test was not conducted on FC-MW-1 because the water column height was insufficient to accommodate the stainless steel slug. The average hydraulic conductivity presented in Table 4-1 was calculated using both the falling and rising head data from all of the wells.

Table 4-1 Slug Test Results Flying Club USTs				
Well	K - Falling Head (feet/minute)	K - Falling Head (feet/minute)	K - Falling Head (feet/day)	K - Falling Head (feet/day)
FC-MW-1	2.4370E-04	N/A	3.5093E-01	N/A
FC-MW-2	2.8334E-05	1.1535E-05	4.0801E-02	1.6610E-02
FC-MW-3	4.9781E-05	1.0000E-04	7.1685E-02	1.4400E-01
FC-MW-4	8.4005E-05	6.9413E-05	1.2097E-01	9.9955E-02
FC-MW-5	3.0607E-05	1.1474E-05	4.4074E-02	1.6523E-02
Average K (ft./day) = 1.0062E-01				
N/A - No data available because the test was not conducted.				

4.2 Monitoring Well Placement

Well placement was based on the results of the soil screening survey described in Section 3.1 and on a topographically-based assumption of groundwater flow direction. Monitoring well FC-MW-1 was placed near the northern portion of the site, upgradient of the former location of the USTs. Monitoring wells FC-MW-2, FC-MW-3, and FC-MW-4 were placed in a downgradient direction: southeast, south, and southwest of the tank pit. Monitoring well FC-MW-5 was placed adjacent to the southwest corner of the tank pit. Upon receipt of the analytical data for the initial soil borings, a sixth well (FC-MW-6) was installed downgradient from FC-MW-3.

4.3 Monitoring Well Construction

Monitoring wells were drilled with a CME 45 rotary drill rig using 4.25-inch inner diameter (8.25-inch outer diameter) hollow-stem augers. Monitoring wells FC-MW-1 and FC-MW-5 were installed on 5/11/93 and FC-MW-2, FC-MW-3, and FC-MW-4 were installed on 5/12/93. All auger, drilling rod, and sampling equipment was steam cleaned before drilling activities began. Decontaminated augers were used for each monitoring well to prevent cross contamination. Monitoring wells were constructed of 2-inch diameter Schedule 40 PVC riser and 10 to 15 feet of 2-inch diameter, Schedule 40 PVC, 0.010-inch slotted well screen.

The annular space surrounding each monitoring well screen was filled with a 20/40 silica sand pack from the bottom of the borehole to 1 foot above the screened interval. Sand was poured from the surface through the annular space of the hollow-stem augers. A 2-foot bentonite seal was placed over the sand pack and the remaining annular space was filled to near land surface with a mixture of 97 percent Portland Type I cement and 3 percent bentonite grout. A water-tight locking expansion cap was placed on each well casing and a 5-foot steel protective cover was installed. Four by 4-foot concrete pads with 3-foot steel protective posts were positioned at the corners each well to help preserve the physical integrity of the wells.

Monitoring well completion data are provided in Table 4-2; and calculated versus actual well construction materials used are provided in Table 4-3. Monitoring well construction logs are provided in Appendix F.

Table 4-2 Well Completion Data Flying Club USTs					
Monitoring Well Identification	Installation Date	Total Depth (ft btoc) ^a	Well Diameter (inches)	Screened Interval (ft bls) ^b	Top of Casing Elevation
FC-MW-1	11 MAY 93	17.57	2	5.0 - 15.0	300.06
FC-MW-2	12 MAY 93	22.60	2	5.0 - 20.0	297.53
FC-MW-3	12 MAY 93	22.60	2	5.0 - 20.0	297.53
FC-MW-4	12 MAY 93	22.59	2	5.0 - 20.0	297.89
FC-MW-5	11 MAY 93	22.55	2	5.0 - 20.0	298.23
FC-MW-6	15 JULY 93	23.10	2	5.0 - 20.0	295.65

Notes:

- ^a - below top of casing
- ^b - feet below land overface

Table 4-3 Well Construction Materials Flying Club USTs								
Monitoring Well Identification	Calculated Material Volumes Used				Actual Material Volumes Used			
	Sand ^a 100 lb. bag	Bentonite ^b 5 gal. bucket	Grout ^c 94 lb. bag	Cement ^d 80 lb. bag	Sand 100 lb. bag	Bentonite 5 gal. bucket	Grout 96 lb. bag	Cement 80 lb. bag
FC-MW-1	3.75	½	1	8	3.75	½	1	8
FC-MW-2	3.75	½	1	8	3.75	½	1	8
FC-MW-3	3.75	½	1	8	3.75	½	1	8
FC-MW-4	3.75	½	1	8	3.75	½	1	8
FC-MW-5	3.75	½	1	8	3.75	½	1	8
FC-MW-6	4	½	1	8	3.75	½	1	8

Notes:

- ^a Sand = 20/40 sieve size
- ^b Bentonite = ¼-inch pellets
- ^c Grout = Portland Type I/Bentonite (97/3%) mixture
- ^d Cement = Sakrete used in pad construction

4.4 Monitoring Well Development

Development of the monitoring wells was carried out by the drilling subcontractor using decontaminated 3-foot PVC bailers. Between six and eight well volumes were removed from each well, and development continued until visual consistency was achieved. Despite development, turbidity remained high due to the fine solids suspended in the groundwater. Well development and purge water were containerized in DOT approved 55-gallon drums, labeled, numbered, and left onsite. No free product was discovered in any of the monitoring wells during well development and later sampling activities

4.5 Monitoring Well Sampling

Groundwater samples were collected from monitoring wells FC-MW-1 through FC-MW-5 on May 26, 1993. Monitoring well FC-MW-6 was sampled on July 20, 1993. Compliance/leak detection wells located around the perimeter of the tank pit are out of service and therefore were not sampled. Groundwater samples from FC-MW-1 through FC-MW-5 were collected with disposable 3-foot Teflon single-check valve bailers.

Static water level measurements were measured in each well and a minimum of three casing volumes were purged from each well before groundwater sampling. Purging was performed to remove stagnant water from the well casing and to assure that groundwater samples were representative of the surrounding aquifer. Select water quality measurements were collected during purging including pH, temperature and conductivity. Data collected during the purging process are included in Table 4-4. Measured water quality parameters were stabilized to within the following specifications before sampling:

pH	=	± 0.5 units
Temperature	=	± 1° C
Conductivity	=	± 10%

Table 4-4 Well Purging Data Flying Club USTs							
Well #	Total Depth (ft. btoc)*	Depth to Water (ft. btoc)	Well Volume (gallons)	Purge Volume (gallons)	pH	Conductivity (mhos)	Temperature (°C)
5/26/93							
FC-MW-1	17.57	11.39	1.86	5.57	5.9	0.18	26
					6.0	0.18	25
					5.9	0.19	24
5/26/93							
FC-MW-2	22.6	11.12	1.81	5.44	6.2	0.25	25
					6.1	0.25	23
					6.1	0.25	23
5/26/93							
FC-MW-3	22.6	12.57	2.05	6.15	4.5	0.45	24
					6.1	0.45	23
					6.3	0.45	23
5/26/93							
FC-MW-4	22.59	11.48	1.87	5.61	6.1	0.17	22
					6.1	0.17	22
					6.1	0.17	22
5/26/93							
FC-MW-5	22.55	9.98	1.63	4.88	6.5	0.59	24
					6.6	0.59	22
					6.6	0.59	22

Table 4-4 Well Purging Data Flying Club USTs							
Well #	Total Depth (ft. btoc)*	Depth to Water (ft. btoc)	Well Volume (gallons)	Purge Volume (gallons)	pH	Conductivity (mhos)	Temperature (°C)
7/20/93							
FC-MW-6	23.10	17.32	0.94	2.83	7.0	0.32	34
					6.8	0.30	33
					6.7	0.30	33

Notes:

- * - feet below top of casing

Groundwater samples were transferred directly from the bailer into laboratory-prepared containers containing hydrochloric acid (HCl) preservative, immediately packed in ice and delivered overnight to International Technology Analytical Services, Inc. (IT) in Knoxville, Tennessee. Samples were analyzed using Modified EPA Method 8015/TN GRO.8020 for BTEX and GRO and Modified EPA Method 8015/TN DRO for DRO. Field and equipment blanks were collected and a trip blank accompanied the sample cooler as standard QA/QC procedure.

4.6 Groundwater Analytical Results

Free product was not observed on groundwater in any monitoring wells at the facility. Analytical results indicated benzene concentrations above the TDEC's cleanup level of 0.070 ppm (for a non-drinking water aquifer) in FC-MW-3 (0.53 mg/l), and FC-MW-5 (6.50 mg/l). Analytical results also indicated TPH levels above the TDEC's cleanup level of 1.0 ppm (for a non-drinking water aquifer) in FC-MW-3 (9.99 mg/l), FC-MW-5 (70.2 mg/l), and FC-MW-6 (4.09 ppm). A summary of the analytical results is included in Table 4-5. Laboratory reports for groundwater analyses are provided in Appendix G.

Table 4-5 Groundwater Analytical Results Flying Club USTs							
SAMPLE I.D.	DATE SAMPLED	BENZENE (mg/l)	TOLUENE (mg/l)	ETHYL BENZENE (mg/l)	XYLENES (TOTAL) (mg/l)	GRO (mg/l)	DRO (mg/l)
FC-MW-1	5/16/93	0.001U	0.001U	0.001U	0.001U	0.1U	0.1U
FC-MW-2	5/26/93	0.001U	0.001U	0.001U	0.001U	0.1U	0.1U
FC-MW-2DUP	5/26/93	0.001U	0.001U	0.001U	0.001U	0.1U	0.1U
FC-MW-3	5/26/93	0.53	7.2	0.036	0.140	9.500	0.490
FC-MW-4	5/26/93	0.001U	0.001U	0.001U	0.001U	0.1U	0.1U
FC-MW-5	5/26/93	6.500	98.000	0.140	0.670	68.00	2.200
FC-MW-6	7/20/93	0.003	0.620	0.031	0.140	3.90	0.190

Data Validation

Data validation was performed on all analytical data collected during the field investigation. A total of 18 soil samples, eight groundwater samples, two trip blanks, and four field/rinsate blanks were collected as part of this investigation. Sample collection at the Flying Club was performed and reported under four separate sample delivery groups (SDGs): ENFA 54572, ENFA 54598, ENFA 54100, and ENFA 54176. The SDGs were all received by the laboratory with the samples in good condition, with the proper custody documents and seals intact.

The samples were analyzed for the following parameters:

- Total high-boiling petroleum hydrocarbons, also known as DRO, by the Tennessee modification of EPA method 8015.
- BTEX by EPA method 8020.

- Total low-boiling petroleum hydrocarbons, also known as GRO, by the Tennessee modification of EPA method 8015.

The technical holding times, from the time of sample collection until the time of sample extraction and/or analysis, were found to be within method requirements. All surrogate spike recoveries, MS/MSD, and blank spike analysis results were within QC criteria, with the following exceptions:

- Surrogate spike recovery in the GRO analysis of sample FC-SB4-15 was 1 percent higher than QC limits. Qualification of the sample GRO results was not deemed necessary.
- Surrogate spike recovery in the DRO analysis of sample FC-RB, SDG ENFA 54100, was 24 percent above QC limits. No contamination was detected in the rinsate blank. Qualification of the data was not deemed necessary because the high surrogate recovery was associated with a QC sample and did not affect field sample data.

Method blanks were analyzed in compliance with QC requirements, and no contamination was detected in the method, trip, or field blanks.

Data Assessment

The analytical data produced in support of the environmental assessment at the NAS Memphis Flying Club has been reviewed and validated in accordance with applicable EPA guidelines as found in *Quality Assurance/Quality Control Guidance for Removal Activities: Sampling QA/QC Plan and Data Validation Procedures, EPA/540/G-90/004*, as well as applicable Naval Environmental and Engineering Support Activity (NEESA) guidelines. No significant QC problems were encountered during the data review. The data quality is considered to be good and the data are usable.

The analytical data is presented in summary form and lists the positively detected compounds only.

Data Qualifier Definitions

Following is a brief explanation of the data qualifiers used in the validation process.

- U** — The compound was analyzed for, but was not detected above the reported sample quantitation limit.

- J** — The compound was positively detected, but, the reported concentration is considered to approximate the concentration within the sample.

- UJ** — The compound was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the compound in the sample.

- R** — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. The presence or absence of the compound cannot be verified.

4.7 Groundwater Contaminant Plume

The horizontal groundwater contaminant plume maps for benzene and TPH (Figures 4-2 and 4-3) indicate the approximate extent of benzene and TPH above the appropriate cleanup levels of 0.070 ppm and 1.00 ppm, respectively. Groundwater contamination exceeding the cleanup levels appears limited to the area between FC-MW-5 and FC-MW-6. The cross section line in area view is shown on Figure 4-4. The suspected contaminant plumes for benzene and TPH in a cross sectional view are presented in Figures 4-5 and 4-6.

4.8 Water Level Data

To determine the direction of groundwater flow beneath the site, a water level measuring point on each monitoring well was established and referenced to a known elevation on the naval base. Wells were then surveyed by a registered surveyor. Depth to groundwater was measured on June 3, 1993 and July 20, 1993 to the nearest 1/100th foot. Water level measurements were converted to piezometric surface diagrams (Table 4-6) and are provided in Figures 4-7 and 4-8.

4.9 Groundwater Classification

A water use survey was conducted in the vicinity of the facility to determine whether any domestic or agricultural wells are accessing the surficial aquifer. A water well survey completed by the Memphis and Shelby County Health Department (included in Appendix H) found the closest well to be located approximately one mile west of the site. Furthermore, there are no reported records of wells near the site.

Table 4-6 Water Table Elevations Flying Club USTs					
Monitoring Well	Measuring Point Elevation (feet)	Date of Measurements			
		June 3, 1993		July 20, 1993	
		Depth to Water (ft btoc) ^a	Water Level Elevations (ft) ^b	Depth to Water (ft btoc)	Water Level Elevations (ft)
FC-MW-1	300.06	11.94	288.12	14.96	285.10
FC-MW-2	297.53	11.17	286.36	14.37	283.16
FC-MW-3	297.53	12.77	284.76	16.67	280.86
FC-MW-4	297.89	12.13	285.76	14.39	283.50
FC-MW-5	298.23	10.66	287.57	14.47	283.76
FC-MW-6	295.65	—	—	17.33	278.32

Notes:

- ^a - feet below top of casing
- ^b - mean sea level

A groundwater sample was collected from monitoring well FC-MW-5 on May 26 and analyzed for several of the Primary and Secondary Drinking Water Standards listed in TDEC's Technical Guidance Document 002. Analytical results (Table 4-7) indicate iron, manganese and turbidity in excess of the respective suggested levels for drinking water:

Table 4-7 Primary/Secondary Drinking Water Standards Monitoring Well FC-MW-5 Flying Club USTs			
	Iron^a (ppm)	Manganese^a (ppm)	Turbidity^b (S.U.)
Standard	0.3	0.05	2
FC-MW-5	23.7	17.0	625

Notes:

- ^a - Secondary Standard (TDEC Technical Guidance Document 002 - 1/14/92)
- ^b - Primary Standard (TDEC Technical Guidance Document 002 - 1/14/92)

Due to the shallow aquifer not being utilized as a water source (drinking or otherwise) local to the site, and the failure to meet drinking water standards, the aquifer can be characterized as a "non-drinking water" aquifer. Based on this classification, the TDEC cleanup levels for non-drinking water are 0.070 ppm benzene and 1.00 ppm TPH.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the information gathered during the assessment activities.

Conclusions:

- A petroleum release occurred from Tanks 1205N and 1205S at the Flying Club UST site, however, the tanks have been removed from the site.
- Depth to the static water table beneath the site ranges between 10.5 and 12.5 feet below grade.
- The groundwater flow direction beneath the site is in a southwesterly direction and has a calculated hydraulic gradient ranging from 0.025 to 0.055 ft/ft.
- Permeabilities of soil samples collected in native soil outside the tank pit exhibited average hydraulic conductivities ranging from 1.1×10^{-6} cm/sec to 3.5×10^{-6} cm/sec, which are typical permeabilities for clay.
- TDEC has established that soil cleanup levels for soil in a "non-drinking water aquifer" within this permeability range are 500 ppm for BTX and 1000 ppm for TPH. TDEC established cleanup levels for groundwater in a "non-drinking water aquifer" are 0.070 ppm benzene and 1.0 ppm TPH.
- BTEX and TPH concentrations in soil did not exceed the TDEC cleanup level for a non-drinking water aquifer in any of the analyzed soil samples.

- TPH and benzene concentrations in groundwater exceeding the TDEC cleanup levels for a non-drinking water aquifer have migrated downgradient of Tanks 1205N and 1205S. Petroleum hydrocarbons do not appear to have migrated downgradient to monitoring wells FC-MW-2 or FC-MW-4.
- Free product was not detected in any monitoring wells.
- The aquifer can be classified as non-drinking water, based on a water use survey in the site vicinity and a water sample collected near the site which did not meet several primary and secondary drinking water standards.

Recommendations:

- EnSafe/Allen & Hoshall recommends the development of a Corrective Action Plan to determine the best course of action to remediate groundwater contamination onsite.
- The release detection wells present at the site should be abandoned in accordance with TDEC UST Guidance to protect the surficial aquifer from surface water runoff.

6.0 SIGNATURE PAGE

I, the undersigned, do hereby affirm that the information contained in this report is accurate and correct to the best of my knowledge and belief.

_____, P.G.

David Fuehrer
Registration No. TN0679
October 13, 1993

Signature/Date

APPENDIX A

Remedial Design Parameters

Table A-1 Remedial Design Parameters (Soil) Flying Club USTs		
Parameter	Results	
Microbial Plate Count ^a	Total Heterotrophs	Diesel Degraders
	7.5 x 10 ⁷	1.4 x 10 ⁸

^a - CFU/gm, Colony Forming Units per gram of dry soil

Table A-2 Remedial Design Parameters (Groundwater) Flying Club USTs	
Parameter	Results
Alkalinity as CaCO ₃	358
Total Organic Carbon	43
Total Phosphorus	0.22
Nitrate-Nitrite-N	BDL
Turbidity	625
Total Suspended Solids	24
Iron	23.7
Manganese	17.0

APPENDIX B

Boring Logs

DESCRIPTION OF SUBSURFACE MATERIALS

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	HNU READING	USCS SYMBOL	DESCRIPTION
				0 GC	LIGHT BROWN SILTY SOFT CLAY WITH TAN CHERT COBBLES TO 0.8'
				0 SM	REDDISH BROWN COARSE SANDY SILT FROM 1.6 TO 1.9'
	SS	53		0 CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH WHITE CLAY
				N/R	
5				N/R	
				0 CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
				0	
	SS	100		0	
				M	
				L	GROUNDWATER AT 8.4'
10				0 CH	MEDIUM BROWN SILTY SOFT CLAY, WET MOTTLED WITH GRAY CLAY
				0	
				0	
	SS	100		0	
				CH	
				CL	MEDIUM BROWN SILTY SOFT CLAY, SATURATED TO 13.5', THEN DRYER
15				0	
	TD				
20					
25					



ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

FC-SB-1
BORING LOG
FLYING CLUB UST SITE
NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FBR1

DEPTH (FEET)
 SAMPLE TYPE
 % RECOVERY
 HNU READING
 USCS SYMBOL

DESCRIPTION OF SUBSURFACE MATERIALS

0	CL	MEDIUM BROWN SILTY SOFT CLAY MOTTLED WHITE CLAY
0		
SS 100	0	
0		
5	0	
0	CL	MEDIUM BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
0		
SS 100	0	
0	CL	MEDIUM BROWN SILTY SOFT CLAY WITH GRAY CLAY INCREASING TO 50% GROUNDWATER AT 9.5'
10	M L	
0	CH	CONTACT LIGHT GRAY SILTY MOIST CLAY FROM 11.0' TO 11.3'
20		
SS 100	50	CL MEDIUM TO DARK BROWN SILTY CLAY, DRYER
100		
15	270	CH DARK BROWN SILTY STIFF CLAY, WET WITH VERY STRONG PETROLEUM ODOR
100		
70	CH	MEDIUM BROWN SILTY SOFT CLAY WET, STRONG PETROLEUM ODOR
SS 100	5	
15	CH	MEDIUM BROWN SILTY SOFT CLAY MOTTLED WITH REDDISH BROWN CLAY AT 18.5'
20	0	
TD	CH	CONTACT MEDIUM BROWN SILTY SOFT CLAY WITH BLACK BITUMINOUS NODULES FROM 19.3' 19.6', DRYER
25		



ENVIRONMENTAL
 ASSESSMENT REPORT
 NAS MEMPHIS
 CTO-67

FC-SB-2
 BORING LOG
 FLYING CLUB UST SITE
 NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FBR2

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	HNU READING	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
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0					
0				CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH LIGHT GRAY TO WHITE CLAY
5	SS	100			
0					
0					
0				CL	LIGHT TO MEDIUM BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
10	SS	73			
0				M L	GROUNDWATER AT 8.3'
0				CH	MEDIUM BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY
15	SS	100			
0					
1					
3				CH	DARK BROWN SILTY SOFT CLAY DRYER WITH PETROLEUM ODOR AT 13.0
5					
15				N/R	
5				CH	DARK BROWN SILTY SOFT CLAY MOTTLED WITH GRAY, WET, PETROLEUM ODOR
8					
20	SS	100			
3					
3					
0					CONTACT LIGHT BROWN STIFF DRY SILTY CLAY MOTTLED WITH ORANGE/ BROWN CLAY AT 19.8'
25	TD				



ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

FC-SB-3
BORING LOG
FLYING CLUB UST SITE
NAS MEMPHIS

DWG DATE: 08/12/93	DWG NAME: 067FBR3
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DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	HNU READING	USCS SYMBOL	DESCRIPTION OF SUBSURFACE MATERIALS
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0					0-0.5' ASPHALT
0				CL	DARK GRAY SILTY STIFF CLAY FROM 0.5' TO 4.5'
0					
0	SS 63				
0					
0			N/R		
0				CL	
5			N/R		CONTACT LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY AT 4.5'
0				CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
0					
0	SS 56				
0					
0			N/R		GROUNDWATER AT 8.5'
10			N/R	M L	
0				CH	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY AND VERY MOIST
1					
1	SS 100				
3					
5				CH	DARK BROWN SILTY SOFT CLAY WITH STRONG PETROLEUM ODOR
6					
15				5 CH	DARK BROWN SILTY SOFT CLAY, PETROLEUM ODOR STILL PRESENT
1					
1	SS 100				
0					
0					
0					CONTACT LIGHT BROWN SILTY STIFF DRY CLAY MOTTLED WITH ORANGE/ BROWN CLAY AT 19.5'
20	TD				
25					



ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

FC-SB-4
BORING LOG
FLYING CLUB UST SITE
NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FBR4

DEPTH (FEET)
 SAMPLE TYPE
 % RECOVERY
 HNU READING
 USCS SYMBOL

DESCRIPTION OF SUBSURFACE MATERIALS

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	HNU READING	USCS SYMBOL	DESCRIPTION
0				CL	
0					LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
5	SS	100	0		
0					
0				CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
0					
0	SS	100	0		
0				M	GROUNDWATER 8.1'
0				L	
0					
0				CH	LIGHT BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY
0					
0	SS	100	0		
0					
0				CH	CONTRACT DARK BROWN SILTY MOIST CLAY SOME MOTTLING WITH GRAY AT 14.1'
0				0.1	
0				CH	DARK BROWN SILTY SOFT CLAY, SLIGHT PETROLEUM ODOR
0					
0					
0	SS	100	4	CL	LIGHT BROWN SILTY STIFF CLAY, DRYER NO ODOR
0					
0				CL	LIGHT BROWN SILTY STIFF CLAY
0					
20					
	TD				
25					



ENVIRONMENTAL
 ASSESSMENT REPORT
 NAS MEMPHIS
 CTO-67

FC-SB-5
 BORING LOG
 FLYING CLUB UST SITE
 NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FBR5

DESCRIPTION OF SUBSURFACE MATERIALS

DEPTH (FEET)	SAMPLE TYPE	% RECOVERY	HNU READING	USCS SYMBOL	DESCRIPTION
0				CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY AND DARK BROWN CLAY
0					
5	SS	90	0		
0					
0				CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
0					
10	SS	93	0		
0				M L	GROUNDWATER AT 8.6'
0					
0				CH	LIGHT BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY
0					
15	SS	100	0		CONTACT DARK BROWN SILTY STIFF CLAY, DRYER AT 13.2'
0					
0				CL	
0					
0				CH	LIGHT BROWN SILTY WET CLAY MOTTLED WITH GRAY CLAY
0					
20	SS	100	0		
0					
0				CL	CONTACT LIGHT BROWN SILTY STIFF CLAY MOTTLED WITH ORANGE/BROWN CLAY AT 19.5'
0					
25	TD				



ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS
CTO-67

FC-SB-7
BORING LOG
FLYING CLUB UST SITE
NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FBR7

DEPTH (FEET)
 SAMPLE TYPE
 % RECOVERY
 HNU READING
 USCS SYMBOL

DESCRIPTION OF SUBSURFACE MATERIALS

5					
10	ST 100	N/A		CL	LIGHT BROWN SILTY SOFT CLAY MOTTLED WITH GRAY CLAY
				CH	LIGHT BROWN SILTY SOFT CLAY, MOIST MOTTLED WITH GRAY CLAY
15	ST 108	N/A		CH	DARK BROWN SILTY MOIST CLAY
	TD			CH	DARK BROWN SILTY WET CLAY
20					
25					



ENVIRONMENTAL
 ASSESSMENT REPORT
 NAS MEMPHIS
 CTO-67

GEOTECHNICAL SOIL BORING LOG
 FLYING CLUB UST SITE
 NAS MEMPHIS

DWG DATE: 08/12/93

DWG NAME: 067FGBR1

APPENDIX C

Permeability Results



Tri-State Testing Services, Inc.

Measurement of Hydraulic Conductivity

Client: Ensafe/Allen & Hoshall

Date of Report: 06/02/93

Project Name: Naval Air Station @ Millington, TN

Sample I.D.: Boring # 8 Sample: ST 1, Depth 8'-10'

Soil Description: Brown Silty Clay

	<u>Pre-Test</u>	<u>Post Test</u>
Wet Density (Lbs/ft ³)	120.9	120.0
Dry Density (Lbs/ft ³)	95.3	92.5
Moisture (% Dry Wt)	26.8	29.7
Porosity (n)	.420	.438
Degree of Saturation (%)	98.0	100.0

Permeability

Temperature Correction, $R_t = 1.000$

$$K_1 = 1.1 \times 10^{-6} \text{ cm/sec}$$

$$K_2 = 1.0 \times 10^{-6} \text{ cm/sec}$$

$$K_3 = 1.2 \times 10^{-6} \text{ cm/sec}$$

$$K_4 = 1.1 \times 10^{-6} \text{ cm/sec}$$

Coefficient of Permeability, $K_{20} = 1.1 \times 10^{-6} \text{ cm/sec}$

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. L-93-1008A

Reviewed By:


David D. McCray

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

6756 Buckles Cove • Memphis, TN 38133
(901) 385-1199 • Fax (901) 386-6614



Tri-State Testing Services, Inc.

Measurement of Hydraulic Conductivity

Client: Ensafe/Allen & Hoshall

Date of Report: 06/02/93

Project Name: Naval Air Station @ Millington, TN

Sample I.D.: Boring # 8 Sample: ST 2, Depth 13'-15'

Soil Description: Brown Silty Clay

	<u>Pre-Test</u>	<u>Post Test</u>
Wet Density (Lbs/ft ³)	118.5	119.9
Dry Density (Lbs/ft ³)	93.8	94.0
Moisture (% Dry Wt)	26.4	27.5
Porosity (n)	.428	.423
Degree of Saturation (%)	92.5	100.5

Permeability

Temperature Correction, $R_t = 0.988$

$$K_1 = 1.6 \times 10^{-5} \text{ cm/sec}$$

$$K_2 = 3.8 \times 10^{-5} \text{ cm/sec}$$

$$K_3 = 1.2 \times 10^{-5} \text{ cm/sec}$$

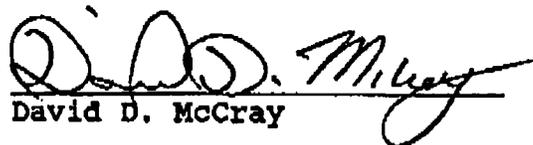
$$K_4 = 7.6 \times 10^{-5} \text{ cm/sec}$$

Coefficient of Permeability, $K_{20} = 3.5 \times 10^{-5} \text{ cm/sec}$

Tested in accordance with Method 9100 of Test Methods for evaluation Solid Waste, Third Addition (SW-846) and in general accordance with ASTM D-5084-90.

Lab No. L-93-1008B

Reviewed By:


David D. McCray

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

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APPENDIX D

Soil Analytical Results

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB1-8	Collection Date:	05/11/93
Lab Sample ID:	XX4188	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling carbons, as die	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4188	102	103

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB1-8	Collection Date:	05/11/93
Lab Sample ID:	XX4170	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4170	110	104

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-9	Collection Date:	05/11/93
Lab Sample ID:	XX4189	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4189	115	107

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-9	Collection Date:	05/11/93
Lab Sample ID:	XX4171	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	12		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4171	93	106

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-15	Collection Date:	05/11/93
Lab Sample ID:	XX4190	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/03/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C₂₃	C₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4190	112	104

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-15	Collection Date:	05/11/93
Lab Sample ID:	XX4172	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.4	⊕	0.1
toluene	56 _{DI}	⊕	0.1
ethyl benzene	0.3	⊕	0.1
xylene (total)	1.0	⊕	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	300		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4172	121	---
XX4172 _{DI}	80	107

⊕ - Analyte confirmed on secondary column.
 DI - Analyzed at 1/1000 dilution on 05/25/93.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-19	Collection Date:	05/11/93
Lab Sample ID:	XX4191	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4191	108	96

1

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB2-19	Collection Date:	05/11/93
Lab Sample ID:	XX4173	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4173	109	111

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-15	Collection Date:	05/11/93
Lab Sample ID:	XX4192	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4192	102	91

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-15	Collection Date:	05/11/93
Lab Sample ID:	XX4174	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	⊕	0.1
toluene	4.2	⊕	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	⊕	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	77		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4174	82	106

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-15 DUP	Collection Date:	05/11/93
Lab Sample ID:	XX4193	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4193	100	106

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-15 DUP	Collection Date:	05/11/93
Lab Sample ID:	XX4175	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	2.0	⊕	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	46		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4175	97	113

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-20	Collection Date:	05/11/93
Lab Sample ID:	XX4194	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/02/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4194	107	116

2

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB3-20	Collection Date:	05/11/93
Lab Sample ID:	XX4176	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	⊕	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4176	122	123

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-10	Collection Date:	05/11/93
Lab Sample ID:	XX4195	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/03/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4195	105	117

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-10	Collection Date:	05/11/93
Lab Sample ID:	XX4177	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4177	110	110

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-15	Collection Date:	05/11/93
Lab Sample ID:	XX4196	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/03/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4195	93	105

2

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-15	Collection Date:	05/11/93
Lab Sample ID:	XX4178	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	2.4	⊕	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.2	⊕	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	81		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4178	119	127 S

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-20	Collection Date:	05/11/93
Lab Sample ID:	XX4197	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	06/03/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4197	88	101

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB4-20	Collection Date:	05/11/93
Lab Sample ID:	XX4179	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/25/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4179	109	111

251

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-9	Collection Date:	05/12/93
Lab Sample ID:	XX4198	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/29/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4198	90	106

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-9	Collection Date:	05/12/93
Lab Sample ID:	XX4180	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4180	96	102

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-15	Collection Date:	05/12/93
Lab Sample ID:	XX4199	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/29/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4199	75	82

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

2/1A

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-15	Collection Date:	05/12/93
Lab Sample ID:	XX4181	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4181	100	105

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-18	Collection Date:	05/12/93
Lab Sample ID:	XX4200	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/29/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4200	79	95

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-18	Collection Date:	N/A
Lab Sample ID:	XX4182	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.4	⊕	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4182	98	108

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-18 DUP	Collection Date:	05/12/93
Lab Sample ID:	XX4201	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/29/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4201	83	94

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB5-18 DUP	Collection Date:	05/12/93
Lab Sample ID:	XX4183	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.6	⊕	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	17		10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4183	101	116

⊕ - Analyte confirmed on secondary column.

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB6-16	Collection Date:	05/12/93
Lab Sample ID:	XX4202	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/30/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4202	86	92

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB6-16	Collection Date:	05/12/93
Lab Sample ID:	XX4184	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4184	108	110

23

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	ENSAFE NAS MEMPHIS	Job Number:	ENFA 54100
Client Sample ID:	FC-SB7-16	Collection Date:	05/12/93
Lab Sample ID:	XX4203	Extraction Date:	05/25/93
Sample Matrix:	SOIL	Analysis Date:	05/30/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits:SOIL	(41-149%)	(59-179%)
Lab Sample I.D.		
XX4203	72	71

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS Memphis	Job Number:	ENFA 54100
Client Sample ID:	FC-SB7-16	Collection Date:	05/12/93
Lab Sample ID:	XX4185	Extraction Date:	05/26/93
Sample Matrix:	SOIL	Analysis Date:	05/26/93
Concentration Units:	mg/kg	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylenes (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample I.D.		
XX4185	94	101

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54572
Client Sample ID:	FC-SB9-15	Collection Date:	07/15/93
Lab Sample ID:	XX9414	Extraction Date:	08/05/93
Sample Matrix:	SOIL	Analysis Date:	08/06/93
Concentration Units:	mg/kg (ppm)	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: SOIL	(41-149%)	(59-179%)
Lab Sample ID: XX9414	90	95

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54572
Client Sample ID:	FC-SB9-15	Collection Date:	07/15/93
Lab Sample ID:	XX9410	Extraction Date:	07/28/93
Sample Matrix:	SOIL	Analysis Date:	07/29/93
Concentration Units:	mg/kg (ppm)	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample ID: XX9410	101	95

NAS Memphis, Millington, TN
 Facility I.D.# 0-790479

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54572
Client Sample ID:	FC-SB9-20	Collection Date:	07/15/93
Lab Sample ID:	XX9417	Extraction Date:	07/23/93
Sample Matrix:	SOIL	Analysis Date:	08/06/93
Concentration Units:	mg/kg (ppm)	Dryness Factor:	N/A

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	10	U	10

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: SOIL	(41-149%)	(59-179%)
Lab Sample ID: XX9417	123	120

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	N/A
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54572
Client Sample ID:	FC-SB9-20	Collection Date:	07/15/93
Lab Sample ID:	XX9413	Extraction Date:	07/28/93
Sample Matrix:	SOIL	Analysis Date:	07/29/93
Concentration Units:	mg/kg (ppm)	Dryness Factor:	N/A

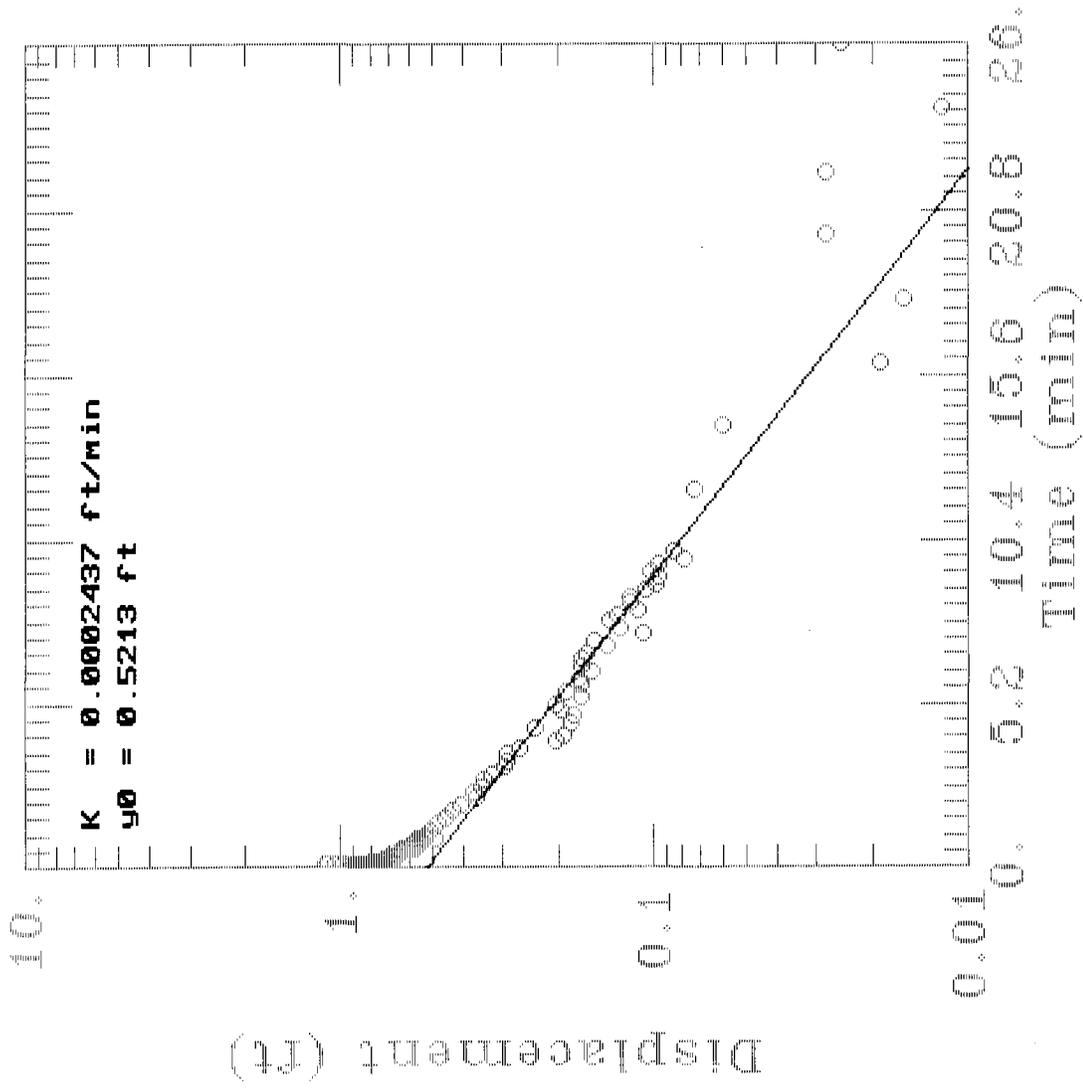
Compound	Results	Qualifiers	Detection Limits
benzene	0.1	U	0.1
toluene	0.1	U *	0.1
ethyl benzene	0.1	U	0.1
xylene (total)	0.1	U *	0.1
total low boiling petroleum hydrocarbons, as gasoline range organics	10	U	10

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: SOIL	(78-124%)	(50-126%)
Lab Sample ID: XX9413	100	100

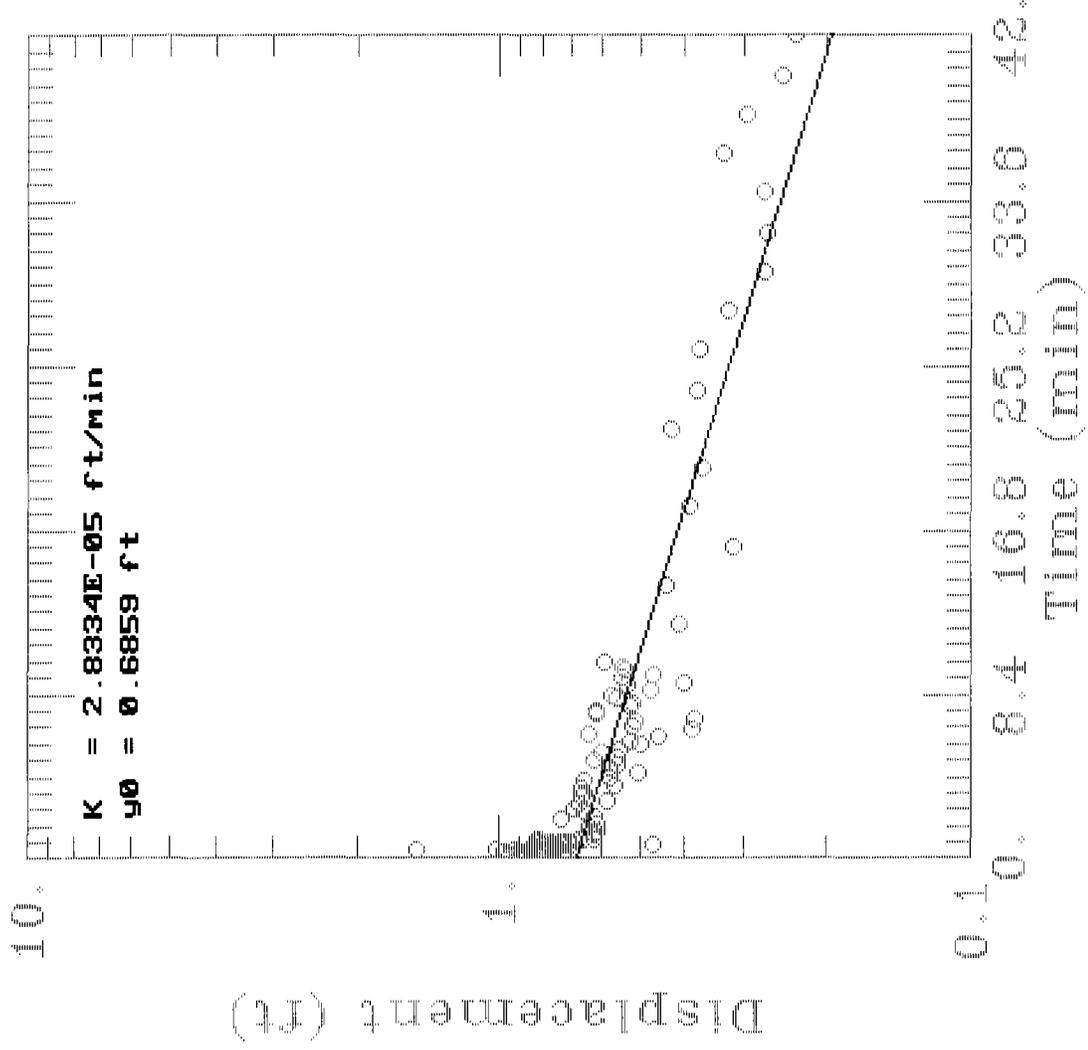
* - Analyte quantitated from the con NAS Memphis, Millington, TN
Facility I.D.# 0-790479

APPENDIX E
AQTESOLV Graphs

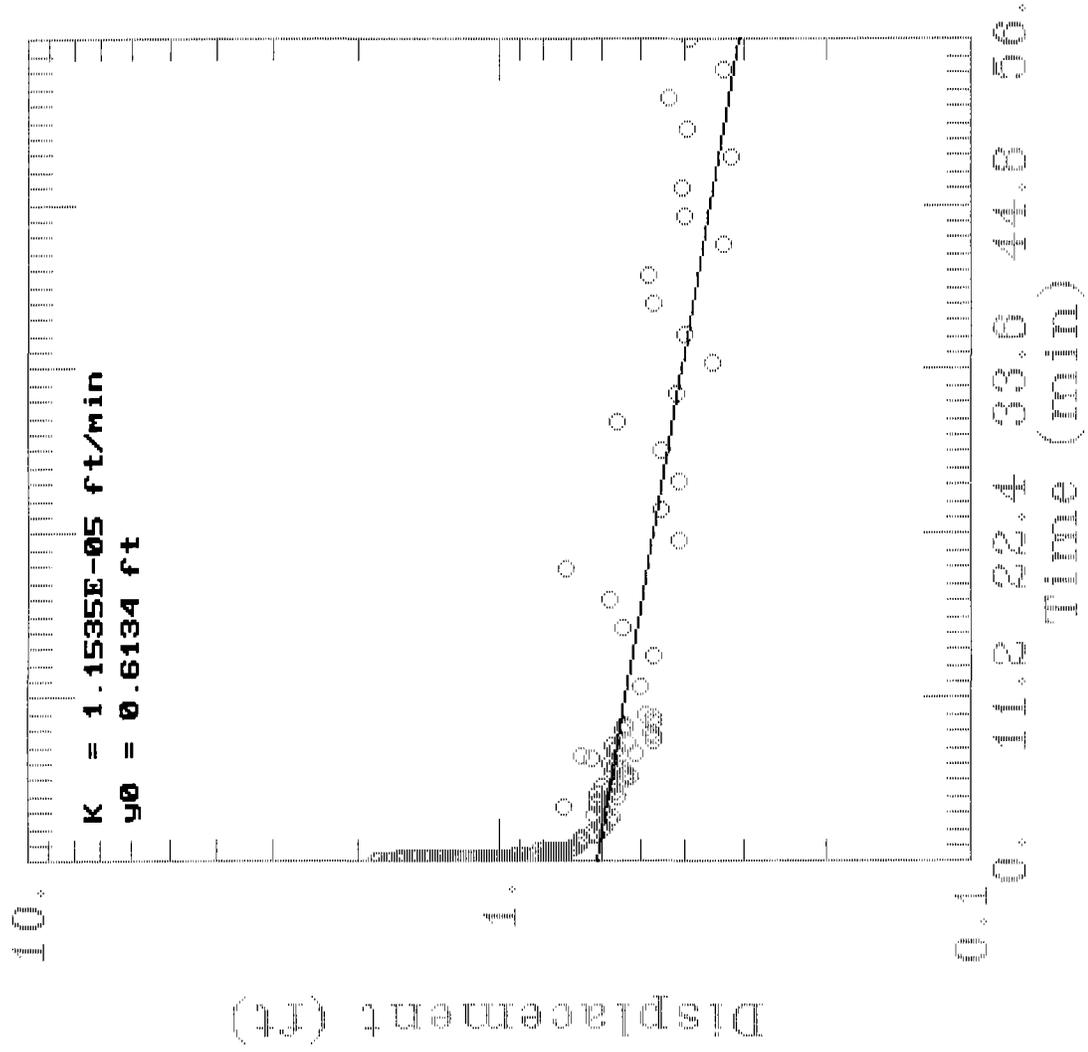
Falling Head Slug Test on FCMW-1



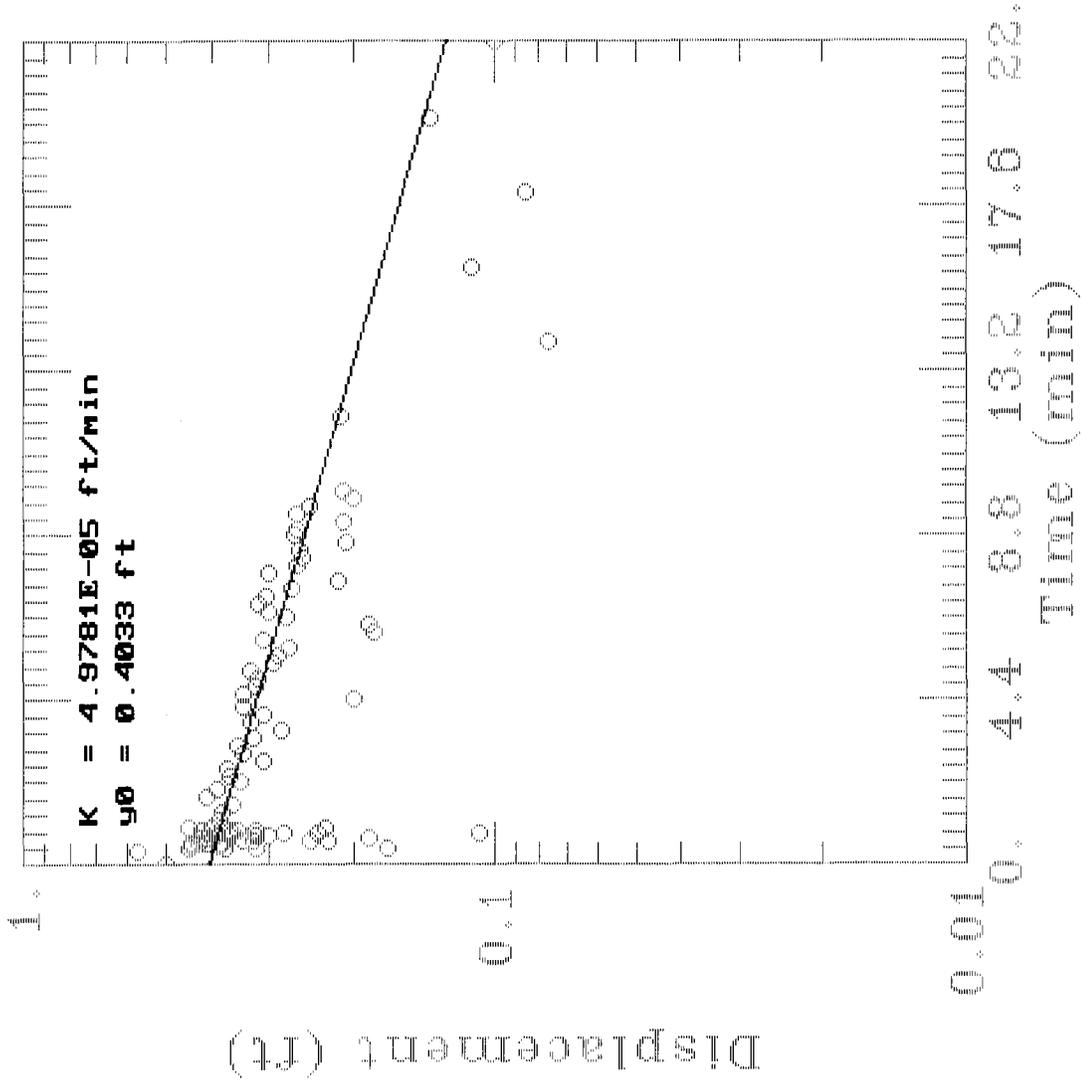
Falling Head Slug Test on FCMW-2



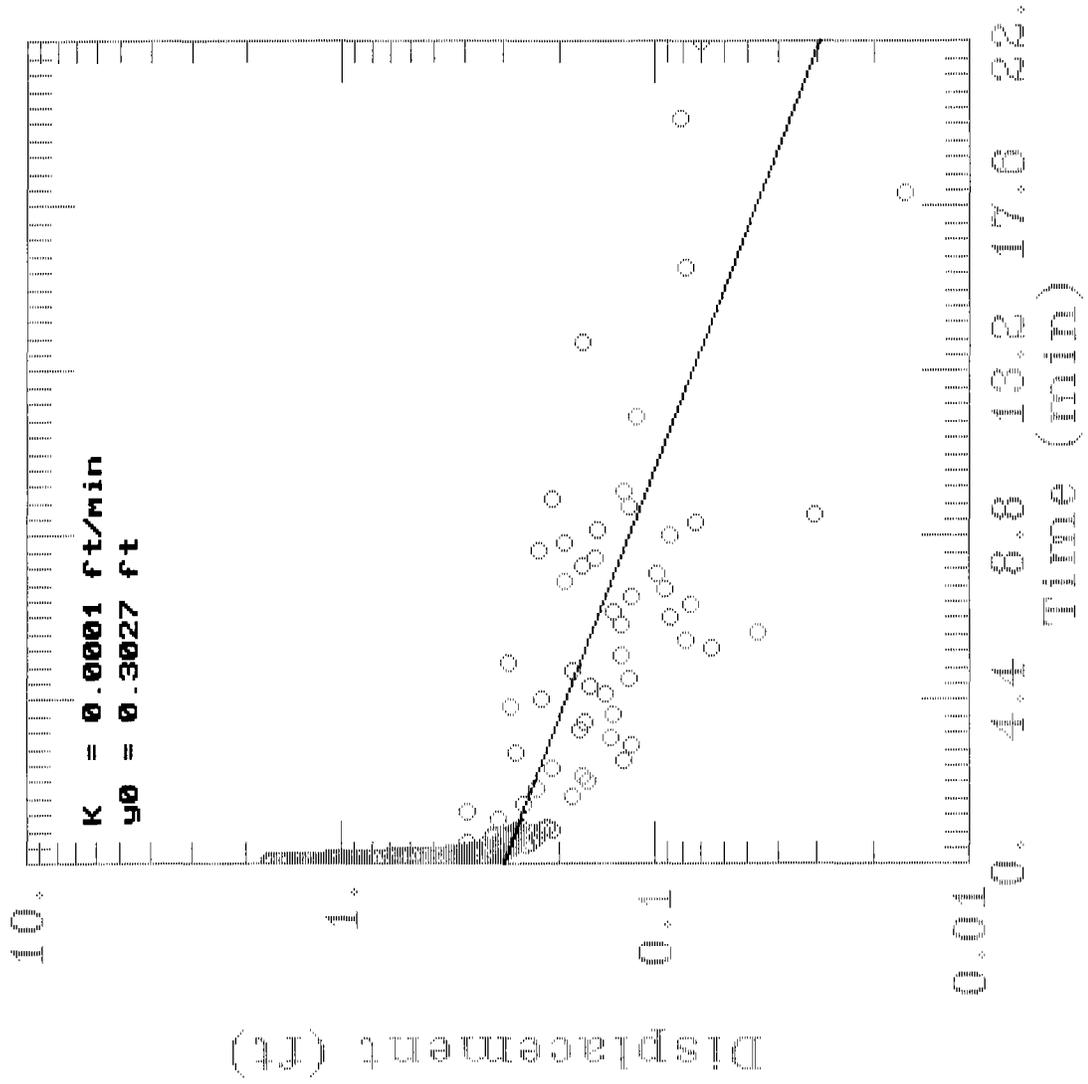
Rising Head Slug Test on FCMW-2



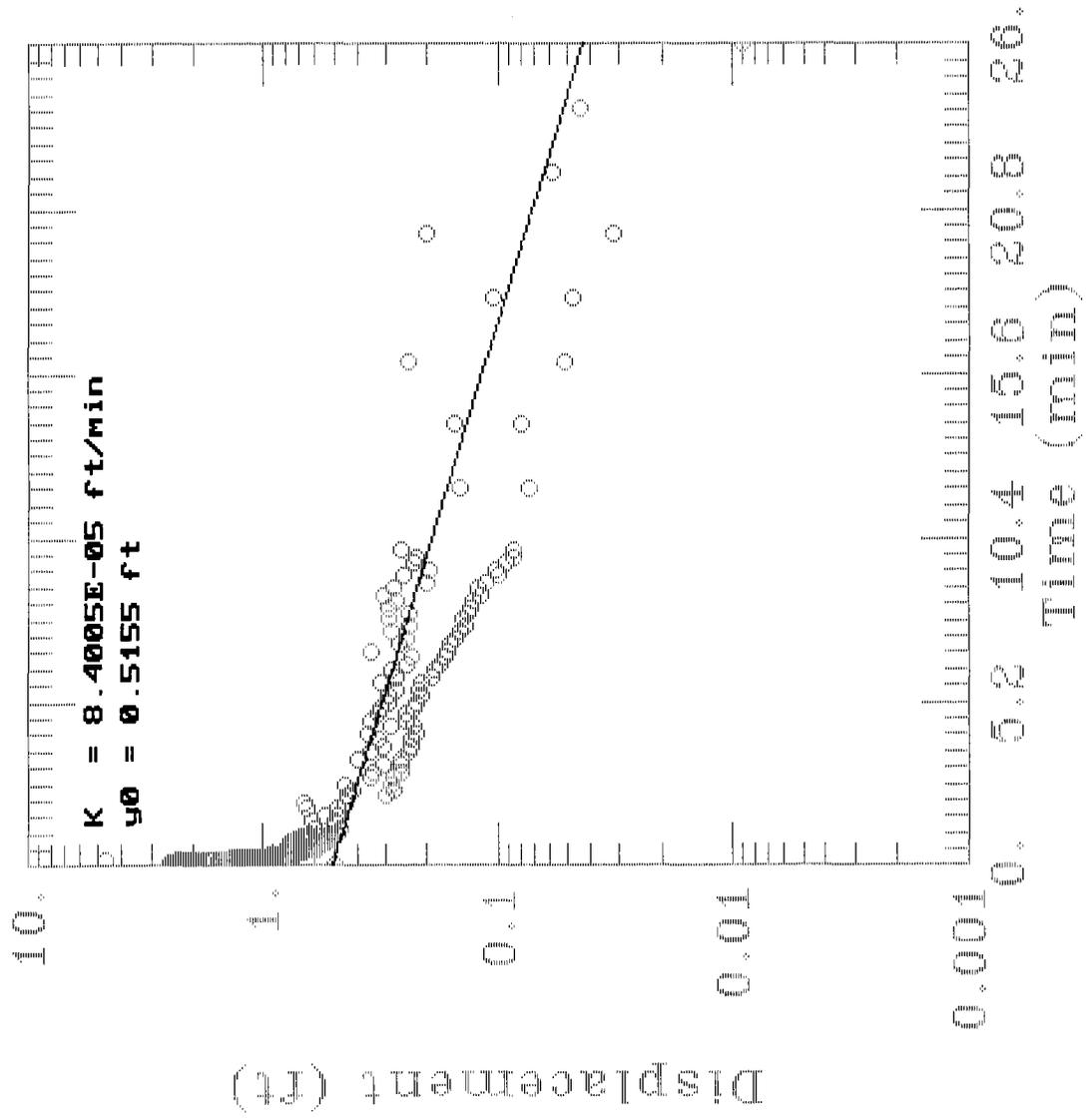
Falling Head Slug Test on FCMW-3



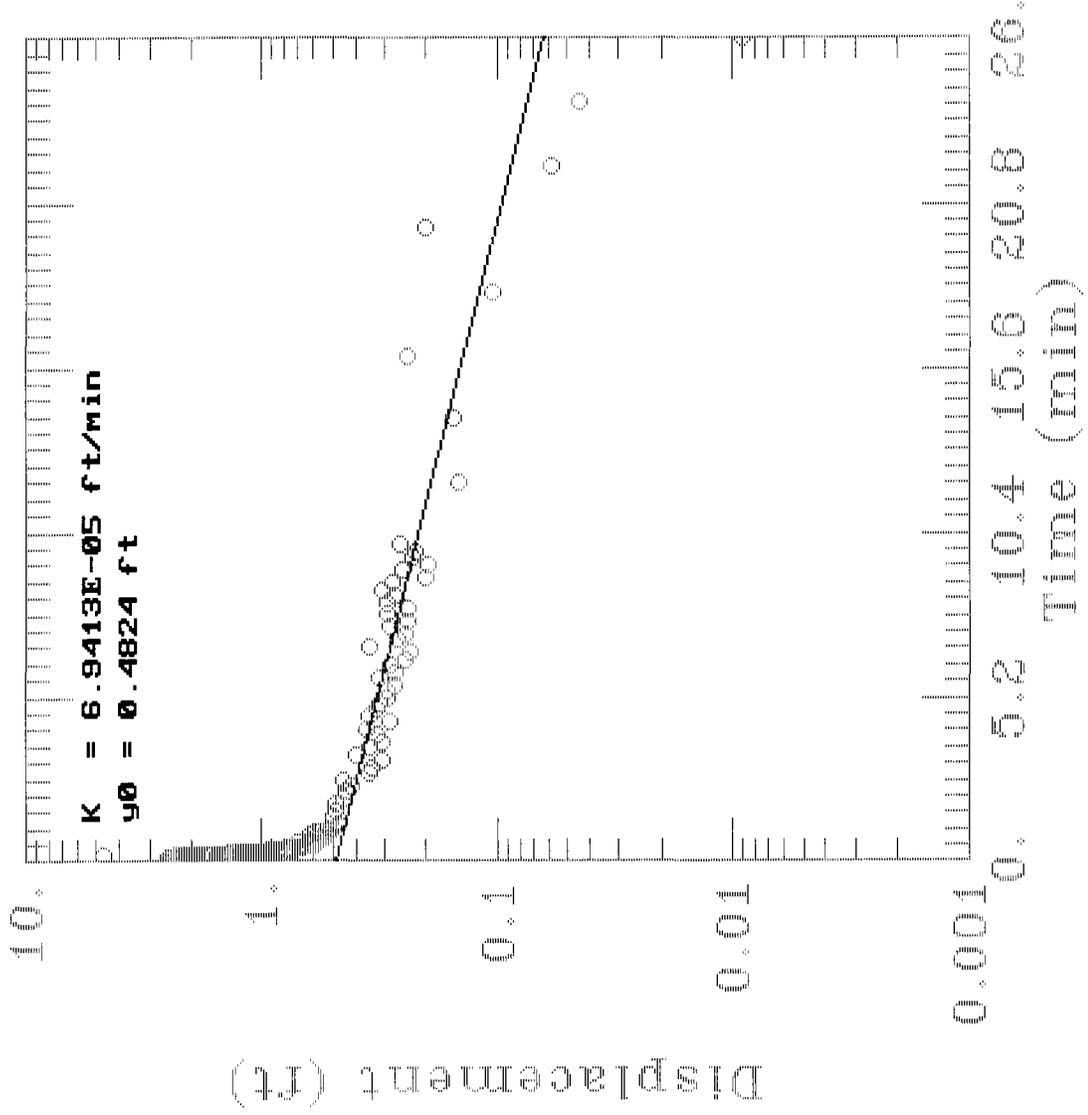
Rising Head Slug Test on FCMW-3



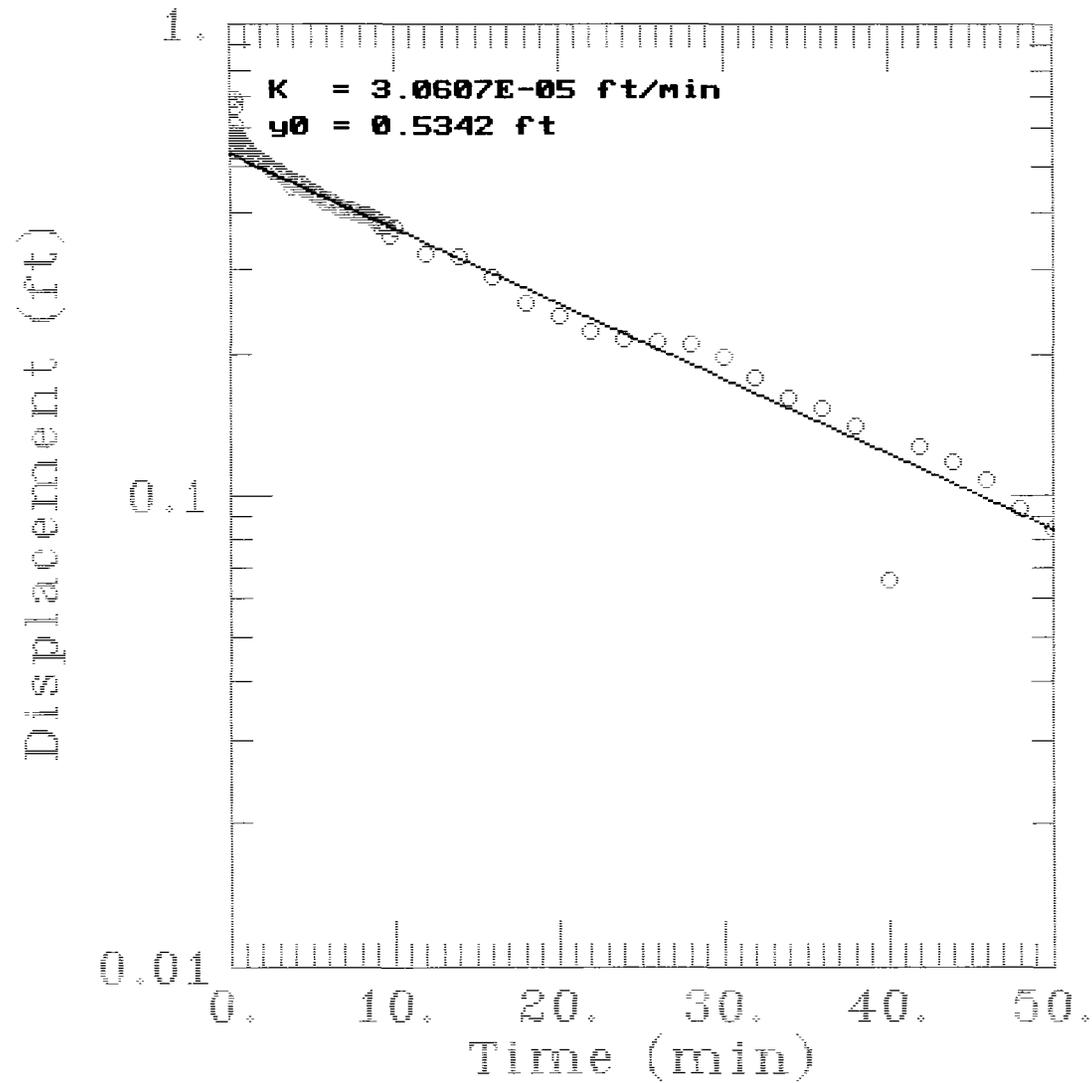
Falling Head Slug Test on FCMW-4



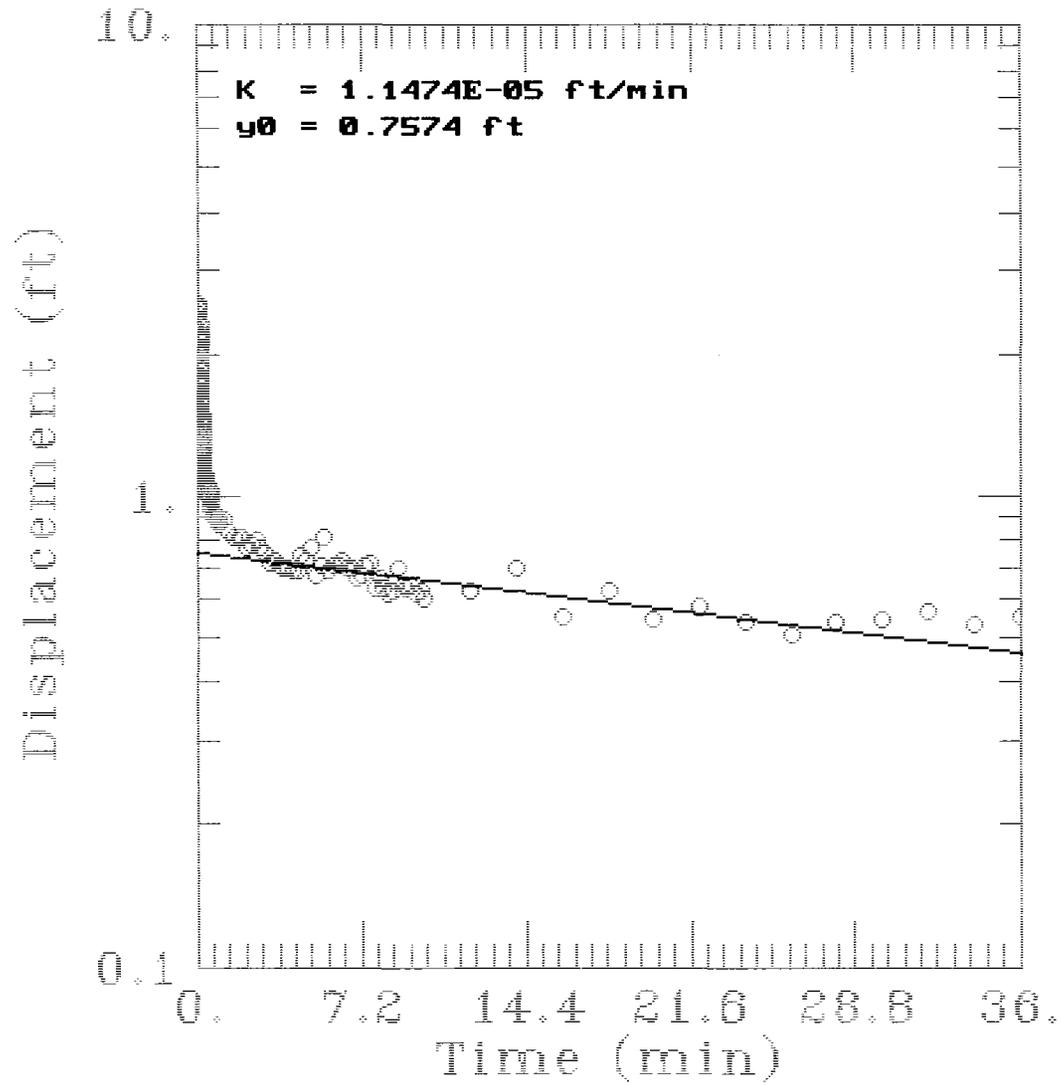
Rising Head Slug Test on FCMW-4



Falling Head Slug Test on FCMW-5



Rising Head Slug Test on FCMW-5



APPENDIX F

Well Construction Logs

WELL CONSTRUCTION LOG. FC-MW-1

NAS MEMPHIS UST EAR

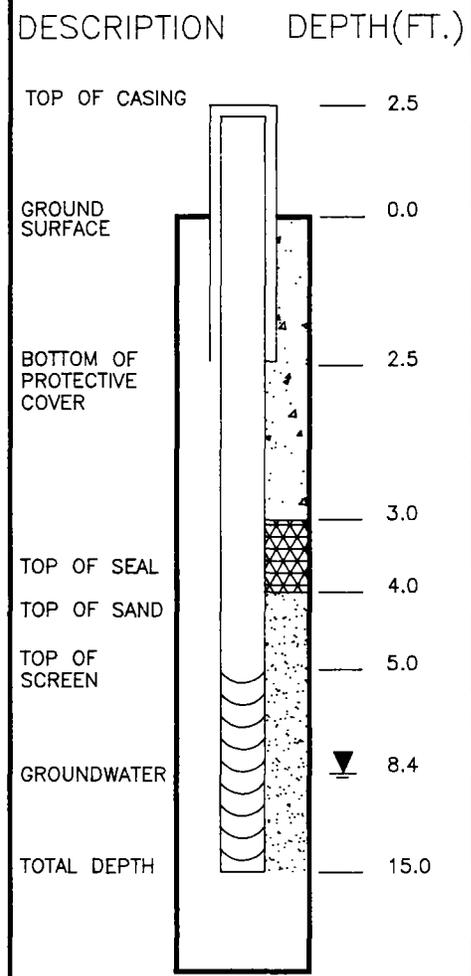
WELL LOCATION FLYING CLUB

DATE INSTALLED 11 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 285.1
 a) DEPTH TO SATURATED ZONE 8.4 FEET
3. TOP OF CASING ELEV. 300.06
4. PROTECTIVE CASING YES YES NO
 a) CASING LENGTH N/A
5. LENGTH OF SCREEN 10.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 15.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 15.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
 QUANTITY USED 374 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
 QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
 GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
 METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS UPGRADIENT WELL

INSTALLATION DESCRIPTION



JOB NUMBER 067-C01014



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 08/05/93

DWG NAME: 067FWC1

WELL CONSTRUCTION LOG. FC-MW-2

NAS MEMPHIS UST EAR

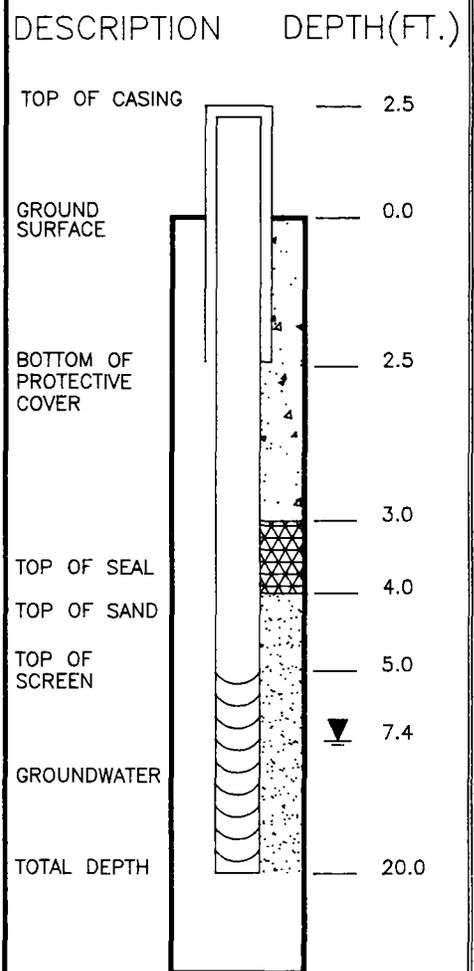
WELL LOCATION FLYING CLUB

DATE INSTALLED 12 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 283.16
 a) DEPTH TO SATURATED ZONE 7.4 FEET
3. TOP OF CASING ELEV. 297.53
4. PROTECTIVE CASING YES NO
 a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
 QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
 QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
 GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
 METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS _____

INSTALLATION DESCRIPTION



JOB NUMBER 067-C01014



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 08/05/93

DWG NAME: 067FWC2

WELL CONSTRUCTION LOG. FC-MW-3

NAS MEMPHIS UST EAR

WELL LOCATION FLYING CLUB

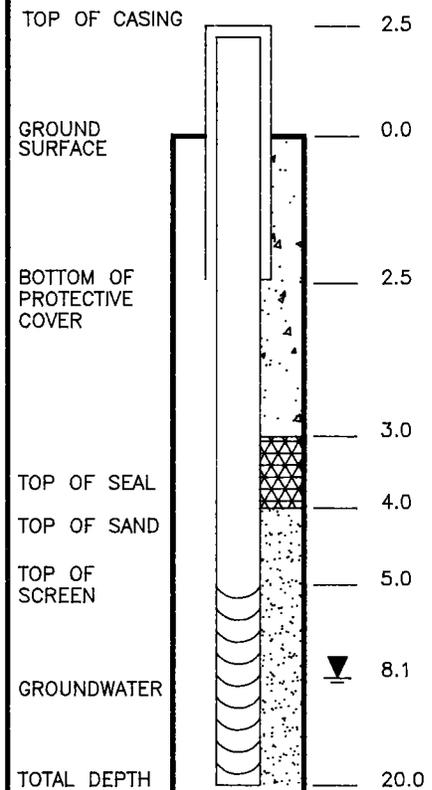
DATE INSTALLED 12 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 280.86
 a) DEPTH TO SATURATED ZONE 8.1 FEET
3. TOP OF CASING ELEV. 297.53
4. PROTECTIVE CASING YES NO
 a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
 QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
 QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
 GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
 METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS _____

INSTALLATION DESCRIPTION

DESCRIPTION DEPTH(FT.)



JOB NUMBER 067-C01014



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 10/05/93

DWG NAME: 067FWC3

WELL CONSTRUCTION LOG. FC-MW-4

NAS MEMPHIS UST EAR

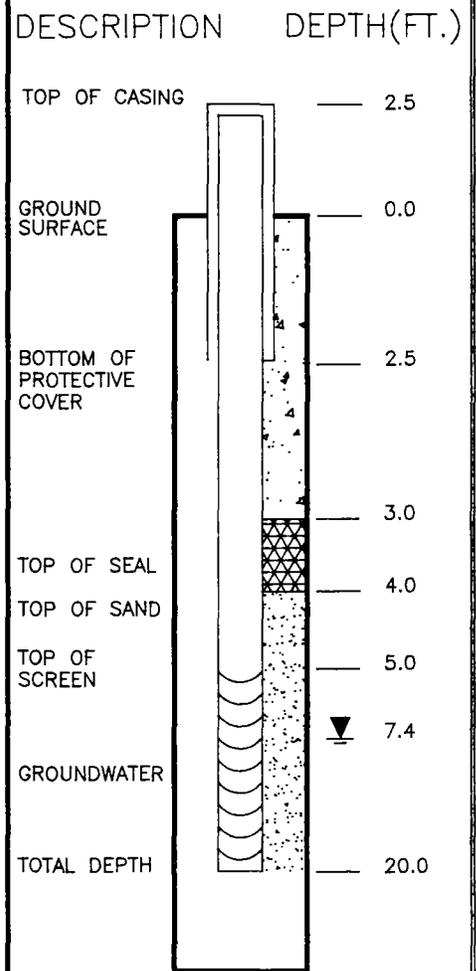
WELL LOCATION FLYING CLUB

DATE INSTALLED 12 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 283.5
 a) DEPTH TO SATURATED ZONE 7.4 FEET
3. TOP OF CASING ELEV. 297.89
4. PROTECTIVE CASING YES NO
 a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
 QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
 QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
 GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
 METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS _____

INSTALLATION DESCRIPTION



JOB NUMBER 067-C01014



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 08/05/93

DWG NAME: 067FWC4

WELL CONSTRUCTION LOG. FC-MW-5

NAS MEMPHIS UST EAR

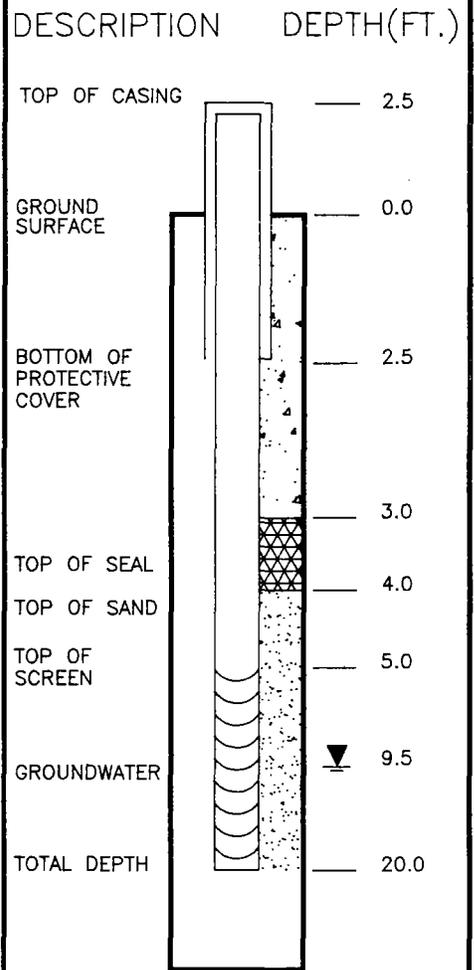
WELL LOCATION FLYING CLUB

DATE INSTALLED 11 MAY 93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 283.76
 a) DEPTH TO SATURATED ZONE 9.5 FEET
3. TOP OF CASING ELEV. 298.23
4. PROTECTIVE CASING YES NO
 a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
 QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
 QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
 GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
 METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS _____

INSTALLATION DESCRIPTION



JOB NUMBER 067-C01014



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 08/05/93

DWG NAME: 067FWC5

WELL CONSTRUCTION LOG. FC-MW-6

NAS MEMPHIS UST EAR

WELL LOCATION FLYING CLUB

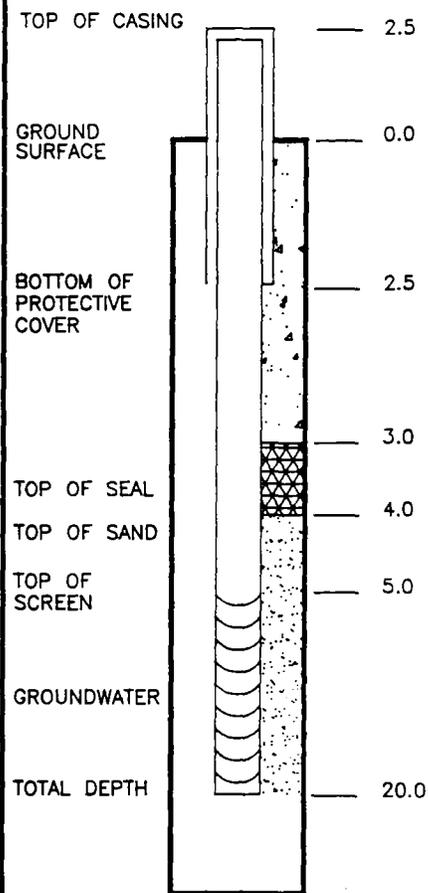
DATE INSTALLED 7/15/93

TYPE OF WELL 2 INCH ID SCH 40 PVC

1. HEIGHT OF CASING ABOVE GROUND 2.50 FEET
2. WATER SURFACE ELEV. 278.33 (7/20/93)
 - a) DEPTH TO SATURATED ZONE _____
3. TOP OF CASING ELEV. 295.65
4. PROTECTIVE CASING YES NO
 - a) CASING LENGTH N/A
5. LENGTH OF SCREEN 15.0 FEET
6. SIZE\TYPE OF SCREEN 0.010 INCH SLOTTED PVC
7. LENGTH OF SUMP N/A
8. TOTAL DEPTH OF BORING 20.0 HOLE DIAMETER 8.25
9. SCREENED INTERVAL 5.0 FEET TO 20.0 FEET
10. TYPE OF SCREEN FILTER PACK SILICA SAND
QUANTITY USED 544 lbs. SIZE 20/40 U/C
11. DEPTH TO TOP OF FILTER 4.0 FEET
12. TYPE OF SEAL 1/4 INCH BENTONITE PELLETS
QUANTITY USED 26 lbs
13. DEPTH TO TOP OF SEAL 3.0 FEET
14. TYPE OF GROUT PORTLAND CEMENT
GROUT MIXTURE 93% CEMENT 7% BENTONITE BY WT.
METHOD OF PLACEMENT PRESSURIZED HOSE
15. COMMENTS _____

INSTALLATION DESCRIPTION

DESCRIPTION DEPTH(FT.)



JOB NUMBER N0067C0104



ENVIRONMENTAL
ASSESSMENT PLAN
NAS MEMPHIS
CTO-67

FIGURE
WELL CONSTRUCTION
LOG

DATE: 08/05/93

DWG NAME: 067FWC5

APPENDIX G

Groundwater Analytical Results

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-1	Collection Date:	05/26/93
Lab Sample ID:	XX4728	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/02/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	1	U	1
toluene	1	U	1
ethyl benzene	1	U	1
xylene (total)	1	U	1
total low boiling petroleum hydrocarbons, as gasoline range organics	100	U	100

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4728	99	96

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-1	Collection Date:	05/26/93
Lab Sample ID:	XX4739	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	100	U	100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4739	72	97

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-2	Collection Date:	05/26/93
Lab Sample ID:	XX4729	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/02/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	1	U	1
toluene	1	U	1
ethyl benzene	1	U	1
xylenes (total)	1	U	1
total low boiling petroleum hydrocarbons, as gasoline range organics	100	U	100

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4729	98	86

**NAS Memphis, Millington, TN
Facility I.D.# 0-790479**

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-2	Collection Date:	05/26/93
Lab Sample ID:	XX4740	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	μg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	100	U	100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4740	63	106

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-2DUP	Collection Date:	05/26/93
Lab Sample ID:	XX4730	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/02/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	1	U	1
toluene	1	U	1
ethyl benzene	1	U	1
xylene (total)	1	U	1
total low boiling petroleum hydrocarbons, as gasoline range organics	100	U	100

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4730	97	88

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-2 DUP	Collection Date:	05/26/93
Lab Sample ID:	XX4741	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	μg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	100	U	100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4741	79	86

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-3	Collection Date:	05/26/93
Lab Sample ID:	XX4731	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/03/93, 06/04/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	530	D ₁ ⊕	20
toluene	7,200	D ₂ ⊕	500
ethyl benzene	36	D ₁ ⊕	20
xylenes (total)	140	D ₁ ⊕	20
total low boiling petroleum hydrocarbons, as gasoline range organics	9,500	D ₁	2,000

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4731 D ₁ , XX4731 D ₂	98	102

- D₁ - Analyzed at 1/20 dilution on 06/03/93.
- D₂ - Analyzed at 1/500 dilution on 06/04/93.
- ⊕ - Analyte confirmed on secondary column (6/7/93).

NAS Memphis, Millington, TN
 Facility I.D.# 0-790479

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-3	Collection Date:	05/26/93
Lab Sample ID:	XX4742	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	490	A	100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4742	81	103

MATRIX SPIKE/MATRIX SPIKE DUPLICATE ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-3	Collection Date:	05/26/93
Lab Sample ID:	XX4731	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/03/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Sample Result	Conc. Spike Added	Conc. MS	% Rec.	Conc. MSD	% Rec.	RPD
gasoline range organics	9,500	20,000	23,000	68	23,000	68	0

Surrogate Recovery	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(65-129%)
Lab Sample I.D.	
XX4731 MS	113
XX4731 MSD	108

**NAS Memphis, Millington, TN
Facility I.D.# 0-790479**

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-4	Collection Date:	05/26/93
Lab Sample ID:	XX4734	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/02/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	1	U	1
toluene	1	U	1
ethyl benzene	1	U	1
xylene (total)	1	U	1
total low boiling petroleum hydrocarbons, as gasoline range organics	100	U	100

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4734	96	95

**NAS Memphis, Millington, TN
Facility I.D.# 0-790479**

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-4	Collection Date:	05/26/93
Lab Sample ID:	XX4745	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	100	U	100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4745	81	67

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

LOW BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-5	Collection Date:	05/26/93
Lab Sample ID:	XX4735	Extraction Date:	NA
Sample Matrix:	WATER	Analysis Date:	06/03/93, 06/07/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
benzene	6,500	D ₁ ⊕	100
toluene	98,000	D ₃ ⊕	2,000
ethyl benzene	140	D ₂ ⊕	20
xylenes (total)	670	D ₂ ⊕	20
total low boiling petroleum hydrocarbons, as gasoline range organics	68,000	D ₁	1,000

Surrogate Recovery	Bromofluorobenzene (PID)	Bromofluorobenzene (FID)
Acceptance Limits: WATER	(72-119%)	(65-129)
Lab Sample I.D.		
XX4735 D ₁	98	104
XX4735 D ₂	100	-
XX4735 D ₃	98	-

D₁ - Analyzed at 1/100 dilution on 06/03/93.

D₂ - Analyzed at 1/20 dilution on 06/03/93.

D₃ - Analyzed at 1/2000 dilution on 06/03/93.

⊕ - Analyte confirmed on secondary analysis.

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54176
Client Sample ID:	FC-MW-5	Collection Date:	05/26/93
Lab Sample ID:	XX4746	Extraction Date:	05/28/93
Sample Matrix:	WATER	Analysis Date:	05/30/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	2,200		100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample I.D.		
XX4746	55	69

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

HIGH BOILING PETROLEUM HYDROCARBONS ANALYSIS

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54598
Client Sample ID:	N-MW-6	Collection Date:	07/20/93
Lab Sample ID:	XX9901	Extraction Date:	07/26/93
Sample Matrix:	WATER	Analysis Date:	08/05/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	2,000		100

Surrogate Recovery	C ₂₃	C ₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample ID: XX9901	119	179 S

Laboratory Name:	ITAS-KNOXVILLE	SDG Number:	NA
Contract Name:	NAS MEMPHIS	Job Number:	ENFA 54598
Client Sample ID:	N-MW-6-DUP	Collection Date:	07/20/93
Lab Sample ID:	XX9902	Extraction Date:	07/26/93
Sample Matrix:	WATER	Analysis Date:	08/05/93
Concentration Units:	µg/liter (ppb)	Dryness Factor:	NA

Compound	Results	Qualifiers	Detection Limits
total high boiling petroleum hydrocarbons, as diesel range organics	1,500		100

Surrogate Recovery	C₂₃	C₃₂
Acceptance Limits: WATER	(23-132%)	(31-155%)
Lab Sample ID: XX9902	107	135

APPENDIX H

Shelby County Well Survey



MEMPHIS AND SHELBY COUNTY
HEALTH DEPARTMENT
RICHARD SWIGGART, M.P.A. SHERMAN KAHN, M.D.
Director *Health Officer*



DR. W. W. HERENTON
Mayor of Memphis

WILLIAM N. MORRIS, JR.
Mayor of Shelby County

August 6, 1992

EnSafe / Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134

Attn: Lawson M. Anderson

RE: Environmental Site Assessment
Water Well Search
Millington Naval Air Station-Willis Gate
Intersection Of Navy Road And Third Avenue
Millington, Tennessee

Dear Mr. Anderson:

Please find enclosed a list of quasi-public, commercial, and residential wells located within an approximate two (2) mile radius of the above location that are contained in our files. This list does not contain the location of any public water supply wells that are operated by the Public Utility Division, nor does it contain wells used for groundwater monitoring. Public water well information may be obtained from Memphis Light, Gas, and Water Division, 245 South Main St., Memphis, Tennessee (901)528-4011. Information regarding monitoring wells associated with leaking petroleum storage tanks may be obtained from the Tennessee Department of Environment and Conservation, Division of Water Management, 2500 Mt. Moriah Road, (901)543-6695.

Our records indicate five (5) wells on the Naval Air Station property, however, information regarding the exact location, use, and depth of these wells is not included in our files. You may contact Lt. Ron Gruzesky, NAS Memphis, 873-5230 for additional information about these wells.

Page 1 of 2

August 6, 1992

wp-0075I/115

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

814 JEFFERSON AVENUE, MEMPHIS, TENNESSEE 38105
PHONE (901) 576-7600 FAX (901) 576-7832

August 6, 1992

I hope this clarifies the facts for which we have records on file in our office. If Pollution Control can be of further assistance, feel free to contact me at 576-7775.

Sincerely,



S. L. Sherrill, Jr., Asst. Manager
POLLUTION CONTROL

ENCLOSURE

wp-00751/116
WAS/SLS
HK-199

WATER WELL LIST

Page 1 of 2

August 6, 1992

Water Well Number: 1
Owner of Well: James E. Krosp
Location of Well: 7378 Krosp Road
Mailing Address: James E. Krosp
7378 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 150 Feet
Well Classification: Residential

Water Well Number: 2
Owner of Well: Clifford O. Longmire
Location of Well: 7431 Krosp Road
Mailing Address: Clifford O. Longmire
7431 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 120 Feet
Well Classification: Residential

Water Well Number: 3
Owner of Well: Terry Longmire
Location of Well: 7473 Krosp Road
Mailing Address: Terry Longmire
7473 Krosp Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 130 Feet
Well Classification: Residential

Water Well Number: 4
Owner of Well: Phoenix Zinc
Location of Well: 4525/4599 Big Creek Church Road
Mailing Address: 4525/4599 Big Creek Church Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: Not Listed
Well Classification: Commercial

Water Well Number: 5
Owner of Well: Shelby County Conservation Board
Location of Well: Edmond Orgill Park
Mailing Address: Shelby County Conservation Board
2599 Avery
Memphis, TN 38053
Attn: Ed Price
Number of wells at this location: 1
Well Depth: Depth Not Listed
Well Classification: Irrigation And To Maintain Lake Level

wp0075I/117

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

WATER WELL LIST (Continued)

Page 2 of 2

August 6, 1992

Water Well Number: 6
Owner of Well: Harold Bradley
Location of Well: 5230 Bateman Road
Mailing Address: Harold Bradley
5230 Batman Road
Millington, TN 38053
Number of wells at this location: 1
Well Depth: 150 Feet
Well Classification: Residential

wp0075I/118

NAS Memphis, Millington, TN
Facility I.D.# 0-790479

APPENDIX I

Chain-of-Custody Forms



SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 05/19/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54100
Client Number : 3164**

Subject: NAS Memphis

On 05/14/93, sixteen (16) soil samples, two (2) waters samples and one (1) trip blank arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee.

The following nonconformance(s) were noted at the time of receipt.

SAMPLE RECEIVED:

- Broken/Leaking**
- Without proper preservative**
- In improper container**
- With incomplete/unclear paperwork**
- Holding time exceeded at time of receipt**
- With custody seal missing or broken**
- Other**

COMMENTS: Sample #FC-SB2-10 was not received, but was on the paperwork. The trip blank was received, but was not on the paperwork.

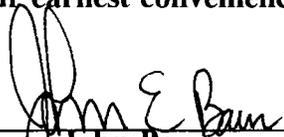
CORRECTIVE ACTION:

- Client was verbally notified.
- Client was informed in writing.
- Sample(s) processed as received.
- Sample(s) on hold until notified by client.

COMMENTS: Lawson Anderson was verbally notified by John Baur on 05/14/93. The trip blank was processed for BTEX by 8020.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator:


John Baur

Date: 5-19-93

Enclosure(s): Chain of Custody



NAVY CLEAN
ENSURE/ALLEN & HOSHAL
 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 3

CLIENT NAS MEMPHIS/ENSURE/Allen & Hoshal PROJECT MANAGER Robert Smith
 ADDRESS 5724 Summer Trees Dr. TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER NA07C0104 FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) M.P.S.

NO. OF CONTAINERS	ANALYSIS REQUIRED						REMARKS
	BET/GR	DRO	TOC	NITROGEN	PHOSPHORUS	PLATE COUNT	

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION										
					TEMP.	CHEMICAL									
FC-SB1-908	5/11/93	1020	Soil	60 ml, 125 ml	4°	—	2	x	x						
FC-SB2-10	5/11/93	1410			4°	—	2	x	x						
FC-SB2-16 ^{RS} 15	5/11/93	1425			4°	—	4	x	x	x	x	x			CMS samples
FC-SB2-26 ^{RS} 19	5/11/93	1445			4°	—	2	x	x						
FC-SB3-15	5/11/93	1645			4°	—	2	x	x						
FC-SB3-15 DUP	5/11/93	1645			4°	—	2	x	x						Duplicate
FC-SB3-20	5/11/93	1700			4°	—	2	x	x						
FC-SB4-10	5/11/93	1815			4°	—	2	x	x						
FC-SB4-15	5/11/93	1845			4°	—	2	x	x						
FC-SB4-20	5/11/93	1900			4°	—	2	x	x						

RELINQUISHED BY: SIGNATURE <u>M.P.S.</u> PRINTED <u>Robert Smith</u> COMPANY <u>E/A&H</u> REASON <u>LAB</u>	DATE <u>5/13/93</u> TIME <u>1830</u>	RECEIVED BY: SIGNATURE <u>FED-X</u> PRINTED _____ COMPANY _____ REASON _____	DATE TIME	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE TIME	RECEIVED BY: SIGNATURE <u>KA Klemm</u> PRINTED <u>KA Klemm</u> COMPANY <u>ETAS-KN</u> REASON <u>Analyses</u>	DATE <u>5/14/93</u> TIME <u>09:45</u>
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____	COMMENTS: <u>Rec'd @ 6°C</u>	AFTER ANALYSIS, SAMPLES ARE TO BE: <input type="checkbox"/> DISPOSED OF (ADDITIONAL FEE) <input type="checkbox"/> STORED (90 DAYS MAX) <input type="checkbox"/> STORED OVER 90 DAYS (ADDITIONAL FEE) <input type="checkbox"/> RETURNED TO CUSTOMER
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 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 2 OF 3

CLIENT NASMEM/E/ALH PROJECT MANAGER R. SMITH
 ADDRESS 5724 Summer Trees Dr. TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER N0007C0104 FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) Mr. P.S. J.

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED							REMARKS	
					TEMP.	CHEMICAL		BETX/GRO	DRO	TOC	Phosphorus	NO ₃ /NO ₂				
FC-SBS-9	5/12/93	1030	Soil	60ml, 125ml	4°C	—	2	x	x							
FC-SBS-18	5/12/93	1100					2	x	x							
FC-SBS-15	5/12/93	1045					2	x	x							
FC-SB6-16	5/12/93	1400					2	x	x							
FC-SB7-16	5/12/93	1415					2	x	x							
FC-SB7-16 MS	5/12/93	1615					2	x	x							MATRIX SPIKE
FC-SB7-16 MSD	5/12/93	1615	↓	↓	↓	↓	2	x	x							MATRIX SPIKE DUP
FC-RB	5/12/93	1725	H ₂ O	40ml, 1L	4°C	HCl	4	x	x							Rinsate Blank
FC-FB	5/12/93	1725	H ₂ O	" "	4°C	HCl	4	x	x							FIELD Blank
FC-SB2-9	5/11/93	1410	Soil		4°C	—	3	+	+	+						

RELINQUISHED BY: SIGNATURE <u>Mr. P.S. J.</u> PRINTED <u>Robert Smith</u> COMPANY <u>E/ALH</u> REASON <u>LAB</u>	DATE <u>5/13/93</u> TIME <u>1830</u>	RECEIVED BY: SIGNATURE _____ PRINTED <u>FEDX</u> COMPANY _____ REASON _____	DATE _____ TIME _____	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE <u>K. Klemm</u> PRINTED <u>Kerry Klemm</u> COMPANY <u>ITAS-KN</u> REASON <u>Analysis</u>	DATE <u>5/14/93</u> TIME <u>09:45</u>
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METHOD OF SHIPMENT: _____
 SHIPMENT NO. _____
 SPECIAL INSTRUCTION: _____

COMMENTS: Rec'd @ 60c

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER



NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 3 OF 3

CLIENT _____ PROJECT MANAGER #1
 ADDRESS SEE PAGE #1 TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER _____ FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) _____

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED	REMARKS
					TEMP.	CHEMICAL			
FC-SB5-18 DUP	5/12/93	1100	Soil	40ml, 125ml	4C	-	2 x 1	DRB	Duplicate
REMAINDER OF TABLE IS BLANK									

RELINQUISHED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>Robert T. Smith</u> COMPANY <u>E/A-H</u> REASON <u>LAB</u>	DATE _____ TIME _____	RECEIVED BY: SIGNATURE <u>KAKlemm</u> PRINTED <u>Kerry Klemm</u> COMPANY <u>ITAS-KN</u> REASON <u>Analysis</u>	DATE <u>5/14/93</u> TIME <u>0945</u>	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____

COMMENTS: Rec'd @ 60C

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER



**INTERNATIONAL
TECHNOLOGY
CORPORATION**

JAN 19 1993

SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 05/18/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54106
Client Number : 3164**

Subject: NAS Memphis

6/14
On 05/15/93, eleven (11) soil samples arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee

The samples were logged in under ITAS Project Code ENFA54106.

The samples were received in good condition, and there were no nonconformances noted.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator John E Baur Date 5-18-93
John Baur

Enclosure(s): Chain of Custody



**NAVY CLEAN
ENSAFE/ALLEN & HOSHALL**
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 2

CLIENT E/A&H/NAS MEMPHIS PROJECT MANAGER Robert Smith
 ADDRESS 5724 Summer Trees Dr TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER N0067CC109 FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) [Signature]

NO. OF CONTAINERS	ANALYSIS REQUIRED										REMARKS	
	BETX	ISRE	DRE									
2	x	x										OK GC
2	x	x										
2	x	x										
2	x	x										
2	x	x										
2	x	x										
2	x	x										
2	x	x										
2	x	x										
2	x	x										

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	BETX	ISRE	DRE								
					TEMP.	CHEMICAL												
N-SB1-13	5/13/93	1116	Soil	40ml, 125ml	4°C	-	2	x	x									
N-SB2-8	5/13/93	1345					2	x	x									
N-SB2-20	5/13/93	1400					2	x	x									
N-SB3-13	5/13/93	1525					2	x	x									
N-SB3-13 DUF	5/13/93	1525					2	x	x									Duplicate
N-SB3-21	5/13/93	1550					2	x	x									
N-SB4-8	5/14/93	0900					2	x	x									
N-SB4-18	5/14/93	0930					2	x	x									
N-SB4-18MS	5/14/93	0930					2	x	x									MATRIX SPIKE
N-SB4-18MSD	5/14/93	0930	x	x	x		2	x	x									MATRIX SPIKE

RELINQUISHED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>Robert Smith</u> COMPANY <u>ENSAFE</u> REASON <u>LAB</u>	DATE <u>5/14</u> TIME <u>1700</u>	RECEIVED BY: <u>Alicia</u> SIGNATURE <u>[Signature]</u> PRINTED <u>FED</u> COMPANY <u>ITASKN</u> REASON _____	DATE <u>5/14/93</u> TIME <u>1000</u>	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER

ENFIA 54106



NAVY CLEAN
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 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 2 OF 2

CLIENT SEE Page #1 PROJECT MANAGER _____
 ADDRESS _____ TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER _____ FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) _____

NO. OF CONTAINERS	ANALYSIS REQUIRED			REMARKS
	BET	IGRC	DRO	
2	x	x	x	O/C 6K
2	x	x	x	
2	x	x	x	

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION	
					TEMP.	CHEMICAL
N-585-9	5/14/93	1020	Soil	40ml, 125ml	4c	—
N-585-20	5/14/93	1045				—
N-586-12	5/14/93	1400				—

RELINQUISHED BY: SIGNATURE <u>Robert Smith</u> PRINTED <u>ROBERT SMITH</u> COMPANY <u>ENSAFE</u> REASON <u>LAB</u>	DATE <u>5/14</u> TIME <u>1700</u>	RECEIVED BY: SIGNATURE <u>Alicia Blau</u> PRINTED _____ COMPANY <u>ITASKN</u> REASON _____	DATE <u>5/14/93</u> TIME <u>1000</u>	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____

COMMENTS: _____

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER

2 NPH 54106



**INTERNATIONAL
TECHNOLOGY
CORPORATION**

SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 05/19/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54114
Client Number : 3164**

Subject: NAS Memphis

On 05/18/93, five (5) soil samples, one (1) trip blank and two (2) rinsates arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee.

The following nonconformance(s) were noted at the time of receipt.

SAMPLE RECEIVED:

- Broken/Leaking**
- Without proper preservative**
- In improper container**
- With incomplete/unclear paperwork**
- Holding time exceeded at time of receipt**
- With custody seal missing or broken**
- Other**

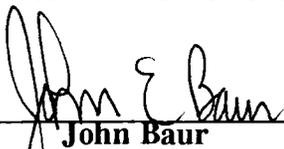
COMMENTS: 1) One VOA vial for N-126RB was received broken. 2) The rinsates for the DROs was received with a pH of 7.

CORRECTIVE ACTION:

- Client was verbally notified.
- Client was informed in writing.
- Sample(s) processed as received.
- Sample(s) on hold until notified by client.

COMMENTS: The samples were processed as received. The remaining vials for N-126RB were used for analysis.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator:  Date: 5-19-93
John Baur

Enclosure(s): Chain of Custody



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ENSURE/ALLEN & HOSHAL
 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT SOUTH DIV / NAS MEMPHIS PROJECT MANAGER Robert Smith
 ADDRESS _____ TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER NO06700109 FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) [Signature]

NO. OF CONTAINERS	ANALYSIS REQUIRED						REMARKS
	RETN/LEAD	DRO	TOL NO ₂ /NO ₃	MICROBIOLOGICAL	PLATE COUNT		

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED						REMARKS		
					TEMP.	CHEMICAL		RETN/LEAD	DRO	TOL NO ₂ /NO ₃	MICROBIOLOGICAL	PLATE COUNT				
N-SB8-9	5/17/93	1040	Soil	40ml, 125ml	4°C	—	2	X	X							
N-SB8-9 DUP	5/17/93	1040				—	2	X	X							Duplicate
N-SB7-17	5/17/93	0930				—	2	X	X							
N-SB8-20	5/17/93	1100				—	2	X	X							
N-SB8-13	5/17/93	1055				—	2	X	X							
N-RB	5/17/93	1230	H ₂ O	1L, 20-1		HCl	4	X	X							RINSEATE BLANK
N-FB	5/17/93	1230	H ₂ O	1L, 20-1		HCl	4	X	X							Field Blank
N-SB9-20	5/17/93	1315	Soil	250ml		—	2			X	X					
TRIP BLANK							2	X								

RELINQUISHED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>Robert Smith</u> COMPANY <u>ENSURE</u> REASON <u>LAB</u>	DATE <u>5/17</u> TIME <u>1100</u>	RECEIVED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>FED-X</u> COMPANY _____ REASON _____	DATE _____ TIME _____	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>Starr</u> COMPANY <u>ITAS</u> REASON _____	DATE <u>5/19/93</u> TIME <u>0830</u>
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____

COMMENTS: SAMPLE: N-SB8-9 High
N-SB8-9 DUP CONCENTRATION

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER

Samples rec'd at 6°C KAK 5-18-93

ENFA 54114



SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 06/07/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54176
Client Number : 3164**

Subject: NAS Memphis

On 05/27/93, twelve (12) water samples arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe Allen & Hoshall, Memphis, Tennessee.

The following nonconformance(s) were noted at the time of receipt.

SAMPLE RECEIVED:

- Broken/Leaking**
- Without proper preservative**
- In improper container**
- With incomplete/unclear paperwork**
- Holding time exceeded at time of receipt**
- With custody seal missing or broken**
- Other**

COMMENTS: The sample container for FC-MW-3MS was received broken for DRO.

Regional Office

5815 Middlebrook Pike ■ Knoxville, Tennessee 37921 ■ 615-588-6401

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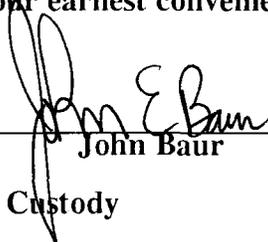
CORRECTIVE ACTION:

- Client was verbally notified.
- Client was informed in writing.
- Sample(s) processed as received.
- Sample(s) on hold until notified by client.

COMMENTS: The samples were processed as received. The remaining bottles will be used for MS/MSD.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator: _____


John Baur

Date: 6-7-93

Enclosure(s): Chain of Custody



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 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 2

CLIENT _____ PROJECT MANAGER Robert Smith
 ADDRESS _____ TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER N0067C0104 FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) M.A.F. Smith

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED										REMARKS				
					TEMP.	CHEMICAL		BTEX/GRO	DRO	TOC	TSS/AIK. Temp	MICROBIAL PLATE COUNT	METALS (I/Row)	NB-NOX, TOTAL Phos								
FC-MW-1	5/26/93	1315	H2O	40ml, 1L	4C	HCl	4	X	X													
FC-MW-2		1330					4	X	X													
FC-MW-2 DUP		1330					4	X	X												Duplicate	
FC-MW-3		1400					4	X	X													
FC-MW-3MS		1400					4	X	X												MATRIX SPIKE	
FC-MW-3MSD		1400					4	X	X												MATRIX SPIKE IDY.	
FC-MW-4		1445					4	X	X													
FC-MW-5		1515					4	X	X													
FC-ENG-5		1515		VARIED		HCl, HNO3 H2SO4	4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
FC-RB		1530		40ml, 1L		HCl	4	X	X													Rinse Blank

RELINQUISHED BY: SIGNATURE <u>M.A.F. Smith</u> PRINTED <u>Robert Smith</u> COMPANY <u>ENSAFE</u> REASON <u>LAB</u>	DATE <u>5/24/93</u> TIME <u>1730</u>	RECEIVED BY: SIGNATURE <u>FED-X</u> PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE <u>Drew Allen</u> PRINTED <u>DREW ALLEN</u> COMPANY <u>IT CORP.</u> REASON <u>ANALYZE</u>	DATE <u>5/27/93</u> TIME <u>0900</u>
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METHOD OF SHIPMENT: FED-X COMMENTS: _____
 SHIPMENT NO. _____
 SPECIAL INSTRUCTION: _____
2 COOLERS

AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER

50C



NAVY CLEAN
ENSAFE/ALLEN & HOSHAL
 (901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 2 OF 2

CLIENT _____ PROJECT MANAGER _____
 ADDRESS SEE Pg #1 TELEPHONE NO. (901) 372-7962
 PROJECT NAME/NUMBER _____ FAX. NO. (901) 372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) AKP

NO. OF CONTAINERS	ANALYSIS REQUIRED							REMARKS
	BTEX/GRC	DRO	TOX	ISS/AIR Temp	Microbial/PAE	HEAVY METALS	OTHER	
4	x	x						Field Blank
2	x							Trap Blank
1								Temp Blank

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	BTEX/GRC	DRO	TOX	ISS/AIR Temp	Microbial/PAE	HEAVY METALS	REMARKS	
					TEMP.	CHEMICAL									
FC-FB	5/26/93	1530	H2O	40ml, 1L	4°C	HCl	4	x	x						Field Blank
FC-TB	5/26/93	1530	H2O	40 ml	4°C	HCl	2	x							Trap Blank
Temp Blank	5/26/93	—	"	40 - 1	4°C	—	1								Temp Blank

RELINQUISHED BY: SIGNATURE <u>AKP</u> PRINTED _____ COMPANY <u>ENSAFE</u> REASON _____	DATE <u>5/26/93</u> TIME <u>1730</u>	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE <u>Drew Allen</u> PRINTED <u>DREW ALLEN</u> COMPANY <u>IT CORP.</u> REASON <u>ANALYZE</u>	DATE <u>5/26/93</u> TIME <u>0900</u>
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METHOD OF SHIPMENT: _____ SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____	COMMENTS: <u>2 COOLERS</u>	AFTER ANALYSIS, SAMPLES ARE TO BE: <input type="checkbox"/> DISPOSED OF (ADDITIONAL FEE) <input type="checkbox"/> STORED (90 DAYS MAX) <input type="checkbox"/> STORED OVER 90 DAYS (ADDITIONAL FEE) <input type="checkbox"/> RETURNED TO CUSTOMER
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5°C



**INTERNATIONAL
TECHNOLOGY
CORPORATION**

SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 06/05/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54185
Client Number : 3164**

Subject: NAS Memphis

^{6/24}
On 05/28/93, nine (9) water samples and one (1) trip blank arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee

The samples were logged in under ITAS Project Code ENFA54185.

The samples were received in good condition, and there were no nonconformances noted.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator


John Baur

Date

6-7-93

Enclosure(s): Chain of Custody

Regional Office

5815 Middlebrook Pike • Knoxville, Tennessee 37921 • 615-588-6401



SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 07/21/93

**EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson**

**Project Code : ENFA54572
Client Number : 3164**

Subject: NAS Memphis

On 07/16/93, two (2) soil samples arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee

The samples were logged in under ITAS Project Code ENFA54572.

The samples were received in good condition, and there were no nonconformances noted.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator  **Date** 8/4/93

Enclosure(s): COC

Regional Office

5815 Middlebrook Pike ■ Knoxville, Tennessee 37921 ■ 615-588-6401

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**NAVY CLEAN
ENSAFE/ALLEN & HOSHAL**
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT NASMEM PROJECT MANAGER Lawson Anderson
 ADDRESS _____ TELEPHONE NO. 901/372-7962
 PROJECT NAME/NUMBER N0067C0104/HOSHAL FAX. NO. 901/372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) M. P. Smith

NO. OF CONTAINERS	ANALYSIS REQUIRED				REMARKS
	GR	BTEX	AP	Other	
2	X	X			
2	X	X			

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	GR	BTEX	AP	Other	REMARKS
					TEMP.	CHEMICAL						
FC-SB9-15	7/15/93	1100	SOIL	250 ml, 60 ml	4c	—	2	X	X			
FC-SB9-20	7/15/93	1110	SOIL	250 ml, 60 ml	4c	—	2	X	X			

RELINQUISHED BY: SIGNATURE <u>M. P. Smith</u> PRINTED <u>Robert Smith</u> COMPANY <u>ENSAFE</u> REASON <u>LAB</u>	DATE <u>7/15/93</u> TIME <u>1400</u>	RECEIVED BY: SIGNATURE <u>[Signature]</u> PRINTED <u>Simon</u> COMPANY <u>ITAS</u> REASON <u>Analysis</u>	DATE <u>7/16/93</u> TIME <u>8:31</u>	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____
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METHOD OF SHIPMENT: Fed-X SHIPMENT NO. _____
 SPECIAL INSTRUCTION: _____
 COMMENTS: _____
 AFTER ANALYSIS, SAMPLES ARE TO BE:
 DISPOSED OF (ADDITIONAL FEE)
 STORED (90 DAYS MAX)
 STORED OVER 90 DAYS (ADDITIONAL FEE)
 RETURNED TO CUSTOMER

F-6c



INTERNATIONAL
TECHNOLOGY
CORPORATION

SAMPLE RECEIPT ACKNOWLEDGEMENT/NONCONFORMANCE

Date: 07/30/93

EnSafe/Allen & Hoshall
P.O. Box 341315
Memphis, TN 38184-1315
Attention: Lawson Anderson

Project Code : ENFA54598
Client Number : 3164

Subject: NAS Memphis

On 07/21/93, four (4) water samples arrived at the ITAS-Knoxville, Tennessee, laboratory from EnSafe/Allen & Hoshall, Memphis, Tennessee.

The samples were logged in under ITAS Project Code ENFA54598.

The samples were received in good condition, and there were no nonconformances noted.

We appreciate this opportunity to offer our services to you. If you have any questions, please contact me at your earliest convenience.

Project Coordinator


Janice Landshof

Date

8/4/93

Enclosure(s): COC

Regional Office

5815 Middlebrook Pike ■ Knoxville, Tennessee 37921 ■ 615-588-6401

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**NAVY CLEAN
ENSAFE/ALLEN & HOSHALL**
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT NASMEM PROJECT MANAGER L. ANDERSON
 ADDRESS _____ TELEPHONE NO. 901/372-7942
 PROJECT NAME/NUMBER N006700104/N006700107 FAX NO. 901/372-2454
 MEDIA STATUS: (A, B, OR C) _____ SAMPLERS: (SIGNATURE) Mr P Smith

NO. OF CONTAINERS	ANALYSIS REQUIRED				REMARKS
	GRD	BTEX	DRB		
4	X	X			OK. 5C REMARKS
4	X	X			
4	X	X			
4	X	X			

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	GRD	BTEX	DRB									
					TEMP.	CHEMICAL													
FC-MW-6	7/20/93	1045	WATER	40ml, 1L	4°C	HCl	4	X	X										
FC-MW-6-DUP		1045					4	X	X										Duplicate
N-MW-6-		1140					4	X	X										
N-MW-6-Dup		1140					4	X	X										Duplicate

RELINQUISHED BY: SIGNATURE <u>Mr P Smith</u> PRINTED <u>Robert Smith</u> COMPANY <u>ENSAFE</u> REASON <u>LAB</u>	DATE <u>7/20</u> TIME <u>1600</u>	RECEIVED BY: SIGNATURE <u>Alicia Blandford</u> PRINTED <u>Alicia Blandford</u> COMPANY <u>ITASKW</u> REASON <u>LAB</u>	DATE <u>7/21/93</u> TIME <u>9:00</u>	RELINQUISHED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____	RECEIVED BY: SIGNATURE _____ PRINTED _____ COMPANY _____ REASON _____	DATE _____ TIME _____
--	--------------------------------------	--	---	---	--------------------------	---	--------------------------

METHOD OF SHIPMENT: <u>FED-X</u> SHIPMENT NO. _____ SPECIAL INSTRUCTION: _____	COMMENTS: _____ _____ _____	AFTER ANALYSIS, SAMPLES ARE TO BE: <input type="checkbox"/> DISPOSED OF (ADDITIONAL FEE) <input type="checkbox"/> STORED (90 DAYS MAX) <input type="checkbox"/> STORED OVER 90 DAYS (ADDITIONAL FEE) <input type="checkbox"/> RETURNED TO CUSTOMER
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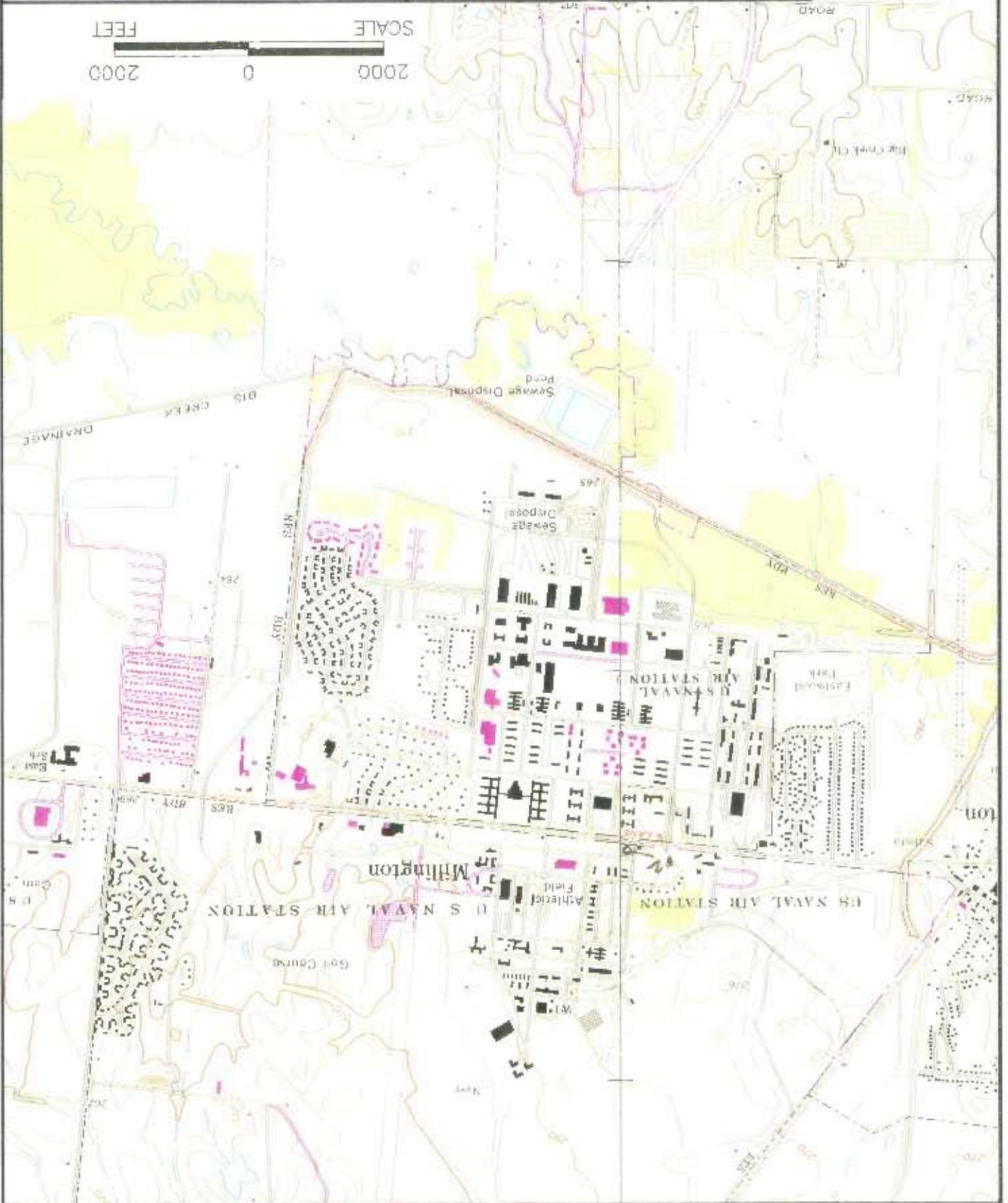


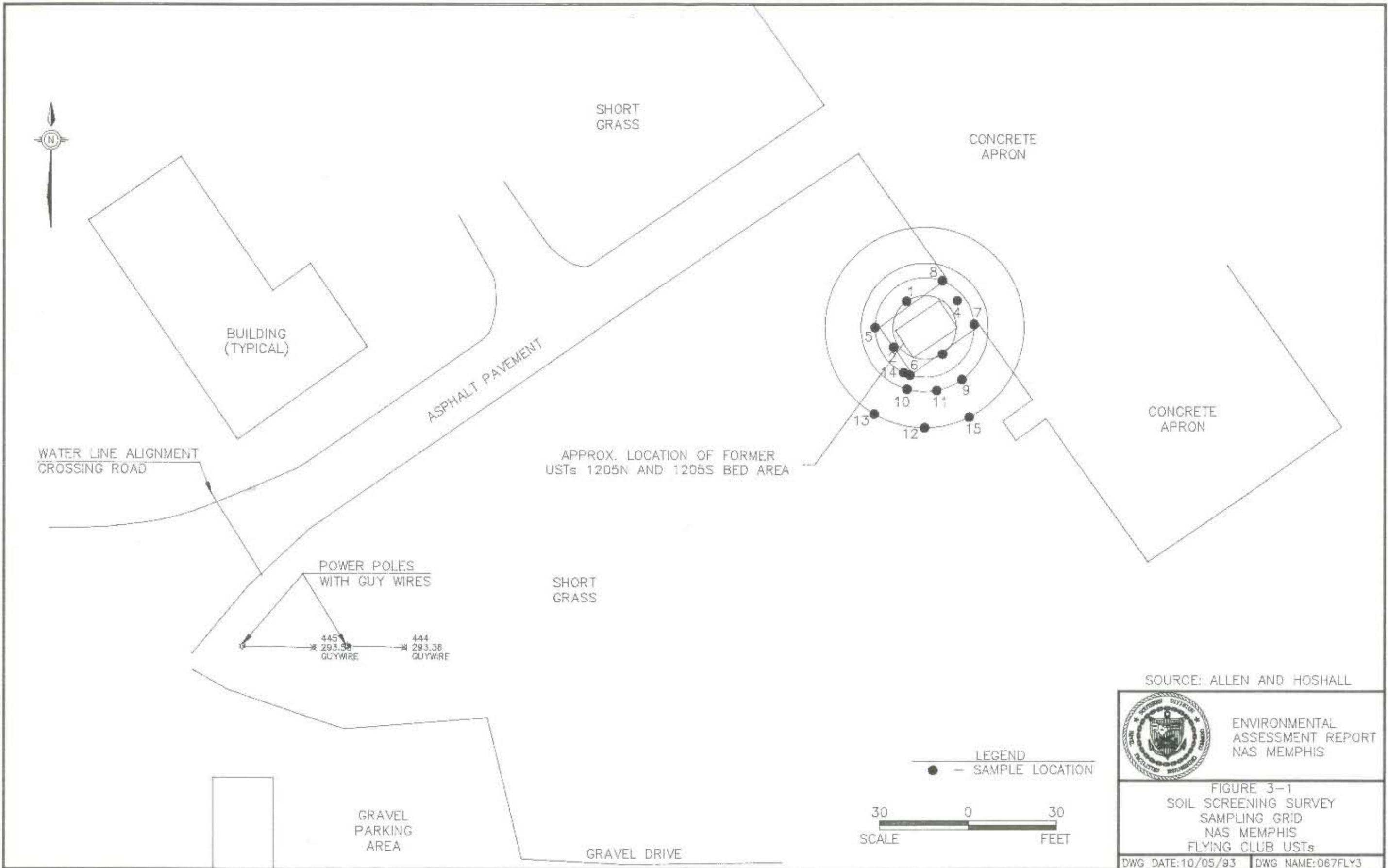
ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS

DWG DATE: 07/28/93 DWG NAME: BOARD

FIGURE 2-3
TOPOGRAPHIC MAP
NAS MEMPHIS

SCALE
2000 0 2000
FEET





SOURCE: ALLEN AND HOSHALL

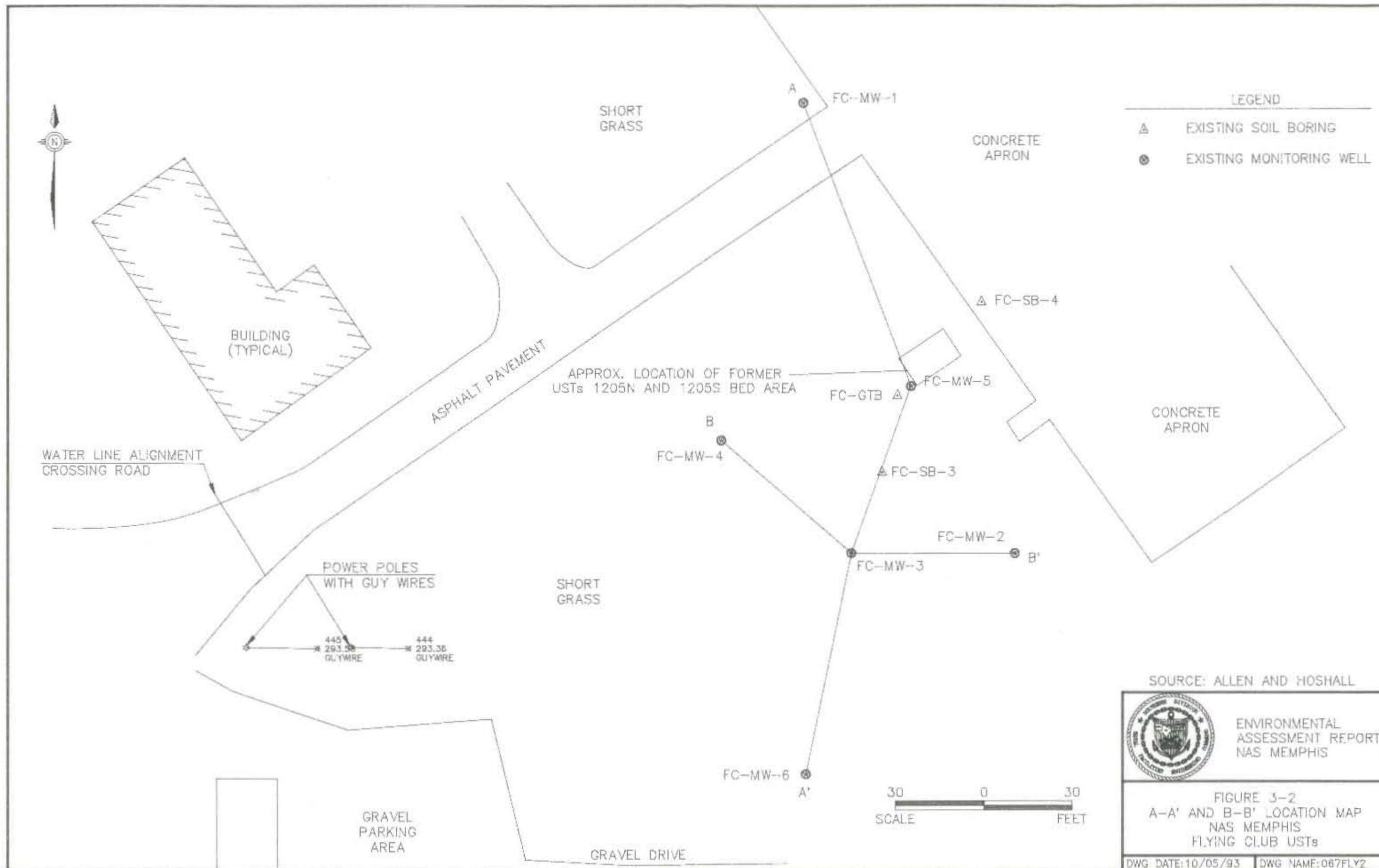


ENVIRONMENTAL
ASSESSMENT REPORT
NAS MEMPHIS

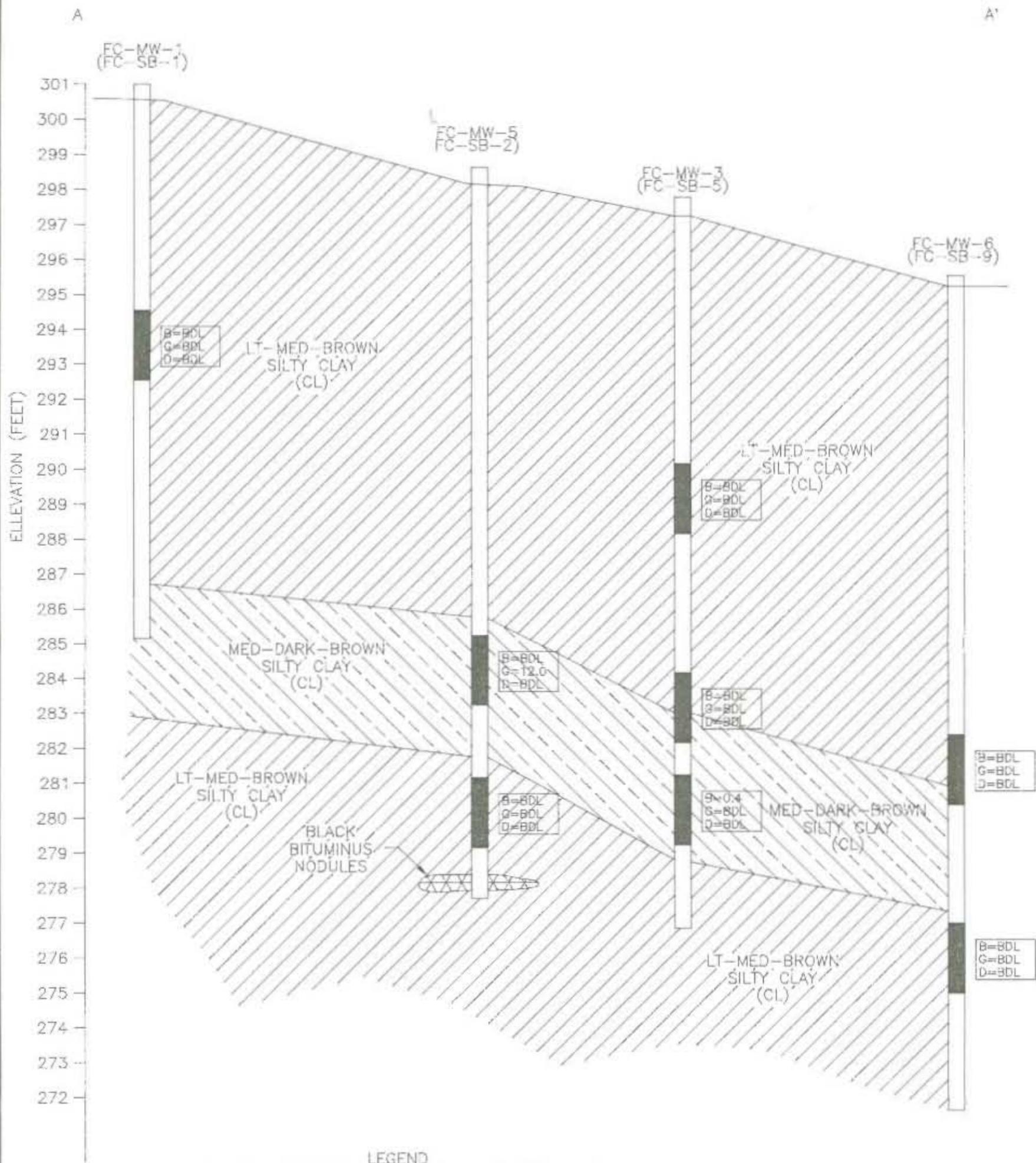
FIGURE 3-1
SOIL SCREENING SURVEY
SAMPLING GRID
NAS MEMPHIS
FLYING CLUB USTs

DWG DATE: 10/05/93 | DWG NAME: 067FLY3

00462 666 022



00462 G66 B32



LEGEND

ANALYTICAL SOIL SAMPLE LOCATION

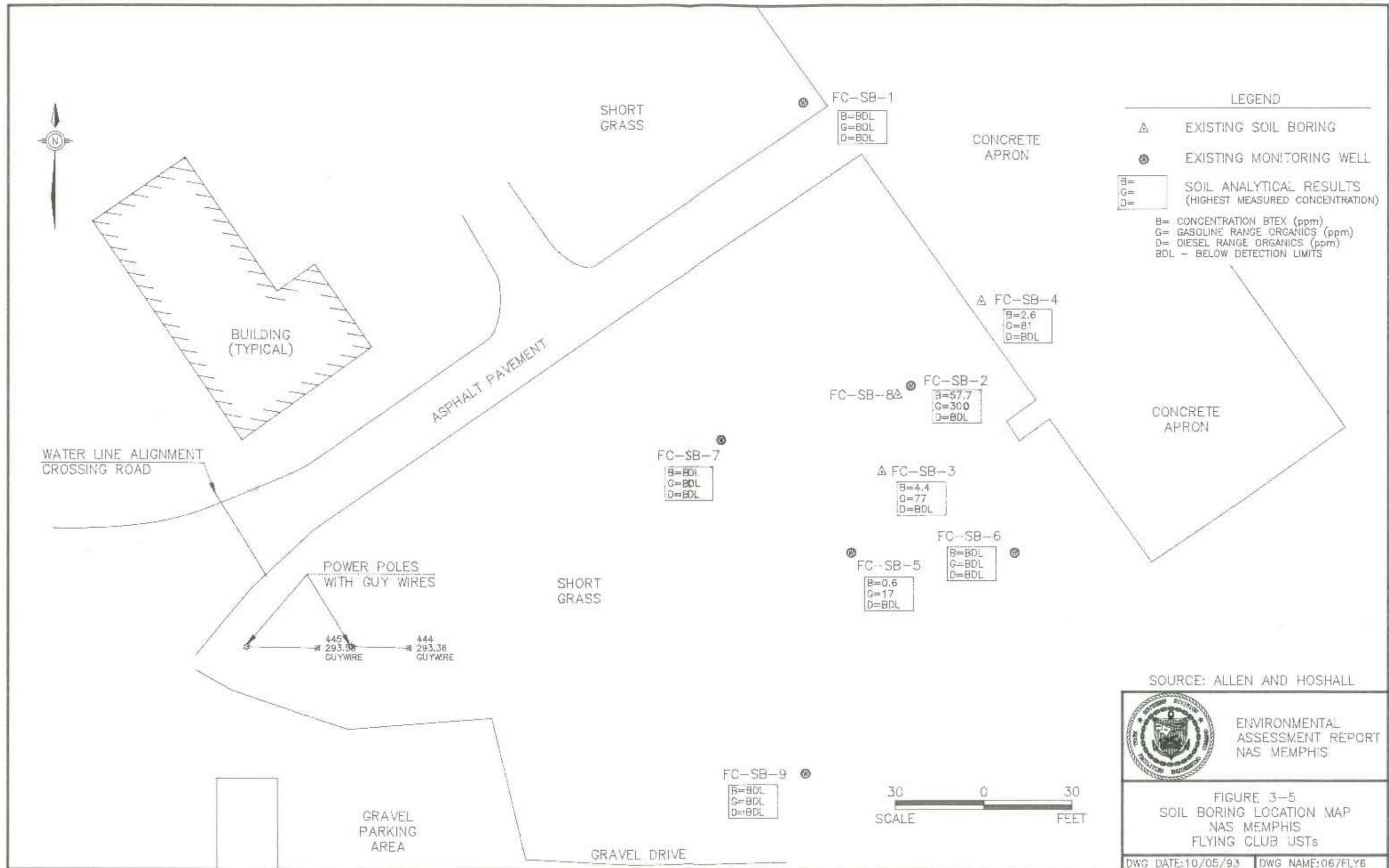
SOIL ANALYTICAL RESULTS

B = CONCENTRATION BTEX (ppm)
 G = GASOLINE RANGE ORGANICS (ppm)
 D = DIESEL RANGE ORGANICS (ppm)
 BDL = BELOW DETECTION LIMITS

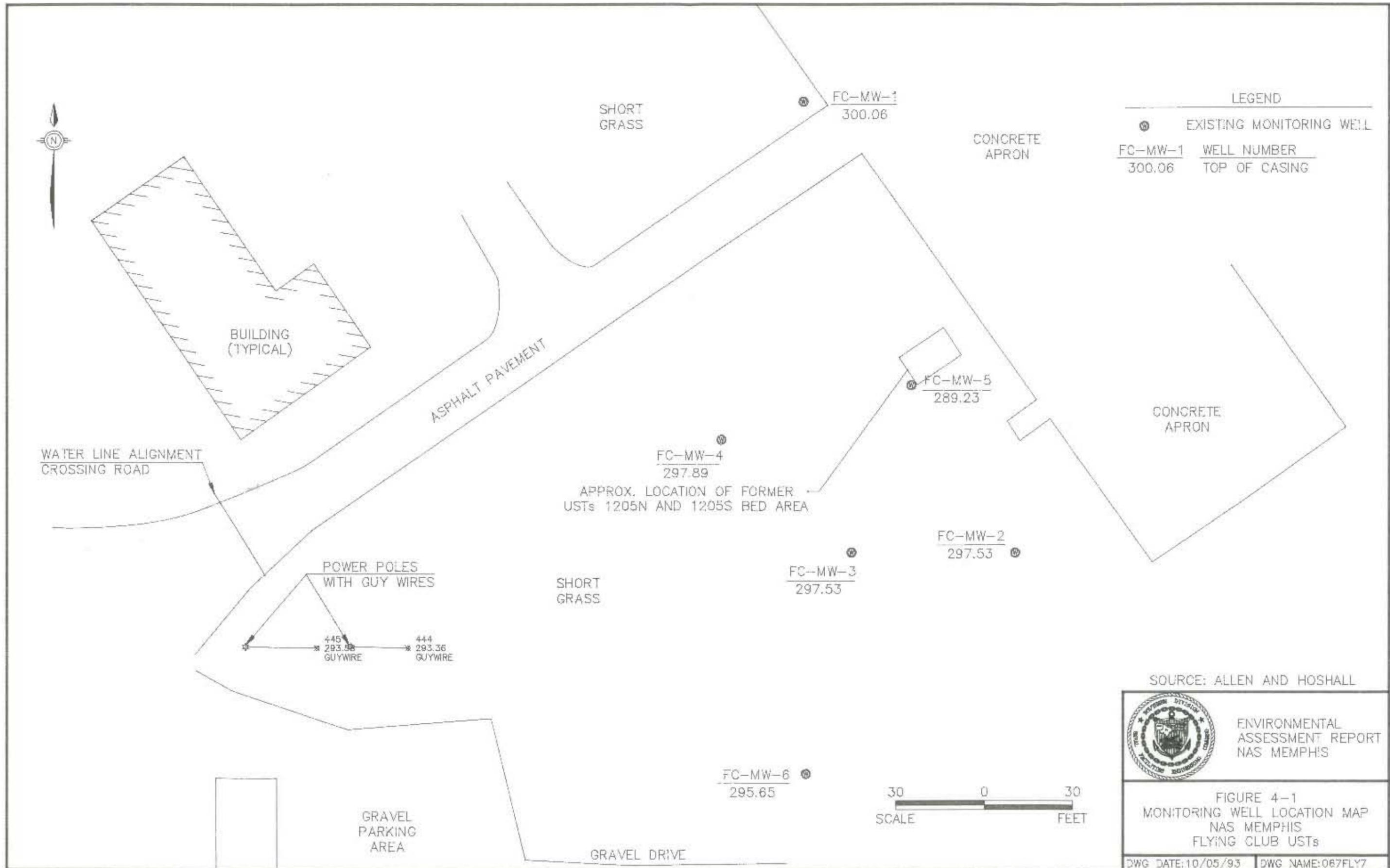


FIGURE 3-3
 A-A' CROSS SECTION
 NAS MEMPHIS
 FLYING CLUB

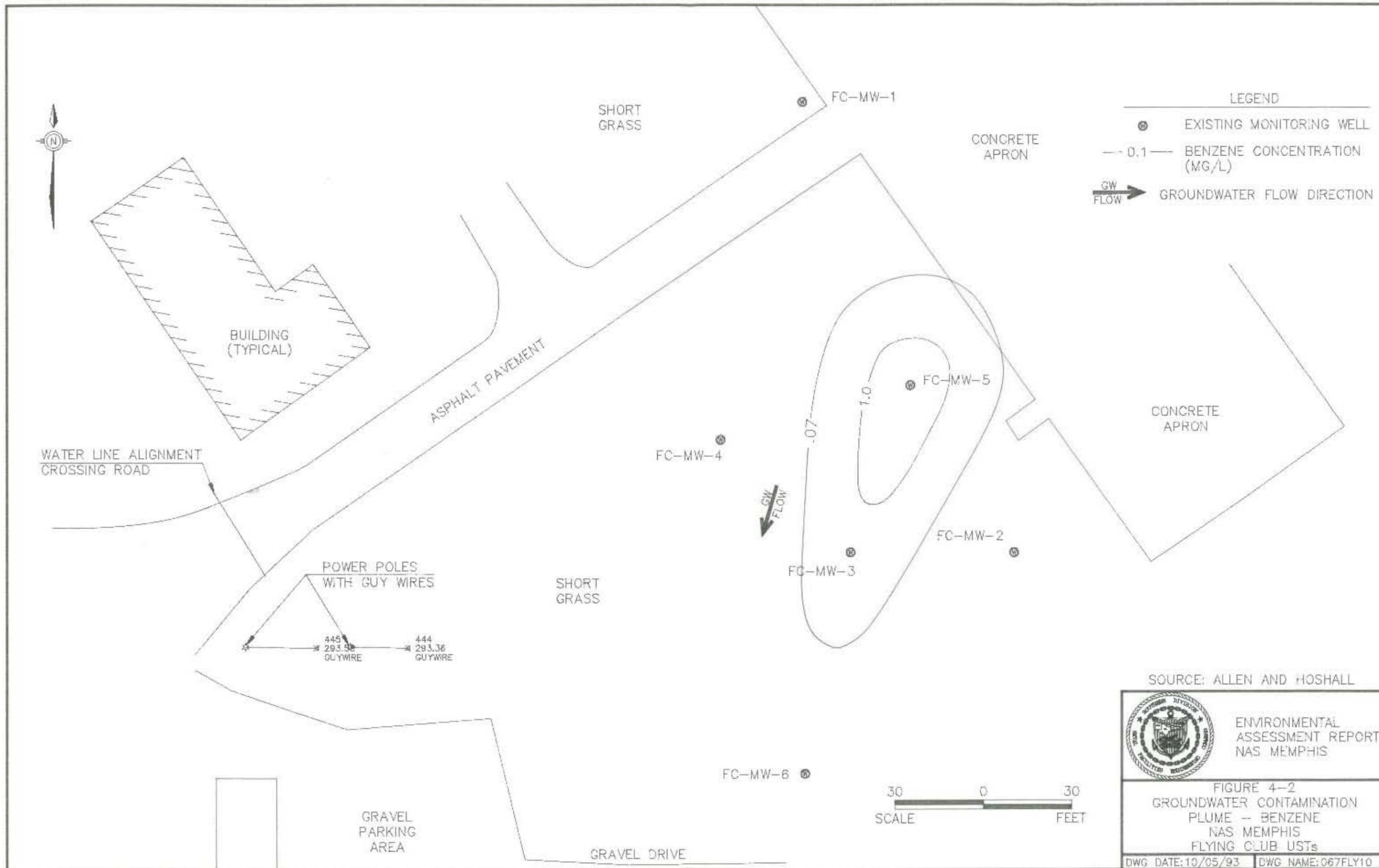
DWG DATE: 10/05/93 | DWG NAME: 067FLY4



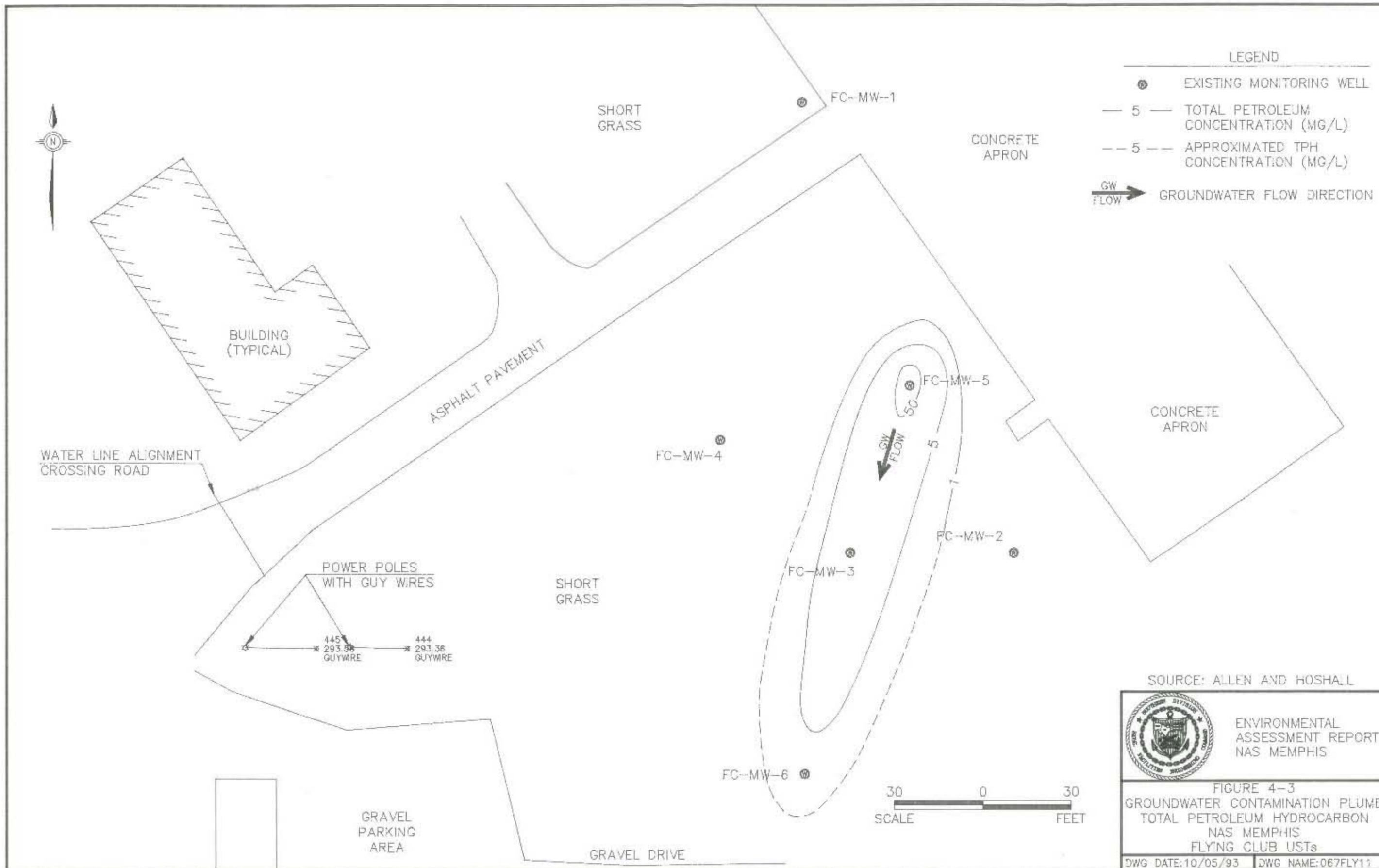
00462 GGG 042



00462666052



00462GGG B62



LEGEND

	EXISTING MONITORING WELL
— 5 —	TOTAL PETROLEUM CONCENTRATION (MG/L)
- - 5 - -	APPROXIMATED TPH CONCENTRATION (MG/L)
	GROUNDWATER FLOW DIRECTION

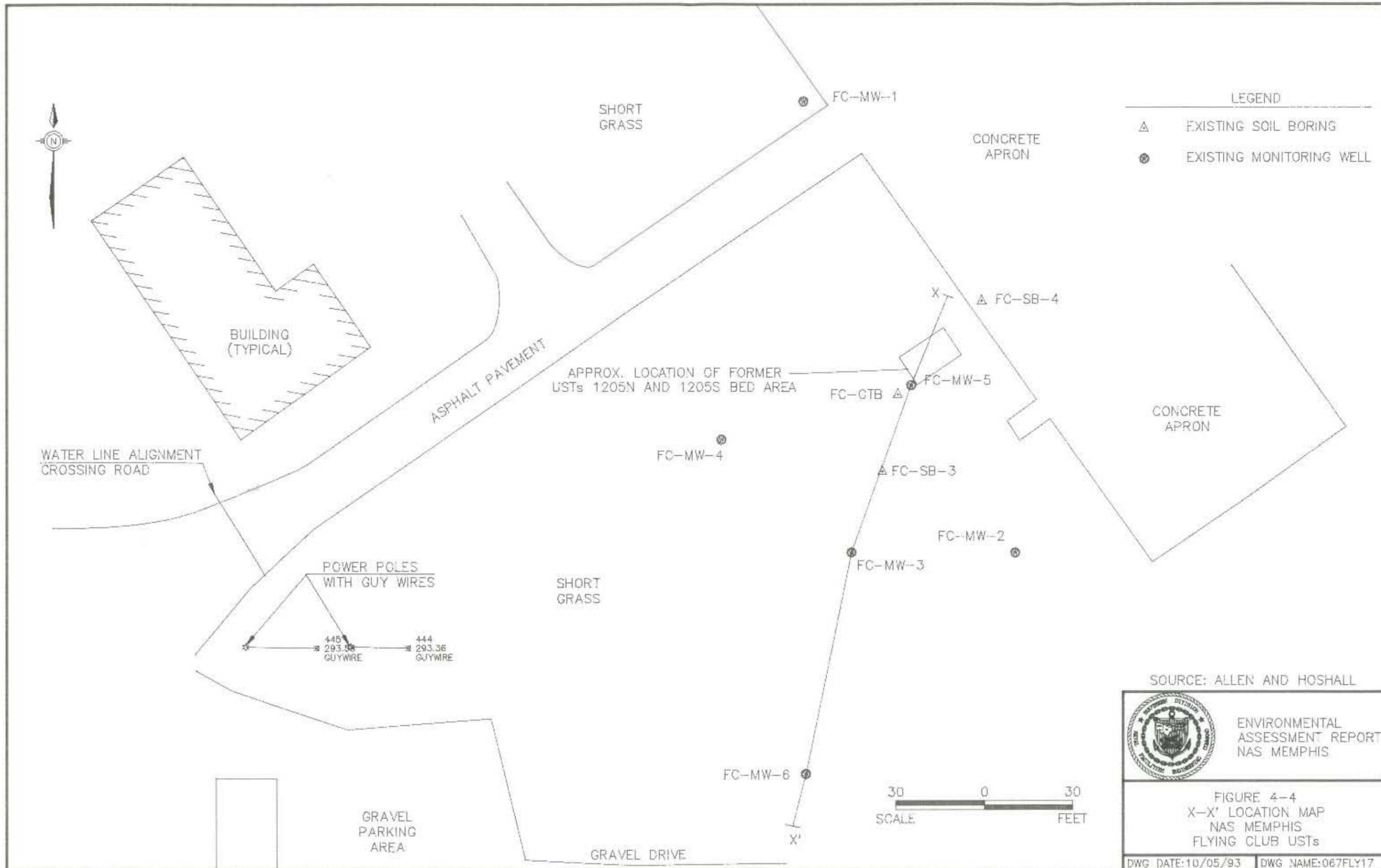
SOURCE: ALLEN AND HOSHALL



ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS

FIGURE 4-3
GROUNDWATER CONTAMINATION PLUME
TOTAL PETROLEUM HYDROCARBON
NAS MEMPHIS
FLYING CLUB USTs

DWG DATE: 10/05/93 | DWG NAME: 067FLY11

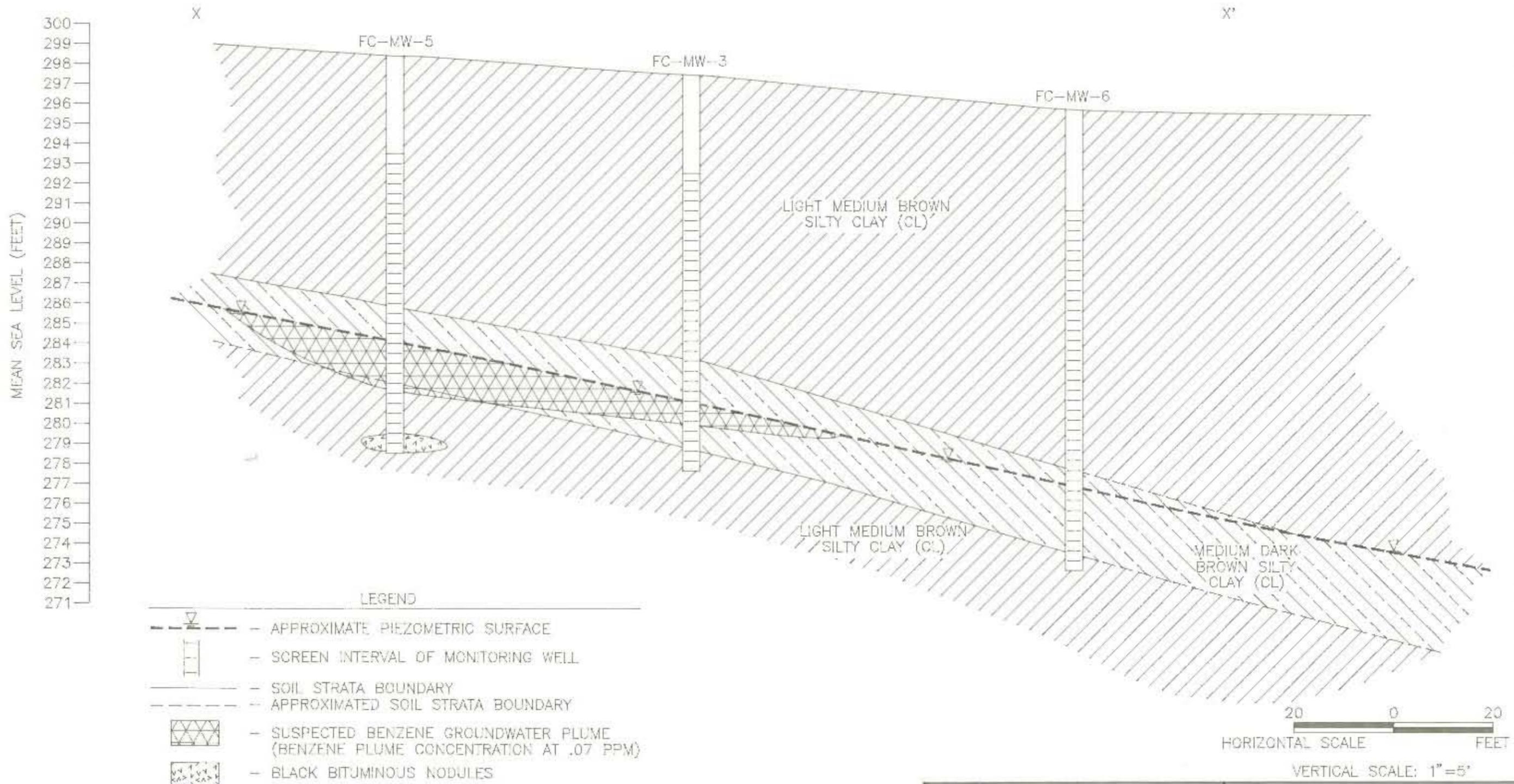


SOURCE: ALLEN AND HOSHALL


 ENVIRONMENTAL
 ASSESSMENT REPORT
 NAS MEMPHIS

FIGURE 4-4
 X-X' LOCATION MAP
 NAS MEMPHIS
 FLYING CLUB USTs

DWG DATE: 10/05/93 | DWG NAME: 067FLY17



- LEGEND
- APPROXIMATE PIEZOMETRIC SURFACE
 - SCREEN INTERVAL OF MONITORING WELL
 - SOIL STRATA BOUNDARY
 - APPROXIMATED SOIL STRATA BOUNDARY
 - SUSPECTED BENZENE GROUNDWATER PLUME (BENZENE PLUME CONCENTRATION AT .07 PPM)
 - BLACK BITUMINOUS NODULES

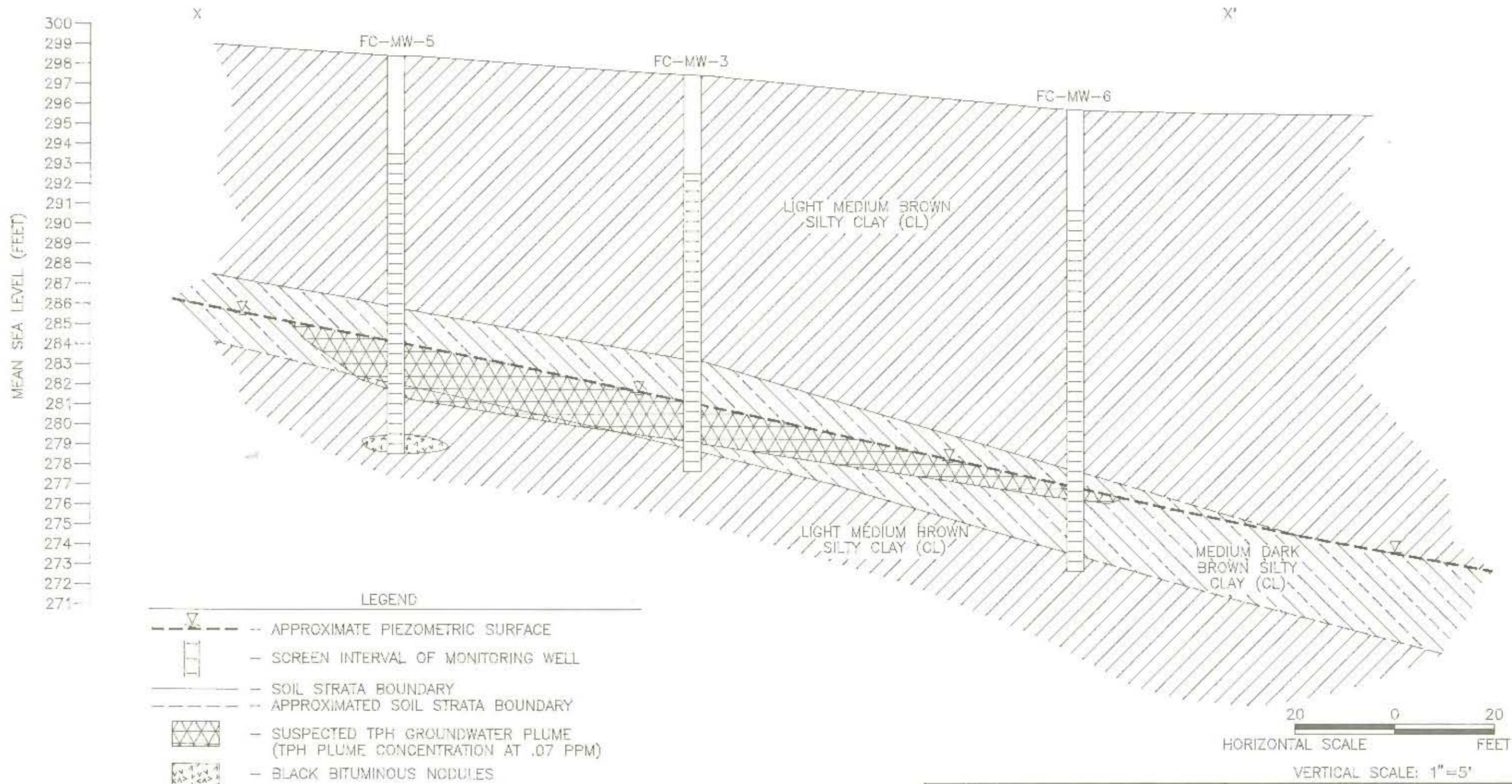
NOTE: SIZE OF WELLS HAS BEEN EXAGGERATED FOR EASE OF PRESENTATION
 SOIL STRATA EXTENDED BEYOND FC-MW-6 AND FC-MW-5 HAS BEEN ESTIMATED



ENVIRONMENTAL ASSESSMENT REPORT
 NAS MEMPHIS

FIGURE 4-5
 X-X' CROSS SECTION (BENZENE)
 NAS MEMPHIS
 FLYING CLUB

DWG DATE: 10/06/93 DWG NAME: 087FLY15



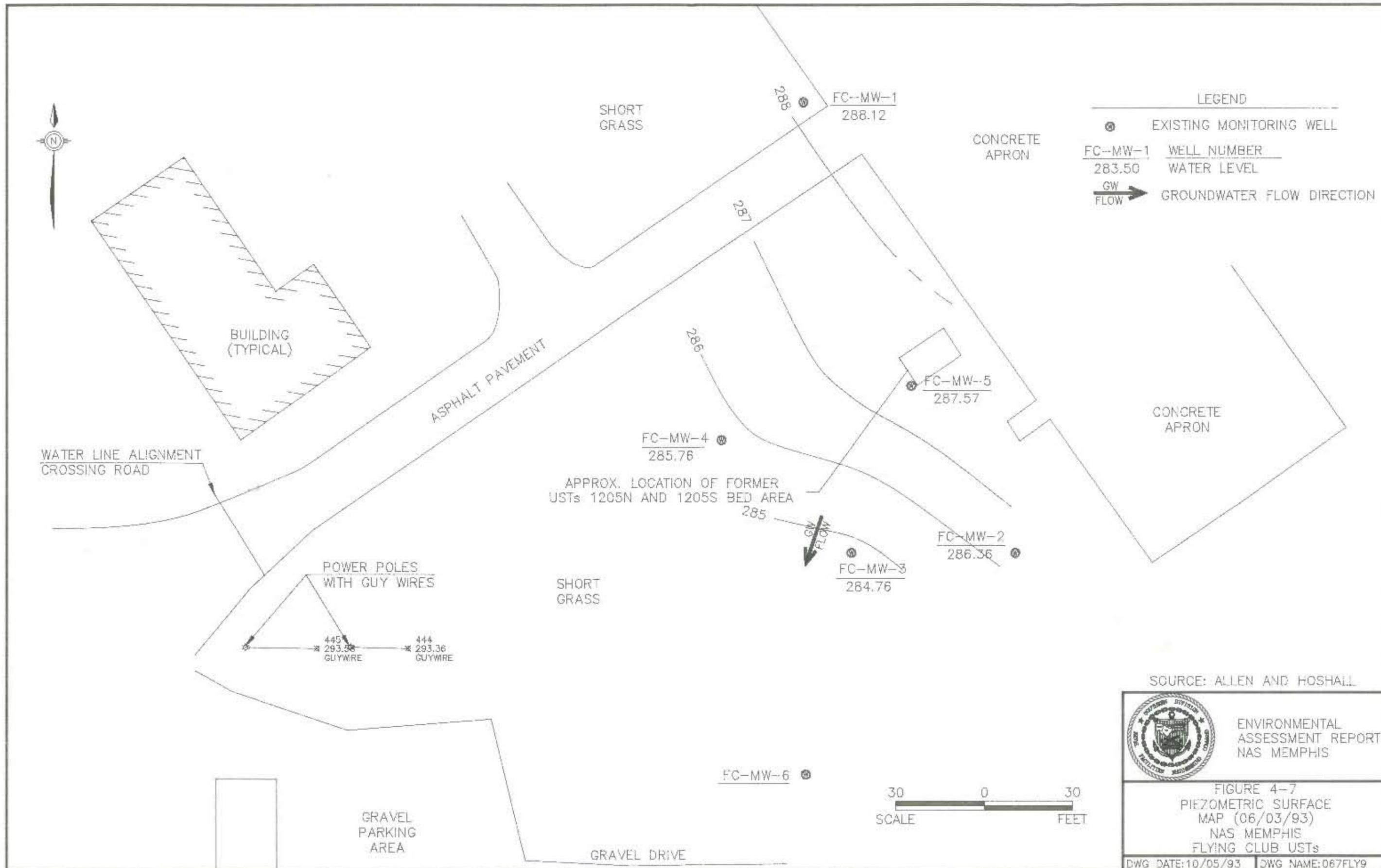
NOTE: SIZE OF WELLS HAS BEEN EXAGGERATED FOR EASE OF PRESENTATION
SOIL STRATA EXTENDED BEYOND FC-MW-6 AND FC-MW-5 HAS BEEN ESTIMATED



ENVIRONMENTAL ASSESSMENT REPORT
NAS MEMPHIS

FIGURE 4-6
X-X' CROSS SECTION (TPH)
NAS MEMPHIS
FLYING CLUB

DWG DATE: 10/06/93 DWG NAME: 067FLY14



00462666B7Z

