



SAMPLING AND ANALYSIS PLAN
FOR
REMEDIAL ACTION AT THE NAVY FUEL FARM
NAVAL AIR STATION JOINT RESERVE BASE (NASJRB) WILLOW GROVE
HORSHAM TOWNSHIP, PENNSYLVANIA

Contract No. N62472-92-D-1296

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EA CTO Manager: Carl Reitenbach

In compliance with EA's Quality Procedures for review of deliverables outlined in the Quality Management Plan, this final deliverable has been reviewed for quality by the undersigned Senior Technical Reviewer(s). The information presented in this report/deliverable has been prepared in accordance with the approved Implementation Plan for the Contract Task Order (CTO) and reflects a proper presentation of the data and/or the conclusions drawn and/or the analyses or design completed during the conduct of the work. This statement is based upon the standards identified in the CTO and/or the standard of care existing at the time of preparation.

Tim Beck - P.G. for C.W.H.

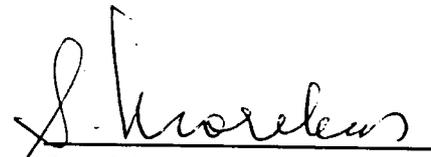
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20 August 1997

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ACRONYMS AND ABBREVIATIONS

| | |
|-------|---|
| ARF | Air Reserve Facility |
| AST | aboveground storage tank |
| BRAC | Base Realignment and Closure |
| BTEX | Benzene, Toluene, Ethylbenzene, and Xylenes |
| CLEAN | Comprehensive Long-Term Environmental Action Navy |
| CLP | Contract Laboratory Program |
| cm | centimeters |
| CTO | Contract Task Order |
| DI | deionized |
| DO | dissolved oxygen |
| DP | direct push |
| DQO | Data Quality Objective |
| EA | EA Engineering, Science, and Technology |
| EPA | Environmental Protection Agency |
| ECD | electron capture detector |
| FSP | Field Sampling Plan |
| ft | feet |
| gal | gallon |
| GC | gas chromatograph |
| gpm | gallons per minute |
| HCl | hydrochloric acid |
| ICP | inductive-coupled plasma |
| IDW | investigative derived waste |
| in. | inch |
| IR | Installation Restoration |
| kg | kilogram |
| L | Liter |

LCS laboratory control sample
LNAPL Light Non Aqueous Phase Liquid

ACRONYMS AND ABBREVIATIONS (Cont.)

LEL Lower Explosive Limit
LIMS Laboratory Information Management System

MCL Maximum Contaminant Level
MDL Minimum Detection Level
MEK Methyl Ethyl Ketone
MS/MSD matrix spike/matrix spike duplicate

NAS Naval Air Station
NASJRB Naval Air Station Joint Reserve Base
NAVFAC Naval Facilities Engineering Command
NCRs non conformance reports
ND not detected
NEFSC Naval Engineering Facilities Service Center
NIST National Institute of Standards and Technology
NTU nephelometric turbidity unit

OVA organic vapor analyzer

PAANG Pennsylvania Air National Guard
PADEP Pennsylvania Department of Environmental Protection
PID photoionization detector
PPE personal protective equipment
ppmv parts per million volume

QAPP Quality Assurance Project Plan
QA/QC Quality Assurance/Quality Control
QSM Quality Services Manager

SAP Sampling and Analysis Plan
sec second
SOP standard operating procedure
SSHERP Site Safety, Health and Emergency Response Plan
SRM standard reference material

TCL Target Compound List

| | |
|---------------|------------------------------|
| TOC | top of casing |
| μg | microgram |
| TPH | total petroleum hydrocarbons |
| UST | underground storage tank |
| VOC | volatile organic compound(s) |

1. INTRODUCTION

1.1 AUTHORIZATION

This Sampling and Analysis Plan for the Navy Fuel Farm facility, Naval Air Station Joint Reserve Base (NASJRB), Willow Grove, Horsham Township, Pennsylvania has been prepared for Northern Division, Naval Facilities Engineering Command (NAVFAC) under Contract No. N62472-92-D-1296, Contract Task Order (CTO) No. 0074.

1.2 OBJECTIVES

As discussed in Chapter 2, the Navy has completed a pilot study of remedial alternatives to address the recovery of light non-aqueous phase liquid (LNAPL) petroleum products at the Navy Fuel Farm (EA 1996). Based on results of the pilot study, the Navy recommends expansion of the vacuum enhanced LNAPL recovery system to include recovery from three wells. The expansion of the pilot system as well as operation and monitoring of the remediation system will be addressed in a separate document.

The Navy intends to pursue transferring the regulatory oversight of remedial efforts at the Navy Fuel Farm from the Installation Restoration (IR) Program to the Commonwealth of Pennsylvania Department of Environmental Protection's (PADEP) underground storage tank/aboveground storage tank (UST/AST) program. However, during previous investigations, several non-petroleum related volatile organic compounds (VOC) have been reported in samples of subsurface soil and ground water at the Navy Fuel Farm. As a result, there is a potential that some non-petroleum VOC, which would require investigation under CERCLA, may be present at the Navy Fuel Farm. Therefore, the objectives of the work to be conducted under this Sampling and Analysis Plan (SAP) are to:

- assess subsurface soil and ground water for the presence of non-petroleum VOC and,
- evaluate the current conditions of petroleum and potential non-petroleum related VOC in the ground water.

To meet these objectives, soil and ground-water samples will be collected and analyzed. The results of this sampling effort will be used to evaluate the regulatory oversight of the remedial efforts at the Navy Fuel Farm. If non-petroleum VOC are present, they could be regulated as a separate operable unit under the IR Program. This would allow the remediation of the petroleum related site constituents to be regulated by PADEP's UST/AST program.

Results of the sampling and analysis will be provided in a comprehensive report that will summarize sampling procedures and analytical results.

1.3 ORGANIZATION OF THE REPORT

This report is divided into four chapters. Chapter 1 is the Introduction; Chapter 2 describes the Navy Fuel Farm facility and includes a summary of the site setting, characteristics, and history; Chapter 3 contains the Field Sampling Plan (FSP) that describes sampling methods to be utilized as part of the investigation, and Chapter 4 presents a Quality Assurance Project Plan (QAPP) that outlines all Quality Assurance/ Quality Control (QA/QC) activities which will ensure achievement of desired data quality goals. Appendix A contains the Safety, Health, and Emergency Response Plan (SSHERP).

2. BACKGROUND INFORMATION

2.1 SITE SETTING

The Navy Fuel Farm is located along the north side of Privet Road and immediately south of the Pennsylvania Air National Guard (PAANG) portion of the Air Reserve Facility (ARF) at NAS Willow Grove. Figure 2-1 is a site location map and Figure 2-2 is a site plan of the Navy Fuel Farm. The Navy Fuel Farm and a portion of the adjoining property to the north, occupied by PAANG (Buildings 345 and 340), constitute the area requiring remedial efforts. The Navy Fuel Farm is bordered on all sides by NAS grounds. Located to the north of the Navy Fuel Farm are ARF Buildings 330, 340, and 345. Several other base facilities exist within 1,000 ft of the site. The Navy Fuel Farm is approximately 2 acres in area and consists of three aboveground storage tanks (ASTs), associated aboveground piping, and building Nos. 119 and 81.

The topography of the Navy Fuel Farm area is characterized as flat and gently sloping to the north-northwest. There is a slight downgrade at the north end of the facility which encourages runoff to flow northeast into the catchment basin or the adjacent drainage ditch.

On and directly adjacent to the Navy Fuel Farm grounds exist several buried utilities, including water, electric, sewer, telephone, and product piping. Several storm and sanitary sewer lines traverse the southern portion of Navy Fuel Farm grounds.

2.2 SITE GEOLOGY

Site geology has been characterized based on the geologic logs of 40 soil borings installed on and adjacent to the Navy Fuel Farm, 21 of which were completed as ground-water monitoring wells. Soil cover at the site varies in thickness from 6 to 21 ft. In general, soil depth increases from south to north, reflecting the dip of the underlying bedrock strata. The northeast edge of the site is underlain by soil types belonging to the Readington Silt Loam group; the remainder of the site is covered with fill material. The site-specific shallow stratigraphy is comprised primarily of silty clay and clayey silt with varying amounts of sand and gravel. The high proportion of clay in the soil leads to reduced permeability and slow infiltration rates.

Unconsolidated materials at the site are underlain by the Middle Arkosic Member of the Late Triassic Stockton Formation. This member consists of interbedded red shale, siltstone, and gray-tan, medium-grained, arkosic sandstone which was deposited as part of coalescing fluvial channel system. Red shale and siltstone are predominant along the south edge of the site, whereas the arkosic sandstone underlies the remainder of the site.

Depth to competent rock may range from 6 ft in areas where soil was previously removed to competent sandstone bedrock during site construction activities to 20 ft in areas underlain by

shale or siltstone. Relict bedding structure within soil is often present as a zone several feet thick and overlying shale or siltstone units. Regional bedrock formation dip ranges from 5 to 15 degrees with strike to the north-northwest (Rima *et al.* 1962). Rock beds vary in thickness, often pinching out or grading into other facies, making stratigraphic correlation difficult.

Regionally, small displacement normal faults trending northeast-southwest are present throughout the unit. Two sets of vertical joints, roughly parallel and perpendicular to the strike direction, are well developed. A third set of joints, though not as well expressed as the first two, trends northwest-southeast (Rima *et al.* 1962).

2.3 SITE HYDROGEOLOGY

The depth to static ground water at the site on 19 February 1996 ranged from approximately 4 ft (well NFFW-9) to 26 ft (well NFFW-20) below grade. However, water levels in the monitoring wells fluctuate several feet annually due to seasonal influences. In most cases, ground water is observed within bedrock fractures or within the weathered zone immediately overlying competent rock. Static water levels not only reflect the regional potentiometric surface, but also the composite head resulting from the different water-yielding zones that the well intercept. For this reason, water levels may show marked differences in nearby wells depending on the number, location, and size of fractures intercepted by each well.

Based upon several rounds of well gauging, ground-water flow at the Navy Fuel Farm is predominantly to the north, as illustrated in Figure 2-3. However, because flow is primarily through fractures within the bedrock or weathered bedrock, localized flow direction may vary. Ground-water flow through the arkosic sandstone is more rapid than through the shale/siltstone as evidenced by more rapid recharge rates during well development and purging prior to sampling. This may be due to the greater size and density of the fractures present within the sandstone.

Using the Neuman Method for unconfined aquifers, the average hydraulic conductivity, as derived from pumping test data at wells NFFW-2R, NFFW-8, NFFW-12, NFFW-14, and NFFW-16 (EA 1991), was estimated at 4.05×10^{-5} cm/sec. The average ground-water velocity has been estimated at 30 ft/year, assuming an effective porosity of 7 percent and a hydraulic gradient of 0.029 ft/ft (EA 1991). Aquifer tests that have been conducted during low and high water table conditions and results of the remedial pilot study have indicated that the wells are low yielding, typically 0-2 gallons per minute (gpm) during low water table conditions (EA 1991) and 5-10 gpm during high water table conditions (EA 1996).

2.4 HISTORY OF FUEL STORAGE AND PRODUCT RELEASES AT THE NAVY FUEL FARM

From 1950 to 1991, two partially buried 210,000-gal JP-4/JP-5 aviation fuel tanks (Tank Nos. 115 and 116) were located at the site. A 500-gal underground waste oil tank and an underground diesel fuel tank were also located at the southwestern corner of the site.

In 1986, a spill occurred when Tank 115 was overfilled and fuel was released from the vent pipe onto the ground. The event was attributed to faulty gauges that registered less fuel than was actually present. During this same year, a utility trench was excavated along the western boundary of the site but work discontinued when LNAPL was observed floating on the water within the trench. The area where the LNAPL was discovered is immediately adjacent to a former drywell. The drywell accepted water that was periodically siphoned from the bottom of the fuel tanks.

In March 1989, JP-5 jet fuel was detected emanating from two patches of dead grass on the west side of Tank 115. Heavy rains flushed this fuel into the ditch on the north side of the site. Navy personnel responded with the placement of sorbant material in the ditch and adjacent to Tank 115. With this evidence of tank leakage, it was decided to empty and remove the two main fuel tanks (Tank Nos. 115 and 116). Removal of these tanks occurred in 1991. Also during this time, the waste oil and diesel fuel underground storage tanks (USTs) were removed. Inspection of the waste oil tank during removal revealed the tank was not intact as holes up to 1-in. in diameter were reported.

Subsequent to the completion of removal activities, a new AST system was installed to the east of the former tank field location. In order to accommodate the newly constructed Navy Fuel Farm, Building No. 157 was removed. The new tank system at the Navy Fuel Farm consists of aboveground steel tanks set in a concrete berm. The Navy Fuel Farm currently is inactive.

2.5 PREVIOUS INVESTIGATIONS

Several investigations have been conducted at the Navy Fuel Farm to assess the extent of petroleum hydrocarbons. Pilot studies have also been conducted to assess remedial alternatives at the site. The Navy plans to pursue the transfer of the Navy Fuel Farm from the Navy's Installation Restoration (IR) Program to the Commonwealth of Pennsylvania's UST/AST program. Therefore, this section presents a summary of soil and ground-water sampling results reported from previous investigations and presents a comparison of these results to the guidance criterion established by Pennsylvania's Land Recycling Program.

2.5.1 Soil Results

Soil samples in the vicinity of the fuel farm were first collected in March 1989 as part of an investigation to assess potential subsurface hydrocarbon contamination in areas planned for

future construction (EA 1989b). At that time a total of 24 soil samples were collected from 18 borings installed around Building 340 (Figure 2-4). The samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX). As shown on Table 2-1, none of the samples collected contained individual BTEX components exceeding the guidance criterion.

Also in 1989, as part of additional investigations at the Navy Fuel Farm, four soil samples were collected during the installation of three monitoring wells and one soil boring (EA 1989b). The samples were analyzed for several VOC and base neutral extractable compounds. Only one of the four samples collected contained VOC concentrations exceeding the regulatory guidance criterion. Methylene chloride and 2-butanone (or methyl ethyl ketone [MEK]) were reported in the soil sample collected from monitoring well NFFW-7. Methylene chloride was present at a concentration of 2,300 $\mu\text{g}/\text{kg}$ and the guidance criterion is 500 $\mu\text{g}/\text{kg}$. The concentration of 2-butanone was 88 $\mu\text{g}/\text{kg}$ and the guidance criterion is 50 $\mu\text{g}/\text{kg}$. The results of the VOC analyses are summarized on Table 2-2.

Additional soil samples were collected in April 1991 during the installation of four monitoring wells and analyzed for BTEX (EA 1991). Of the four samples collected, only one sample contained a concentration of any analyte exceeding the regulatory guidance criteria. The sample collected from monitoring well NFFW-8 reported a total xylene concentration of 290,000 $\mu\text{g}/\text{kg}$ compared to a guidance criterion of 5,000 $\mu\text{g}/\text{kg}$. These results are also summarized on Table 2-3.

2.5.2 Ground-Water Results

A total of 36 ground-water samples were collected from selected monitoring wells on five occasions from June 1989 through June 1993. Of the 23 ground-water samples collected prior to June 1993, 8 samples contained concentrations of benzene in excess of the 5 $\mu\text{g}/\text{L}$ guidance criterion with concentrations ranging from 10 to 990 $\mu\text{g}/\text{L}$. These wells were NFFW-1, 2 (two samples), 7 (two samples), 9, 13 and 16. None of the other analytes tested exceeded the guidance criterion. It should be noted that several existing wells were not sampled due to the occurrence of LNAPL.

During the most recent, June 1993, sampling event 5 of the 13 ground-water samples collected contained benzene concentrations in excess of the 5 $\mu\text{g}/\text{L}$ guidance criterion with concentrations ranging from 6-67 $\mu\text{g}/\text{L}$. These wells were NFFW-5, 9, 11, 17, and 19. Benzene was the only analyte to exceed the guidance criterion. The results of the June 1993 sampling event are summarized on Table 2-3. During this event, wells NFFW-1, 2R, 6, 7, 12, 13, 14, 16, and 19 were not sampled due to the presence of LNAPL.

Non-petroleum VOC were also reported for the June 1993 ground-water sampling event. As presented in Table 2-3, the reported compounds include; acetone (10 wells), carbon disulfide (three wells), trichloroethene (two wells), and chlorobenzene (one well).

2.5.3 LNAPL Occurrence and Distribution

The occurrence of LNAPL in monitoring wells is directly related to periods where the water levels are falling. LNAPL has been detected in 11 of the site's 21 monitoring wells, primarily at times when the water table elevation was decreasing. The occurrence is more dramatic in some wells (NFFW 2R and NFFW-14), however, it is an immediate and direct response. The immediacy of the occurrence is indicative that the LNAPL's time-of-travel is short, indicating a more direct travel route and/or a short distance from the well. Table 2-4 summarizes the occurrence of LNAPL in the monitoring wells. LNAPL was present most often in NFFW-14 (77% of the gauging events), NFFW-2R (56%), and NFFW-16 (42%). These wells were also the only wells where a LNAPL layer over 1 ft thick was gauged. An isopach map for the period representing the most frequent product distribution is presented in Figure 2-5.

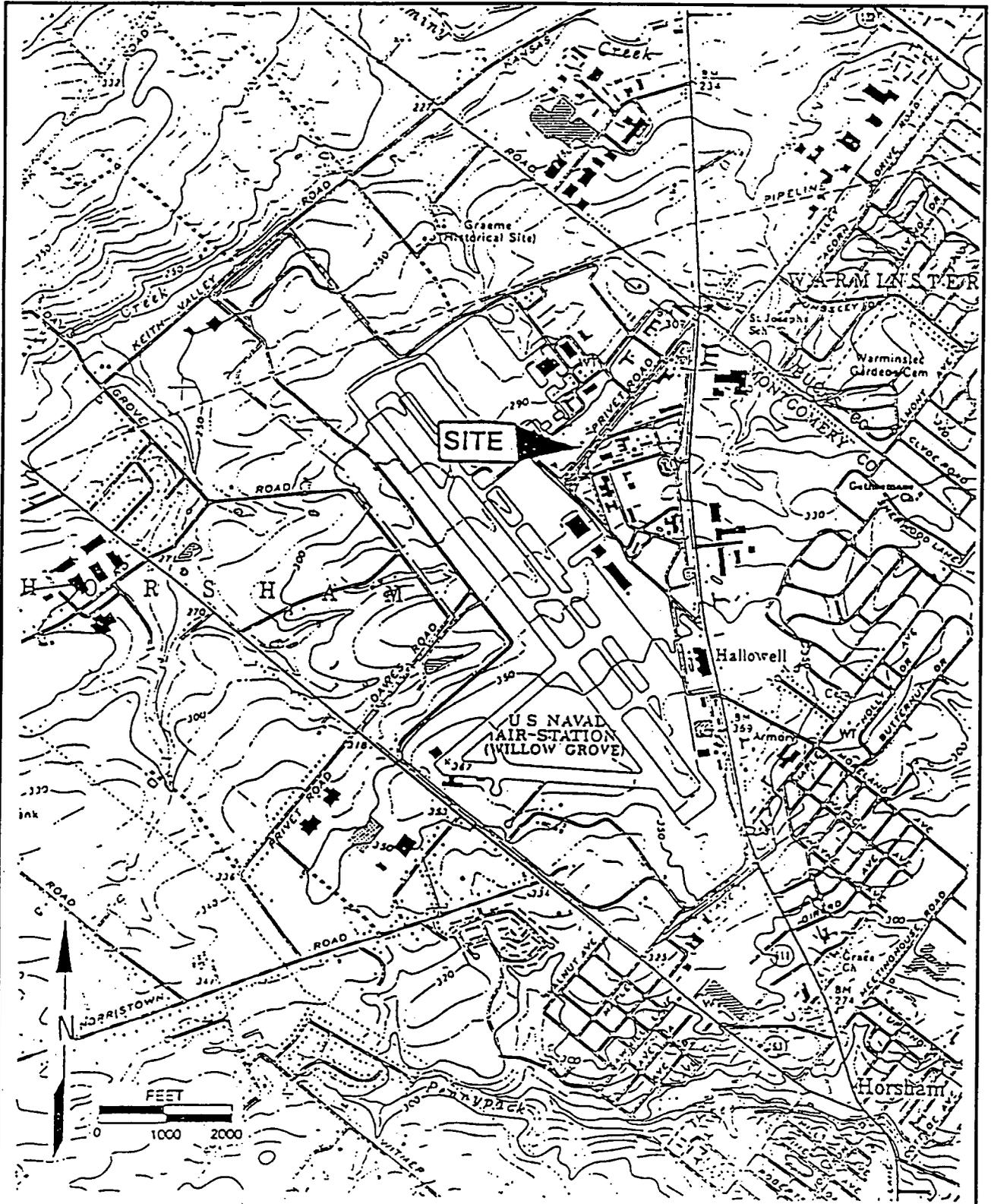
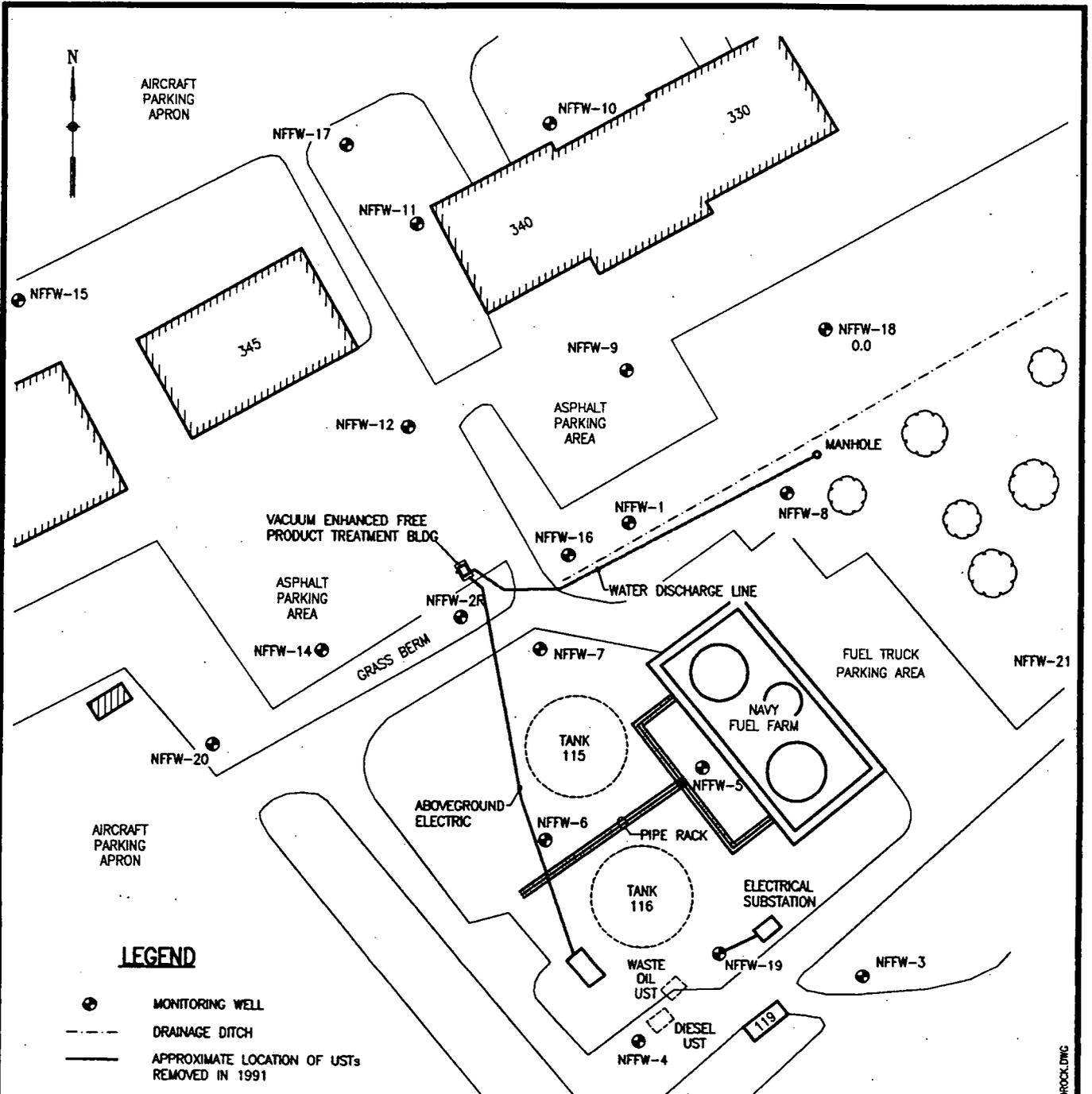


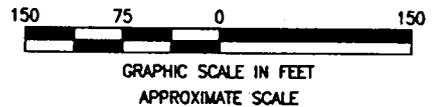
Figure 2-1. Site Location Map, Navy Fuel Farm Facility, Naval Air Station Joint Reserve Base, Willow Grove, Pennsylvania.





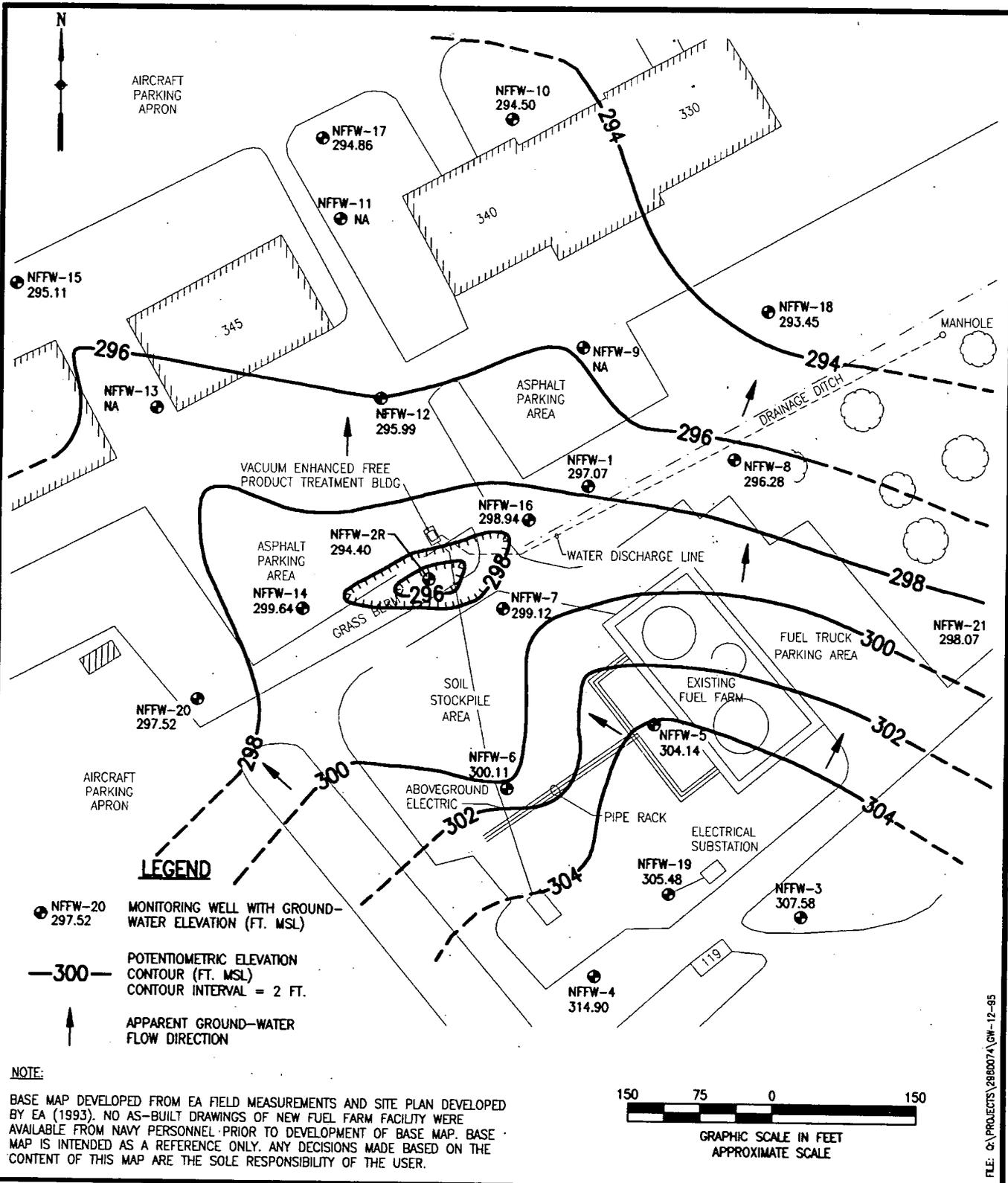
NOTE:

BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.



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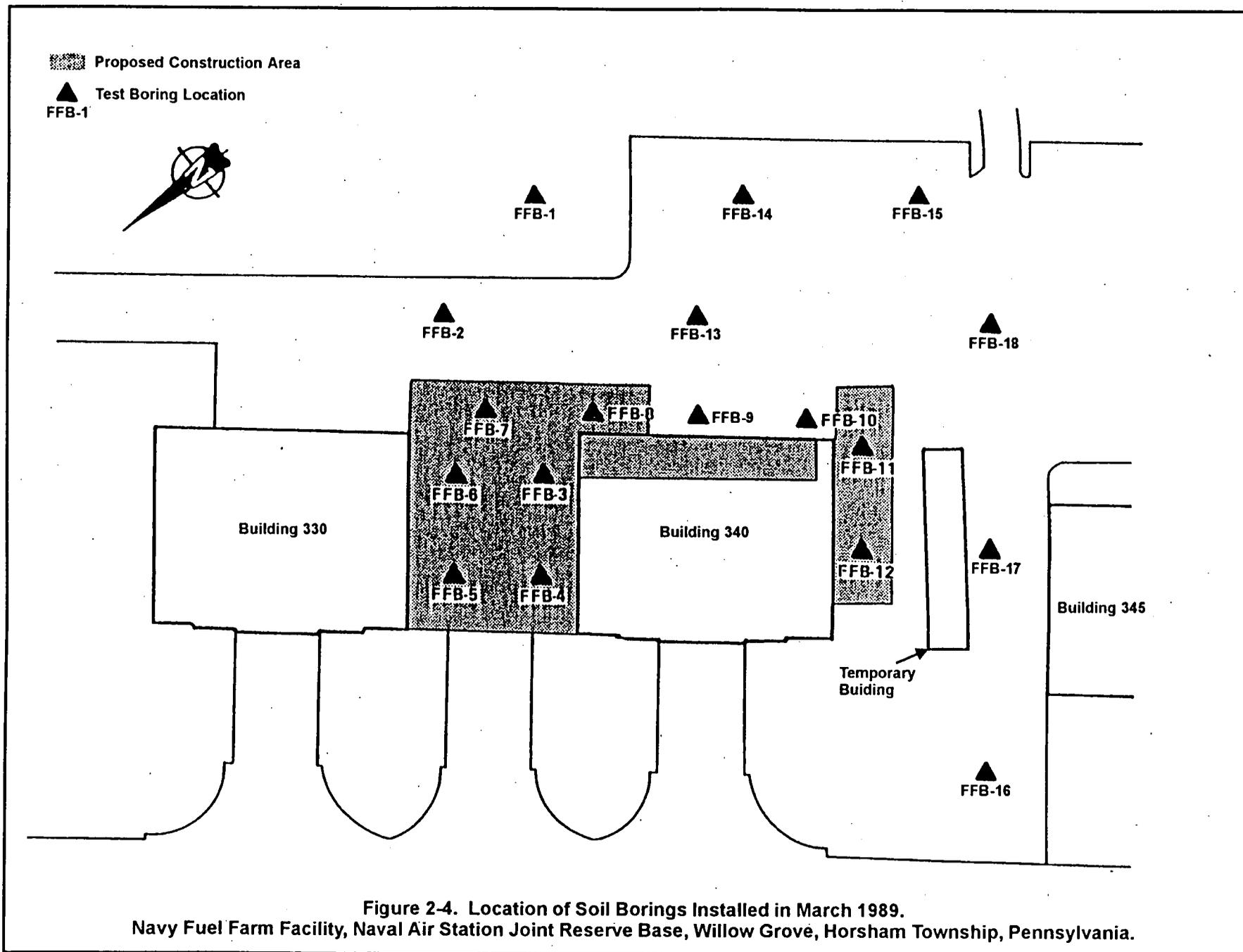
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| EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC. | | NAVY FUEL FARM FACILITY NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA | | | SITE PLAN | | |
| PROJECT MGR | DESIGNED BY | DRAWN BY | CHECKED BY | SCALE | DATE | PROJECT NO | FIGURE |
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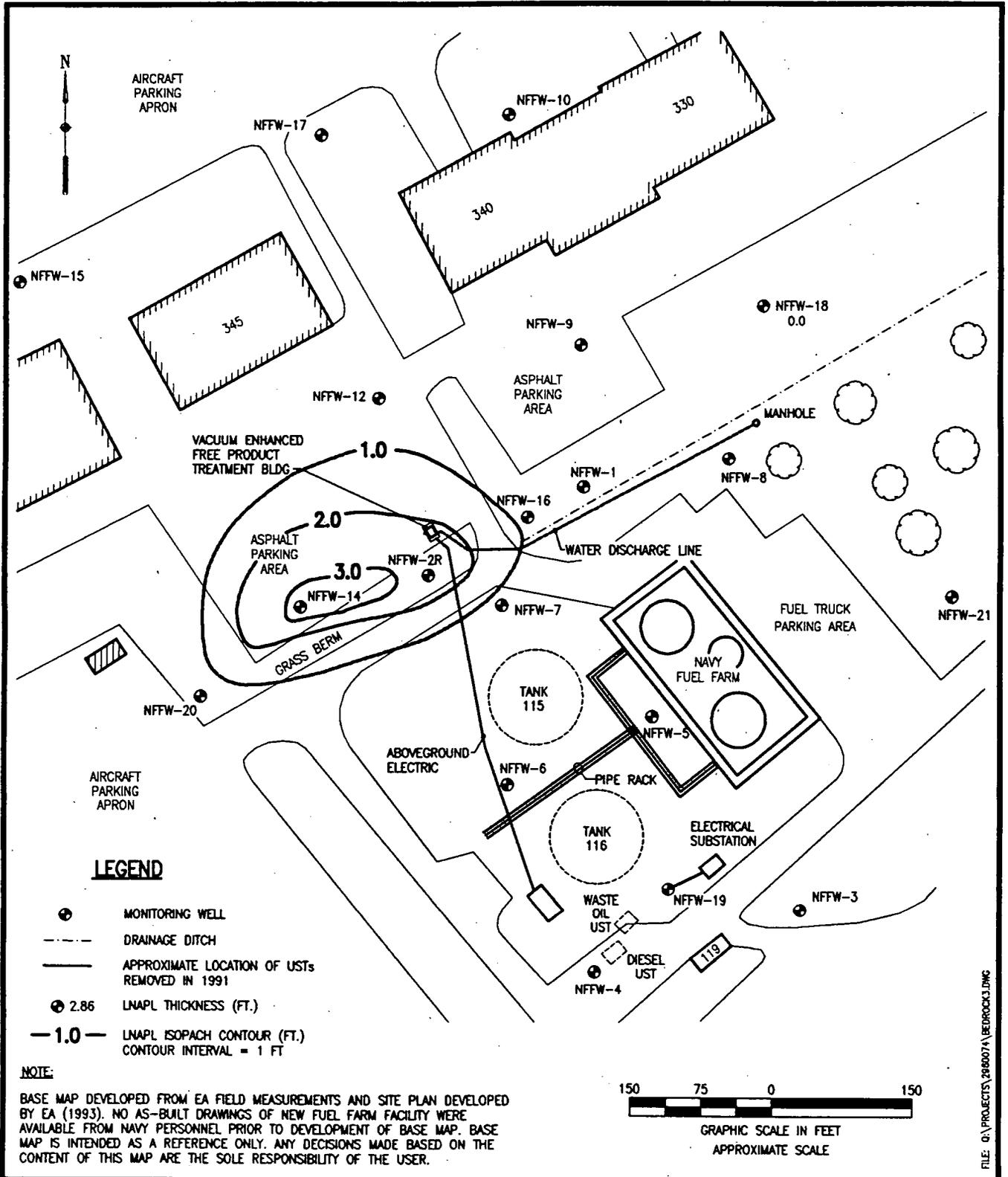


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 BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.

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|--|-------------|---|------------|-----------|--|------------|--------|
|  EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC. | | NAVY FUEL FARM FACILITY NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA | | | POTENTIOMETRIC SURFACE 8 DECEMBER 1995 | | |
| PROJECT MGR | DESIGNED BY | DRAWN BY | CHECKED BY | SCALE | DATE | PROJECT NO | FIGURE |
| CR | BS | DWM | BS | 1" = 150' | 8-4-97 | 29600.74 | 2-3 |





| | | | | | | | |
|-------------|-------------|---|------------|---|---------|------------|--------|
| | | NAVY FUEL FARM FACILITY NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA | | ISOPACH MAP OF LNAPL MEASURED IN MONITORING WELLS 28 SEPTEMBER 1995 | | | |
| PROJECT MGR | DESIGNED BY | DRAWN BY | CHECKED BY | SCALE | DATE | PROJECT NO | FIGURE |
| CR | SHD | CJV/DWM | CR | 1"=150' | 4-16-97 | 29600.74 | 2-5 |

TABLE 2-1 SUMMARY OF SOIL SAMPLE RESULTS—SOIL BORINGS
NAVY FUEL FARM FACILITY, NAVAL AIR STATION JOINT RESERVE BASE, WILLOW GROVE
HORSHAM TOWNSHIP, PENNSYLVANIA

Results of Soil Samples Collected on 2-16 March 1989

| Parameter | Units | *Cleanup Standard | FFB1 | FFB2 | FFB3 | FFB4 | FFB5 | FFB6 | FFB7 | FFB-8 | FFB9 | FFB10 | FFB10 | FFB11 |
|----------------|-------|-------------------|------|------|------|------|------|------|------|-------|------|-------|-------|-------|
| Sample Depth | ft | | 1 | 1 | 4.5 | 4.5 | 6 | 3.5 | 3.5 | 5.5 | 5 | 2 | 5 | 4 |
| Benzene | µg/kg | 800 | ND | 2 | 2 | 2 | ND | ND | ND | ND | ND | ND | ND | ND |
| Ethylbenzene | µg/kg | 70,000 | ND | ND | ND | ND | ND |
| Toluene | µg/kg | 100,000 | ND | ND | ND | ND | ND |
| Xylenes, total | µg/kg | 5,000 | ND | ND | ND | ND | ND |

| Parameter | Units | *Cleanup Standard | FFB11 | FFB12 | FFB12 | FFB-13 | FFB14 | FFB15 | FFB15 | FFB16 | FFB16 | FFB17 | FFB18 | FFB18 |
|----------------|-------|-------------------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|-------|
| Sample Depth | ft | | 5 | 6 | 8 | 6.5 | 4.5 | 6.5 | 7 | 5 | 8.5 | 4 | 3 | 9 |
| Benzene | µg/kg | 800 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Ethylbenzene | µg/kg | 70,000 | ND | ND | 52 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Toluene | µg/kg | 100,000 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Xylenes, total | µg/kg | 5,000 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

ND: Not Detected.

*: Cleanup Standard per Pennsylvania's Land Recycling Program, Technical Guidance, 18 July 1995, Soil to Ground Water Pathway.

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TABLE 2-2 SUMMARY OF SOIL SAMPLE RESULTS—WELL INSTALLATIONS
NAVY FUEL FARM FACILITY, NAVAL AIR STATION JOINT RESERVE BASE, WILLOW GROVE
HORSHAM TOWNSHIP, PENNSYLVANIA

Results of Soil Samples Collected in 1989

| Parameter | Units | *Cleanup Standard | NFB-1 (5 ft) | NFFW-5 (3 ft) | NFFW-6 (9 ft) | NFFW-7 (7 ft) |
|----------------------|-------|-------------------|--------------|---------------|---------------|---------------|
| 2-Butanone (MEK) | µg/kg | 50 | ND | ND | ND | 88 |
| 4-Methyl-2-pentanone | µg/kg | NA | ND | 29 | ND | ND |
| Acetone | µg/kg | 400,000 | 42 | 120 | ND | 190 |
| Ethylbenzene | µg/kg | 70,000 | ND | ND | ND | 160 |
| Methylene chloride | µg/kg | 500 | ND | ND | ND | 2,300 |
| Toluene | µg/kg | 100,000 | ND | ND | ND | 83 |
| Xylenes, total | µg/kg | 5,000 | ND | ND | ND | 1,500 |

Results of Soil Samples Collected in April 1991

| Parameter | Units | *Cleanup Standard | NFFW-8 (5 ft) | NFFW-9 (5 ft) | NFFW-10 (5 ft) | NFFW-11 (5 ft) | NFFW-12 (5 ft) |
|----------------|-------|-------------------|----------------|---------------|----------------|----------------|----------------|
| Benzene | µg/kg | 800 | ND | ND | ND | ND | ND |
| Ethylbenzene | µg/kg | 70,000 | 39,000 | ND | ND | 6,000 | ND |
| Toluene | µg/kg | 100,000 | 6,000 | ND | ND | 13,000 | ND |
| Xylenes, total | µg/kg | 5,000 | 290,000 | ND | ND | 4,000 | ND |

NFFW-1 (5 ft): Sample Identification (depth)

ND: Not Detected.

*: Cleanup Standard per Pennsylvania's Land Recycling Program, Technical Guidance, 18 July 1995, Soil to Ground Water Pathway.

88: Bolded result exceeds Cleanup Standard.

TABLE 2-3 SUMMARY OF ANALYTICAL RESULTS FOR GROUND-WATER SAMPLES TAKEN 10-21 JUNE 1993
AT THE NAVY FUEL FARM FACILITY, NAVAL AIR STATION JOINT RESERVE BASE,
WILLOW GROVE, PENNSYLVANIA

| Compound | Guidance Criteria | NFFW-3 | NFFW-4 | NFFW-5 | NFFW-5D | NFFW-8 | NFFW-9 | NFFW-10 | NFFW-11 |
|--|-------------------|--------|--------|--------|---------|--------|--------|---------|---------|
| VOLATILE ORGANIC COMPOUNDS ($\mu\text{g/L}$) | | | | | | | | | |
| Acetone | * | --- | --- | --- | 77 | 59 B | --- | 14 B | --- |
| Carbon Disulfide | * | --- | --- | 14 | 12 | --- | --- | --- | --- |
| Trichloroethene | 5 | --- | --- | --- | --- | --- | --- | --- | --- |
| Chlorobenzene | 100 | --- | --- | --- | --- | --- | 5 J | --- | --- |
| Benzene | 5 | --- | --- | 53 | 52 | --- | 29 | --- | 16 |
| Toluene | 1,000 | --- | --- | --- | --- | --- | --- | --- | --- |
| Ethylbenzene | 700 | --- | --- | 23 | 21 | 30 | --- | --- | 70 |
| Total Xylenes | 1,000 | --- | --- | 12 | 11 | 9 J | --- | --- | --- |
| Total BTEX | * | --- | --- | 88 | 84 | 39 | 29 | --- | 86 |
| TOTAL PETROLEUM HYDROCARBONS ($\mu\text{g/L}$) | | | | | | | | | |
| TPH (Gasoline Range Organics -GRO) | * | 1,600 | --- | 1,600 | 1,700 | 8,800 | 1,300 | 360 | 8,300 |
| TPH (JP-4) | * | --- | --- | --- | --- | 3,200 | --- | --- | 40,000 |

TABLE 2-3 (Cont.)

| Compound | Guidance Criteria | NFFW-15 | NFFW-17 | NFFW-18 | NFFW-19 | NFFW-20 | NFFW-21 | Trip Blank | Trip Blank |
|---|-------------------|---------|---------|---------|-----------|-----------|---------|------------|------------|
| VOLATILE ORGANIC COMPOUNDS ($\mu\text{g/L}$) | | | | | | | | | |
| Acetone | * | 13 B | 15 B | 27 B | 24 B | 19 B | 13 B | 16 B | --- |
| Carbon Disulfide | * | --- | --- | --- | --- | 17 | --- | --- | --- |
| Trichloroethene | 5 | 3 J | --- | --- | --- | 2 J | --- | --- | --- |
| Chlorobenzene | 100 | --- | --- | --- | --- | --- | --- | --- | --- |
| Benzene | 5 | --- | 6 J | 2 J | 67 | 6 J | 1 J | --- | --- |
| Toluene | 1,000 | --- | --- | 1 J | 17 J | 2 J | 1 J | --- | --- |
| Ethylbenzene | 700 | --- | --- | --- | 320 | --- | --- | --- | --- |
| Total Xylenes | 1,000 | --- | --- | --- | 500 | 46 | --- | --- | --- |
| Total BTEX | * | --- | 6 | 3 | 904 | 54 | 2 | --- | --- |
| TOTAL PETROLEUM HYDROCARBONS ($\mu\text{g/L}$) | | | | | | | | | |
| TPH (Gasoline Range Organics - GRO) | * | --- | 530 | 6,800 | 6,900 | 5,900 | --- | NA | NA |
| TPH (JP-4) | * | --- | 8,400 | --- | 3,600,000 | 1,600,000 | --- | NA | NA |
| <p>NOTE: Wells NFFW-1, NFFW-2, NFFW-6, NFFW-7, NFFW-12, NFFW-13, NFFW-14, NFFW-16, and NFFW-19 not sampled due to presence of LNAPL in well.</p> <p>Dashes (---) indicate not detected; refer to EA (1993) for complete results.</p> <p>D = Duplicate sample; NA = Not analyzed; J = Estimated concentration; and B = Compound detected in associated method blank; * = No Value; 6 = Bolded values exceed guidance criteria.</p> <p>Guidance Criteria = Statewide Human Health Standards for Groundwater, Pennsylvania Land Recycling and Environmental Remediation Standards Act, 19 May 1995. Aquifer ingestion \leq 2,500 TDS.</p> | | | | | | | | | |

TABLE 2-4 LNAPL OCCURRENCE and THICKNESS DISTRIBUTION
DURING THE PILOT STUDY CONDUCTED AT THE
NAVY FUEL FARM FACILITY
NAVAL AIR STATION JOINT RESERVE BASE, WILLOW GROVE
HORSHAM TOWNSHIP, PENNSYLVANIA

| Well # | Number of Monitoring Events | LNAPL Occurrence and Thickness Distribution | | | | Product Occurrence Total |
|---------|-----------------------------|---|-------------------|-------------------|-----------|--------------------------|
| | | 0.01 ft - 0.10 ft | 0.11 ft - 0.50 ft | 0.51 ft - 1.00 ft | > 1.00 ft | |
| NFFW-1 | 72 | 9 | 8 | 0 | 0 | 17 |
| NFFW-2R | 92 | 13 | 9 | 7 | 23 | 52 |
| NFFW-6 | 68 | 19 | 6 | 0 | 0 | 25 |
| NFFW-7 | 71 | 14 | 15 | 2 | 0 | 31 |
| NFFW-8 | 61 | 5 | 0 | 0 | 0 | 5 |
| NFFW-12 | 71 | 9 | 2 | 0 | 0 | 11 |
| NFFW-14 | 77 | 28 | 18 | 4 | 9 | 59 |
| NFFW-16 | 72 | 12 | 7 | 3 | 8 | 30 |
| NFFW-19 | 71 | 4 | 0 | 0 | 0 | 4 |
| NFFW-20 | 62 | 3 | 11 | 2 | 0 | 16 |
| NFFW-21 | 62 | 1 | 0 | 0 | 0 | 1 |

Source: EA 1996

3. FIELD SAMPLING PLAN

3.1 INTRODUCTION

The objective of this field sampling plan (FSP) is to provide procedures for sampling soil and ground water at the Navy Fuel Farm.

3.2 FIELD SAMPLING PLAN

Previous investigations at the Navy Fuel Farm have focused on the distribution of petroleum constituents. Limited numbers of soil and ground-water samples have been collected during previous investigations and analyzed for non-petroleum VOC. Methylene chloride and 2-butanone (MEK) were reported in a soil sample collected during the installation of well NFFW-7. Previous investigations at the Navy Fuel Farm have reported non-petroleum VOC (chlorobenzene, trichloroethene, and carbon disulfide) in a limited number of ground-water samples.

The goals of this investigation are to:

- assess subsurface soil and ground water for the presence of non-petroleum VOC
- evaluate the current conditions of petroleum and potential non-petroleum related VOC in the ground water.

This field work will be performed in accordance with the procedures presented in this chapter.

3.2.1 Soil Sampling

The purpose of collecting soil samples is to assess the presence of non-petroleum VOC. This will be accomplished through the installation of 10 direct-push (DP) soil sampling points. The DP samples will consist of continuous soil sampling until probe refusal is reached. The sample interval exhibiting the highest headspace reading using an organic vapor analyzer from each boring (one sample) during sample collection will be submitted for Target Compound List (TCL) VOC analysis. Table 3-1 contains the parameter list, as well as other pertinent information. Proposed soil boring locations are presented on Figure 3-1.

The rationale for proposing 10 soil borings and their locations is as follows:

- One soil boring will be advanced in the area of well NFFW-7. The soil sample collected during the installation of NFFW-7 had reported concentrations of methylene chloride and MEK. However, the soil around NFFW-7 was subsequently removed during the removal of tanks 115 and 116 in 1991. This sample will help evaluate if non-petroleum VOC impacted soil in the area of NFFW-7 has been removed.

- Two soil borings will be advanced in the former location of Tank 115 and Tank 116. As with the sample at NFFW-7, these samples will help assess if the soil potentially impacted by non-petroleum VOC remains in this area or was removed during the tank removal.
- Three borings will be advanced in close proximity to existing monitoring wells NFFW-8, NFFW-14, and NFFW-16. These locations were chosen because they roughly form a line of sample points immediately adjacent and down-gradient to the Navy Fuel Farm.
- One boring will be advanced in close proximity to the former well NFFW-11. This well, which had reported low levels of trichloroethene in a sample of ground water, was destroyed during the Building 340 and 341 construction activities.
- Two borings will be advanced in the area of the former dry well. The dry well is believed to be a possible source area of both petroleum and non-petroleum VOC.
- One proposed location is in the approximate location of NFFW-13. This well was covered with asphalt during paving operations and has not been located.

3.2.2 Ground-Water Sampling

The goal of the ground-water sampling is to document current conditions with respect to petroleum hydrocarbons and assess the presence of potential non-petroleum VOC in the ground water. This will be accomplished by collecting 10 ground-water samples from monitoring wells and one ground water sample using a DP method. The monitoring wells to be sampled include: NFFW-5 through NFFW-8, NFFW-10, NFFW-12, NFFW-14, NFFW-16, NFFW-19 and NFFW-20. Monitoring well locations are presented on Figure 3-1.

The rationale for choosing the ground-water sample locations for this investigation is as follows:

- Wells NFFW-5 through NFFW-8, NFFW-14, NFFW-16, NFFW-19 and NFFW-20 and are located in or are immediately adjacent to the Navy Fuel Farm.
- Wells NFFW-10 and NFFW-12 are down-gradient with NFFW-10 being the furthest down-gradient well.

- In addition, a ground-water sample will be collected, if encountered, during the installation of the soil boring in the former NFFW-11 location.

To ensure that the data collected during the field investigation will meet the data quality objectives of the project, Environmental Protection Agency (EPA) Data Quality Objective (DQO) Level I (field screening using portable equipment), and Level IV (TCL with data validation) will be used.

The following sections describe the FSP for collection and analysis of water samples with respect to DQOs, field sampling operations, laboratory analytical methods (Table 3-1), equipment decontamination and investigative derived waste handling.

3.3 FIELD SAMPLING PROCEDURES

The following subsections present the field procedures for collecting soil and ground-water samples.

3.3.1 Soil Sampling

A DP sampling technique will be used to collect subsurface soil samples for laboratory analysis. This technique will allow for the collection of several discrete soil samples in a timely manner.

3.3.1.1 Utility Clearance

Prior to the installation of the soil borings, the location of existing utilities will be assessed and the proposed boring locations will be clearly marked. Utility clearance will be secured from the Public Works Department at NASJRB Willow Grove prior to the installation of the soil borings.

3.3.1.2 Soil Sampling Equipment

DP soil sampling will be performed from each location by hydraulically driving a 2-in. diameter x 48-in. long piston-type sampler, continuously until bedrock is encountered (approximately 15 ft).

Equipment:

- Truck-mounted DP sampling rig.
- 2-in. diameter x 48-in. long piston-type samplers.
- 2-in. diameter x 48-in. long acetate core liners.
- Stainless steel trowel for cutting samples.

- Decontamination Supplies including, brushes, deionized (DI) water, laboratory - grade detergent (e.g. Alconox) and isopropyl alcohol.
- PID instrument to monitor vapor concentrations during sampling as required by the sampling protocol and the SSHERP.
- Electron capture detector (ECD) to screen soil samples for chlorinated VOC.

3.3.1.3 Field Analytical Equipment

Field equipment to be employed during the soil sampling will include an organic vapor analyzer (OVA) equipped with a photoionization detector (PID) and a portable gas chromatograph (GC) with an electron capture detector (ECD). These instruments will be checked by the operator to be in proper working order before its use and will be calibrated as required. After each use, the instrument will be checked and stored in an area shielded from weather conditions. Instruments will be calibrated before sampling each day and on an as-needed basis in accordance with the manufacturer's instructions.

3.3.1.4 Soil Sampling

DP points will be continuously sampled and advanced to bedrock, which occurs at an approximate depth of 10-15 ft. The soil will be visually evaluated and field screened using a PID and ECD for VOC. Field screening using the ECD will allow for selective screening of chlorinated VOC while the PID will screen for total VOC. One subsurface sample will be collected at each of 10 locations and submitted for laboratory analysis for VOC.

A dedicated non-reactive clear (acetate) liner will be placed in each sampler barrel prior to sample collection. Upon retrieval of each soil core barrel, the liner will be removed, and the outside will be wiped dry using a clean paper towel. Dedicated caps will be placed on each end to minimize the loss of VOC, and the sampling interval will be marked on the outside of the liner using a permanent marking pen. The cores from each hole will be collected, labeled, and set aside until bedrock is encountered. The cores will then be sliced open using a new dedicated steel blade, starting with the first 0 to 4-ft core. The soil will be visually inspected and the open core will be screened for VOC using a PID and the readings will be recorded in a field notebook. The zone of each core that exhibits the highest PID readings will be collected and analyzed in the field using the ECD. If the PID readings for the entire core are not above background, then a sample from the bottom of the core will be analyzed using the ECD. The next core (4-8 ft) will then be opened using a clean blade and field screened in the same manner. This screening will be conducted for each core collected at that sample location.

For each boring, the zone of highest total chlorinated VOC concentration, as determined by the ECD analysis, will be determined. A second boring in the same location will be used to collect the sample for laboratory analysis. The second boring will be advanced to the sample interval exhibiting the highest chlorinated VOC concentration, based on the initial boring results, and the

sample will be collected. If chlorinated VOC are not detected, the sample from the bottom of the boring will be submitted for analysis. The sample will be immediately placed in the appropriate sample jar and submitted to the laboratory for analysis. Soil observations (e.g., depth of recovery, depth of impacted layer, color, soil type, moisture, and visual observations) will be recorded in a field notebook. The containers to be used are listed in Table 3-1.

In accordance with Quality Assurance/Quality Control (QA/QC) procedures outlined in Chapter 4, one duplicate soil sample will be collected and one matrix spike/ matrix spike duplicate (MS/MSD) will be performed. Two field blanks will be collected, one from the tap water source used for equipment decontamination, and one from the laboratory-supplied DI water. One rinsate blank will be collected from the acetate liners, and one trip blank will be included in the cooler containing VOC samples. Table 3-2 presents a summary of laboratory analyses to be performed. Samples will be analyzed in accordance with the Quality Assurance Project Plan (QAPP) that has been prepared as part of this investigation (Chapter 4).

3.3.2 Monitoring Well Sampling

Rapid and significant changes can occur in ground-water samples upon exposure to the surface (e.g., exposure to sunlight, temperature, and pressure changes). Therefore, ground-water sampling will be conducted in a manner which will minimize interaction of the sample and the surface environment. The equipment and protocol for collecting ground-water samples are described in the following subsections. Sampling equipment that is not dedicated to each well will be decontaminated before each use in accordance with Section 3.6. If LNAPL is encountered, the LNAPL will be bailed from the well and ground water will be sampled from below the LNAPL. Monitoring wells containing LNAPL will be sampled last during the sampling event to reduce cross contamination.

3.3.2.1 Purging and Sampling Equipment

Well purging will be performed and ground-water samples will be collected from monitoring wells using a low-flow sampling protocol, which utilizes variable speed (Redi-Flow II®) submersible ground-water pumps with dedicated lengths of Teflon-lined polyethylene tubing for each well.

Equipment:

- Submersible ground-water pump
- Teflon-lined polyethylene tubing dedicated to each well.
- Electronic interface probe with accuracy of 0.01 ft.
- Flow measurement device (containers graduated in milliliters) and stop watch.

- Water quality meter (Grant YSI 3800 or similar) with flow-through-cell for field measurement of pH, turbidity, specific conductance salinity, temperature, Eh, and dissolved oxygen (DO).
- Decontamination supplies including, DI water, laboratory-grade detergent (e.g. Alconox) and isopropyl alcohol (only needed for cleaning the water quality meter's flow-through-cell prior to purging each well, and other reusable equipment, if needed.)
- PID instrument to monitor vapor concentrations during purging and sampling as required by the SSHERP.

3.3.2.2 Field Analytical Equipment

Field monitoring equipment to be employed at the site will include a Grant YSI 3800 water quality meter, or similar, with a flow-through-cell (which includes probes for measurement of pH, Eh, DO, temperature, conductivity, and turbidity). Additional equipment will include an OVA with a PID. Each piece of equipment will be checked by EA to be in proper working order before its use and calibrated as required. Prior to each use, field analytical equipment probe(s) will be decontaminated in accordance with Section 3.6. After each use, the instrument will be checked and stored in an area shielded from weather conditions. Instruments will be calibrated before sampling each day and on an as-needed basis in accordance with the manufacturer's instructions.

3.3.2.3 Ground-Water Sampling

The low-flow sampling protocol will be as follows:

a. Measure Water Level

Using a properly cleaned (Section 3.6) oil/water interface probe, determine the water level in each well and the total well depth. If LNAPL is present, the LNAPL will be bailed off prior to sampling and placed in the LNAPL storage tank located on-site.

b. Purge Well

Purge each well with a submersible pump and a dedicated length of Teflon-lined polyethylene tubing dedicated to each well until the pH, specific conductance, DO, Eh, turbidity (5 NTU goal) and temperature have stabilized (less than ± 0.2 pH units and less than a 10 percent change for the other parameters between three consecutive readings at five minute intervals), as follows:

- Place the Teflon-lined polyethylene tubing with attached submersible pump so that the pump intake is at the approximate middle of the screened interval of the well or within 5 ft of the well bottom, if this zone is screened. For well screens that breach the water table, the pump intake will be placed at the approximate middle of the water column in the well. To minimize sediment/silt mobilization (turbidity) from the bottom of the well, the pump intake should be kept a minimum of 2-3 ft above the bottom of the well.
- Connect the Teflon-lined polyethylene tubing (in the well) to the cleaned flow-through cell of the water quality meter (Grant / YSI 3800 or equivalent).
- Care will be taken to keep the Teflon-lined polyethylene tubing and the flow-through cell full of water in that portion of the tubing above the top of the well during purging and sampling (i.e., to mitigate the presence of air pockets).
- Using the variable speed submersible pump, purge the monitoring well.

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Once water reaches the well cap/flow-through-cell, decrease the flow rate and check the water level. Adjust pump speed until water level drawdown stabilizes (ideally less than 2 ft). Continue purging until indicator field parameters stabilize. For wells with low recharge rates with screened intervals that are totally below the water table (or potentiometric surface), do not draw the water level in the well down below the top of the screened interval. Stop the pump when the water level is just above the top of the screened interval, allow time for recharge, and then resume pumping. Repeat this step as necessary until the water quality parameters have stabilized as stated above. For wells with minimal recharge rates (less than 50 % recovery within 30 minutes), where the well is essentially dewatered during purging, the well will be pumped down two times and then sampled as soon as sufficient volume has recharged into the well bore for sampling purposes. Then notify the EA Project Manager and record that information in the sampling form.

Every 3-4 liters of water removed, measure and record the depth to water (below the top of the well casing), the pumping rate (in milliliters/minute), pH, turbidity, specific conductance, temperature, Eh, and DO.

Stabilization of the water level in the well must be achieved and is defined as no more than 0.2 ft drawdown between the 5-minute measuring intervals. The pumping rate should be adjusted (decreased) to mitigate drawdown of the water level to within the specified target range. (Ideally at the pumping rate of 100-300 ml/min, there would be no drawdown of the water level). If no more than 2 ft of drawdown occurs, the drawdown is considered negligible and sampling

can begin after achieving stabilization of the field measured water quality parameters.

If more than 2 ft of drawdown occurs during the purging process, then at a minimum, the volume of water discharged to that point must again be removed from the well (e.g., if 0.5 gals of water was purged from the well prior to stabilization of the water level, then an additional 0.5 gals must be purged whether or not the field measured water quality parameters have stabilized). The final purge volume must be greater than the stabilized drawdown volume plus pump/tubing volume.

If the stabilization of the water level or water quality parameters or the recharge rate requires more than two hours of purging time for the well, call the EA Project Manager for discussion and decision as to how to proceed. Purged water will be containerized and staged in accordance with Section 3.7.2.

c. Collect Sample

After stabilization of the water level and field measured water quality of the well, disconnect the Teflon-lined tubing from the flow-through-cell of the water quality meter and collect the discharging water in the laboratory prepared and preserved sample bottles. Fill all sample containers by allowing the pump discharge to flow down the inside wall of the sample container, minimizing turbulence. A sample of ground water will be collected and tested for residual chlorine prior to sample collection. Should residual chlorine be present in the ground water, ascorbic acid will be added to sample containers as a preservative where appropriate.

Ground-water sampling will continue directly after completion of purging using the same pump and Teflon-lined polyethylene tubing. The short length of tubing connecting the well cap with the flow-through-cell will be disconnected from the cell and ground-water samples will then be taken. VOC samples will be collected first directly into the pre-cleaned, pre-preserved sample containers provided and designated by the laboratory. A test VOC sample container will be checked with pH paper to confirm adequate preservation. Additional hydrochloric acid (HCl) will be added to the VOC vials if necessary. VOC vials will be completely filled without headspace above the liquid portion (to minimize volatilization). Check that a Teflon-lined silicone septum is correctly placed in the cap and secure the cap tightly. After the cap is sealed, vials should be inverted, lightly tapped and checked for bubbles. If bubbles are present, they will be eliminated by adding additional sample water before the vial is resealed. As each sample is obtained, any observations made will be recorded on the Field Sampling Form and the field notebook.

Sample container handling, chain-of-custody (COC) forms and shipping to EA Laboratories will be performed in accordance with Section 3.4.

One trip blank will be included per shipping cooler containing water samples to be analyzed for TCL VOC. Field duplicate ground-water samples will be collected at the rate of one per every 10 ground-water samples and will be collected from monitoring wells expected to have the highest concentrations. The field duplicate samples will be analyzed for the same parameters as the other ground-water samples. Field blanks will be collected each day samples are collected. The field blank will consist of pumping DI through the sampling pump and into the sampling container. One sample will also be collected from the tap water source used for equipment decontamination.

3.4 SAMPLE DESIGNATION, HANDLING, CUSTODY, AND SHIPPING

3.4.1 Sample Designation and Labeling

Once the sample is collected, label the sample bottle with the appropriate sample tag and provide the following data: sample identification number, project number, date, time, sampler's signature, analysis requested, and preservative(s) added.

EA will employ the following coding (sample designation) system:

I. Ground-water Samples

Example: NFFW-7

- > NFFW = Monitoring well from Navy Fuel Farm Well
- > 7 - Ground-water sample obtained from monitoring well 7

II. Soil Samples

Example: NFFSB-1

- > NFFSB = Soil Boring from Navy Fuel Farm
- > 1 - Soil obtained from soil boring 1

II. QC

Example: NFFW-DUP-1

- > NFFW- Well sample from Navy Fuel Farm Well
- > DUP 1 - First duplicate sample from a monitoring well. The actual well number from which the sample is collected will be recorded in the field notebook.

3.4.2 Handling, Custody, and Shipping

Seal the sample containers with custody tape (for VOC vials, seal the vials in a quart plastic bag and attach the custody seal around the bag). Complete the COC document entries and record the sampling event in the bound field notebook in indelible ink.

The properly labeled and sealed containers will be placed in a plastic "Ziplock" type bag and sealed. Approximately 1-3 in. of inert cushioning and absorbing material (e.g., bubble wrap) will be placed in the bottom of the cooler. The sample will be packed in ice which has been double bagged with heavy duty polyethylene bags, prior to placement into the cooler. Samples will be packed so as to maintain a temperature between at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$

The COC form will be sealed in a Ziploc-type bag and taped to the inside of the cooler lid. The lid of the cooler will be sealed with packing, fiber, or duct tape. Samples will be shipped to the laboratory via overnight courier or delivered by the field personnel. The laboratory will be notified by phone of the sample shipment at least 24 hours before arrival and 48 hours before arrival if the arrival is to occur on a Saturday. The containers for each matrix are listed in Table 3-1.

A Cooler Receipt Form must also accompany the COC form. Upon receipt of the cooler at EA Laboratories, the receiver will open the cooler, remove the COC form and Cooler Receipt Form, and complete the Preliminary Examination Phase portion of the Cooler Receipt Form. After the samples have been logged in, the Log-In Phase of the Cooler Receipt Form will be completed. The Cooler Receipt Form must accompany and be part of the COC form.

3.5 SAMPLE DOCUMENTATION

The documentation necessary for this investigation includes the following:

- Field Notebook
- COC form
- Cooler Receipt Form
- Field Sampling form

3.5.1 Field Notebook

The field notebook is a bound daily log maintained by the Site Field Manager and contains the record of sampling activities for the days of field work. At a minimum, this document should include:

- Arrival and departure times of workers and visitors to the Site
- General description of work performed (e.g., samples collected, sampling times, sampling personnel names, and deviation from plans).

- Field data collected (e.g., pH, conductivity, location of sampling points, well depth, and calibration records).

3.5.2 Chain-of-Custody and Cooler Receipt Forms

A completed COC form will accompany the samples shipped to the laboratory and will contain the following information:

- Project name and EA project number
- Name of person collecting samples
- Date and time samples were collected
- Type of sampling conducted (composite/grab)
- Parameters and method for analysis
- Location of sampling station
- Field filtration/preservation methods
- Number and type of containers used
- Signature of EA field personnel relinquishing sample
- Date and time of custody transfer to overnight courier
- Sample shipper (UPS, Federal Express, etc.)

Samples suspected to contain elevated concentrations of the parameters specified, based on field screening and monitoring results, will be noted on the COC.

3.5.3 Field Sampling Form

This document is used by the person sampling to record the physical measurements of the sample information and also as a reference.

3.6 DECONTAMINATION PROCEDURES

The primary objective of the decontamination process is to prevent the accidental introduction of potential contaminants to non-contaminated areas and/or samples. This section describes the methods associated with decontamination of field equipment. The SSHERP (Appendix A) addresses personnel decontamination.

All sampling equipment will be cleaned prior to use in the field. Wherever possible, sampling equipment will be dedicated to a single location to minimize potential for cross-contamination. All non-dedicated sampling equipment will be decontaminated as described below.

3.6.1 Stainless Steel or Teflon

This includes stainless steel equipment used for soil sampling activities:

1. Wash thoroughly (at each well location) using a brush and Alconox, or similar detergent.
2. Rinse equipment thoroughly with DI water.
3. Rinse with isopropyl alcohol by spray bottle and allow to air dry.
4. Flush with DI water to remove isopropyl alcohol.
5. Air dry and store on plastic poly sheeting, or if not being used shortly, in plastic garbage bags to prevent contamination during storage and/or transport to the field.

3.6.2 Submersible Pumps

1. Steam clean pump.
2. Rinse equipment thoroughly with DI water.
3. Rinse with isopropyl alcohol by spray bottle and allow to air dry.
4. Flush with DI water to remove isopropyl alcohol.
5. Air dry and store on plastic poly sheeting, or if not being used shortly, in plastic garbage bags to prevent contamination during storage and/or transport to the field.

3.6.3 Interface Probes

1. Rinse with Alconox or similar detergent and DI water solution.
2. Rinse with DI water.
3. Rinse with isopropyl alcohol and allow to air dry.
4. Rinse with DI water.
5. Store equipment in polyethylene bag during transport or storage.

3.7 INVESTIGATIVE DERIVED WASTE

This section addresses the procedures for collection, storage, testing, and disposition of investigative derived waste (IDW).

3.7.1 Soil Cuttings

Soil cuttings will not be generated using the DP sampling technology. Samples collected for screening analysis and not submitted to the laboratory will be spread on-site.

3.7.2 Purge Water

Water removed from monitoring wells for sampling purposes will be containerized, treated using the granular activated carbon, and discharged to the sanitary sewer.

3.7.3 Decontamination Fluids

Liquid generated as a result of decontamination activities will be included with the well purge water (Section 3.7.2).

3.7.4 Other Decontamination Waste

Other wastes generated during decontamination activities, including discarded personal protective equipment (PPE), aluminum foil, and other debris, will be double bagged and disposed of as general refuse.

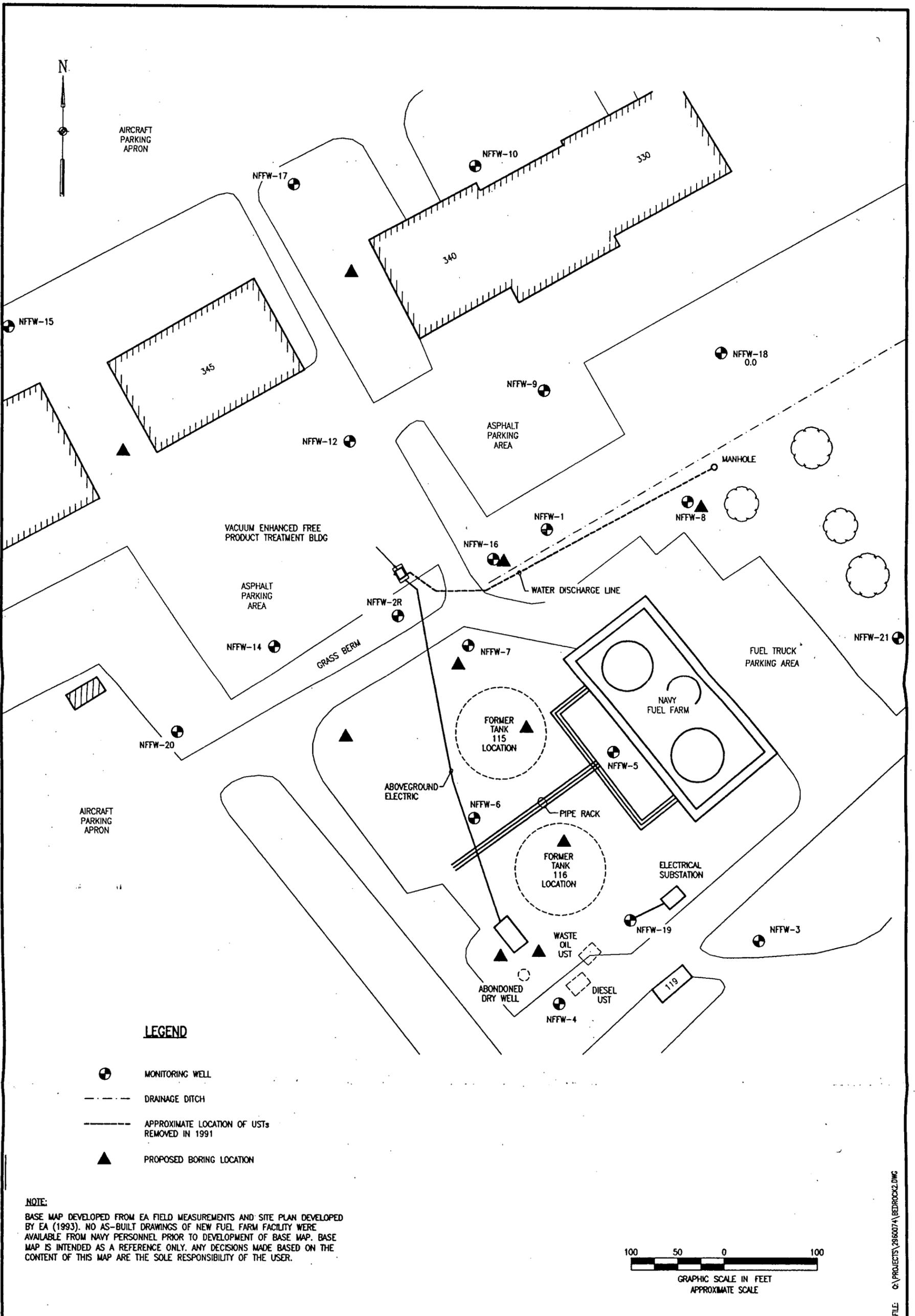
3.7.5 Waste Disposal

All liquid waste will be disposed of as described in Section 3.7.2. Subcontracted waste disposal will not be required.

3.8 SURVEYING

A Pennsylvania licensed land surveyor will be contracted to provide horizontal and vertical coordinates for all of the DP soil sampling locations (10 locations). The surveyor will mobilize to the site in the company of EA personnel. The surveyor will establish elevations with respect to bench marks currently available at NASJRB Willow Grove. The elevation of the sample location will be established for the land surface at each location. All vertical measurements will be referenced to the National Vertical Datum of 1929 and reported to ± 0.01 ft.

Horizontal control will be established by traverse runs to establish location with respect to the Pennsylvania State planar horizontal coordinate grid system and be provided in Pennsylvania planar and UTM coordinates (NAD83). Horizontal traverses will be into establishes permanent benchmarks. Horizontal traverse runs will be tied back to initial control points as a check for closure, and error of closure will be recorded.



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| | | | | | | | | | |
|--------------------|--------------------|--|------------------|----------------|-------------------------------------|-------------------------|-----------------------|------------------|---------------|
| | | NAVY FUEL FARM FACILITY NAVAL AIR STATION JOINT RESERVE BASE WILLOW GROVE, PENNSYLVANIA | | | DIRECT PUSH SOIL SAMPLING LOCATIONS | | | | |
| PROJECT MGR. CR | DESIGNED BY SHD | DRAWN BY CJV/DWM | CHECKED BY CR | DATE 4-9-97 | SCALE AS SHOWN | PROJECT NO. 29600.74 | FILE NAME BEDROCK2 | DRAWING NO. - | FIGURE 3-1 |

TABLE 3-1
SAMPLE METHODOLOGY and CONTAINER REQUIREMENTS

| Description | Method | Matrix | Bottle Type Preservation | Holding Time |
|--|-------------|--------|--------------------------------|--------------|
| Volatile Organics by GC/MS | SW-846 8260 | Soil | 4 oz soil jar/ no preservative | 14 days |
| Volatile Organics by GC/MS | SW-846 8260 | Water | 3 x 40 VOAS w/ 1:1 HCl | 14 days |
| Dissolved Oxygen, pH, Eh, Temperature, Conductivity, and Turbidity | EPA 150.1 | Water | YSI | Field |

TABLE 3-2 SUMMARY OF LABORATORY ANALYSIS TO BE PERFORMED

| Description and Method | Quantity and Type | | | | | | | |
|---|-------------------|--------------|------------|-------------|-----------|-----------------|--------|-------|
| | Soil | Ground Water | Trip Blank | Field Blank | Duplicate | Equipment Blank | MS/MSD | Total |
| VOC SW-846 8260 (Direct Push Sampling) | 10 | 1 | 1 | 2 | 2 | 2 | 1 | 17 |
| VOC SW-846 8260 (Well Sampling) | 0 | 10 | 3 | 2 | 1 | 3 | 1 | 20 |

Notes:

- TB - Trip Blanks - 1 per day of VOC shipment
- FB - Field Blanks - 1 sample each of DI water and decon source water per event
- DUP - Duplicates - 5 percent of samples
- Equipment Blank - Equipment Rinsate - one per sampling technique per day
- MS/MSD - Matrix Spike/Matrix Spike Duplicates - 5 percent of samples

4.0 QUALITY ASSURANCE PROJECT PLAN

4.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for sampling activities at the Navy Fuel Farm at the NASJRB in Willow Grove, Pennsylvania. The QAPP serves as a controlling mechanism during field sampling and laboratory activities to ensure the data collected are technically valid, meet project goals, and are legally defensible. The QAPP outlines the organization, objectives, and all Quality Assurance/Quality Control (QA/QC) activities which will ensure achievement of desired data quality goals.

4.2 LABORATORY QA/QC ORGANIZATION AND RESPONSIBILITIES

This section addresses the performance of analytical chemistry analyses of environmental samples collected during the investigation at the Navy Fuel Farm. The contracted laboratory, EA Laboratories, has identified the roles and responsibilities of key personnel within its organizational structure. Positions and responsibilities of key individuals are identified below and an organization chart for EA Laboratories is presented in Figure 4-1.

Laboratory Director

- Ensures laboratory data quality
- Maintains laboratory staffing
- Develops laboratory budget
- Ensures laboratory safety
- Approves laboratory equipment acquisition
- Promotes laboratory marketing and client interface
- Sets analytical priorities

Quality Services Manager

- Develops the laboratory Quality Assurance (QA) program
- Manages state and federal laboratory certifications
- Maintains the laboratory QA, Standard Operating Procedures (SOP) and methods manuals
- Maintains an independent QA staff
- Responsible for review and approval of nonconformance reports (NCRs)
- Exercises authority to shut down any instrument, method, or operational group if an out-of-control situation exists
- Conducts performance, systems, and data audits
- Provides escort for all inspections, provides written response to findings, and maintains audit records

- Oversees personnel training on Quality Control (QC) requirements and procedures, distributes quality related information, procedural changes, and guidance to departmental personnel

Laboratory Project Manager

- Serves as client-laboratory contact through project duration
- Responsible for identifying project specific QA/QC requirements
- Coordinates projects for the duration of their life cycle within the laboratory
- Ensures coordination of production efforts, on-time delivery of data packages which meet all client specifications for parameters, methods, quality control, and report format

Information Systems Manager

- Responsible for the site preparation, and onsite configuration of hardware and software for the laboratory's Laboratory Information Management System (LIMS)
- Identifies custom programming needs, and prepares protocols for system operation
- Responsible for user training, and routine system maintenance
- Assists the laboratory director by providing specialized technical knowledge in overall computerization of laboratory functions, including data management, scheduling, management reports, and financial reports

Section Chief

- Responsible for the implementation of analytical programs operating in the inorganics and organics laboratories
- Provides technical knowledge of methodologies and instrumentation for group, company, and clients
- Responsible for data review against project requirements and internal QC criteria.
- Plans for expansions or purchases in order to increase the efficiency of the operation.
- Provides information on capacity, pricing, and scheduling of work
- Performs personnel functions such as hiring, performance reviews, time sheet approval, time-off approval, and salary adjustment recommendations
- Participates in planning laboratory programs on the basis of specialized knowledge of problems and methods and probable value of results
- Assist the Laboratory Managers in one or more areas of overall management of the analytical laboratory, including personnel, physical plant, and financial budgeting and planning
- Troubleshoots problems regarding analytical procedures and equipment performance
- Performs quantitative and qualitative analyses using manual or specialized and complex instrumental methods
- Fully competent and proficient in the operation of sophisticated scientific equipment.
- Interprets results, prepares reports, and provides technical advice in specialized area

- Supervises and trains staff in methods of analyses, standard operating procedures, and QA/QC requirements
- Provides advice to Laboratory Managers in budgetary and personnel matters.

Sample Management Officer

- Receives, logs, and assigns control numbers to incoming samples.
- Inspects sample shipping containers for presence/absence and condition of:
 - Custody seals, locks, "evidence tape," etc.
 - Container breakage and/or container integrity
- Records condition of both shipping containers and sample containers (bottles, jars, cans, etc.)
- Signs documents shipped with samples (i.e., air bills, COC records, etc.)
- Verifies and records agreement or nonagreement of information on sample documents (i.e., sample tags, chain-of-custody records, traffic reports, air bills, etc.) in appropriate logbooks or on appropriate forms. If there is nonagreement, recording the problems, and notifying appropriate laboratory personnel for contacting the Laboratory Project Manager for direction.
- Labels samples with laboratory accession numbers, cross-referencing laboratory numbers to client numbers and/or sample tag numbers
- Controls access to samples in storage and assuring that laboratory SOPs are followed when samples are removed from and returned to storage
- Monitors storage conditions for proper sample preservation, such as refrigeration temperature and prevention of cross-contamination
- Returns shipping containers to the proper sampling teams
- Follows SOPs applicable to sample management
- Responsible for sample storage facilities. Maintains a log record on these facilities, including temperature of storage rooms, and procedures for sample storage area

4.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

4.3.1 Introduction

The overall quality assurance objective for laboratory analysis of environmental samples is to provide technically valid, legally defensible data which conforms to the program requirements of the NAVY Base Realignment and Closure (BRAC) and the EPA. Laboratory QA/QC requirements are designed to ensure that the data quality objectives of the project are achieved, and that the quality assurance objectives of precision, accuracy, representativeness, completeness, and comparability described below, are maintained throughout the analytical program.

Precision is the mutual agreement among individual measurements of the same property and is a measure of the random error component of the data collection process. The overall precision of the data is the sum of that due to sampling and analysis. To determine the

analytical precision of the method and/or laboratory analyst, a routine program of replicate analyses is performed. The results of the replicate analyses are used to calculate the relative percent difference (RPD), which is the governing quality control parameter for precision. The precision requirements for this project are listed in Table 4-1.

Accuracy is the agreement between a measurement and the true value. It is a measure of the bias or systematic error of the entire data collection process. To determine the accuracy of an analytical method a periodic program of laboratory control sample spiking is conducted. The results of sample spiking are used to calculate the quality control parameter for accuracy evaluation, the percent recovery (%R). Criteria for accuracy for the project are listed in Table 4-1.

Representativeness is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design and implementation of the sampling program. The sampling program has been designed so that the samples collected are as representative as possible of the medium being sampled and that a sufficient number of samples will be collected. Representativeness is addressed by the description of the sampling techniques and the rationale used to select the sampling locations.

Completeness is the adequacy in quantity of valid data points to prevent misinterpretation and to answer important questions. For this project, the data completeness objective is 90% for soils and 95% for aqueous matrices, per analyte, per method.

Comparability is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusion. For this project, comparability among measurements will be achieved through the use of standard procedures and uniform concentration units.

4.4 SAMPLING PROCEDURES

Sampling procedures and protocols are outlined in the Field Sampling Plan, Chapter 3.

4.4.1 Sample Containers

Sample containers will be selected to ensure compatibility with the potential contaminants and to minimize breakage during transportation. Aqueous samples for organic analyses will be contained in glass vials with teflon-lined, screw-type caps. Sample bottles, analytical methods and preservation required are listed in Table 3-1 of the Field Sampling Plan (FSP).

Sample labels will be filled out at the time of sampling and will be affixed to each container to identify the sample number, collector's name, date and time of collection, location of the sampling point, preservatives added, and analyses requested for sample.

After the bottles for a given sample site have been filled, they will be placed in a shipping cooler. Samples to be analyzed for volatile organics will not be shipped in the same cooler with samples submitted for total petroleum hydrocarbon analysis (if any). Samples requiring preservation at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ will be covered with crushed ice in plastic bags and placed in a separate cooler. Field personnel will provide crushed ice or ice packs to add to the shipping coolers as the samples are collected. Each sample container will be cushioned and sealed in a cooler container for shipment to the laboratory by overnight delivery. Daily sample collection activities will be scheduled in order to assure overnight delivery.

A COC record will be prepared and will accompany all samples to provide documentation of all samples collected and to trace sample possession.

4.4.2 Field Quality Control (QC) Samples

The percentage of field QC samples per sampling event for the Level D analyses, based on current Navy (NEFSC, 1996) guidance are given in the following sections. A sampling event is defined as the time from which the sampling personnel arrive at the site until these personnel complete the sampling task.

Trip blanks, field blanks, and duplicate samples will be collected as part of each sampling event, in order to ascertain a measure of quality control during each sampling round. The following sections describe the purpose and usage of each of these types of samples.

4.4.2.1 Trip Blanks

Trip blanks are defined as samples which originate as analyte-free water which is placed in volatile organic (glass vials with teflon-lined septa) vials, preserved with HCl in the laboratory, and shipped to the site with the field sampling kit. These vials are subsequently returned to the laboratory with the VOC samples. One trip blank will accompany each cooler containing samples to be analyzed for VOC, and will be stored at the laboratory with the samples. Trip blanks will be analyzed in order to evaluate the effect of ambient site conditions and sample shipment on sample integrity, and to ensure proper sample container preparation and handling techniques. All trip blanks will be labeled according to the proper COC procedures and will be analyzed for volatile organic compounds.

4.4.2.2 Equipment Blanks

Equipment blanks will be collected in order to determine the effectiveness of the decontamination of sample collection equipment whenever dedicated equipment are not employed. The equipment blank will be collected by pouring laboratory-supplied, analyte-free DI water directly over the decontaminated sample collection equipment (i.e., bailer, stainless steel spoon, etc.) and into the appropriate sample containers. Equipment blanks will be collected for each matrix sampled. All equipment blanks will be analyzed for the same analytical parameters as the sample matrix. A minimum of one equipment blank will be collected for every

20 samples or a minimum of one equipment blank per day per matrix will be collected. All equipment blanks will be preserved in accordance with the methods specified in Table 3-1 of the FSP, labeled according to the proper COC procedures, and stored and shipped according to the procedures discussed previously.

4.4.2.3 Source Water Blanks

Source water blanks consist of the source water used during decontamination (e.g., steam cleaning). At a minimum, one source blank from each source of water will be collected and analyzed for the same parameters as the related samples.

4.4.4.4 Field Duplicates

Duplicate samples will be collected, homogenized (except those collected for VOC analysis), and split. The procedure for collecting duplicate samples consists of alternating the collection of the sample between the sample collection bottle and the duplicate collection bottle. Samples for VOC analyses will not be mixed, but equal portions of the sample will be collected simultaneously and placed in appropriate containers listed in Table 3-1 of the FSP. Field duplicates will be collected at a frequency of 10 percent per sample matrix. All duplicate samples will be sent to the primary laboratory responsible for analysis.

4.5 SAMPLE CUSTODY

4.5.1 Introduction

Sample custody procedures will be observed to ensure the validity of the data generated during this program. Sample COC will be initiated with selection and preparation of the sample containers. To reduce the chance for error, the number of personnel handling samples will be restricted, and one person will be assigned the responsibility of field sample custodian.

Onsite monitoring data will be controlled and entered daily in permanent log books, as appropriate. Personnel involved with the sample COC process will be trained in sample collection and handling procedures prior to project initiation.

4.5.2 Field Sample Custody

Sample custody and documentation procedures described in this section will be followed throughout all sample collection activities at NASJRB Willow Grove. Components of sample custody procedures include the use of field notebooks, sample labels, and COC forms.

4.5.2.1 Field Notebooks

The EA CTO Manager will control all field notebooks. Each field notebook will receive a serialized number and be issued to the field team leader. Field notebooks will be bound books, preferably with consecutively numbered pages, that are at least 4 1/2 in. × 7 in. in size. Field notebooks will be maintained by the EA field team leader and other team members to provide a daily record of significant events, observations, and measurements during the field investigation. All notebook entries will be signed and dated.

All information pertinent to the field survey and/or sampling will be recorded in the notebooks. Field notebook entries will include the following information (at a minimum):

- Name and address of field contact
- Name and title of author, date and time of entry, and physical/environmental conditions during field activity
- Names and titles of field crew
- Names and titles of any site visitors
- Type of sampling activity
- Location of sampling activity
- Description of sampling point(s)
- Date and time of sample collection
- Sample media (e.g., soil, sediment, etc.)
- Number and volume of sample(s) taken
- Analyses to be performed
- Field observations
- Calibration/Maintenance requirements of field instruments
- References for maps and photographs of the sampling site(s)

Original data recorded in either the field notebooks, on sample labels, or in the COC records will be written with waterproof ink. None of these accountable, serialized documents will be destroyed or discarded, even if they are illegible or contain inaccuracies.

If an error is made on an accountable document assigned to an individual, that individual will make all corrections by crossing a line through the error and entering the correct information and initialing and dating the cross-out. The erroneous information will not be obliterated. Any subsequent error discovered on an accountable document will be corrected by the person who made the entry, and will be initialed and dated, as appropriate.

4.5.2.2 Sample Labels

Once the sample is collected, label the appropriate sample bottle with the appropriate sample tag and provide the following data: sample identification number, project number and name, date, time, sampler's signature, number of containers per analyte, analysis requested, and preservative(s) added. Chapter 3, Section 3.4.1 contains examples of the labeling system.

4.5.2.3 Custody Seals

Each sample container will be sealed with a custody seal. Samples will be placed in sample coolers and the coolers sealed with custody seals prior to shipment to the laboratory. Clear adhesive tape will be placed over the seals only on the coolers to ensure that seals are not accidentally broken during shipment.

4.5.2.4 Chain-Of-Custody Records

All samples will be accompanied by a COC record, a representation of which is shown in Figure 4-2. A COC record will accompany the sample from initial sample container selection and preparation commencing at the laboratory, to the field for sample containment and preservation, and through its return to the laboratory. When transferring samples, the individuals relinquishing and assuming sample custody will sign, date, and note the transfer time on the record.

Two copies of the COC record and Cooler Receipt Form will follow each sample to the laboratory. The completed original will be returned as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler, to another EA team member, to a shipper, or to the laboratory, and also to verify the date of sample receipt in the laboratory.

Shipments will be sent by overnight carrier with appropriate bill of lading documentation. Bills of lading will be retained as part of the permanent program documentation.

4.5.2.5 Sample Shipment

Samples will be shipped to the primary laboratory for analysis as soon as practical after sample collection, preferably the same day the samples are collected. All samples will be stored in coolers at a temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. The samples will be accompanied by the COC record. During sampling and sample shipment activities, the EA field team leader (or his designee) will contact the laboratory daily to provide information about impending shipments.

4.5.3 Laboratory Sample Custody

The EA field team leader will notify the laboratory of upcoming field sampling activities and subsequent sample transfer to the laboratory. This notification will include information concerning the number and type of samples to be shipped, as well as the anticipated sample arrival date.

The laboratory sample custodian will be responsible for maintaining sample custody and for maintaining all associated custodial documentation records. After receiving the samples, the sample custodian will check the original COC record and request for analysis documents against

the labeled contents of each sample container for correctness and traceability. The sample custodian will then sign the COC record and record the date and time that the sample shipment was received at the laboratory. The samples will then be logged into the laboratory system.

Care will be exercised in the laboratory to annotate any labeling or descriptive errors associated with the sample containers. In the event of discrepant documentation, the laboratory will immediately contact the EA field team leader or CTO Manager as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies such as broken or leaking bottles. This assessment will be recorded as part of the incoming COC procedure.

Samples will be stored in a secured area and at a temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$, if necessary, until analyses are performed. Samples designated for metals analyses will be stored at a temperature of $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. A laboratory COC record will accompany the sample or sample fraction through final analysis for sample control. A copy of the COC record will accompany the laboratory's analytical report and will become a permanent part of the project's records. The pH of incoming water samples will be checked by the laboratory when preservatives have been added to the sample. Details of the COC for laboratory activities is provided in the laboratory's QA Management Plan and in laboratory Standard Operating Procedures (SOPs).

4.5.4 Project File

The EA CTO Manager will serve as file custodian. At the project's completion, the files will be returned to the Navy's Northern Division Office where they will be permanently archived.

The project file will contain all incoming materials related to the project such as sketches, correspondence, authorizations, and logs. These documents will be placed in the project file as soon as possible. If correspondence is needed for reference by project personnel, a copy will be made rather than manipulating the original. Records shall be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents
- Correspondence
- Photographs
- Laboratory data
- Reports
- Procurement agreements

Outgoing project correspondence and reports will be reviewed by the project manager or designee prior to mailing.

In the event that the laboratory finds it necessary to make changes in the protocols for this project, the requested changes/modifications and their rationale, after review by the Quality

Services Manager (QSM) and Laboratory Director, will be submitted in writing to the Project Manager for approval by the Navy. Revisions to procedures shall be subject to the same level of review and approval as the original document. No changes/modifications will be implemented without approval from the Navy.

In the event that revisions are approved and implemented in the laboratory, protocols outlined in the Quality Assurance Management Plan and laboratory SOPs will be followed to prevent the use of superseded protocols.

4.6 CALIBRATION PROCEDURES AND FREQUENCY

4.6.1 Calibration System

Instruments and equipment used in this investigation are controlled by a formal calibration program. The program verifies that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. All instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration is performed by laboratory personnel using reference standards or externally by calibration agencies or equipment manufacturers. All calibrations are documented.

Two types of calibration are performed:

- *Periodic Calibration*, which is performed at prescribed intervals for equipment, such as balances and thermometers. In general, equipment which can be calibrated periodically is a distinct, singular purpose unit and is relatively stable in performance.
- *Operational Calibration*, which is routinely performed as part of an analytical procedure or test method, such as the development of a standard curve for use with an atomic absorption spectrophotometer. Operation calibration is generally performed for instrument systems.

Written procedures are used for all instruments and equipment subject to calibration. Whenever possible, recognized procedures, such as those published by ASTM or the EPA or procedures provided by manufacturers, are adopted. If established procedures are not available, a procedure is developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operational error on the quantities measured. Equipment that is subject to calibration is identified by a unique number assigned by the laboratory, and calibration records reference the specific instrument identification.

4.6.1.1 Periodic Calibration

Instruments and equipment are calibrated at prescribed intervals and/or as part of the operational use of the equipment. Calibration frequency is based on the type of equipment, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended

data use, specified analytical methods, effect of error upon the measurement process, and prior experience.

Two types of reference standards are used within the laboratory for calibration: *physical standards*, such as weights for calibrating balances and certified thermometers for calibrating working thermometers, refrigerators and ovens; and *chemical standards*, such as Standard Reference Materials (SRMs) provided by the National Institute of Standards and Technology (NIST) or the EPA. These may include vendor-certified materials traceable to NIST or EPA SRMs.

Equipment that cannot be calibrated or becomes inoperable is removed from service. Such equipment must be repaired and satisfactorily recalibrated before reuse. For laboratory equipment that fails calibration, analysis cannot proceed until appropriate corrective action is taken and the analyst achieves an acceptable calibration.

4.6.1.2 Operational Calibration

Operational calibration is generally performed as part of the analytical procedure and refers to those operations in which instrument response (in its broadest interpretation) is related to analyte concentration. Included is the preparation of a standard response (calibration) curve and often the analysis of blanks. Table 4-2 contains the operational calibration procedures and criteria used by the various instrument groups to meet requirements for the analysis of samples for this project. Formulas used for calibration are listed in Table 4-3.

Preparation of a standard calibration curve is accomplished by using calibration standards prepared from certified stock and diluted to concentrations which cover the working range of the instrument. The calibration curve is prepared by plotting or regressing the instrument responses versus the analyte concentrations. A calibration blank is included to ascertain that the solvent used to prepare the standard curve does not contribute to the instrument response.

4.6.2 Field Instrument Calibration Program

Calibration of field instruments will be performed and documented at approved intervals as specified by the manufacturer or more frequently, as conditions dictate. At a minimum, all field instruments will be calibrated at the beginning and end of each day. Calibrations may also be performed at the start and completion of each test run, however, such calibrations will be reinitiated as a result of delay due to meals, work shift change, or instrument damage. Calibration standards used as reference standards will be traceable to the NIST, when possible. Calibration procedures for field instruments will be as specified by the instrument manufacturer. Equipment manuals describing calibration procedures will be maintained in the field office during site investigations.

4.7 ANALYTICAL PROCEDURES

4.7.1 Laboratory Methods

Target compounds for this project are the volatile organic compounds listed in the cited method and on Table 4-4. Volatile compounds will be determined in water and soil matrices using the methods 5030A and 8260B from EPA *Test Methods for Evaluating Solid Waste Physical/Chemical Methods SW846* as referenced in Table 3-1 (FSP). The methods are followed as written exceptions noted below.

Volatile Organics Analysis

Volatile organic compounds in aqueous samples will be determined according to SW846 Methods 5030A/8260B using a 25 mL purge volume. This modification will achieve levels of detection at or below the Federal Maximum Contaminant Levels (MCLs).

4.7.2 Reporting Limits

Reporting Limits for all analytical parameters are provided in Table 4-4. Reporting limits are the laboratory quantitation limits established to provide data of the precision and accuracy specified in Table 4-1. Reporting limits are based on the laboratory MDL determined according to the procedure stated in 40 CFR 136 Appendix B, the Practical Quantitation Limits listed in the methods, and any method modifications which have been specified in Section 4.7.1.

Laboratory reporting limits are established in the laboratory using clean matrices. In analyzing environmental samples, reporting limits are affected by sample matrix interferences, and may not always be achievable. For this project, data may be adjusted for any manipulation necessary to minimize interferences, such as diluting the sample or modifying the method procedures.

4.7.3 Standard Operating Procedures

A SOP is a written step-by-step description of laboratory operating procedures. The contract laboratory shall document all analytical procedures in formal, approved SOPs, which are issued in a document-controlled manual. All SOPs are submitted in draft to the Quality Services Manager (QSM), who is responsible for initiating the review and approval process and for distributing and controlling the final SOPs.

The SOPs address the following areas:

- Storage containers and sample preservatives
- Sample receipt and logging
- Sample custody
- Sample handling procedures
- Sample transportation

- Glassware cleaning
- Laboratory security
- QC procedures and criteria
- Equipment calibration and maintenance
- Documentation
- Safety
- Data handling procedures
- Document control
- Personnel training and documentation
- Sample and extract storage
- Preventing sample contamination
- Traceability of standards
- Data reduction and validation
- Maintaining instrument records and logbooks
- Nonconformance
- Corrective actions
- Records management

The QSM is responsible for maintaining the original copies of all SOPs, as well as a historical file of all versions.

4.7.4 Documentation

The contract laboratory shall maintain extensive records to ensure that all aspects of the analytical process are adequately documented. Because the keeping of laboratory records is a legal requirement, it is important to consider the format and quality of the records. These records should convey:

- What was done
- When it was done
- Who did it
- What was found

4.7.4.1 Recordkeeping

The requirements for laboratory recordkeeping shall be provided in an SOP. All data entries are made in indelible, water-resistant ink. The date of the entry and the observer is clear on each entry. The observer uses his/her full name or initials. An initial and signature log is maintained so that the recorder of every entry can be identified.

All information is recorded in a notebook or on other records at the time the observations are made. Recording information on loose pieces of paper is not allowed.

When a mistake is made, the wrong entry is crossed out with a single line, initialed and dated by the person making the entry, and the correct information recorded. Obliteration of an incorrect entry or writing over it is not allowed; neither is the use of correction tape or fluid on any laboratory records.

4.7.4.2 Laboratory Records

The following records are used to document activities in the laboratory. These are in addition to those discussed elsewhere in this document, such as COC forms, log-in sheets, internal COC forms, maintenance records, and nonconformance forms.

Reagent and Titrant Preparation Records: The procedure for each analysis includes the procedures for reagent/ titrant preparation, including concentration, storage, and discard information. After a reagent/titrant is prepared, the following information is entered on a label affixed to the storage bottle: (1) its identity, (2) intended use, (3) titer/concentration, (4) preparation date, (5) storage requirement, (6) discard date, and (7) preparer. For titrimetric analyses, the procedure includes directions for standardizing the titrant, and the laboratory data sheets include space for titrant standardization data.

Standards Preparation Logs: The preparation of stock, intermediate, and working standard solutions is recorded in standards preparation logbooks, which are specific to the requirements of each operational group. Each standard is assigned a number that is used to trace the preparation from stock to working standards and to reference the analysis of the standards. The logbooks are completed by the appropriate analysts as they prepare the standards and are reviewed by the supervisor.

Sample Preparation Logs: Sample preparation operations, such as digestions and extractions, are documented in sample preparation logs, which are specific to the operations involved. The information in these logs can include: date, analyst, sample identification, weight or volume of sample used, reagents used, final volume, and volume of spiking, surrogate, or internal standard solution.

Bench Data Sheets: Laboratory bench data sheets are used for those analyses in which instrument responses are manually transcribed from instrument readout or from recorder tracings. The data sheets are preprinted to reflect the requirements of the analysis and are used to ensure that the information is recorded in a complete and organized manner.

Instrument Run Logs: When instrumentation is involved in the data generation, the sequence of the introduction of standards, field samples, and QC samples is recorded in an instrument run log. The following information is recorded when applicable: instrument identification, date, time, analyst, sample identifications, dilutions, filenames for disk storage. In addition, instrument malfunctions, repairs, and maintenance activities are recorded in the run logs.

Strip Chart Recordings/Chromatograms/Computer Output: All strip chart recordings, chromatograms, computer output, and other instrument-generated records are clearly labeled with the following information: instrument identification, date, analyst, sample identifications, and operational conditions, if applicable.

4.8 DATA COLLECTION, REDUCTION, VERIFICATION, AND REPORTING

4.8.1 Laboratory Data Processing

Data Collection: For chromatographic organic analyses, the raw data are instrument responses in the form of chromatograms, integrator outputs, or computer-generated data files. The chromatograms and printer output are stored in project-specific files. The data files are archived on magnetic tape or disks. Other types of data are collected as computer-generated printouts from inductively-coupled plasma (ICP) or graphite furnace (GFAA) absorption of analyte concentrations, or hand-written entries in laboratory notebooks.

Data reduction includes all processes that change either the values or numbers of data items. The data reduction processes used in the laboratory include establishment of calibration curves, calculation of sample concentrations from instrument responses, and computation of quality control parameters. The reduction of instrument responses to sample concentrations takes different forms for different types of methods. These calculations are generally performed by the associated computerized data systems. Calculations include factors such as sample dilution ratios, corrections for titrant normality, and conversion to dry-weight basis for solid samples. Considerations for data reporting also include significant figure guidelines.

Data review consists of an orderly process of analyst, peer, managerial, and quality assurance reviews performed at varying stages during the generation, collection, and reporting of laboratory data. Data are initially reviewed by the analyst, who verifies the results against method, program, and project specified criteria. The analyst initiates the process of identifying data which are outside the criteria, diluted, or otherwise affected in some way by the analysis performance. All data are forwarded for peer review against method, laboratory, and project specific criteria. During peer review, 100% of the laboratory data are again evaluated against QC requirements, qualified if necessary, and a narrative written describing the samples' chronology (fractional preparations and dates, analytical information, methods, holding time evaluation), laboratory method performance (compliance with laboratory method performance criteria), and sample performance (evaluation of sample performance, matrix spike and duplicate analyses, indications of matrix effect or bias, and qualifiers).

Data reporting is completed utilizing a format compliant with the requirements of this project. CLP-type forms are used to report the data, and all raw data which are required to reconstruct the analyses or validate the results are included. Fractional data packages are forwarded for compilation of the data report package, which undergoes managerial review prior to release to the client. A minimum of 10 percent of all final reports also undergoes a review by the quality services group. The analytical report is forwarded to the Laboratory Project Manager (LPM),

who releases the report to the prime contractor. The prime contractor then reviews the data against the field quality control, for outliers, and performs a final "sanity check" before forwarding it to the final client. A copy of the report is filed and maintained at the laboratory for a period of seven years.

4.8.2 Data Validation

Field sampling data will be validated by the EA Field QC Coordinator or QA/QC Manager, based on their judgment of the representativeness of the sample, maintenance and cleanliness of sampling equipment, and adherence to the approved, written sample collection procedure. The following criteria will be used to evaluate the field sampling data:

- Use of approved sampling procedures.
- Use of reagents that have conformed to QC-specified criteria.
- Proper COC maintained and documented.

Analytical data validation, which differs from internal laboratory data verification, will include validation independent of the laboratory. Data from laboratory analyses, including internal QC sample results, will be validated along with the results from field blanks, replicate samples, and other field QC samples.

The criteria listed below will be used to evaluate the analytical data:

- Use of approved analytical procedures.
- Use of properly operating and calibrated instrumentation.
- Acceptable results from analyses of laboratory control samples (i.e., the reported values should fall within the 95 percent confidence interval for these samples).
- Precision and accuracy for this project should be comparable to that achieved in previous analytical programs and consistent with objectives stated in Section 4.7 of this QA Project Plan.

Independent of the analytical laboratory, analytical data validation will be conducted which will follow the most stringent of the requirements and protocols specified in the referenced methods and identified in this QAPP. One hundred percent of the Phase III RI data will be validated in accordance with these requirements.

4.9 INTERNAL QUALITY CONTROL CHECKS AND FREQUENCY

4.9.1 Introduction

Quality control checks will be performed in the laboratory to ensure the generation of technically valid analytical results on all samples. Specific QC checks will be included with each analytical procedure performed in the laboratory according to method and program requirements. The contract laboratory will employ the following types of QC samples routinely.

Method (Reagent) Blank - The reagent or method blank is used to monitor laboratory contamination. This is usually a sample of laboratory reagent water processed through the same analytical procedure as the sample (i.e., digested, extracted, distilled). One method blank is prepared and analyzed with each batch of samples that are prepared or analyzed.

Laboratory Control Sample (LCS) - Normally, fortified method blank samples (LCSs) are analyzed with each batch of twenty (20) or fewer samples. These samples generally consist of laboratory reagent water or standard solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. They are prepared and analyzed with the associated sample batch. The analyte recovery from each is used to monitor analytical accuracy and to determine the analytical precision from batch to batch by determining the moving range.

Matrix Spike - A fortified sample or matrix spike is an aliquot of a sample which is fortified with the analyte(s) of interest and analyzed to monitor matrix effects associated with a particular sample. Samples to be spiked are selected in the field as representative of the samples taken during the event. If no spike samples are designated, the client is contacted to select the sample to be used. One matrix spike and a matrix spike duplicate (for organic analyses) will be performed for every analytical batch of twenty (20) or fewer samples.

Surrogates - are organic compounds that are similar to analytes of interest in chemical composition, extraction, and chromatography, but are not normally found in environmental samples. These compounds are spiked into all blank, standards, samples, and spiked samples prior to analysis for organic parameters. Generally, surrogates are not used for inorganic analyses. Percent recoveries are calculated for each surrogate, and evaluated against the acceptance criteria

Analytical Duplicates - An analytical or laboratory duplicate is a separate aliquot of a sample which is processed through the entire laboratory analytical procedure. Generally, duplicate analyses are performed with each batch of 20 or fewer samples for inorganic analyses. The results are used to calculate the analytical precision, but are affected by the homogeneity of the sample.

4.9.2 Performance Criteria

All QC samples are required to meet certain criteria specified in the method and/or program requirements. Wherever possible, recovery criteria will be based on internal laboratory historical performance data. The requirements for precision and accuracy for matrix spikes, matrix spike duplicates, surrogates, and laboratory control samples for EA Laboratories are defined in Table 4-1; the method requirements and laboratory corrective actions to be taken for results outside of the defined control criteria are listed in Table 4-2.

4.10 PREVENTIVE MAINTENANCE

4.10.1 Preventive Maintenance Procedures

Field equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedure developed by the operators. The laboratory follows an orderly program of positive actions to prevent the failure of laboratory equipment or instruments during use. This preventive maintenance program, along with the prescribed calibration procedures, helps to assure accurate measurements from instrumentation. Routine maintenance procedures are followed for all instruments, glassware, reagents, analytical balances, and equipment used to produce deionized water. Specific procedures will be outlined in the laboratory SOPs.

Periodic preventive maintenance is required for all sensitive equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks. Major instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Maintenance is documented in permanent records maintained by the individual responsible for each instrument.

Laboratory Managers are responsible for preparation and documentation of the program. Supervisors implement the program, and the quality assurance manager reviews implementation to verify compliance. For each operational group, the preventive maintenance program includes listing of the instruments and equipment that are included in the program; the frequency of maintenance based upon manufacturer's recommendations and/or previous experience with the equipment; and maintenance of a file with the following information: spare parts maintained by the laboratory, external service contracts, a checklist of items to be checked and/or serviced during maintenance, and directions for performing maintenance (if external service is not provided or if not stated in manufacturer's instrument manuals).

4.11 CORRECTIVE ACTION

4.11.1 Introduction

The acceptance limits for the sampling and analyses under this program will be those stated in the method or defined by other means in the QAPP. Corrective actions are often immediate in nature, implemented by the analyst or CTO Manager. The corrective action usually involves recalculation, reanalysis, or repeating sample collection.

4.11.2 Immediate Corrective Action

If an immediate corrective action can be taken as part of normal operating procedures, the collection of poor quality data can be avoided. Instrument and equipment malfunctions are amenable to this type of action. QC procedures include troubleshooting guides and corrective action suggestions. The actions taken will be noted in field or laboratory notebooks, but no other formal documentation is required, unless further corrective action is necessary. These on-the-spot corrective actions are an everyday part of the QA/QC system.

Corrective action during the field sampling portion of a program is most often a result of equipment failure or an operator oversight and may require repeating a sampling run. Operator oversight is best avoided by having field crew members audit each others' work before and after a test. Every effort will be made by the field team leader to ensure that all QC procedures are followed. If potential problems are not solved as an immediate corrective action, EA will apply formalized long-term corrective action if necessary.

Corrective action for analytical work will include recalibration of instruments, reanalysis of known QC samples and, if necessary, reanalysis of actual field samples. Specific QC procedures and checklists are used by the laboratory to help analysts detect the need for corrective action. Often the person's experience will be valuable in alerting the operator to suspicious data or malfunctioning equipment.

4.11.3 Long-Term Corrective Action

The need for long-term corrective action may be identified by standard QC procedures, control charts, performance, or system audits. Any quality problem which cannot be solved by immediate corrective action falls into the long-term category. The contract laboratory's quality system ensures that the quality problem is reported to a person responsible for correcting it, and who is part of a closed-loop action and follow-up plan.

The essential steps in the closed-loop corrective action system are listed below:

- Identify and define the problem
- Assign responsibility for investigating the problem
- Investigate and determine the cause of the problem
- Determine a corrective action to eliminate the problem
- Assign and accept responsibility for implementing the corrective action
- Establish effectiveness of the corrective action and implement it
- Verify that the corrective action has eliminated the problem

Documentation of the problem is important to the system. A NCR is filled out by the person finding the quality problem. This form identifies the problem, possible causes, and the person responsible for action on the problem. The responsible person may be an analyst, supervisor, or

the QSM. If no person is identified as responsible for action, the QSM investigates the situation and determines who is responsible in each case.

The NCR includes a description of the corrective action planned, executed, and the date it was taken, and space for follow-up. The QS Manager checks to be sure that initial action has been taken and appears effective and, at an appropriate later date, checks again to see if the problem has been fully solved. The QS Manager receives a copy of all NCRs and enters them in a permanent log, which aids the QS Manager in follow-up and makes recurrent quality problems visible to management. The log may also prove valuable in listing a similar problem and its solution.

4.12 SYSTEM AND PERFORMANCE AUDITS

Audits are systematic checks to determine the quality of operation of some activity or function in the laboratory. Audits are of two types. *Performance audits* are independent health and safety, procedure, and/or sample checks made by a supervisor or auditor to arrive at a quantitative measure of the quality of the data produced by one section or the entire measurement process. Performance audits are conducted by reviewing project documents and/or introducing control samples, in addition to those used routinely, into the data production process. *System audits* are onsite qualitative inspections and reviews of the quality assurance system used by some part of or the entire measurement system. System audits are conducted by the QA group with the assistance and involvement of laboratory and project personnel. The audits are performed against a set of requirements, which may be a QA project or program plan, a standard method, or a project statement of work.

Quality assurance audits to be conducted during the project may include system, performance, and data audits. Audits will be conducted at appropriate intervals, but at a minimum on an annual basis. The audits may be conducted more frequently for a specific task or activity. The project QA officer will keep on record a tentative schedule that details the number and types of audits, both scheduled and unscheduled, for the current year and a current list of the dates of completed audits. An individual audit plan will be developed to provide a basis for each audit, identifying the audit scope, activities to be audited, audit personnel, any applicable documents, and the schedule.

4.13 QUALITY ASSURANCE REPORTS TO MANAGEMENT

4.13.1 Internal Laboratory Reports

An monthly summary report is prepared by the QSM, detailing all of the QC activities in the laboratory. This report is submitted to the Laboratory Director, and summarizes NCR activity, internal audit activities, project status, and SOP and Method status. Project specific NCRs are addressed in each of the applicable laboratory data reports and detail the nature of the nonconformance, possible effects on the data usability, and all corrective actions taken.

4.13.2 Reports to the U.S. Navy Northern Division

The status of ongoing QA/QC activity will be presented in the project progress reports. Monthly progress reports from the Project Manager will be sent to the Navy's engineer-in-charge and Navel Engineering Facilities Service Center (NEFSC) QA/QC contract representative, as required. The final report for the project will include a section summarizing the significant findings of all QA/QC activity.

FIGURES AND TABLES

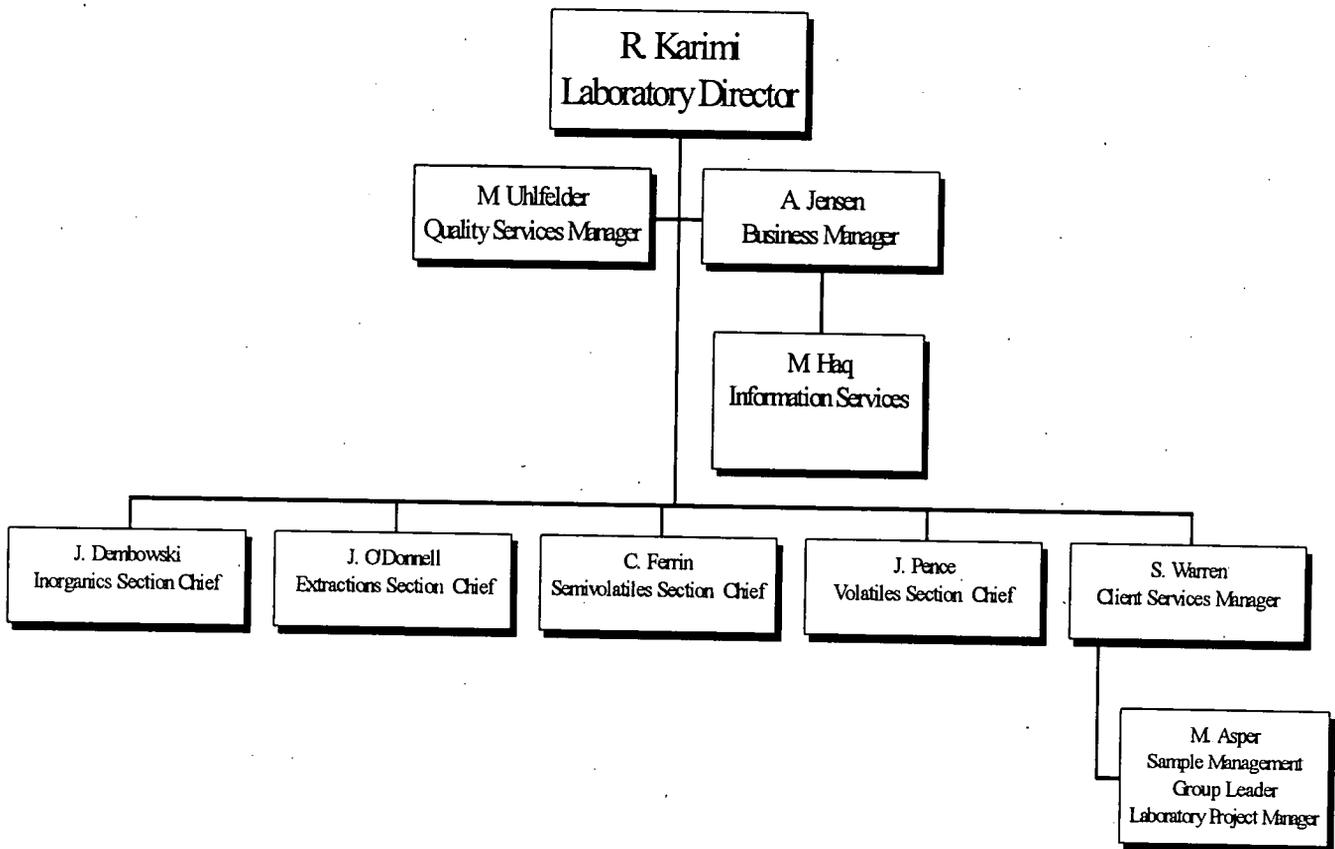


Figure 4-1. EA Laboratories Organizational Chart

| | | | | | | | | | | | | | | | |
|--|------|---------------------------------------|------------------------------|---|--------------------------------------|--------------------------|--|-----------------------------|--|-------------------|--|--|--|--|--|
| Company Name: | | Project Manager or Contact: Phone: | | Parameters/Method Numbers for Analysis* | | | | | | | | | | Chain of Custody Record | |
| Project No. | | Project No. | | | | | | | | | | | |  EA Laboratories 19 Loveton Circle Sparks, MD 21152 (410) 771-4920 Fax (410) 771-4407 | |
| Sample Storage Location: | | ATO Number: | | | | | | | | | | | | | |
| Page | of | Job ID | | | | | | | | | | | | EA Labs Accession Number | |
| Date | Time | W | S | Sample Identification 19 Characters | | | | | | | | | | | |
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| Samples by: (Signature) | | Date/Time | Relinquished by: (Signature) | | Date/Time | Received by: (Signature) | | Date/Time | | | | | | | |
| Relinquished by: (Signature) | | Date/Time | Received by: (Signature) | | Date/Time | Aitbill Number: | | Sample Shipped by: (Circle) | | | | | | | |
| Cooler Temp: ___C pH: ___ YES ___ NO Comments: | | | | | Custody Seals Intact: ___ YES ___ NO | | | | | Fed Ex. PURO. UPS | | | | | |
| NOTE: Please indicate method number for analyses requested. This will help clarify any questions with laboratory techniques. | | | | | | | | | | Hand Carried | | | | | |
| | | | | | | | | | | OTHER: | | | | | |

Shaded Areas for Lab Use Only

Figure 4-2. Representation of EA Laboratories Chain of Custody Form

TABLE 4-1 QUALITY CONTROL CRITERIA FOR PRECISION AND ACCURACY FOR MATRIX SPIKES, MATRIX SPIKE DUPLICATES, SURROGATES, AND LABORATORY CONTROL SAMPLES ^(A)

| QC Parameter | Spiking Compounds | Spike Concentration | | Accuracy (%R) | | Precision (b) | |
|---|----------------------------|---------------------|--------------|---------------|--------|---------------|------|
| | | Water (ug/L) | Soil (ug/kg) | Water | Soil | Water | Soil |
| SW846 Method 5030A/8260B Volatile Organic Compounds by GC/MS - in soils and waters (25 mL purge volume) | | | | | | | |
| MS/MSD | Benzene | 10 | 50 | 76-127 | 66-142 | <15 | <21 |
| | Toluene | 10 | 50 | 76-125 | 59-139 | <15 | <21 |
| | Chlorobenzene | 10 | 50 | 75-130 | 60-133 | <15 | <21 |
| | 1,1-Dichloroethene | 10 | 50 | 61-145 | 59-172 | <15 | <22 |
| | Trichloroethene | 10 | 50 | 71-120 | 62-137 | <15 | <24 |
| Surrogate Spike | 1,2-Dichloroethane-d4 | 10 | 50 | 76-114 | 70-121 | -- | -- |
| | 4-Bromofluorobenzene (BFB) | 10 | 50 | 86-115 | 74-121 | -- | -- |
| | Toluene-d8 | 10 | 50 | 88-110 | 81-117 | -- | -- |
| | Dibromofluoromethane | 10 | 50 | 86-118 | 80-120 | -- | -- |
| LCS | Benzene | 10 | 50 | 78-123 | 78-119 | <28 | <25 |
| | Toluene | 10 | 50 | 77-122 | 73-130 | <27 | <35 |
| | Chlorobenzene | 10 | 50 | 79-123 | 69-139 | <27 | <43 |
| | 1,1-Dichloroethene | 10 | 50 | 75-118 | 74-128 | <27 | <33 |
| | Trichloroethene | 10 | 50 | 73-122 | 72-122 | <30 | <31 |

(A) Laboratory Control Sample (LCS) limits are based on historical performance data and are updated annually.

(B) Precision for LCS is calculated as the moving range for successive LCS recoveries; precision for matrix spikes is listed for the relative percent difference (%RPD).

TABLE 4-2 SUMMARY OF LABORATORY QUALITY CONTROL AND CORRECTIVE ACTION PROCEDURES FOR EPA METHODS ^(a)

| QC Check | Frequency | Acceptance Criteria | Laboratory Corrective Action |
|--|--|--|---|
| SW846 5030A/8260B Volatile Organic Compounds in Waters and Soils by GC/MS | | | |
| Holding time | 14 days from sampling (preserved); 7 days (unpreserved) | Analysis is completed within holding time. | Notify client, determine if laboratory to proceed or if client will resample. |
| Tuning | Every 12 hours | Within limits of method | Adjust instrument parameters. |
| Calibration curve | Established initially at 5 concentration levels, verified daily at mid level | <ol style="list-style-type: none"> 1. Initial calibration %RSD for all CCCs is less than 30 percent; RF for SPCCs is >method specified minimum 2. Continuing calibration %D for CCCs from initial calibration is less than 20 percent; RF for SPCCs is method specified minimum | <ol style="list-style-type: none"> 1. Recalibrate instrument. 2. Reanalyze samples since last criteria met. 3. Document actions taken. |
| Method Blank | 1 per analytical batch | Concentration is less than the MDL of the analyte except that the common laboratory contaminants MeC12, and acetone are less than five times the MDL. | <ol style="list-style-type: none"> 1. Determine source of contamination, i.e. instrument, blank water, reagents. 2. Take appropriate corrective action and document. 3. Reanalyze or prepare analytical batch. 4. If samples cannot be reanalyzed or reprepared, qualify data. |
| LCS | 1 per analytical batch | Values are within acceptance criteria in Table 4.1. | <ol style="list-style-type: none"> 1. Validate instrument parameters, sensitivity and linearity. Correct problems and document. 2. Validate standards. 3. Validate LCS preparation. 4. Reanalyze LCS and samples. 5. If reparation of samples is not possible, qualify data. 6. Document actions taken. |

(a) Abbreviations: RPD, relative percent difference; RL, reporting limit; QC, quality control; LCS, laboratory control sample; SD, standard deviation; MS, matrix spike, RSD, relative standard deviation, CCC, calibration check compounds, RF, response factor, SPCC, system performance check compound.

TABLE 4-2 SUMMARY OF LABORATORY QUALITY CONTROL AND CORRECTIVE ACTION PROCEDURES FOR EPA METHODS (A)

| QC Check | Frequency | Acceptance Criteria | Laboratory Corrective Action |
|---|--|--|--|
| Surrogate spike | All laboratory blanks, LCS, MS/MSD and field samples | See Table 4.1 for surrogate spiking compounds, spike concentrations and control limits. | <ol style="list-style-type: none"> 1. Examine all QC (including but not limited to LCS, MB). 2. If surrogate in LCS and/or MB is out-of-control, check quantitation. If quantitation is correct reanalyze. 3. If similar results are obtained from reanalysis, obtain fresh, verified surrogate solution and reanalyze the analytical batch. 4. If samples cannot be reprepared, qualify data. 5. If surrogate spike in LCS and MB are acceptable but out-of-control for samples, validate preparation of samples. If no errors or problems are discovered for sample preparation, qualify data. 6. If errors are discovered in preparation of samples, reprepare QC samples and all affected samples. 7. Document actions taken. |
| Internal Standard Responses and Retention Times | Internal standards are added to all calibration standards, LCS, samples and blanks | <ol style="list-style-type: none"> 1. Retention time for any internal standard must be within 30 seconds of the latest daily calibration standard. For samples analyzed with an initial calibration, the retention times are compared to the 10 µg/L (25 ml purge aqueous) or 50 ug/kg (soils) standard. 2. The area counts for all internal standards in the CCV must be within a factor of two (-50% to +100%) of last daily calibration check standard. | <ol style="list-style-type: none"> 1. Inspect the mass spectrometric system for malfunction and correct. 2. Reanalyze affected samples. If the areas meet criteria, report data from the compliant analysis. 3. If reanalysis of the sample does not solve the problem, submit data from both runs, and document all inspection and corrective actions taken in the analytical narrative. |
| MS/MSD | 1 set per 20 samples | See Table 4.1 for matrix spiking compounds, spike concentrations, and control limits. | <ol style="list-style-type: none"> 1. Analyze spiking solution. 2. If spiking solution is valid, qualify data. 3. If spiking solution is not valid, obtain fresh, certified spiking solution and reanalyze the sample and the associated matrix spikes. 4. If reanalysis of samples is not possible, qualify data. 5. Document actions taken. |

(a) Abbreviations: RPD, relative percent difference; RL, reporting limit; QC, quality control; LCS, laboratory control sample; SD, standard deviation; MS, matrix spike, RSD, relative standard deviation, CCC, calibration check compounds, RF, response factor, SPCC, system performance check compound.

Table 4-3 Operational Calibration Formulas

| Application | Formula | Symbols |
|--------------------------------------|--|--|
| Linear regression calibration curves | $R = C a_1 + a_0$ | <p>C = Concentration of the calibration standard</p> <p>R = instrument response</p> <p>a_0 = intercept of regression curve (instrument response when concentration is zero)</p> <p>a_1 = slope of regression curve (change in response per change in concentration)</p> |
| Response factors | $RF = \frac{C_{is} A_x V_f}{C A_{is} V_i}$ | <p>C = Concentration of the calibration standard</p> <p>RF = internal standard response factor</p> <p>C_{is} = concentration of the internal standard (ug/L)</p> <p>A_x = area of the characteristic ion for the target compound</p> <p>V_f = final volume of extracted sample (mL)</p> <p>A_{is} = area of the characteristic ion for the internal standard</p> <p>V_i = initial volume of sample extracted (mL)</p> |

TABLE 4-4 REPORTING LIMITS (RLs) FOR WATER AND SOIL SAMPLES

| Parameter | Units (Water) | Reporting Limits (Water) | Units (Soil) | Reporting Limits (Soil) |
|---|------------------|-----------------------------|-----------------|----------------------------|
| Volatile Organics GC/MS - Capillary Column (SW846 5030A/8260B) | | | | |
| Benzene | ug/L | 1 | ug/kg | 5 |
| Bromobenzene | ug/L | 1 | ug/kg | 5 |
| Bromochloromethane | ug/L | 1 | ug/kg | 5 |
| Bromodichloromethane | ug/L | 1 | ug/kg | 5 |
| Bromoform | ug/L | 1 | ug/kg | 5 |
| Bromomethane | ug/L | 1 | ug/kg | 5 |
| sec-Butylbenzene | ug/L | 1 | ug/kg | 5 |
| n-Butylbenzene | ug/L | 1 | ug/kg | 5 |
| tert-Butylbenzene | ug/L | 1 | ug/kg | 5 |
| Carbon tetrachloride | ug/L | 1 | ug/kg | 5 |
| Chlorobenzene | ug/L | 1 | ug/kg | 5 |
| Chloroethane | ug/L | 1 | ug/kg | 5 |
| Chloroform | ug/L | 1 | ug/kg | 5 |
| Chloromethane | ug/L | 1 | ug/kg | 5 |
| 2-Chlorotoluene | ug/L | 1 | ug/kg | 5 |
| 4-Chlorotoluene | ug/L | 1 | ug/kg | 5 |
| Dibromochloromethane | ug/L | 1 | ug/kg | 5 |
| 1,2-Dibromo-3-chloropropane (DBCP) | ug/L | 1 | ug/kg | 5 |
| 1,2-Dibromoethane (EDB) | ug/L | 1 | ug/kg | 5 |
| Dibromomethane | ug/L | 1 | ug/kg | 5 |
| 1,2-Dichlorobenzene | ug/L | 1 | ug/kg | 5 |
| 1,3-Dichlorobenzene | ug/L | 1 | ug/kg | 5 |
| 1,4-Dichlorobenzene | ug/L | 1 | ug/kg | 5 |
| Dichlorodifluoromethane | ug/L | 1 | ug/kg | 5 |
| 1,1-Dichloroethane | ug/L | 1 | ug/kg | 5 |
| 1,2-Dichloroethane | ug/L | 1 | ug/kg | 5 |
| 1,1-Dichloroethene | ug/L | 1 | ug/kg | 5 |
| cis-1,2-Dichloroethene | ug/L | 1 | ug/kg | 5 |
| trans-1,2-Dichloroethene | ug/L | 1 | ug/kg | 5 |
| 1,2-Dichloropropane | ug/L | 1 | ug/kg | 5 |
| 1,3-Dichloropropane | ug/L | 1 | ug/kg | 5 |
| 2,2-Dichloropropane | ug/L | 1 | ug/kg | 5 |
| 1,1-Dichloropropene | ug/L | 1 | ug/kg | 5 |
| Ethylbenzene | ug/L | 1 | ug/kg | 5 |
| Hexachlorobutadiene | ug/L | 1 | ug/kg | 5 |
| Isopropylbenzene | ug/L | 1 | ug/kg | 5 |
| p-Isopropyltoluene | ug/L | 1 | ug/kg | 5 |
| Methylene chloride | ug/L | 1 | ug/kg | 5 |
| Naphthalene | ug/L | 1 | ug/kg | 5 |
| n-Propylbenzene | ug/L | 1 | ug/kg | 5 |
| Styrene | ug/L | 1 | ug/kg | 5 |
| 1,1,1,2-Tetrachloroethane | ug/L | 1 | ug/kg | 5 |
| 1,1,2,2-Tetrachloroethane | ug/L | 1 | ug/kg | 5 |
| Tetrachloroethene | ug/L | 1 | ug/kg | 5 |
| Toluene | ug/L | 1 | ug/kg | 5 |
| 1,2,3-Trichlorobenzene | ug/L | 1 | ug/kg | 5 |
| 1,2,4-Trichlorobenzene | ug/L | 1 | ug/kg | 5 |

TABLE 4-4 REPORTING LIMITS (RLs) FOR WATER AND SOIL SAMPLES

| Parameter | Units (Water) | Reporting Limits (Water) | Units (Soil) | Reporting Limits (Soil) |
|------------------------|------------------|-----------------------------|-----------------|----------------------------|
| 1,1,1-Trichloroethane | ug/L | 1 | ug/kg | 5 |
| 1,1,2-Trichloroethane | ug/L | 1 | ug/kg | 5 |
| Trichloroethene | ug/L | 1 | ug/kg | 5 |
| Trichlorofluoromethane | ug/L | 1 | ug/kg | 5 |
| 1,2,3-Trichloropropane | ug/L | 1 | ug/kg | 5 |
| 1,2,3-Trimethylbenzene | ug/L | 1 | ug/kg | 5 |
| 1,2,4-Trimethylbenzene | ug/L | 1 | ug/kg | 5 |
| 1,3,5-Trimethylbenzene | ug/L | 1 | ug/kg | 5 |
| Vinyl chloride | ug/L | 1 | ug/kg | 5 |
| m&p-Xylenes | ug/L | 1 | ug/kg | 5 |
| o-Xylene | ug/L | 1 | ug/kg | 5 |

APPENDIX A

**Site Safety, Health, and Emergency
Response Plan**

**Site Safety, Health, and Emergency
Response Plan
Navy Fuel Farm Facility
Naval Air Station Joint Reserve Base, Willow Grove
Horsham Township, Pennsylvania**

Contract No. N62472-92-D-1296
Contract Task Order No. 0074

Prepared for

Department of the Navy
Northern Division
Naval Facilities Engineering Command
Lester, Pennsylvania

Prepared by

EA Engineering, Science, and Technology
Sparks, Maryland

Approved by: *Kris H. Hoiem* *8/21/97*

Kris H. Hoiem, Certified Industrial Hygienist
Program Safety and Health Officer

Date

Carl G. Reitenbach *8/21/97*

Carl G. Reitenbach
CTO Manager

Date

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SITE SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP)

1. SITE INFORMATION

Site: Navy Fuel Farm Facility

Location: Naval Air Station Joint Reserve Base, Willow Grove, Horsham Township, Pennsylvania

Scheduled field activities dates: June 1997 - November 1998

2. KEY PERSONNEL AND RESPONSIBILITIES

2.1 CTO MANAGER: Carl Reitenbach

The responsibilities of the Contract Task Order (CTO) Manager include:

- Assuring compliance with the Program Safety and Health Management Plan and this SHERP.
- Coordinating with the designated Navy Technical Representative.
- Preparing the SHERP.
- Providing overall supervisory control for safety and health protocols in effect for the project.
- Assigning the Site Manager and Site Safety and Health Officer (SSHO) and assuring that the assigned onsite staff will enforce provisions of the approved SHERP.
- Ensuring that individuals who will work onsite and who may be exposed to hazardous wastes, have completed training, and are currently participating in a medical surveillance program in accordance with OSHA 1926.65, the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Activities" and the NEESA "Safety and Health Guidelines for Navy Assessment and Control of Installation Pollutants Confirmation Studies."
- Assuring adequate resources are available for safety and health.

- Preparing and submitting project reports.

2.2 SITE SAFETY AND HEALTH OFFICER: Scott Dobson (Brian Stempowski as Alternate)

The SSHO will be onsite throughout the project (with the exception of routine monitoring and maintenance visits) and will be responsible for daily compliance with site safety and health requirements. The duties of the SSHO include:

- Conducting daily inspections of the site.
- Stopping work when imminent safety or health risks exist or as outlined in the site specific SHERP.
- Implementing usage of forms in appendixes.
- Implementing the SHERP.
- Providing an initial safety and health briefing to site workers and visitors and providing weekly safety and health meetings during the project performance.
- Reviewing training and medical records prior to site work.
- Evaluating reported hazardous conditions and recommending corrective action.
- Conducting necessary monitoring.
- Establishing and ensuring compliance with site control areas and procedures.
- Supervising decontamination to ensure decontamination of personnel, tools, and equipment.
- Supervising the distribution, use, maintenance, and disposal of personal protective clothing and equipment.
- Investigating and preparing incident reports as necessary.

2.3 SITE MANAGER: Brian Stempowski (Scott Dobson as Alternate)

The Site Manager's responsibilities also include:

- Providing technical support to the SSHO, particularly in the modification of site safety and health requirements.

- Evaluating onsite environmental monitoring results and reporting to the CTO Manager.
- Reviewing site safety and health documentation to ensure compliance with the Program Safety and Health Management Plan.

During any emergency, the Site Manager (or the senior site supervisor in the absence of the Site Manager) will be responsible for initiating and coordinating responses. In this situation, the Site Manager will:

- Work with the SSHO to identify and evaluate hazards.
- Be responsible for initiating the evacuation of the work site when needed, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders.
- Determine if the abatement of hazardous conditions is sufficient prior to allowing resumption of work operations after an emergency.

2.4 FIELD PERSONNEL

The following personnel are assigned to field work under this CTO:

- Scott Dobson
- Brian Stempowski
- Rick Shockley
- Jeff Smith
- Bill Parnella
- Carl Reitenbach

Responsibilities of EA personnel include:

- Following the site specific SHERP and applicable safety and health rules, regulations, and procedures.
- Using required controls and safety devices, including personal protective equipment.
- Complying with training and medical requirements.
- Notifying his/her supervisor of suspected safety or health hazards.

3. PURPOSE AND WORK SCOPE

The primary objective of this project is sampling and analysis soil and ground water and the installation of a full scale remedial system at the Navy Fuel Farm facility. Field work is limited to collection and sampling of the soil and ground water which may have been impacted with JP-4/JP-5 and chlorinated solvents. Shallow trenching activities will also be conducted during the installation of the remedial system.

4. SITE DESCRIPTION

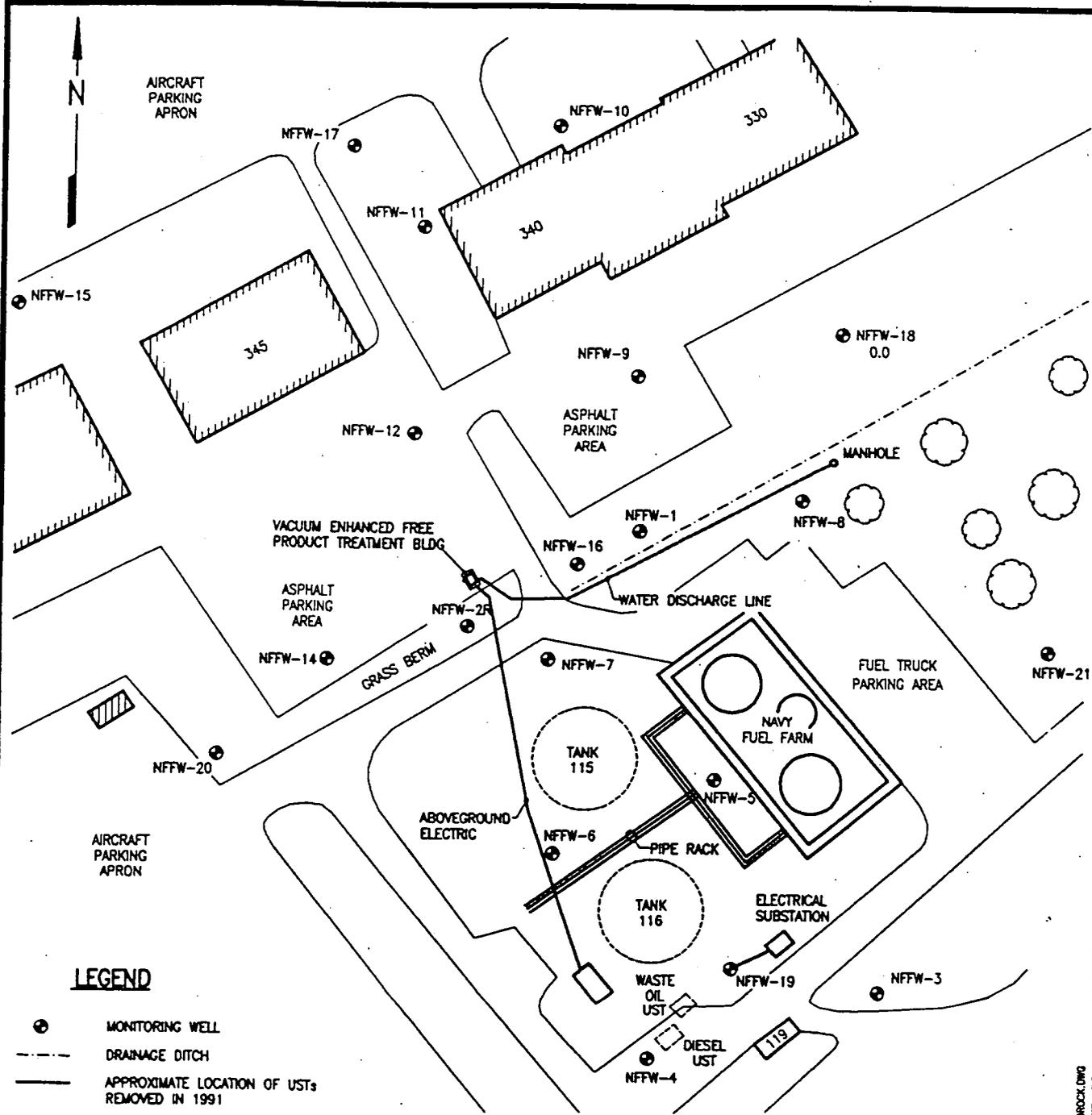
The Navy Fuel Farm facility is located along the north side of Privet Road and immediately south of the Pennsylvania Air National Guard portion of the Air Reserve Facility at NAS Willow Grove (Figure 1). The Navy Fuel Farm facility is bordered on all sides by NAS grounds. West of the subject site, across an access road, sits the aircraft parking apron off Runway 15. To the east, at the previous location of Building 157, sits the newly constructed Navy Fuel Farm facility, complete with a bermed enclosure containing the newly erected aboveground storage tanks. Abutting the Navy Fuel Farm facility to the north are Air Reserve Facility Buildings 330, 340, and 345. Several other base facilities exist within 1,000 ft of the site.

The Navy Fuel Farm facility is approximately 2 acres in area and consists of three aboveground storage tanks, associated aboveground piping, Buildings 119 and 81, and a fuel truck parking area.

The topography of the Navy Fuel Farm facility area is characterized as flat and gently sloping to the north-northwest. There is a slight downgrade at the north end of the facility which encourages runoff to flow northeast into the catchment basin or the adjacent ditch.

Information relating the site's history has been taken from EA (1993). From 1950 to 1991, two partially buried 210,000-gal JP-4/JP-5 aviation fuel tanks (Tank Nos. 115 and 116) were located at the site. A 500-gal underground waste oil tank and an underground diesel tank were also located at the southwestern corner of the site. The former locations of these tanks is provided in Figure 1.

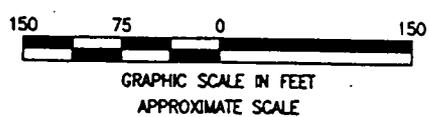
In 1986, a spill occurred when Tank No. 115 was overfilled and fuel was released from the vent pipe onto the ground. The event was attributed to faulty gauges which registered less fuel than was actually present. During this same year, a utility trench was excavated along the western boundary of the site but work discontinued when free-product was observed floating on the water within the trench. Subsequent observations have confirmed the continued presence of at least a sheen of free-product in the trench. The area where the free-product was discovered is immediately adjacent to a former drywell. The drywell accepted water which was periodically siphoned from the bottom of the fuel tanks.



LEGEND

- ⊕ MONITORING WELL
- - - DRAINAGE DITCH
- APPROXIMATE LOCATION OF USTs REMOVED IN 1991

NOTE:
 BASE MAP DEVELOPED FROM EA FIELD MEASUREMENTS AND SITE PLAN DEVELOPED BY EA (1993). NO AS-BUILT DRAWINGS OF NEW FUEL FARM FACILITY WERE AVAILABLE FROM NAVY PERSONNEL PRIOR TO DEVELOPMENT OF BASE MAP. BASE MAP IS INTENDED AS A REFERENCE ONLY. ANY DECISIONS MADE BASED ON THE CONTENT OF THIS MAP ARE THE SOLE RESPONSIBILITY OF THE USER.



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EA ENGINEERING,
 SCIENCE, AND
 TECHNOLOGY, INC.

NAVY FUEL FARM FACILITY
 NAVAL AIR STATION JOINT
 RESERVE BASE
 WILLOW GROVE, PENNSYLVANIA

SITE PLAN

| | | | | | | | |
|-------------------|--------------------|---------------------|------------------|------------------|----------------|------------------------|-------------|
| PROJECT MGR CR | DESIGNED BY SHD | DRAWN BY CJV/PMH | CHECKED BY CR | SCALE 1"=150' | DATE 4-7-97 | PROJECT NO 29600.74 | FIGURE 1 |
|-------------------|--------------------|---------------------|------------------|------------------|----------------|------------------------|-------------|

In March 1989, JP-5 jet fuel was detected emanating from two patches of dead grass on the west side of Tank No. 115. Heavy rains flushed this fuel into the ditch on the north side of the site. Navy personnel responded with the placement of sorbent material in the ditch and adjacent to Tank No. 115. With this evidence of tank leakage, it was decided to empty and remove the two main fuel tanks (Tank Nos. 115 and 116). Removal of these tanks occurred in 1991. Also during this time, the waste oil and diesel underground storage tanks were removed. Inspection of the waste oil tank during removal revealed the tank was not intact as holes up to 1-in. in diameter were reported.

Subsequent to the completion of removal activities, a new aboveground tank system was installed to the east of the former tank field location. In order to accommodate the newly constructed Navy Fuel Farm facility, Building 157 was removed. The new tank system at the Navy Fuel Farm consists of aboveground steel tanks set in a concrete berm. The Navy Fuel Farm facility is currently inactive.

5. TASK-BY-TASK HAZARD ANALYSIS

5.1 HAZARD COMMUNICATION

A Material Safety Data Sheet (MSDS) for each chemical supplied by EA shall be kept onsite by the Site Safety and Health Supervisor (SSHS). EA employees shall be informed of the location of MSDSs. Chemicals brought onsite must be properly labeled in accordance with OSHA's Hazard Communication requirements (29 CFR 1910.1200) and EA's Hazardous Communication program.

MSDSs for substances that may be brought on site can be found in Attachment A of this SHERP.

5.2 CHEMICAL HAZARDS

Table 1 provides a summary of the volatile organic compounds detected in ground water collected from wells at the Navy Fuel Farm facility. It is assumed that the soil could contain any of these compounds.

Potential routes of worker exposure to these chemicals (e.g., inhalation, skin contact) and expected magnitude of exposure are summarized below by task.

- Soil Sampling and Trenching— Chemical hazards may involve inhalation and dermal contact with vapors and soil containing petroleum hydrocarbons including exposure to benzene.

TABLE 1 SUMMARY OF ANALYTICAL RESULTS FOR GROUND-WATER SAMPLES TAKEN 10-21 JUNE 1993
 AT THE NAVY FUEL FARM FACILITY, NAVAL AIR STATION JOINT RESERVE BASE, WILLOW GROVE,
 PENNSYLVANIA

| Compound | NFFW-3 | NFFW-4 | NFFW-5 | NFFW-5D | NFFW-8 | NFFW-9 | NFFW-10 | NFFW-11 |
|--|--------|--------|--------|---------|--------|--------|---------|---------|
| VOLATILE ORGANIC COMPOUNDS ($\mu\text{g/L}$) | | | | | | | | |
| Acetone | --- | --- | --- | 77 | 59 B | --- | 14 B | --- |
| Carbon Disulfide | --- | --- | 14 | 12 | --- | --- | --- | --- |
| Trichloroethene | --- | --- | --- | --- | --- | --- | --- | --- |
| Chlorobenzene | --- | --- | --- | --- | --- | 5 J | --- | --- |
| Benzene | --- | --- | 53 | 52 | --- | 29 | --- | 16 |
| Toluene | --- | --- | --- | --- | --- | --- | --- | --- |
| Ethylbenzene | --- | --- | 23 | 21 | 30 | --- | --- | 70 |
| Total Xylenes | --- | --- | 12 | 11 | 9 J | --- | --- | --- |
| Total BTEX | --- | --- | 88 | 84 | 39 | 29 | --- | 86 |
| TOTAL PETROLEUM HYDROCARBONS ($\mu\text{g/L}$) | | | | | | | | |
| TPH (Gasoline) | 1,600 | --- | 1,600 | 1,700 | 8,800 | 1,300 | 360 | 8,300 |
| TPH (JP-4) | --- | --- | --- | --- | 3,200 | --- | --- | 40,000 |
| <p>NOTE: Wells NFFW-1, NFFW-2, NFFW-6, NFFW-7, NFFW-12, NFFW-13, NFFW-14, NFFW-16, and NFFW-19 not sampled due to presence of free-product in well. Dashes (---) indicate not detected; refer to EA (1993) for complete results. D = Duplicate sample; NA = Not analyzed; J = Estimated concentration; and B = Compound detected in associated method blank.</p> | | | | | | | | |

TABLE 1 (Continued)

| Compound | NFFW-15 | NFFW-17 | NFFW-18 | NFFW-19 | NFFW-20 | NFFW-21 | Trip Blank | Trip Blank |
|--|---------|---------|---------|-----------|-----------|---------|---------------|---------------|
| VOLATILE ORGANIC COMPOUNDS ($\mu\text{g/L}$) | | | | | | | | |
| Acetone | 13 B | 15 B | 27 B | 24 B | 19 B | 13 B | 16 B | --- |
| Carbon Disulfide | --- | --- | --- | --- | 17 | --- | --- | --- |
| Trichloroethene | 3 J | --- | --- | --- | 2 J | --- | --- | --- |
| Chlorobenzene | --- | --- | --- | --- | --- | --- | --- | --- |
| Benzene | --- | 6 J | 2 J | 67 | 6 J | 1 J | --- | --- |
| Toluene | --- | --- | 1 J | 17 J | 2 J | 1 J | --- | --- |
| Ethylbenzene | --- | --- | --- | 320 | --- | --- | --- | --- |
| Total Xylenes | --- | --- | --- | 500 | 46 | --- | --- | --- |
| Total BTEX | --- | 6 | 3 | 904 | 54 | 2 | --- | --- |
| TOTAL PETROLEUM HYDROCARBONS ($\mu\text{g/L}$) | | | | | | | | |
| TPH (Gasoline) | --- | 530 | 6,800 | 6,900 | 5,900 | --- | NA | NA |
| TPH (JP-4) | --- | 8,400 | --- | 3,600,000 | 1,600,000 | --- | NA | NA |

- Ground-Water Sampling — Chemical hazards may involve dermal contact from splashing of water containing petroleum hydrocarbons including exposure to benzene.

During all phases of the work, strict adherence to the monitoring procedures in Table 2 will help protect against inhalation of organic vapors.

5.3 PHYSICAL HAZARDS

Physical hazards are listed below for each work task (Physical Hazard Information Sheets can be found in Attachment B):

- Boring Installation/Trenching: Heavy Equipment Hazards, General Physical Hazards, Trenching and Excavation Hazards, Heat Stress, Drilling, Electrical Hazards, Underground Utilities, Noise Hazards.
- System Monitoring and Maintenance: Material Handling/Moving/Lifting, General Physical Hazards, Heat Stress, Cold Stress, Electrical Hazards, Noise Hazards.
- Ground-Water Sampling: General Physical Hazards

6. EMPLOYEE TRAINING ASSIGNMENTS

Dates of employee training must be documented in Table 3. Any person who does not meet these training requirements is prohibited from engaging in site operations. Once the SHERP has been signed by the CTO Manager and the Program Manager, no other personnel may be added to the project field work without prior written approval by the CTO Manager or SSHO, who must review the proposed employee's training and medical status. The following training must be completed prior to the start of work operations:

All Site Workers:

- Prior to project start-up, 40 hours of initial offsite Hazardous Waste Operations training and 3 days onsite training under the direct supervision of a more experienced site worker.
- Eight-Hour annual Hazardous Waste Operations refresher training (if > 12 months have passed since 40-hour initial training or previous 8-hour refresher).

Site Manager: Above requirements for site workers, plus one-time 8-Hour Supervisor's Training.

TABLE 2 ENVIRONMENTAL MONITORING REQUIREMENTS

| SITE: Navy Fuel Farm Facility CTO No. 0074 | | | | |
|--|-----------------------------|---|--|--|
| Project No.: 29600.74 | | | | |
| Task | Instrument | Frequency and Location | Action Levels | Required Response |
| Soil and Ground-Water Sample Collection, Trenching, Drilling | PID with 11.7eV lamp or FID | Initially and every 15 min thereafter in the breathing zone | <p>0-1 ppm above background for 5 minutes</p> <p>1-5 ppm above background</p> <p>> 5 ppm above background</p> | <p>Evacuate to a safe upwind location and wait for levels to dissipate. Retest the area after 15 minutes. If levels have not dissipated continue work in Level C PPE.</p> <p>Continue work in Level C PPE. Monitor continuously.</p> <p>Evacuate to a safe upwind location immediately. Retest the area after 15 minutes wearing Level C PPE. If levels have not dissipated in 30 minutes, contact the EA CTO Manager and Program Safety and Health Officer.</p> |
| Trenching and Drilling Activities | CGI | Initially and 15 min at the borehole or trench opening | <p>0-5 %</p> <p>5-10%</p> <p>> 10%</p> | <p>Continue work with caution</p> <p>Continue work with continuous monitoring</p> <p>Evacuate to a safe upwind location immediately. Retest the area after 15 minutes. If levels have not dissipated in 30 minutes, contact the EA CTO Manager and Program Safety and Health Officer.</p> |

First Aid/CPR: At least one onsite worker must be currently certified in both first aid and CPR by the American Red Cross or equivalent organization. First aid training must be updated every 3 years; CPR training must be updated annually.

Pre-Entry Briefing: Site workers will read the SHERP and will indicate their understanding of the requirements by signing Attachment C, Site SHERP Review Record. The SSHO must check the training status of all onsite personnel and then brief workers on the potential hazards at the site and protective measures to be implemented, both prior to entry and daily during the work. An evacuation location to be used in the event of an emergency must be designated to all personnel. This location should be an upwind point from site activities, in an area not expected to be affected by emergency situations onsite. The SSHO must brief visitors prior to initial entry. Visitors are not permitted to enter areas where they may be exposed to hazardous substances if they do not meet the training requirements summarized above.

Non-hazardous waste site workers will be trained to meet applicable OSHA requirements specific to their work. Training records and certification letters will be managed and maintained per the Program Management Plan.

7. MEDICAL SURVEILLANCE

Hazardous waste site workers must have satisfactorily completed a comprehensive physical examination within 12 months prior to the start of site operations. Non-hazardous waste site workers will be medically examined to meet OSHA requirements specific to their job. The date of physical examination of each site worker will be recorded on Table 3. Subcontractors shall provide this information in writing to the CTO Manager for their workers onsite. Medical surveillance protocols for hazardous workers must comply with 29 CFR 1926.65. Records will be managed and maintained per the Program Management Program.

8. PERSONAL PROTECTIVE EQUIPMENT

Based on evaluation of the potential safety and health hazards (Section 5), the required initial levels of personal protective equipment (PPE) are presented in Table 4 for each work task. Upgrade and downgrade PPE levels are listed below:

Upgrade PPE Level C. Components: Steel toe/steel shank neoprene safety boots, poly-coated tyvek coveralls, latex inner gloves, nitrile or neoprene outer gloves, hard hat, full face air purifying respirator with organic vapor/HEPA cartridges.

Downgrade PPE Level: None

TABLE 3 SITE WORKER TRAINING AND PHYSICAL EXAMINATION RECORD

| SITE: Navy Fuel Farm Facility, NASJRB Willow Grove, Pennsylvania | | | | | | CTO No. 0074 |
|---|-----------------|------------|------------------------|------------------|-------------------------|-------------------|
| Project No.: 296.0074 | | | | | | |
| NOTE: No employees other than those listed below are permitted to work onsite without prior written approval by the CTO Manager or SSO. | | | | | | |
| Name | HAZWOPER | | First Aid ¹ | CPR ¹ | Supervisor ² | Last Medical Exam |
| | 40-Hour Initial | Annual | | | | |
| Scott Dobson | 06/11/90 | 03/24/97 | 03/10/97 | 03/10/97 | 01/04/91 | 03/21/97 |
| William Parnella | 10/20/88 | 03/15/96 * | 03/28/97 | 03/11/97 | 09/05/90 | 11/26/97 |
| Carl Reitenbach | 01/12/90 | 02/15/96 * | ---- | ---- | 09/05/90 | ----* |
| Brian Stempowski | 07/26/91 | 02/15/96 * | 03/19/96 | 03/11/97 | 09/04/90 | 03/13/97 |
| Jeff Smith | 04/1/93 | 02/20/97 | 03/10/97 | 03/10/97 | ---- | 11/12/96 |
| Rick Shockley | 07/15/94 | 02/20/97 | 03/10/97 | 03/10/97 | ---- | 03/21/96 * |
| <p>1. At least one person onsite must have current certification in First Aid/CPR for all tasks.</p> <p>2. At a minimum, the site manager must have had supervisor's training.</p> <p>* Will be updated prior to conducting field work.</p> | | | | | | |

TABLE 4 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

| SITE: Navy Fuel Farm Facility, NASJRB Willow Grove, Pennsylvania CTO No. 0074 | | |
|---|-----------------------------|--|
| Project No.: 296.0074 | | |
| Work Task | Initial Level of Protection | Specific PPE |
| Sampling/Drilling/ Trenching | D | Steel toe/steel shank safety boots, cotton coveralls, safety glasses, hard hat (drilling only), latex inner gloves, nitrile outer gloves*, faceshield (drilling operator only) |
| Construction Activities | D | Steel toe/steel shank safety boots, cotton coveralls, safety glasses, hard hat (when overhead hazards), leather work gloves, (nitrile outer gloves*) |
| * Work gloves may be worn during drilling or construction. Nitrile outer gloves and latex inner gloves are to be worn during pump maintenance and when contact with contaminated soil, free product, or ground water is imminent. | | |

Only the SSHO can authorize an upgrade or downgrade in the PPE level worn onsite, using only those criteria presented in Section 9. Changes in PPE levels must be documented on Attachment D, along with the rationale for the PPE changes. When respirators are required, site workers must have been successfully fit-tested within one year prior to the start of work operations. Fit-test dates for all site workers are summarized in Table 3.

EA will furnish all employees with the appropriate PPE for work under this CTO. Subcontracted personnel will be required to supply their own appropriate PPE.

The SSHO will review appropriate procedures for donning and doffing PPE prior to the start of work tasks. PPE must be inspected by site workers prior to use and regularly during use. If any site worker experiences a failure or alteration of PPE that affects the level of protection offered, that person shall immediately leave the Exclusion Zone. Re-entry shall not be permitted until the equipment has been repaired or replaced.

9. ENVIRONMENTAL MONITORING

9.1 ENVIRONMENTAL MONITORING REQUIREMENTS

Task-specific environmental monitoring requirements for site work are summarized in Table 2, including the type of monitoring to be performed, the frequency and location of monitoring, action levels, and required responses if action levels are detected. Only personnel trained in proper use and calibration may operate the monitoring instruments.

Measurements must be logged in the Environmental Monitoring Record provided as Attachment E. If no detectable levels are measured, this must be documented on Attachment E at least once every 30 minutes. Each exceedance of an action level must be documented on Attachment E, along with the corrective action/protective measure taken.

If a determination is made by the SSHO, based upon environmental monitoring and visible dust emissions, that full shift personnel or environmental monitoring is necessary, monitoring will be conducted according to NIOSH, OSHA, and EPA protocols. Visible dust in the breathing zone will require dust suppression or monitoring. If visible dust continues in the breathing zone after suppression is implemented, upgrade to Level C is required.

9.2 CALIBRATION OF MONITORING INSTRUMENTS

The calibration of each instrument must be checked at the beginning of each day of use and at least once during the day. The calibration procedures to be used for each instrument listed in Table 2 are provided in Attachment F.

10. SITE CONTROL

10.1 WORK ZONES

Work zones have been established as follows and shall be delineated on site.

Exclusion (EZ): A 25-ft radius from any soil boring, trenching, or monitoring well location.

Contamination Reduction (CRZ): Delineated by the SSHO. All decontamination procedures must take place in the CRZ. There shall be only one access point between the EZ and CRZ.

Support Zone: EA vehicle

Personnel who enter any of the work zones must sign the Site Entry and Exit Log, Attachment G.

10.2 SAFE WORK PRACTICES

Safe work practices to be followed by site workers include:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the Exclusion and Contamination Reduction Zones.
- Hands and face must be thoroughly washed upon leaving the work area.
- Prescription drugs must not be taken by personnel unless specifically approved by a licensed occupational physician who is familiar with the issues of worker exposure to hazardous materials.
- When respirators are required, facial hair that interferes with the face-to-facepiece fit of the respirator will not be permitted.
- Personnel onsite must use the buddy system; visual contact must be maintained between team members at all times.
- Work is allowed during daylight hours only.
- If dust is being visually generated in the Exclusion Zone, the SSHO will advise on procedures for misting or wetting the soil to prevent possible exposure from inhalation of soil contaminants.

- Possessing, using, purchasing, distributing, selling, or having controlled substances in your system during the work day, including meal or break periods onsite, is strictly prohibited.
- The use of possession of alcoholic beverages onsite is prohibited. Similarly, reporting to work or performing one's job assignments with excessive levels of alcohol in your system will not be permitted.

11. DECONTAMINATION PROCEDURES

11.1 PERSONNEL DECONTAMINATION

Wash outer gloves with detergent and water; rinse; and remove. Remove coveralls, then respirator, if worn. Remove and discard inner gloves. Wash hands, face, and other exposed skin with soap and water. Shower and shampoo as soon as possible at the end of the work day, before dining or social activities. Place nondisposable coveralls in plastic bags prior to leaving the site and prior to entering any EA vehicle. Launder nondisposable clothing worn in the exclusion zone prior to reuse, separately from other laundry items.

11.2 EQUIPMENT DECONTAMINATION

Wet-wipe instruments used onsite with clean water prior to leaving the site. Wet-wipe respirator exteriors whenever exiting work areas. Clean respirators with a manufacturer-recommended sanitizer, then hang to drip dry, and place in plastic bags for protection against dust. Change respirator cartridges at least daily, when breakthrough occurs, or when breathing resistance becomes high, whichever occurs first. Used cartridges shall be damaged to prevent accidental reuse.

11.3 WASTE DISPOSAL PROCEDURES

Potentially contaminated materials and equipment must be disposed of properly. Clothing, tools, buckets, brushes, and all cleaning solutions and spoils must be secured in drums or other leak-proof containers and correctly labeled.

12. EMERGENCY RESPONSE PLAN

Prior to work start-up, all personnel must be familiar with this Emergency Response Plan. The CTO Manager must make this plan available for inspection and copying. Review the location of evacuation areas and exit routes. Determine the location of the nearest operating telephone for emergency use.

EA site personnel must immediately stop work, evacuate the Exclusion Zone and report to the EA Site Manager under any of the following potential emergency situations:

- Injury to any EA or contractor personnel.
- Discovery of any unexpected chemical hazards.
- Any chemical release or spill.

12.1 PROCEDURES FOR HANDLING EMERGENCY INCIDENTS

In the event of an emergency, the information available at that time must be properly evaluated and the appropriate steps taken to implement the emergency response plan. The Site Manager (or SSHO if the Site Manager is part of the emergency) shall assume command of the situation. He/She must call the appropriate emergency services, evacuate personnel to the predesignated evacuation location as needed, and take other steps necessary to gain control over the emergency. Emergency telephone numbers, directions to the nearest hospital, and the location of the nearest telephone and other site communication equipment are presented in Table 5. Attachment H provides a site plan showing the location of the NAS Medical Clinic.

Give the following information when reporting an emergency:

1. Name and location of person reporting
2. Location of accident/incident
3. Name and affiliation of injured party
4. Description of injuries, fire, spill, or explosion
5. Status of medical aid and/or other emergency control efforts
6. Details of any chemicals involved
7. Summary of accident, including suspected cause and time it occurred
8. Temporary control measures taken to minimize further risk.

This information is not to be released under any circumstances to parties other than those listed in this section and emergency response team members. Once emergency response agencies have been notified, the EA CTO Manager and Safety and Health Manager must be notified immediately.

12.2 MEDICAL EMERGENCIES

Personnel should always be alert for signs and symptoms of illnesses related to chemical, physical, and disease factors onsite. Severe injuries resulting from accidents must be recognized as emergencies and treated as such. At one person currently trained in first aid/CPR must be present onsite at all times.

TABLE 5 EMERGENCY INFORMATION

| | |
|--|--|
| SITE: Navy Fuel Farm Facility, NAS Willow Grove, Pennsylvania Project No.: 296.0074 | CTO No. 0074 |
| ONSITE EMERGENCY CONTACTS | |
| Nearest telephone: Mobile phone in EA vehicle Other site communication equipment: None | |
| Onsite Dialing Instructions | |
| Calls Within NAS Willow Grove: | Dial 4-digit extension number. |
| Outside Calls: | Dial 9 then 7-digit number. |
| Long Distance Calls: | Dial 9, then 1 and area code, then 7-digit number. |
| Name | Phone Number |
| Police: Horsham Police Department NAS Security Police | (215) 672-2800 6067/6068 |
| Fire: NAS Fire Department | 1333 |
| Ambulance: | 1600 |
| Hospital: NAS Clinic Building 137 Hornet Road | 6360 |
| NOTE: Initial medical treatment will be provided by the NAS Clinic located near the main entrance gate (see attachment H). Should additional treatment be required, the NAS ambulance will transfer injured personnel to Abington Hospital or Warminster General Hospital. | |
| OFFSITE EMERGENCY CONTACTS | |
| NAVFAC Technical Manager: Paul Briegel | (215) 595-0590 |
| EA CTO Manager: Carl Reitenbach | (800) 876-4950 (work) (301) 695-9102 (home) |
| Program Safety and Health Officer: Kris Hoiem, CIH | (800) 876-4950 (work) (410) 357-5485 (home) |
| EA Medical Services: | (914) 294-5441 |
| Name: EMR | |
| Address: 4360 Chamblee Dunwoody Road, Ste. 202 Atlanta, Georgia 30341 | (800) 229-3674 |
| EA Corporate Medical Director: Dr. Elayne F. Theriault, M.D. | (800) 229-3674 |
| In case of spill, contact Steve Tyahla, CHMM/EA | (800) 876-4950 |
| In case of accident or exposure, contact the EA Human Resources representative within 24 hours: | (410) 584-7000 |
| Site Manager: Brian Stempowski | (410) 771-4950 |
| SSHO: Scott Dobson | (410) 771-4950 |

In a medical emergency, the Site Manager (or the SSHO if the Site Manager is not available) must announce the emergency, upon which work must stop and personnel must move to the decontamination area. Personnel currently trained in first aid will evaluate the nature of the injury, decontaminate the victim if the victim can be moved safely, and initiate first aid assistance immediately. First aid shall be administered as appropriate. The local Emergency Medical Services must be notified immediately if needed. Victims who are heavily contaminated with toxic or dangerous materials must be decontaminated before being transported from the site. No persons shall re-enter the Exclusion Zone until the cause of the injury or symptoms has been determined. A fellow EA worker must accompany injured workers to the hospital to inform the admitting clerk that the injury is work related and to assist in completing the insurance forms.

The Site Manager must complete an EA Accident Investigation Report (Attachment I) and submit it to the EA CTO Manager and Safety and Health Manager within 24 hours of the following types of incidents:

- Job-related injuries and illnesses.
- Accidents resulting in significant property damage.
- Accidents involving vehicles and/or vessels.
- Accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property.
- An accident which results in a fatality or the hospitalization of 3 or more employees must be reported within 8 hours to the U.S. Department of Labor via the EA Human Resources representative. Subcontractors are responsible for notification involving their employees.

First aid/emergency equipment is available at the following locations:

First Aid Kit: EA vehicle
Eye Wash: Contamination Reduction Zone
Shower: NA
Fire Extinguisher (list type): Type ABC; EA vehicle

The eye wash kit must be portable and capable of supplying at least a 15-minute supply of potable water to the eyes.

12.3 FIRE/EXPLOSION EMERGENCIES

Any fire or explosion must be immediately recognized as an emergency. The Site Manager (or SSHO if the Site Manager is not available) must sound the emergency signal and personnel must be evacuated to the predesignated evacuation location and the local emergency services notified. Decontamination will take place once all personnel have been safely evacuated to the pre-designated evacuation location. Only persons properly trained in fire suppression, spill control, and other emergency response procedures should attempt to deal with these situations. Other than small fires or spills, local emergency response services must be notified to handle the emergency. The Site Manager should take measures to reduce injury and illness, primarily by evacuating personnel as quickly as possible. He/she must then notify the CTO Manager. Cleanup after such events may require specialized services. Work shall not resume until the SSHS declares the incident closed.

13. CONFINED SPACE ENTRY PROCEDURES

No confined space entry is permitted or anticipated under this CTO.

14. SPILL CONTAINMENT PROCEDURES

Small incidental spills, i.e., those that cause no injury to personnel or the public, should be cleaned up quickly. For large spills, i.e., those that contaminate personnel or the environment, attend to first aid measures first, stop the source of the spill if possible, then notify the Program Manager and the Navy. The Site Manager (or the SSHO in his/her absence) will notify the CTO Manager as soon as possible. Spills of hazardous materials or wastes that are listed by EPA as having a reportable quantity value must be reported to appropriate federal, state, and local agencies if a reportable quantity or greater is released. It is the Navy's responsibility to contact other appropriate federal, state, and local agencies.

Attachment A

Material Safety Data Sheets

MATERIAL SAFETY DATA SHEET
EXXON COMPANY, U.S.A. P.O. BOX 2150

A. IDENTIFICATION AND EMERGENCY INFORMATION

PRODUCT NAME
EXXON DIESEL 1

CHEMICAL NAME
Kerosene

PRODUCT APPEARANCE AND COLOR
Clear water-white liquid
Mild kerosene odor

EMERGENCY TELEPHONE NUMBER
(713) 656-3424

PRODUCT CODE
071000 - 00700

CAS NUMBER
3008-20-6

B. COMPONENTS AND HAZARD INFORMATION

| COMPONENTS | CAS NO. OF COMPONENTS | APPROXIMATE CONCENTRATION |
|--------------------------|-----------------------|---------------------------|
| Kerosene, ASTM Grade 2-K | 3008-20-6 | 100% |

This product is not suitable for use in flueless space heaters. Exxon USA does not recommend any of its fuels or solvents for use in any type of flueless space heater application. Test results published to date are insufficient to overcome concerns regarding the health effects of normal combustion products from flueless units.

See Section E for Health and Hazard Information.

See Section H for additional Environmental Information.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS)
Health 1 Flammability 2 Reactivity 0
Recommended by Exxon

EXPOSURE LIMIT FOR TOTAL PRODUCT BASIS
100 ppm (735 mg/m³) for an 8-hour workday
Recommended by Exxon

C. PRIMARY ROUTES OF ENTRY AND EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT
If splashed into the eyes, flush with clear water for 15 minutes or until irritation subsides. If irritation persists, call a physician.

SKIN
In case of skin contact, remove any contaminated clothing and wash skin thoroughly with soap and water.

INHALATION
If overcome by vapor, remove from exposure and call a physician immediately. If breathing is irregular or has stopped, start resuscitation, administer oxygen, if available.

E HEALTH AND HAZARD INFORMATION

VARIABILITY AMONG INDIVIDUALS

Health studies have shown that many petroleum hydrocarbons and synthetic detergents have potential human health risks which may vary from person to person. As a precaution, exposure to liquids, vapors, mists or fumes should be minimized.

EFFECTS OF OVEREXPOSURE (Signs and symptoms of exposure)

Prolonged or repeated liquid contact with the skin will dry and chafe the skin, leading to possible irritation and dermatitis.

High vapor concentrations (greater than approximately 1000 ppm) are irritating to the eyes and the respiratory tract, may cause headaches and dizziness, are anesthetic, may cause unconsciousness, and may have other central nervous system effects including death.

NATURE OF HAZARD AND TOXICITY INFORMATION

Prolonged or repeated skin contact with this product tends to remove skin oils possibly leading to irritation and dermatitis; however, based on human experience and available toxicological data, this product is judged to be neither a "corrosive" nor an "irritant" by OSHA criteria.

Product contacting the eyes may cause eye irritation.

Lifetime skin painting studies conducted by the American Petroleum Institute, Exxon and others have shown that similar products boiling between 175-370°C (350-700°F) usually produce skin tumors and/or skin cancer in laboratory mice. The degree of carcinogenic response was weak to moderate with a relatively long latent period. The implications of these results for humans have not been determined.

Limited studies on oils that are very active carcinogens have shown that washing the animal's skin with soap and water between applications greatly reduces tumor formation. These studies demonstrate the effectiveness of cleansing the skin after contact.

Potential risks to humans can be minimized by observing good work practices and personal hygiene procedures generally recommended for petroleum products. See Section I for recommended protection and precautions.

Laboratory animal studies have shown that prolonged and repeated inhalation exposure to light hydrocarbon vapors in the same naphtha boiling range as this product can produce adverse kidney effects in male rats. However, these effects were not observed in similar studies with female rats and male and female mice and in limited studies with other animal species. Additionally, in a number of human studies, there was no clinical evidence of such effects at normal occupational levels. It is therefore highly unlikely that the kidney effects observed in male rats have significant implications for humans exposed at or below the recommended vapor limits in the workplace.

Product has a low order of acute oral and dermal toxicity, but minute amounts aspirated into the lungs during ingestion or vomiting may cause mild to severe pulmonary injury and possibly death.

This product is judged to have an acute oral LD50 (rat) greater than 5 g/kg of body weight, and an acute dermal LD50 (rabbit) greater than 3.16 g/kg of body weight.

PRE-EXISTING MEDICAL CONDITIONS WHICH MAY BE AGGRAVATED BY EXPOSURE

Petroleum Solvents/Petroleum hydrocarbons - Skin contact may aggravate an existing dermatitis.

F. PHYSICAL DATA

The following data are approximate or typical values and should not be used for precise design purposes.

BOILING RANGE
160-290°C (320-550°F)

VAPOR PRESSURE
Less than 5 mm Hg @ 20°C

EXXON DIESEL 1

Director of Industrial Hygiene
Exxon Company, USA
P.O. Box 2130 Room 3157
Houston, Tx 77252-2180

Manager, Marketing Technical Services
Exxon Company, USA
P.O. Box 2180 Room 3333
Houston, Tx 77252-2180



Material Safety Data Sheet

CHEVRON Unleaded Gasoline

CPS201110

Page 1 of 10

TOWNSEND-STRONG INC
P O BOX 2802
LUBBOCK, TX 79406
Print Date: May 06, 1990

MATERIAL ORDERED FOR:
• FOB LUBBOCK
1320 E BROADWAY
LUBBOCK, TX 79408

This Material Safety Data Sheet contains environmental, health and toxicology information for your employees. Please make sure this information is given to them. It also contains information to help you meet community right-to-know/emergency response reporting requirements under SARA Title III and many other laws. If you resell this product, this MSDS must be given to the buyer or the information incorporated in your MSDS. Discard any previous edition of this MSDS.

Revised to update Sections 1, 10, 11 and 12.

1. PRODUCT IDENTIFICATION

CHEVRON Unleaded Gasoline

- DANGER!
- HARMFUL OR FATAL IF SWALLOWED - CAN ENTER LUNGS AND CAUSE DAMAGE
 - VAPOR HARMFUL
 - LONG-TERM EXPOSURE TO VAPOR HAS CAUSED CANCER IN LABORATORY ANIMALS
 - MAY CAUSE EYE AND SKIN IRRITATION
 - EXTREMELY FLAMMABLE
 - KEEP OUT OF REACH OF CHILDREN

PRODUCT NUMBER(S): CPS201110
PRODUCT INFORMATION: (800)582-3835

Revision Number: 12 Revision Date: 03/24/90 MSDS Number: 000372
NDA - No Data Available NA - Not Applicable

Prepared According to the OSHA Hazard Communication Standard (29 CFR 1910.1200) by the Chevron Environmental Health Center, Inc., P.O. Box 4054, Richmond, CA 94804.

2. FIRST AID - EMERGENCY PHONE NUMBER (800) 457-2022

EYE CONTACT:

Flush eyes immediately with fresh water for at least 15 minutes while holding the eyelids open. Remove contact lenses if worn. No additional first aid should be necessary, however, if irritation persists, see a doctor.

SKIN CONTACT:

Remove contaminated clothing. Wash skin thoroughly with soap and water. See a doctor if any signs or symptoms described in this document occur. Discard contaminated non-waterproof shoes and boots. Wash contaminated clothing.

INHALATION:

If respiratory irritation or any signs or symptoms as described in this document occur, move the person to fresh air. If any of these effects continue, see a doctor.

INGESTION:

If swallowed, give water or milk to drink and telephone for medical advice. DO NOT make person vomit unless directed to do so by medical personnel. If medical advice cannot be obtained, then take the person and product container to the nearest medical emergency treatment center or hospital. Note to Physician: Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid which can cause pneumonitis.

3. IMMEDIATE HEALTH EFFECTS - (ALSO SEE SECTIONS 11 & 12)

EYE CONTACT:

This substance is slightly irritating to the eyes and could cause prolonged (days) impairment of your vision. The degree of the injury will depend on the amount of material that gets into the eye and the speed and thoroughness of the first aid treatment. Signs and symptoms may include pain, tears, swelling, redness, and blurred vision. Eye contact with the vapors, fumes, or spray mist from this substance could also cause similar signs and symptoms.

SKIN IRRITATION:

Prolonged or frequently repeated contact may cause the skin to become cracked or dry from the defatting action of this material.

DERMAL TOXICITY:

If absorbed through the skin, this substance is considered practically non-toxic to internal organs.

RESPIRATORY/INHALATION:

This substance is slightly toxic to internal organs if inhaled. The degree of injury will depend on the airborne concentration and duration of exposure. The target organ(s) is the nervous system. Inhalation of gasoline vapor at airborne concentrations exceeding 1000 ppm may cause signs and symptoms of central nervous system effects such as headache, dizziness, loss of appetite, weakness and loss of coordination. Vapor concentrations in excess of 5000 ppm may cause loss of consciousness, coma

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MSDS Number: 000372

NDA - No Data Available

NA - Not Applicable

and death. Brief exposures to high vapor concentrations may also cause pulmonary edema and bronchitis. Intentional exposures to excessively high concentrations (e.g., when used as a drug of abuse) have been reported to result in clinical manifestations that may include convulsions, delirium, and hallucinations. These manifestations are not known to occur following accidental inhalation of gasoline vapor during normal operations.

INGESTION:

This substance is slightly toxic to internal organs if swallowed. The degree of injury will depend on the amount absorbed from the gut. The target organ(s) is the nervous system. Signs and symptoms of central nervous system effects may include one or more of the following: headache, dizziness, loss of appetite, weakness and loss of coordination. Because of the low viscosity of this substance, it can directly enter the lungs if it is swallowed (this is called aspiration). This can occur during the act of swallowing or when vomiting the substance. Once in the lungs, the substance is very difficult to remove and can cause severe injury to the lungs and death.

4. PROTECTIVE EQUIPMENT

EYE PROTECTION:

Do not get this material in your eyes. Eye contact can be avoided by wearing chemical goggles.

SKIN PROTECTION:

No special skin protection is usually necessary. Avoid prolonged or frequently repeated skin contact with this material. Skin contact can be minimized by wearing protective clothing.

RESPIRATORY PROTECTION:

No special respiratory protection is normally required. However, if operating conditions create airborne concentrations which exceed the recommended exposure standards, the use of an approved respirator is required. Refer to the OSHA Benzene Standard to determine what type of respirator is required based on exposure levels.

VENTILATION:

Use this material only in well ventilated areas.

5. FIRE PROTECTION

FLASH POINT: (P-M) < -49F (-45C)

AUTOIGNITION: NDA

FLAMMABILITY: 1.4 - 7.6%

EXTINGUISHING MEDIA:

CO₂, Dry Chemical, Foam and Water Fog.

NFPA RATINGS: Health 1; Flammability 3; Reactivity 0; Special NDA;

HMIS RATINGS: Health 2; Flammability 3; Reactivity 0; Other NDA;

(Least-0, Slight-1, Moderate-2, High-3, Extreme-4). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association or, if applicable, the National Paint and Coating Association, and do not necessarily reflect the hazard evaluation of the Chevron Environmental Health Center. Read the entire

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NA - Not Applicable

document and label before using this product.

FIRE FIGHTING PROCEDURES:

This product presents an extreme fire hazard. Liquid very quickly evaporates, even at low temperatures, and forms vapor (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches.

For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment. This may include self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Read the entire document.

COMBUSTION PRODUCTS:

Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

6. STORAGE, HANDLING, AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS:

NDA.

STABILITY:

Stable.

HAZARDOUS POLYMERIZATION:

Polymerization will not occur.

INCOMPATIBILITY:

May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.

SPECIAL PRECAUTIONS:

Never siphon gasoline by mouth. READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL. Use only as a motor fuel. Do not use for cleaning, pressure appliance fuel, or any other such use. DO NOT USE OR STORE near flame, sparks or hot surfaces. USE ONLY IN WELL VENTILATED AREA. Keep container closed. DO NOT TRANSFER LIQUID TO AN UNLABELED CONTAINER. DO NOT weld, heat or drill container. Replace cap or bung. Emptied container still contains hazardous or explosive vapor or liquid.

7. PHYSICAL PROPERTIES

SOLUBILITY: Soluble in hydrocarbons; insoluble in water.

APPEARANCE: Orange to bronze liquid.

BOILING POINT: 25 - 225C (Variable)

MELTING POINT: NA

EVAPORATION: NDA

SPECIFIC GRAVITY: 0.7 - 0.8

VAPOR PRESSURE: 5 - 15PSI (max.) @ 100F (Variable)

PERCENT VOLATILE (VOLUME %): 99+%

VAPOR DENSITY (AIR=1): 3-4

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NDA - No Data Available

NA - Not Applicable

8. ENVIRONMENTAL CONCERNS, SPILL RESPONSE AND DISPOSAL

CHEMTREC EMERGENCY PHONE NUMBER: (800) 424-9300 (24 hour).

SPILL/LEAK PRECAUTIONS:

Certain geographical areas have air pollution restrictions concerning the use of materials in work situations which may release volatile components to the atmosphere. Air pollution regulations should be studied to determine if this material is regulated in the area where it is to be used.

This material is considered to be a water pollutant and releases of this product should be prevented from contaminating soil and water and from entering drainage and sewer systems. Eliminate all sources of ignition in vicinity of spill or released vapor. Clean up small spills using appropriate techniques such as sorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Follow prescribed procedures for reporting and responding to larger releases.

DISPOSAL METHODS:

Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations. Contact local environmental or health authorities for approved disposal of this material.

9. EXPOSURE STANDARDS, REGULATORY LIMITS AND COMPOSITION

COMPOSITION COMMENT:

All the components of this material are on the Toxic Substances Control Act Chemical Substances Inventory.

The percent compositions are given to allow for the various ranges of the components present in the whole product and may not equal 100%.

PERCENT/CAS# COMPONENT/REGULATORY LIMITS

100.0 % CHEVRON Unleaded Gasoline

CONTAINING

< 1.4 % ETHYLBENZENE
CAS100414 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
125ppm ACGIH STEL
100ppm OSHA PEL
125ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS

< 0.9 % XYLENE-P

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MSDS Number: 000372

NDA - No Data Available

NA - Not Applicable

- CAS106423 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
CERCLA 302.4 RQ=1000 POUNDS
- < 4.6 %
CAS108383 XYLENE-M
A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
150ppm ACGIH STEL
100ppm OSHA PEL
150ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS
- < 6.5 %
CAS108883 TOLUENE
A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
150ppm ACGIH STEL
100ppm OSHA PEL
150ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS
- < 3.0 %
CAS110543 HEXANE
50ppm ACGIH TLV
50ppm OSHA PEL
- < 2.4 %
CAS110827 CYCLOHEXANE
A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
300ppm ACGIH TLV
300ppm OSHA PEL
CERCLA 302.4 RQ=1000 POUNDS
- < 15.0 %
CAS1634044 METHYL TERT BUTYL ETHER
A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
- < 4.9 %
CAS71432 BENZENE
A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
10ppm ACGIH TLV
1ppm OSHA PEL
5ppm OSHA STEL
CERCLA 302.4 RQ=10 POUNDS

Refer to the OSHA Benzene Standard (29 CFR 1910.1028) for detailed training, exposure monitoring, respiratory protection and medical surveillance requirements before using this product.

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NDA - No Data Available NA - Not Applicable

< 2.2 % XYLENE-O
 CAS95476 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
 100ppm ACGIH TLV
 150ppm ACGIH STEL
 100ppm OSHA PEL
 150ppm OSHA STEL
 CERCLA 302.4 RQ=1000 POUNDS

100.0 % GASOLINE (GENERIC)
 300ppm ACGIH TLV
 500ppm ACGIH STEL
 300ppm OSHA PEL
 500ppm OSHA STEL

TLV - Threshold Limit Value
 STEL - Short-term Exposure Limit
 RQ - Reportable Quantity
 CC - Chevron Chemical Company
 PEL - Permissible Exposure Limit
 TPQ - Threshold Planning Quantity
 CPS - CUSA Product Code
 CAS - Chemical Abstract Service Number

10. REGULATORY INFORMATION

DOT SHIPPING NAME: GASOLINE
 DOT HAZARD CLASS: FLAMMABLE LIQUID
 DOT IDENTIFICATION NUMBER: UN1203

SARA 311 CATEGORIES:

1. Immediate (Acute) Health Effects; YES
2. Delayed (Chronic) Health Effects; YES
3. Fire Hazard; YES
4. Sudden Release of Pressure Hazard; NO
5. Reactivity Hazard; NO

WHEN A COMPONENT OF THIS MATERIAL IS SHOWN IN THIS SECTION, THE REGULATORY LIST ON WHICH IT APPEARS IS INDICATED.

| | |
|--------------------------------|--------------------------------------|
| ETHYLBENZENE | 01,02,10,11,14,15,17,18,26,28, |
| P-XYLENE(1,4-DIMETHYL BENZENE) | 01,02,10,11,26,28, |
| M-XYLENE | 01,02,10,11,14,15,17,18,26,28, |
| TOLUENE | 01,02,10,11,14,15,17,18,26,28, |
| HEXANE | 02,10,11,14,17,28, |
| CYCLOHEXANE | 01,02,10,11,14,17,26,28, |
| METHYL TERT BUTYL ETHER | 01,10,11,24,26, |
| BENZENE | 01,02,03,04,06,10,11,14,17,18,20,28, |
| O-XYLENE(1,2-DIMETHYL BENZENE) | 01,02,10,11,14,15,17,18,26,28, |
| GASOLINE (GENERIC) | 04,08,14,15,17,18,20, |

REGULATORY LISTS:

| | | |
|----------------|-------------|-------------------|
| 01=SARA 313 | 02=MASS RTK | 03=NTP Carcinogen |
| 04=CA Prop. 65 | 05=MI 406 | 06=IARC Group 1 |

Revision Number: 12 Revision Date: 03/24/90 MSDS Number: 000372
 NDA - No Data Available NA - Not Applicable

| | | |
|-------------------------|------------------------|------------------------|
| 07=IARC Group 2A | 08=IARC Group 2B | 09=SARA 302/304 |
| 10=PA RTK | 11=NJ RTK | 12=CERCLA 302.4 |
| 13=MN RTK | 14=ACGIH TLV | 15=ACGIH STEL |
| 16=ACGIH Calculated TLV | 17=OSHA PEL | 18=OSHA STEL |
| 19=Chevron TLV | 20=EPA Carcinogen | 21=TSCA SECT 4 |
| 22=TSCA SECT 5 SNUR | 23=TSCA SECT 6 RULE | 24=TSCA SECT 12 EXPORT |
| 25=TSCA SECT 8A CAIR | 26=TSCA SECT 8D REPORT | 27=TSCA SECT 8E |
| 28=Canadian WHMIS | | |

11. PRODUCT TOXICOLOGY DATA

EYE IRRITATION:

The Draize Eye Irritation Score (range, 0-110) in rabbits is 0.

SKIN IRRITATION:

The Draize Skin Primary Irritation Score (range, 0-8) for a 4-hour exposure (rabbits) is 0.98. This material was not a skin sensitizer in the modified Buehler Guinea Pig Sensitization Test.

DERMAL TOXICITY:

The dermal LD50 in rabbits is > 5 ml/kg.

RESPIRATORY/INHALATION:

NDA.

INGESTION:

The oral LD50 in rats is > 5 ml/kg.

ADDITIONAL TOXICOLOGY DATA:

Lifetime inhalation of whole gasoline vapor has caused increased liver tumors in female mice. The mechanism of this response is still being investigated but it is thought to be an epigenetic process unique to the female mouse. Inhalation exposure to whole gasoline vapor also caused kidney damage and eventually kidney cancer in male rats.

No other animal model studied has shown these adverse kidney effects and there is no physiological reason to believe that they would occur in man. The cause of the kidney toxicity is thought to be due to the interaction of isoparaffin hydrocarbons in the product with a specific serum protein, alpha-2-microglobulin. Male rats synthesize large amounts of this protein which is filtered, reabsorbed, and degraded by their kidneys. Isoparaffins or their metabolites combine with this protein and make it "undigestable" by the kidney proteases. With repeated exposure, the protein-isoparaffin complex accumulates in the kidney tubules causing significant cell death and regrowth. It is thought that this continuous kidney injury may contribute to the eventual development of the tumors.

The data above is obtained from studies sponsored by the American Petroleum Institute (API).

12. ADDITIONAL HEALTH DATA

ADDITIONAL HEALTH DATA COMMENT:

This product contains benzene. The OSHA Benzene Standard (29 CFR 1910.1028) contains detailed requirements for training, exposure

Revision Number: 12

Revision Date: 03/24/90

MSDS Number: 000372

NDA - No Data Available

NA - Not Applicable

monitoring, respiratory protection and medical surveillance triggered by the exposure level. Refer to the OSHA Standard before using this product. Repeated or prolonged breathing of benzene vapors has been associated with the development of chromosomal damage in experimental animals and various blood diseases in humans ranging from aplastic anemia to leukemia (a form of cancer). All of these diseases can be fatal. No birth defects have been shown to occur in pregnant laboratory animals exposed to doses not toxic to the mother. However, some evidence of fetal toxicity such as delayed physical development has been seen at such levels. The available information on the effects of benzene on human pregnancies is inadequate but it has been established that benzene can cross the human placenta.

This product contains n-hexane. Prolonged or repeated skin contact or breathing of vapors may cause nerve damage characterized by progressive weakness and numbness in the arms and legs. Recovery ranges from no recovery to complete recovery depending upon the severity of the nerve damage.

This product contains toluene. Toluene has been reported to decrease immunological responses in test animals. It has also been reported that when young rats were exposed to 1000 ppm toluene for 14 hours daily, for two weeks, irreversible hearing loss was detected. The same daily exposure to 700 ppm for as long as 16 weeks was without effect. Since the level necessary to produce hearing loss is greater than 7 times the 1987-88 ACGIH TLV for toluene, worker exposures at or below 100 ppm is not expected to cause any adverse effect. There are also reports that chronic abusers (glue sniffers, solvent huffers) of solvents containing toluene have suffered liver, kidney and brain damage. Scientific studies on toluene have failed to demonstrate birth defects in rats and mice. However, toluene has been shown to cause delayed growth and extra ribs in the offspring of rats and mice at inhaled doses (266-399 ppm) that were non-toxic to the mother. Toluene has not conclusively been shown to cause adverse reproductive effects in humans.

This product contains xylene, a chemical that has been reported to cause developmental toxicity in rats and mice exposed by inhalation during pregnancy. The effects noted consisted of delayed development and minor skeletal variations; additionally, when pregnant mice were exposed by ingestion to a level that killed nearly one-third of the test group, lethality (resorptions) and malformations (primarily cleft palate) occurred. Malformations have not been reported following inhalation exposure. Because of the very high levels of exposure used in these studies, we do not believe that their results imply an increased risk of reproductive toxicity to workers exposed to xylene levels at or below the exposure standard.

Xylene has given negative results in several mutagen testing assays including the Ames assay. In a cancer study sponsored by the National Toxicology Program (NTP), technical grade xylene gave no evidence of carcinogenicity in rats or mice dosed daily for two years.

Whole gasoline exhaust was reviewed by the International Agency for Research on Cancer (IARC) in their Monograph Volume 46 (1989). Evidence for causing cancer was considered inadequate in animals and inadequate in

humans. IARC placed this material in Category 2B, considering it possibly carcinogenic to humans.

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modification of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

Scott Specialty Gases

ROUTE 611 NORTH, PLUMSTEADVILLE, PA 18949 (215) 766-8861

115117

Electronics Group

2330 HAMILTON BOULEVARD, P.O. BOX 648, SOUTH PLAINFIELD, N.J. 07080 (201) 754-7700

REGIONAL PHONE NUMBERS

| | | | |
|-------------------|-------------------|-------------------|-------------------|
| PA (215) 766-8861 | CA (714) 887-2571 | MI (313) 589-2950 | TX (713) 644-4820 |
| NJ (201) 754-7700 | CA (415) 659-0162 | CO (303) 442-4700 | MA (617) 245-8707 |

MATERIAL SAFETY DATA SHEET

SECTION I - MATERIAL IDENTIFICATION

CHEMICAL NAME: Isobutylene SUPPLIER: Scott Specialty Gases
 CHEMICAL FORMULA: $(CH_3)_2CCH_2$ ADDRESS: Route 611 Plumsteadville, PA 18949
 CHEMICAL FAMILY: Hydrocarbon gas In Case of Emergency, Contact your Regional Plant Manager
 DATE PREPARED: 9/14/89 OTHER DESIGNATIONS: Isobutene or 2-methylpropene, CAS# 115-11-7

SECTION II - HAZARDOUS INGREDIENTS

| COMPONENT | CONCENTRATION | EXPOSURE LIMITS (PPM) | | |
|-------------|---------------|-----------------------|------------------|-------|
| | | ACGIH TLV | OSHA PEL | OTHER |
| Isobutylene | 100% | | None Established | |

SECTION III - PHYSICAL DATA

BOILING POINT (°F): 19.6 SPECIFIC GRAVITY ($H_2O = 1$) @ 25°C Sat. Press.: 0.588
 VAPOR PRESSURE @ 21.1°C (atm): 2.65 PERCENT, VOLATILE BY VOLUME (%): 100
 VAPOR DENSITY (AIR = 1) @ 25°C EVAPORATION RATE (_____ = 1): N/A
 1 atm: 1.947
 SOLUBILITY IN WATER: Slight APPEARANCE AND ODOR: Colorless, ethereal odor

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

| FLASH POINT AND METHOD | FLAMMABLE LIMITS | LEL | UEL |
|------------------------|------------------|------|------|
| -105°F | Vol. % | 1.8% | 9.6% |

EXTINGUISHING MEDIA: Do not extinguish burning gas if flow cannot be shut off. Use water spray to keep fire exposed cylinders cool. Move cylinder away from fire if there is no risk.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and full protective clothing. Flammable high pressure liquid or gas.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Dangerous. Vapor may travel considerable distance to source of ignition and flash back. May form explosive mixtures with air. Can react vigorously with oxidizing materials.

DISCLAIMER: The information in this Material Safety Data Sheet is offered without charge for use by technically qualified personnel at their discretion and risk. Scott Specialty Gases has made this sheet available with data we believe is reliable, but the accuracy and completeness of the data is not guaranteed and no warranty is either expressed or implied. Since Scott Specialty Gases has no control over the use of the product described herein, we assume no liability for loss or damage incurred from the proper or improper use of such product. This form is essentially similar to U.S. Department of Labor form OSHA-20.

SECTION V - REACTIVITY DATA

STABILITY: Stable under normal storage conditions

INCOMPATIBILITY (MATERIALS TO AVOID): Oxidizing materials

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon monoxide, carbon dioxide

HAZARDOUS POLYMERIZATION: Will not occur

SECTION VI - HEALTH HAZARD DATA

ROUTES OF ENTRY: Inhalation

EFFECTS OF OVER EXPOSURE (ACUTE): Asphyxiant. Symptoms include rapid respiration, muscular incoordination, fatigue, nausea, and vomiting. Loss of consciousness and death may occur. Contact with liquid may result in symptoms of frostbite. (CHRONIC): None (MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE): None

CARCINOGENICITY - NTP? NO IARC MONOGRAPHS? NO OSHA REGULATED? NO

EMERGENCY AND FIRST AID: Inhalation - Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen. Skin/Eye contact - Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing. If frostbite occurs, warm affected area with water or towel.

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN: Evacuate and ventilate area. Remove leaking cylinder to exhaust hood or safe outdoors area if this can be done safely.

WASTE DISPOSAL METHOD: Return cylinders to supplier for proper disposal with any valve outlet plugs or caps secured and valve protection cap in place. Do not reuse cylinder. Empty cylinder will contain hazardous residue.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (SPECIFY TYPE): Use a self-contained breathing apparatus in case of emergency or non-routine use.

VENTILATION: Provide adequate and local exhaust ventilation to maintain concentration below exposure limits.

OTHER PROTECTIVE EQUIPMENT: Protective gloves are recommended, safety goggles, safety shoes when handling cylinders.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in well ventilated above-ground area away from heat and ignition sources and oxidizing materials. Keep valve protection cap on cylinders when not in use and secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Move cylinder with adequate hand truck. Cylinders should be refilled by qualified producers of compressed gases. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

II(07)IV-V(01)VI(01,04)VII-IX(01)

Attachment B

**Physical Hazard
Information Sheets**

PHYSICAL HAZARD INFORMATION SHEET: COLD STRESS

Cold stress hazards are most likely to occur at low temperatures or low wind chill factors, with wet, windy conditions also contributing to risks. All personnel should be familiar with cold stress symptoms, which include:

- **Hypothermia**—Cold-induced decreasing of the core body temperature that produces shivering, numbness, drowsiness, and muscular weakness. If severe enough, it can lead to unconsciousness and death.
- **Frostbite**—Constriction of blood vessels in the extremities, decreasing the supply of warming blood. May result in formation of ice crystals in the tissues, causing tissue damage. Condition may range from frostnip which is a numbing of extremities, to deep-freezing tissue beneath the skin. Symptoms include white or grayish skin, blisters, numbness, mental confusion, failing eyesight, fainting, shock, and cessation of breathing. Death may occur from heart failure.

Pain in the extremities may be the first warning of cold stress, and precautions (see below) should be taken to reduce exposure. Maximum severe shivering must be taken as a sign of immediate danger to the worker, and exposure to cold must be immediately terminated. Personnel exhibiting signs and symptoms of cold stress must be removed from the site, decontaminated, and given appropriate first aid. Emergency medical services must be contacted if symptoms are severe (e.g., more than numbness of the extremities or shivering). When air temperatures are less than 36 F (including wind chill), workers who become immersed in water or whose clothing becomes wet must be immediately provided a change of clothing and be treated for hypothermia.

To prevent cold stress when air temperature is less than 40 F (including wind chill), personnel should wear layers of loose-fitting clothing including insulated coveralls, head covering, and boots. Protection of the hands, feet, and head is particularly important because these are likely to be injured first by cold. However, actual injury to hands, feet, and head is not likely to occur without prior development of early signs of hypothermia such as numbing and shivering. Bare skin contact with cold surfaces (below 20 F) must be avoided. Personnel should wear wind-resistant outer shell to decrease wind chill effects. No continuous exposure to cold is permitted when the air speed and temperature results in an equivalent chill temperature of 26 F or less.

A temperature-dependent work regimen limiting lengthy periods of outdoor activity may be necessary. Workers entering heated shelters should remove the outer layer of clothing and loosen remaining clothing to permit sweat evaporation. Dehydration must be avoided by drinking warm drinks or soups.

PHYSICAL HAZARD INFORMATION SHEET: GENERAL PHYSICAL HAZARDS

Hazardous waste and other field operation sites include many basic safety hazards, such as:

- Holes, ditches, etc., posing fall, cave-in, and other hazards
- Precariously positioned objects, which may cause crushing or other injuries
- Sharp objects (e.g., nails, metal shards, glass) which may cause cuts, injection, or other injuries
- Slippery surfaces, posing slip and fall hazards
- Steep grades and/or uneven terrain, posing slip, trip, and fall hazards
- Unstable surfaces (e.g., walls that may cave in, unstable underground structures) which may pose fall, crushing, or other injuries.

Basic safety hazards can directly injure workers and create additional hazards. For example, a person may trip due to uneven terrain, fall and be cut on rusty metal shards, and become inoculated with contaminants adhering to the metal.

Site personnel should look constantly, closely, and carefully for these basic safety hazards and immediately inform the SHSO of any conditions that they feel may be hazardous.

PHYSICAL HAZARD INFORMATION SHEET: HEAVY EQUIPMENT HAZARDS

The use of heavy equipment (e.g., backhoes, dump trucks, generators, compressors, etc.) may pose a variety of safety and health hazards to site workers.

All heavy equipment work must be conducted only by trained, experienced personnel. Equipment backing up, swinging loads, buckets, booms, and counter-weights pose serious hazards to ground personnel. If possible, EA personnel must remain outside the turning radius of any large, moving equipment. At a minimum, EA personnel must maintain visual contact with the equipment operator when the equipment is active.

No EA personnel are permitted to work underneath heavy equipment, because this practice poses serious crushing hazards.

Belts, pulleys, sheaves, gears, chains, shafts, clutches, drums, flywheels, and other moving parts of equipment can pose injury hazards. No guard, safety appliance, or other device may be removed or made ineffective unless repairs or maintenance are required, and then only after power has been shut off and locked out. Safety devices must be replaced once repair/maintenance is complete.

Exhaust from all equipment powered by steam or combustion engines must be properly located so that release of exhaust does not endanger workers or obstruct the view of the operator. Gasoline-operated equipment must be refueled properly to prevent fire hazards; power must be off, no smoking allowed, and proper dispensing equipment must be used.

When not operational, equipment shall be set and locked so that it cannot be activated, released, dropped, etc. Backhoe buckets must be lowered to the ground.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET: ELECTRICAL HAZARDS

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. In accordance with OSHA's standard for Electrical Safety-Related Work Practices (29 CFR 1910.331-.335), protective measures must be taken when working near live electrical parts, including but not limited to:

- Insulation and guarding of live parts
- Grounding
- De-energizing live parts followed by lockout/tagout to prevent inadvertent reactivation of the parts
- Electric protective devices (e.g., insulated tools)
- Safe work practices, including:
 - Inspection of work area to identify potential spark sources
 - Maintenance of a safe distance from all live electrical parts
 - Proper illumination of work areas
 - No "blind reaching" around live electrical equipment
 - Provision of barriers, shields, or insulation to prevent inadvertent contact with live parts
 - Use of non-conductive, intrinsically safe equipment near live parts.

Overhead lines pose electrical hazards at many sites, particularly for work involving the use of equipment with elevated parts (e.g., drill rigs, backhoes). If overhead lines cannot be de-energized prior to the start of work, the following minimum distances must be maintained between the lines and both site workers and the longest conductive object present (including vehicles with elevated structural parts:

- 10 ft from overhead lines with voltage of 50 kV or less.
- 10 ft plus 4 in. for every 10 kV over 50 kV for overhead lines with voltages greater than 50 kV. For example, the minimum distance that must be maintained from a 250 kV line is 16.5 ft.

EA personnel are not permitted to work on electric parts of equipment that have not been de-energized, locked out, and tagged by personnel trained to work with electrical equipment. No EA employee may work near energized exposed live parts without the use of any protective measures. Personal protective equipment designed to protect against electrical hazards may be specified for certain work operations. The Project Manager is responsible for

ensuring that appropriate safety measures are implemented to protect against electrical safety hazards on their sites.

Lightning is a hazard during outdoor operations, particularly for workers handling metal equipment. To eliminate this hazard, weather conditions should be monitored and work suspended at the discretion of the SHSO during electrical storms.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET: UNDERGROUND UTILITIES

Underground utilities pose hazardous to workers involved in drilling, excavation, soil vapor contaminant analysis, and other invasive operations. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, water, and/or irrigation lines.

The estimated location of underground installations, including sewer, telephone, fuel, electric, water lines, or other underground installations that reasonably may be expected to be encountered during invasive work shall be determined prior to the start of any invasive work. This may be determined by contacting appropriate utilities, contacting a utility clearance service, using site maps and prominent site features, using a pipe and cable locator, etc. Buried utilities encountered during invasive operations must be protected while digging to prevent risks to site personnel and damage to the utilities.

Site-Specific Hazards and Protective Measures: Drilling/trenching operations must be cleared prior to initiation.

PHYSICAL HAZARD INFORMATION SHEET: FIRE/EXPLOSION HAZARDS

Explosion and fire hazards may be present at various sites due to ignition of chemicals, agitation of shock-sensitive compounds, the sudden release of materials under pressure, etc. All site operations must be conducted in accordance with local fire codes and regulations. Continuous monitoring for combustible gases is required at sites where such gases may be present during spark-generating operations. Fire extinguishers and other fire-fighting provisions may also be necessary. Site personnel must be trained in the use of such fire-fighting equipment prior to the start of work operations. Site-specific requirements for monitoring and fire emergency equipment must be specified in the SHERP.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET: NOISE HAZARDS

Work around large equipment often creates excessive noise. The effects of noise can include:

- Workers being startled, annoyed, or distracted
- Physical damage to the ear, pain, and temporary and/or permanent hearing loss
- Communication interference that may increase potential hazards due to the inability to warn of danger and provide for proper safety precautions to be taken.

If workers are subjected to noise exceeding an 8-hour time-weighted average (TWA) sound level of 85 decibels on the A-weighted scale (dBA), feasible administrative or engineering controls shall be instituted to reduce noise levels to or below the permissible values. All personnel exposed to excessive noise levels shall be provided with and shall wear a hearing protection device which effectively protects the workers. OSHA regulations on noise can be found in 29 CFR Part 1910.95.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET: BIOLOGICAL HAZARDS

Insect Bites/Stings

Protective outer clothing such as gloves, hard hats, and coveralls can help reduce the potential for insect bites and stings. Insect bite symptoms include redness, rash, swelling, chills, fever, diarrhea, and vomiting. Any worker who has been bit or stung and shows symptoms of a severe reaction should seek medical assistance immediately. Workers who know of any allergies they may have to any insects must advise their employer prior to engaging in any field activities and may want to carry antidote kits.

To prevent contact with disease-carrying ticks, wear long-sleeved shirts, long pants, and boots that extend above the ankle with socks pulled over pants cuffs. Permethrin insecticide may be used to kill disease-bearing ticks and may be sprayed only on the outside of clothing (not directly on skin). Frequently check clothing, skin, and hair for the presence of ticks at the end of the work day. If a tick attaches to the body, remove by gently tugging with tweezers where the mouth parts enter the skin. Do not kill the tick prior to removal.

Poisonous Plants

Poisonous plants such as poison ivy may be present on certain sites during part of the year. Know how to recognize these plants and avoid contact. If contact occurs, wash affected areas with soap and water immediately.

Snakes/Rodents

On occasion, field workers may come into contact with snakes and/or rodents (rats, gophers, etc.). In case of a snake bite, which can be fatal, workers must immediately seek medical assistance and report the incident to the SSHS and Site Manager, according to the procedures delineated in the SHERP. Prompt medical attention is also required for rodent bites since many rodents carry rabies and other diseases. Field workers must report rodent bites to the SSHS and Site Manager immediately according to SHERP requirements.

Site-Specific Hazards and Protective Measures: Biological hazards are expected to be minimal due to the time of the year for most of the planned activities. However, workers should keep as much skin as possible covered to protect against bites, stings, etc.

**PHYSICAL HAZARD INFORMATION SHEET: MATERIAL
HANDLING/MOVING/LIFTING**

Improper materials handling accounts for a large number of occupational injuries. Materials handling at hazardous waste sites can vary from heavy equipment handling to manually handling items. Hazards associated with materials handling include physical injury, detonation, fire, explosion, and vapor generation.

When using equipment to move materials, proper work practices must be followed. Equipment used must be designed for the task to be performed. Equipment must be inspected regularly by the SSHO and the Site Manager, and damaged or defective equipment must be removed from service. Planning is critical when handling materials. The Site Manager, in conjunction with the CTO Manager, must plan where the materials are to be moved, taking into consideration the current location of such materials and hazards associated with moving them. Routes for moving materials must be clearly outlined, with paths cleaned of all obstructions so materials may be transported.

Injuries to the back and abdominal muscles from improper lifting of loads is one of the most common occupational injuries reported. Such injuries can range from relatively mild strains to major permanently disabling injuries. Before lifting any load, personnel should consider the overall weight, distribution of weight, unwieldiness or awkwardness of the load, distance to be carried, obstacles to be negotiated, site conditions, and visibility. Loads should be inspected for slivers, sharp edges, slippery surfaces, etc. prior to lifting.

Loads should be lifted using the power of the leg muscles rather than the back, stomach, or arm muscles. Approach the item to balance the load evenly. Never bend over when lifting. The back should be kept straight and the arms nearly parallel with the body. The knees should be bent to grasp the load. Lifting should be done by straightening the legs, holding the load as close to the body as possible, and the back remaining as straight as possible.

Bulky, heavy loads should be handled by at least two people, ensuring that the load is level and evenly distributed between all personnel helping to carry it. All carriers should know the destination and path for the load.

Site-Specific Hazards and Protective Measures:

PHYSICAL HAZARD INFORMATION SHEET: DRILLING

The selection of locations for each drilling activity site will take into account buried utility pipes, wires, conduits, and tanks, or other potentially dangerous structures. Overhead power lines and obstructions will also be surveyed. Prior to raising the mast, the area overhead and surrounding the rig will be checked by the drilling foreman and the SSHO. The longest conductive object on the drill rig will be located with a minimum of 10-ft clearance from overhead lines with voltages less than or equal to 50 kV. For lines with voltages exceeding 50 kV, the longest drill rig object must be at least 10 ft plus 4 in. for every 10 kV over 50 kV (e.g., for 250 kV line, clearance must be at least 16.7 ft). The client will inform EA of the voltages of any overhead lines in the vicinity of drilling operations.

When rotary drilling/sampling, drill rods will not be racked more than 1.5 times the height of the mast. During drilling operations and rig setup and takedown, all persons who enter the Exclusion Zone will wear hard hats, safety shoes/boots, and safety glasses/face shields to protect personnel from the physical hazards.

If during drilling there is any indication that underground tanks, drums, or other containers are being encountered, the drilling will be halted immediately and the SSHO shall notify the Program Safety and Health Officer. Indications that a waste container may have been encountered include: (1) change in the speed or momentum of the auger, (2) visual examination of auger cuttings, (3) odor noted in the cuttings, and/or (4) the presence of airborne total volatile organics as measured with a direct-reading instrument.

Work around drilling equipment also involves basic safety hazards (e.g., snapping cables, slings, ropes, moving heavy equipment, slip and trip hazards, etc.). Accidents may include head injuries from falling tools and equipment, hand and feet injuries due to moving equipment, and crushing injuries from unstable equipment or careless moving of equipment. If possible, EA personnel must remain outside the turning radius of any large moving equipment. If this is not feasible then, at a minimum, EA personnel must maintain visual contact with the equipment operator at all times when equipment is active.

**PHYSICAL HAZARD INFORMATION SHEET: TRENCHING
AND EXCAVATION HAZARDS**

Open excavations and trenches pose a variety of hazards to site workers and equipment working near or inside them, including cave-in hazards (worsened by water accumulation in some excavations), contact with underground utilities, vehicle and pedestrian traffic hazards (see Physical Hazard Information Sheet), dangers from falling loads, hazardous atmospheres inside and emitted from excavations (see Chemical Hazards section of SHERP); stability of adjacent structures, and loose rock and soil. OSHA's standard for Excavations (29 CFR 1926.650-.652) must be enforced at excavation sites.

Personnel are not permitted underneath loads being removed from an excavation. When mobile equipment is operated adjacent to an excavation, or must approach the edge of an excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. Where the stability of adjacent building walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

Entry into Excavations: Site personnel are not permitted to enter excavations without permission of the site-specific competent person. This competent person must be one who is capable of identifying existing and predictable hazards associated with trench or excavation collapse and has the authority to restrict access to excavations and trenches and to take prompt corrective measures to eliminate those hazards. Trenches and excavations must be inspected by the competent person prior to anyone entering. The competent person must document his/her findings, including assumptions used in determining that the excavation is safe for entry and the conditions required for safe. Protective systems (e.g., sloping, benching, and supports/shields) shall be utilized at all times in accordance with the requirements of 29 CFR 1926.652 and implemented prior to personnel entering the excavation. Trenches and excavations must be inspected daily by the competent person to ensure that safe conditions do and to identify potentially hazardous situations. Prior to personnel entering any excavation, access/egress methods must be investigated and implemented, including provisions for emergency exits from excavations. A stairway, ladder, ramp, or other safe means of egress will be located in trench excavations that are four feet or more in depth so as to require no more than 25 feet of lateral travel for workers. Loose rock and soil which could fall and injure personnel entering excavations must be removed or otherwise stabilized prior to entry. Personnel shall not work in excavations in which water has accumulated or is accumulating.

Site-Specific Hazards and Protective Measures:

Attachment C

**Site Safety, Health, and Emergency
Response Plan Review Record**

Attachment D

Site Safety and Health Activity Report

ATTACHMENT D

SITE SAFETY AND HEALTH ACTIVITY REPORT

Site: Navy Fuel Farm Facility

Location: NASJRB Willow Grove, Pennsylvania

Weather Conditions: _____

Onsite Hours: From _____ To _____

Changes in PPE Levels*

Work Operations

Reasons for Change

Site Safety and Health Plan
Violations

Corrective Action
Specified

Corrective Action
Taken (yes/no)

Observations and Comments: _____

Completed by: _____
Site Safety and Health Officer

Date: _____

*Only SSHS may change PPE levels, using only criteria specified in this SHERP.

Attachment E

Environmental Monitoring Record

Attachment F

**Monitoring Instrument Start-Up
and Calibration Procedures**

**START-UP AND CALIBRATION PROCEDURE FOR
MODEL MX-251 INDUSTRIAL SCIENTIFIC
CGI/O₂ METER**

START-UP:

1. Ensure that batteries for both the meter and pump (if to be used with meter) have been fully charged (at least overnight).
2. Turn screw on bottom of meter and rotate metal plate 180 degrees. Tighten screw. Alarm should sound briefly and digital readout should appear.
3. Depress OX switch and ensure that meter reads 20-21 percent. If necessary, loosen metal plate and use small screwdriver to adjust the OX screw until desired oxygen reading appears.
4. Depress LEL Switch and ensure that meter reads 0. If necessary, loosen metal plate and use small screwdriver to adjust the ZERO screw until meter reads 0.

CALIBRATION:

1. If oxygen reading in Step 3 was taken in normal ambient environment, no further calibration of the oxygen meter is needed.
2. Fill Tedlar bag with calibration gas standard (must be in percent concentrations—calibration gas tank label should indicate percent LEL of calibration gas).
3. If meter is to be used in passive mode (i.e., no sampling pump), attach calibration cup to top of meter and attach to Tedlar bag using Tygon tubing. If sampling pump is to be used, attach pump to meter and attach filled Tedlar bag to pump inlet.
4. Depress LEL Switch and note the meter reading. If necessary, adjust the small LEL screw underneath the metal plate as required to make meter reading correspond with calibration gas concentration.
5. Record identity of calibration gas, concentration, and calibration date on the Environmental Monitoring Record each time the instrument is calibrated.

**START-UP AND CALIBRATION PROCEDURE FOR
THE HNU PHOTOIONIZATION DETECTOR,
MODELS HW-101 AND PI-101**

START-UP:

1. Connect the probe to the readout assembly, making sure that the red interlock switch is depressed by the ring on the connector.
2. Turn the function switch to BATT. The needle should move to green region. If not, the battery needs to be recharged.
3. Zero Set--Turn the function switch to STANDBY. Allow the instrument to warm up at least 1 minute. Set the zero point with the ZERO set control.

CALIBRATION:

1. Fill empty Tedlar bag with 100 ppm isobutylene gas standard (used to calibrate HNU to 55 ppm). Attach probe to Tedlar bag. Do not connect HNU probe directly to isobutylene tank.
2. Turn the Function Switch to the 0-200 range position and note the meter reading. If meter does not read 55 ppm, use the SPAN Control Knob to set the meter reading at 55 ppm. Lock the SPAN Control Knob.
3. Record identity and concentration of calibration gas and the SPAN Control setting on the Environmental Monitoring Record each time the instrument is calibrated.
4. Re-calibrate the HNU each time the instrument is turned off. Place the instrument on STANDBY when not in active use during the work day.

CAUTION: Check the battery charger frequently throughout the work period--do not allow the needle to fall below the green line when the function switch is on BATT. If needles approach the left range of this green line, stop and recharge the instrument.

Probe must be attached to the readout assembly, with the interlock switch fully depressed, in order to recharge the instrument.

START-UP AND CALIBRATION PROCEDURE FOR MODELS OVA-128 AND 128-GC CENTURY ORGANIC VAPOR ANALYZER

START-UP:

1. Connect the probe/readout assembly to the Sidepack Assembly by attaching both the sample line and the electronic jack.
2. Move the Instr/Batt Switch to the BATT position and check that readout needle moves beyond the white "batt check" line.
3. Move the Instr/Batt Switch to the "On" position and warm up at least 5 minutes.
4. Turn the Pump Switch on, set Sidepack Assembly in upright vertical position, and make sure that sample flow rate is approximately 1.5-2.5 units. If less, check filters.
5. Set CALIBRATE Switch to the X1 position, and use CALIBRATE knob to set meter to read 0.
6. Open the HYDROGEN TANK VALVE one or two turns. [Hydrogen Tank pressure should read at least 1,500 psi if 8-hour supply is desired. Otherwise, shut down instrument and fill tank with hydrogen.] Open HYDROGEN SUPPLY VALVE one or two turns. Hydrogen Supply Pressure Indicator should read between 8 and 12 psi.
7. Wait approximately 1 minute, then depress IGNITER Button until hydrogen flame lights (meter needle will jump upscale and faint "pop" may be heard if flame ignites). Do not depress igniter more than 6 seconds. If flame does not light, wait 1 minute and tray to re-ignite.
8. Use CALIBRATE knob to "zero" out background by setting CALIBRATE Switch to X1 and reading zero on meter. To avoid false flame out alarm, set meter to 1 ppm with CALIBRATE knob and make differential readings.

CALIBRATION:

1. Fill empty Tedlar bag with 100 ppm methane gas standard.
2. Use Tygon Tubing to connect bag to probe on OVA Readout Assembly. Never connect the OVA directly to methane gas tank.
3. Set CALIBRATE Switch to X10 and read meter. If meter does not read 100 ppm, use the GAS SELECT KNOB to set the readout meter to correspond to 100 ppm. Lock the GAS SELECT KNOB.
4. RECORD identity of calibration gas, concentration, and GAS SELECT reading on Environmental Monitoring Record each time instrument is calibrated.

START-UP AND CALIBRATION PROCEDURE FOR PHOTOVAC MICROTIP

BACKGROUND

The Microtip measures the concentration of airborne ionizable gases and automatically displays and records these concentrations. The Microtip operates automatically, updating the display every 0.5 second. The Microtip automatically records the minimum, maximum, and average concentration for each 15-second period.

The keypad is used to set up and calibrate the Microtip. It has a tutorial function which is activated by pressing the "tutor" key. When "tutor" is pushed, the remaining keys will give a brief explanation of their function when they are pressed. To end the tutorial session, press "exit" twice.

OPERATION

- STEP 1 Place battery pack onto Microtip. Battery must be charged for 8 hours prior to use.
- STEP 2 Turn on rocker switch located on handle; display will read: "Machine warming up—please wait." When machine is ready it will read "ready" and show day, date, and time.
- STEP 3 Now if you care to, you can activate tutor key as mentioned key.
- STEP 4 Fill Tedlar bag included with the Microtip with 100 ppm isobutylene span gas.
- STEP 5 Press "CAL" button on keypad—instrument will read: "Enter zero gas." At this point, expose the Microtip to clean outdoor air to set zero standard. Press enter and the Microtip will automatically calibrate itself.
- STEP 6 The display will now read "Enter span gas concentration." Since we are using 100 ppm isobutylene, set concentration with the #s of the keypad to 100. Attach Tedlar bag of isobutylene and press enter. Machine will automatically calibrate and display will read "ready" with day, date, time, and event # displayed.
- STEP 7 Detach Tedlar bag and Microtip is ready to use. The Microtip should be calibrated at least once a day.

The Microtip has a calibration memory that holds up to five different span gas concentrations. However, regardless of the span gas used, the Microtip cannot pick out separate gases but gives the reading of the total ionizable compounds in the air.

A. *SETUP KEY*

In order to select the range of detection for the Microtip, press the setup key and then select the range 0-20, 0-200, or 0-2000 ppm using the arrow keys. Hit "enter"; next select calibration memory with arrows (using #1 for isobutylene) and press "enter". The Microtip will now display hours, minutes, day, date, etc. If these are correct, continue to press "enter" until "ready display" appears.

B. *EVENT KEY*

Press event key if you want to mark a specific sample—otherwise, the event is numbered when you turn on the instrument.

C. *PLAY*

This key is used to recall date. Press play and the * key for options. You can now enter an event # and the machine will display all data for that event.

THINGS TO BE AWARE OF...

If you get a Lo Bat display you should immediately replace the battery as you will have only 10 minutes of charge left. If you continue to run the Microtip, a second message will appear—"Critically low bat". The Microtip will then turn off to prevent deep discharge and memory loss.

This is a delicate instrument. Please be careful with it as it is not as durable as HNUs and OVAs.

This will get you started in the basic operation of the Microtip. If you have any questions or problems, see the owner's manual as it is clearly laid out and easy to understand.

Attachment G

Site Entry and Exit Log

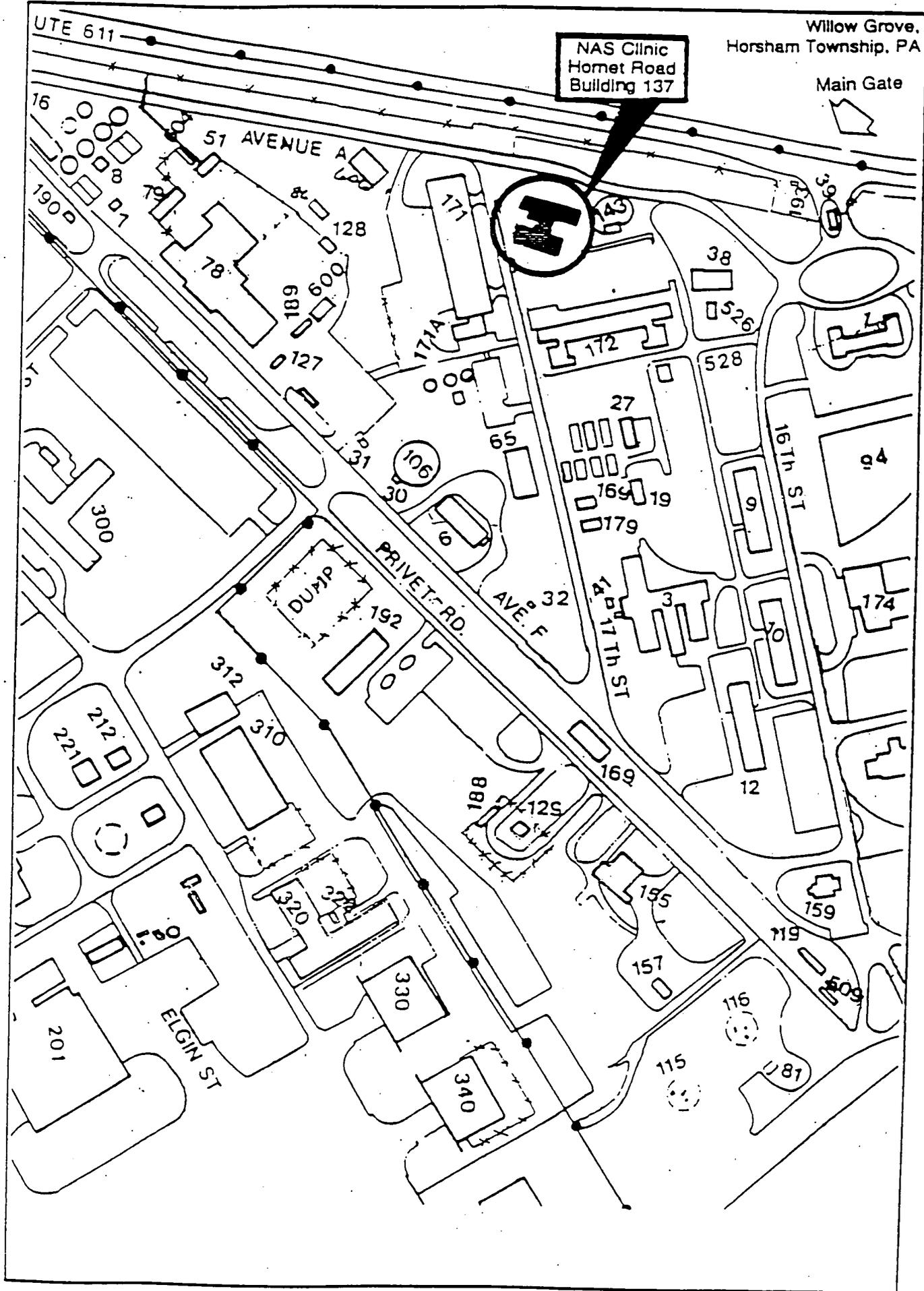
Attachment H

Map to Hospital

Willow Grove,
Horsham Township, PA

NAS Clinic
Hornet Road
Building 137

Main Gate



Attachment I

Accident Investigation Report

ACCIDENT INVESTIGATION REPORT

COMPANY _____ ADDRESS _____

DEPARTMENT _____ LOCATION (if different _____
from mailing address)

| | | | | |
|--|---|---|--|--|
| 1. Name of Injured | 2. Social Security Number | 3. Sex <input type="checkbox"/> M <input type="checkbox"/> F | 4. Age | 5. Date of Accident |
| 6. Home Address | 7. Employee's Usual Occupation | | 8. Occupation at Time of Accident | |
| | 9. Length of Employment <input type="checkbox"/> Less than 1 mo. <input type="checkbox"/> 6 mos.-6 yrs. <input type="checkbox"/> 1-5 mos. <input type="checkbox"/> More than 5 yrs. | | 10. Time in Occupation at Time of Accident <input type="checkbox"/> Less than 1 mo. <input type="checkbox"/> 6 mos.-6 yrs. <input type="checkbox"/> 1-5 mos. <input type="checkbox"/> More than 5 yrs. | |
| 11. Employment Category <input type="checkbox"/> Regular, Full-time <input type="checkbox"/> Temporary <input type="checkbox"/> Regular, Part-time <input type="checkbox"/> Seasonal <input type="checkbox"/> Nonemployee | | 12. Nature of Injury and Part of Body | | |
| 13. Case Numbers and Names of Others Injured in Same Accident | | 14. Name and Address of Physician | | |
| 15. Name and Address of Hospital | | 16. Time of Injury A. _____ A.M./P.M. B. Time within shift C. Type of shift | | 17. Severity of Injury <input type="checkbox"/> Fatality <input type="checkbox"/> Lost workdays—days away from work <input type="checkbox"/> Lost workdays—days of restricted activity <input type="checkbox"/> Medical treatment <input type="checkbox"/> First aid <input type="checkbox"/> Other, specify _____ |
| 18. Specific Location of Accident On Employer's Premises? <input type="checkbox"/> Yes <input type="checkbox"/> No | | 19. Phase of Employee's Workday at Time of Injury <input type="checkbox"/> During rest period <input type="checkbox"/> Entering or Leaving Plant <input type="checkbox"/> Working overtime <input type="checkbox"/> During meal period <input type="checkbox"/> Performing Work Duties <input type="checkbox"/> Other _____ | | |
| 20. Describe How the Accident Occurred | | | | |
| 21. Accident Sequence. Describe in reverse order of occurrence, events preceding the injury and accident. Starting with the injury and moving backward in time, reconstruct the sequence of events that led to the injury. | | | | |
| A. Injury Event _____ | | | | |
| B. Accident Event _____ | | | | |
| C. Preceding Event #1 _____ | | | | |
| D. Preceding Event #2, #3, etc. _____ | | | | |