FINAL

SITE-SPECIFIC WORK PLAN FOR THE PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION AT KEESLER AFB, MISSISSIPPI

May 2001

Prepared for:

Air Force Center for Environmental Excellence
Technology Transfer Division
and
Air Force Environmental Directorate

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LIST OF ACRONYMS AND ABBREVIATIONS

AAFES	Army and Air Force Exchange Service
AFILEV	Air Force Environmental Directorate
AFB	Air Force Base
AFCEE/ERT	Air Force Center for Environmental Excellence, Technology Transfer Division
ANOVA	analysis of variance
AOC-A	Area of Concern - A
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene and xylenes
COPCs	chemicals of potential concern
DoD	Department of Defense
ft/yr	feet per year
GIS	Geographical information system
HASP	Health and Safety Plan
LTM	long-term monitoring
µg/L	micrograms per liter
MTBE	methyl tert-butyl ether
Parsons	Parsons Engineering Science, Inc.
PCE	tetrachloroethene
PDBS	passive diffusion bag sampler
QAPP	Quality Assurance Program Plan
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOPs	Standard Operating Procedures
STL	Severn-Trent Laboratory
SWMU	Solid Waste Management Unit
TCE	trichloroethene
TO	task order
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Project Description

On 27 February 2001, Parsons Engineering Science, Inc. (Parsons) was awarded a task order (TO) under Air Force Center for Environmental Excellence (AFCEE) contract F41624-00-D-8024 (TO24, Project Air Force Environmental Directorate [AFILEV]) to demonstrate the use of passive diffusion bag samplers (PDBSs) in existing groundwater monitoring programs at selected AFILEV installations. The site of the PDBS demonstration outlined in this work plan is Keesler Air Force Base (AFB), Mississippi. The Technology Transfer Division of AFCEE (AFCEE/ERT) has initiated the PDBS demonstration to introduce this technology to multiple Department of Defense (DoD) installations and to improve the cost effectiveness of groundwater monitoring programs for volatile organic compounds (VOCs).

Diffusion sampling is a relatively new technology designed to utilize passive sampling techniques that eliminate the need for well purging. Specifically, a diffusive-membrane capsule is filled with deionized/distilled water, sealed, suspended in a well-installation device, and lowered to a specified depth below the water level in a monitoring well. Over time (no less than 72 hours), the VOCs in the groundwater diffuse across the membrane, and the water inside the sampler reaches equilibrium with groundwater in the surrounding formation. The sampler is subsequently removed from the well, and the water in the diffusion sampler is transferred to a sample container and submitted for laboratory analysis of VOCs. Benefits of diffusion sampling include reduced sampling costs and reduced generation of investigation-derived waste.

1.2 Objective

The PDBS demonstration at Keesler AFB has two primary objectives:

- Develop vertical profiles of VOC concentrations across the screened intervals of the sampled monitoring wells, and

- Assess the effectiveness of PDBS by statistically comparing groundwater analytical results for VOCs obtained using the current (conventional) sampling method (i.e., 3-casing-volume purge/sample) during the upcoming May-June 2001 long-term monitoring (LTM) event with results obtained using the PDBS method.

Vertical contaminant profiles will be developed by placing two to four PDBSs at discrete depths in each monitoring well included in the demonstration, and analyzing the resulting samples for VOCs. The statistical comparison of the conventional and diffusion sampling results will allow assessment of the appropriateness of implementing diffusion sampling for VOCs at each sampled well.

1.3 Scope

The Keesler AFB PDBS sampling demonstration will require two mobilizations to the site: one to place the diffusion samplers in the selected monitoring wells, and a second to retrieve the samplers from the wells. The PDBSs will be installed during the fourth week

of May 2001 (i.e., May 23-24) to provide adequate equilibration time before the incumbent environmental contractor for Keesler AFB, Parsons (Atlanta, Georgia), begins the scheduled LTM sampling event on May 30, 2001. The PDBSs will be retrieved on June 6-7, immediately prior to the conventional sampling of the same wells to ensure temporal comparability of the analytical results obtained using the two methods. The PDBSs will be in place for a minimum of 14 days, which fulfills the 14-day minimum equilibration time period specified in the AFILEV PDBS Project Work Plan (Parsons, 2001).

1.4 Document Organization

This work plan is organized into seven sections, including this introduction, and four appendices. The Keesler AFB site description is presented in Section 2. Section 3 presents the scope of the PDBS investigation at Keesler AFB. Project organization, schedule, and an overview of the PDBS site-specific results report are summarized in Sections 4, 5, and 6, respectively. References used in the preparation of this work plan are presented in Section 7. Appendix A provides a site-specific addendum to the Project Health and Safety Plan (HASP) (Parsons, 2001).

2.0 SITE DESCRIPTION

2.1 Location and Description of Keesler Air Force Base Mississippi

Keesler AFB is located within the city limits of Biloxi, Harrison County, Mississippi, approximately 80 miles east of New Orleans, Louisiana, and 60 miles west of Mobile, Alabama. It is bordered on the north by the Back Bay of Biloxi and on the west, south, and east by residential and commercial areas of the city. The Mississippi Sound is located approximately 0.5 mile south of the Base (Figure 2.1). The Base comprises 1,494 acres of federally owned land and 117 acres of leased, permit, and easement lands.

2.2 PDBS Site Description

The sites to be sampled using PDBS include the following:

- Solid Waste Management Unit (SWMU) 66 – Former Military Service Station;
- Area of Concern A (AOC-A) (ST-06) – BX Service Station;
- Facility 1504 – Army and Air Force Exchange Service (AAFES) Service Station; and
- SWMU 16/37.

2.3 Geology and Hydrogeology

Several major hydrogeologic units exist in the area of Keesler AFB: the Coastal Deposits surficial aquifer, the Citronelle Aquifer, and the Miocene aquifer system. The surficial aquifer, which underlies AOC-A, SWMU 66, and SWMU 16/37, occurs under

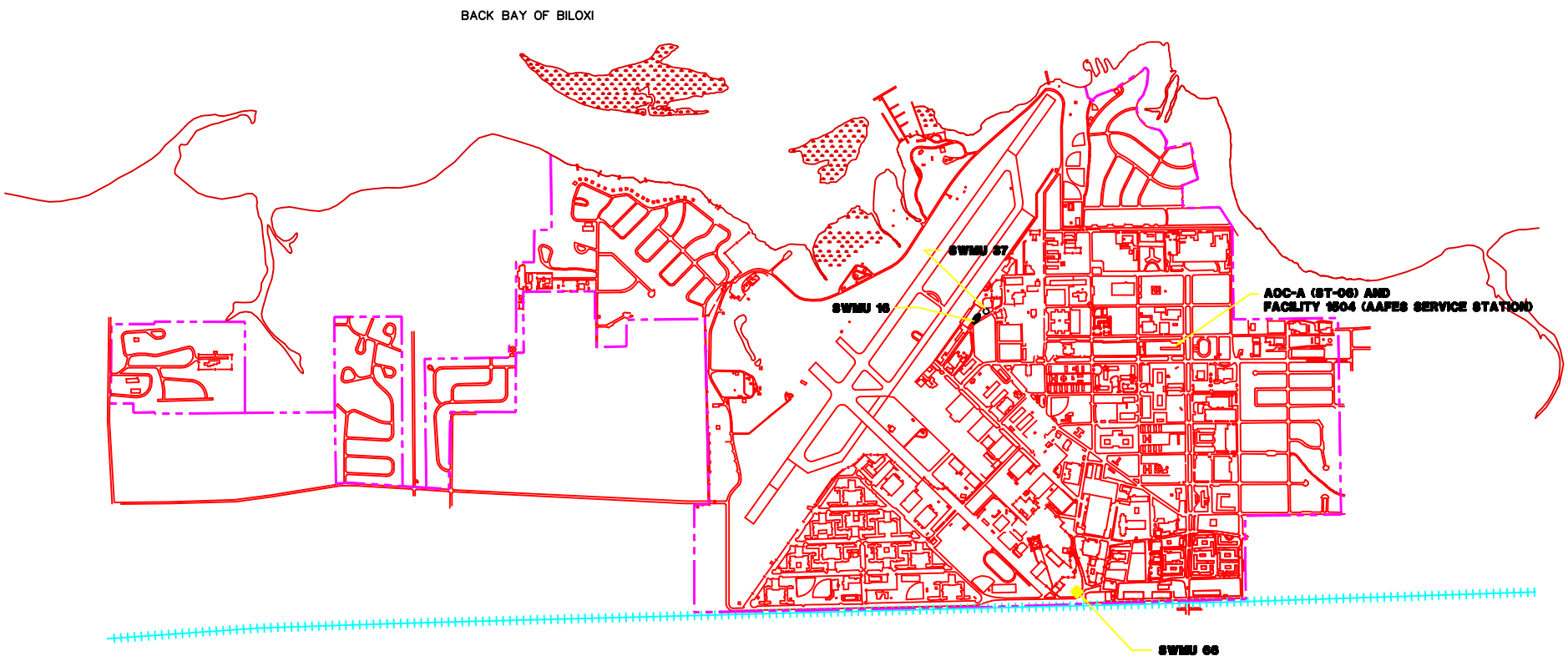

FIGURE 2.1

SITE LOCATIONS

PASSIVE DIFFUSION BAG
SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

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water table conditions within the Pamlico Sand. This formation consists of Holocene- or Pleistocene-age unconsolidated terrace or alluvial deposits of sand. The water table occurs as a subdued replica of the topographic surface and slopes gently toward the Back Bay and Mississippi Sound. The axis of the topographic ridge and the groundwater divide are almost coincident, with steeper topographic slopes and hydraulic gradients south of the Base, and flatter topographic slopes and hydraulic gradients to the north. Localized variations in gradient and flow direction occur within the Base due to minor variations in ground cover and grading. These variations do not affect the overall flow and appear to produce only localized areas of stagnant water, or conversely, localized areas in which the flow rates are higher than the site average.

Water quality within the surficial aquifer is generally poor, which can be attributed to both natural and artificial causes. As early as the 1940s, Brown, *et al*. (1944) reported a deterioration of local water quality due to contamination by sewage. Locally, the water contains hydrogen sulfides and dissolved organic matter, which are responsible for a rotten egg odor and a dark brown color, respectively. The dissolved organic matter is largely attributed to peat resulting from the decay of plant and animal matter. Regionally, the surficial aquifer contains saline water from salt-water intrusion.

The water table is located approximately 5 to 10 feet below ground surface (bgs) at sites where the PDBS demonstration will be implemented. The average horizontal groundwater flow rate for shallow groundwater is 221 feet per year (ft/yr) at SWMU 16/37 (Parsons, 1998), 45 ft/yr at SWMU 66 (Parsons, 1999b), and 292 ft/yr at AOC-A (Parsons, 1999a).

2.4 Chemicals of Concern

Historically, contaminants that have exceeded regulatory limits at Keesler AFB have consisted primarily of chlorinated solvents, their associated breakdown products, and fuel hydrocarbons. Table 2.1 summarizes contaminants that were detected in groundwater at concentrations exceeding regulatory limits during the most recent LTM events. The primary chemicals of potential concern (COPCs) in groundwater at Keesler AFB include tetrachloethene (PCE), trichloroethene (TCE), PCE and TCE degradation compounds, fuel compounds, and metals.

The COPCs at AOC-A (BX Service Station), Facility 1504 (AAFES Service Station), and SWMU 66 include benzene, toluene, ethylbenzene, and xylenes (BTEX) and methyl tert-butyl ether (MTBE). Nine wells at the BX Service Station, five wells at the AAFES Service Station, and nine wells at SWMU 66 are sampled annually for BTEX, MTBE, and natural attenuation indicator parameters. BTEX and MTBE are typically analyzed using US Environmental Protection Agency (USEPA) Method SW8021B. However, the upcoming May-June 2001 event will use Method SW8260B. The natural attenuation parameters targeted for analysis at this site include ammonia, sulfate, ferrous iron, and methane.

The COPCs at SWMU 16/37 include chlorinated VOCs, and metals. Fourteen wells at the site will be sampled semi-annually through 2002, then annually thereafter. Samples are analyzed for VOCs using USEPA Method 8260B; 14 metals including antimony, arsenic, barium, beryllium, cadmium, chromium, copper, lead, mercury,

TABLE 2.1
SUMMARY OF MOST RECENT VOC DETECTIONS IN GROUNDWATER
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

Contaminant	Well Number	Concentration (µg/L)[a/]	Sample Date
SWMU-66			
Benzene	MW9-2	40.1	May-00
Benzene	MW9-7R	424	May-00
Benzene	MW9-8	157	May-00
Toluene	MW9-1	2.9	Jun-99
Toluene	MW9-7R	190	May-00
Toluene	MW9-8	21	May-00
Ethylbenzene	MW9-7R	138	May-00
Ethylbenzene	MW9-8	6.5	May-00
Xylenes	MW9-1	4.9	Jun-99
Xylenes	MW9-7R	670	May-00
Xylenes	MW9-8	494	May-00
MTBE	MW9-2	2.8	May-00
MTBE	MW9-7R	22	May-00
MTBE	MW9-8	7.5	May-00
AOC-A (ST-06/Service Station)			
Benzene	MW8-3	332	Mar-00
Benzene	MW8-4	375	Mar-00
Benzene	MW8-5	583	Mar-00
Benzene	MWA-9	1.2	Sep-99
Benzene	MWA-11	95	Mar-00
Toluene	MW8-3	684	Mar-00
Toluene	MW8-4	61	Mar-00
Toluene	MW8-5	80	Mar-00
Toluene	MWA-8	2.7	Mar-00
Toluene	MWA-9	1	Sep-99
Toluene	MWA-11	15.8	Mar-00
Ethylbenzene	MW8-3	298	Mar-00
Ethylbenzene	MW8-4	95	Mar-00
Ethylbenzene	MW8-5	568	Mar-00
Ethylbenzene	MWA-9	5.8	Mar-00
Ethylbenzene	MWA-11	30.7	Mar-00
Xylenes	MW8-3	970	Mar-00
Xylenes	MW8-4	190	Mar-00
Xylenes	MW8-5	1450	Mar-00
Xylenes	MWA-9	44.5	Mar-00
Xylenes	MWA-11	49.7	Mar-00
MTBE	MW8-3	10	Mar-00
MTBE	MW8-4	11	Mar-00
MTBE	MW8-5	15	Mar-00
MTBE	MWA-11	8.4	Mar-00
Facility 1504 (AAFES Service Station)			
Benzene	MW-5	155.7	May-00
Benzene	MW-7	96.1	May-00
Benzene	MW-8	770	May-00
Toluene	MW-5	10.3	May-00

TABLE 2.1 (Continued)
SUMMARY OF MOST RECENT VOC DETECTIONS IN GROUNDWATER
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

Toluene	MW-7	2.7	May-00
Toluene	MW-8	3934	May-00
Ethylbenzene	MW-5	28.4	May-00
Ethylbenzene	MW-7	5.4	May-00
Ethylbenzene	MW-8	548	May-00
Xylenes	MW-5	76.4	May-00
Xylenes	MW-7	4.6	May-00
Xylenes	MW-8	3316	May-00
SWMU-16/37			
PCE	MW1-1	4.6	Feb-01
PCE	MW1-2	2.8	Feb-01
PCE	MW16-6	11.6	Feb-01
TCE	MW1-2	3.2	Feb-01
TCE	MW16-5	36	Nov-92
TCE	MW16-6	24.6	Feb-01
1,2-DCE	MW1-2	2	Nov-92
1,2-DCE	MW16-5	21	Nov-92
1,2-DCE	MW16-6	7	Nov-92
cis-1,2-DCE	MW1-2	2.6	Feb-01
cis-1,2-DCE	MW16-5	17	Nov-92
cis-1,2-DCE	MW16-6	7.4	Feb-01
trans-1,2-DCE	MW16-5	4	Feb-01

[a/] µg/L = micrograms per liter

nickel, selenium, silver, thallium, and zinc using USEPA Method SW6010; and natural attenuation indicator parameters. The natural attenuation parameters analyzed at this site include methane, ethane, ethene, total organic carbon, alkalinity, nitrate, ferrous iron, sulfate, and chloride.

3.0 SCOPE OF PDBS DEMONSTRATION

An estimated total of 47 passive diffusion samplers will be installed in 17 monitoring wells at Keesler AFB as part of this project. The monitoring wells that will be sampled during this PDBS demonstration are summarized in Table 3.1, and their locations are shown on Figures 3.1 through 3.4.

3.1 Diffusion Sampling

3.1.1 Field Activities

Monitoring wells selected for VOC sampling using the PDBS technique (Table 3.1) were chosen from the list of monitoring wells targeted for sampling by Parsons during the LTM sampling event scheduled to begin in May 2001. Monitoring wells were selected based primarily on VOC concentrations detected during previous sampling events, as indicated below. Selected wells include:

- SWMU 16/37: 4 wells with historical concentrations of chlorinated solvent and daughter products (Figure 3.1).
- SWMU 66: 4 wells with historical concentrations of BTEX and MTBE (Figure 3.2).
- Facility 1504 (AAFES Service Station): 3 wells with historical concentrations of BTEX and MTBE (Figure 3.3).
- AOC-A (BX Service Station): 5 wells with historical concentrations of BTEX and one "clean" well (Figure 3.4).

All of the wells that have recently contained detectable concentrations of VOCs and that are included in the LTM program are targeted for PDBS deployment. In addition, one historically "clean" well at AOC-A (BX Service Station) is targeted for sampling using PDBS.

PDBSs deployed during this investigation will be installed and retrieved in accordance with the diffusion sampler installation and recovery standard operating procedures (SOPs) presented in Appendix B of the AFILEV PDBS Project Work Plan (Parsons, 2001). PDBSs will be installed throughout the screened interval of each well (i.e., 1 PDBS per 3 feet of saturated screen) to obtain a vertical profile of contaminant concentrations. The PDBS samples will be collected prior to conventional sampling of the wells.

Sample aliquots from PDBSs installed in all the wells targeted for sampling will be shipped to Severn-Trent Laboratory (STL) in Savannah, Georgia for VOC analysis using USEPA Method 8260B. This same laboratory will be used by the Parsons Atlanta office

TABLE 3.1
SAMPLING LOCATION SUMMARY
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

Well Number	Total Depth (ft)[a/]	Well Diameter (in)[a/]	Screened Interval (ft Below TOC)[b/]	Dominant Lithology of Screened Interval	Approximate Water Level Range (ft below TOC)	Aquifer Unit	Dedicated Pump yes/no (Y/N)	Estimated Number of PDBSs	Main COCs Concentrations from Most Recent Sampling (mg/L)[b/]	Comments/Sampling Rationale
AOC-A (ST-06)										
MW8-3	16.0	2	6-16	Sand	7.00 - 10.00	Surficial	N	2	March 2000 - Benzene: 332, Toluene: 684, Ethylbenzene: 298, Xylenes: 970, MTBE: 10	Historical detections of fuel compounds.
MW8-4	15.9	2	6-16	Sand	8.00 - 10.00	Surficial	N	2	March 2000 - Benzene: 375, Toluene: 61, Ethylbenzene: 95, Xylenes: 190, MTBE: 11	Historical detections of fuel compounds.
MW8-5	17.3	2	6-16	Sand	9.00 - 11.00	Surficial	N	2	March 2000 - Benzene: 583, Toluene: 80, Ethylbenzene: 568, Xylenes: 1,450, MTBE: 15	Concentrations of BTEX were less than the 18,000 mg/L BTEX cleanup level in March 2000. Historical detections of fuel compounds.
MWA-8	22.5	2	4.5-19.5	Sand	11	Surficial	NA[c/]	4	March 2000 - Toluene: 2.7	
MWA-9	23.3	2	5-20	Sand	8.00 - 11.00	Surficial	N	4	March 2000 - Ethylbenzene: 5.8, Xylenes: 44.5	Concentrations of BTEX were less than the 18,000 mg/L BTEX cleanup level in March 2001. Historical detections of fuel compounds
MWA-11	21.0	4	5-20	Sand	7.00 - 10.00	Surficial	N	4	March 2000 - Benzene: 95, Toluene: 15.8, Ethylbenzene: 30.7, Xylenes: 49.7, MTBE: 8.4	Concentrations of BTEX were less than the 18,000 mg/L BTEX cleanup level in March 2002. Historical detections of fuel compounds. Will collect field duplicates and MS/MSD pairs during sampling.
AOC-A (Facility 1504/AAFFES Service Station)										
MW-5	18.4	4	NA	Sand	9	Surficial	N	3	May 2000 - Benzene: 155.7, Toluene: 10.3, Ethylbenzene: 28.4, Xylenes: 76.4, MTBE: 162	Concentrations of BTEX have always been less than the 18,000 mg/L BTEX cleanup level. Historical detections of fuel compounds.
MW-7	18.2	4	NA	Sand	6	Surficial	N	3	May 2000 - Benzene: 96.1, Toluene: 2.7, Ethylbenzene: 5.4, Xylenes: 4.6, MTBE: 62.6	Historical concentrations of BTEX have always been less than the 18,000 mg/L BTEX cleanup level. Historical detections of fuel compounds.
MW-8	17.9	4	NA	Sand	10	Surficial	N	3	May 2000 - Benzene: 770, Toluene: 3,934, Ethylbenzene: 548, Xylenes: 3,316, MTBE: 374	Concentrations of BTEX were less than the 18,000 mg/L BTEX cleanup level in May 2000. Historical detections of fuel compounds. Will collect field duplicates and MS/MSD pairs during sampling.
SWMU 66										
MW9-1	13.6	2	3.1-13.1	Sand	3.00 - 6.00	Surficial	N	2	May 2000 - ND[d/], June 1999 - Toluene: 2.9, Xylenes: 4.9	Historical detection of fuel compounds.
MW9-2	13.5	2	3-13	Sand	3.00 - 6.00	Surficial	N	2	May 2000 - Benzene: 40.1, MTBE: 2.8	Historical detection of fuel compounds.
MW9-7R	14.0	2	4-14	Sand	6.00 - 7.00	Surficial	N	2	May 2000 - Benzene: 424, Toluene: 190, Ethylbenzene: 138, Xylenes: 670, MTBE: 22	Historical detection of fuel compounds.
MW9-8	NA	NA	NA	Sand	5.00 - 7.00	Surficial	N	3	May 2000 - Benzene: 157, Toluene: 21, Ethylbenzene: 6.5, Xylenes: 494, MTBE: 7.5	Historical detection of fuel compounds.

TABLE 3.1 (Continued)
SAMPLING LOCATION SUMMARY
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

Well Number	Total Depth (ft)[a/]	Well Diameter (in)[a/]	Screened Interval (ft Below TOC)[b/]	Dominant Lithology of Screened Interval	Approximate Water Level Range (ft below TOC)	Aquifer Unit	Dedicated Pump yes/no (Y/N)	Estimated Number of PDBSs	Main COCs Concentrations from Most Recent Sampling (mg/L)[b/]	Comments/Sampling Rationale
SWMU-16/37										
MW1-1	15.0	NA	5-15	Sand	7.00 - 8.00	Surficial		2	February 2001 - PCE: 4.6	Historical detections of chlorinated ethenes.
MW1-2	15.0	NA	5-15	Sand	6.00 - 8.00	Surficial	N	3	February 2001 - cis-1,2-DCE: 2.6, PCE: 2.8, TCE: 3.2	Historical detections of chlorinated ethenes.
MW16-5	23.0	2	10-20	Sand	8.00 - 9.00	Surficial	N	3	February 2001 - ND, November 1992 - 1,2-DCE: 21, cis-1,2-DCE: 17, trans-1,2 DCE: 4	Historical detections of chlorinated ethenes.
MW16-6	26.0	2	13-23	Sand	8.00 - 9.00	Surficial	N	3	February 2001 - cis-1,2-DCE: 7.4, PCE: 11.6, TCE: 24.6	Historical detections of chlorinated ethenes.

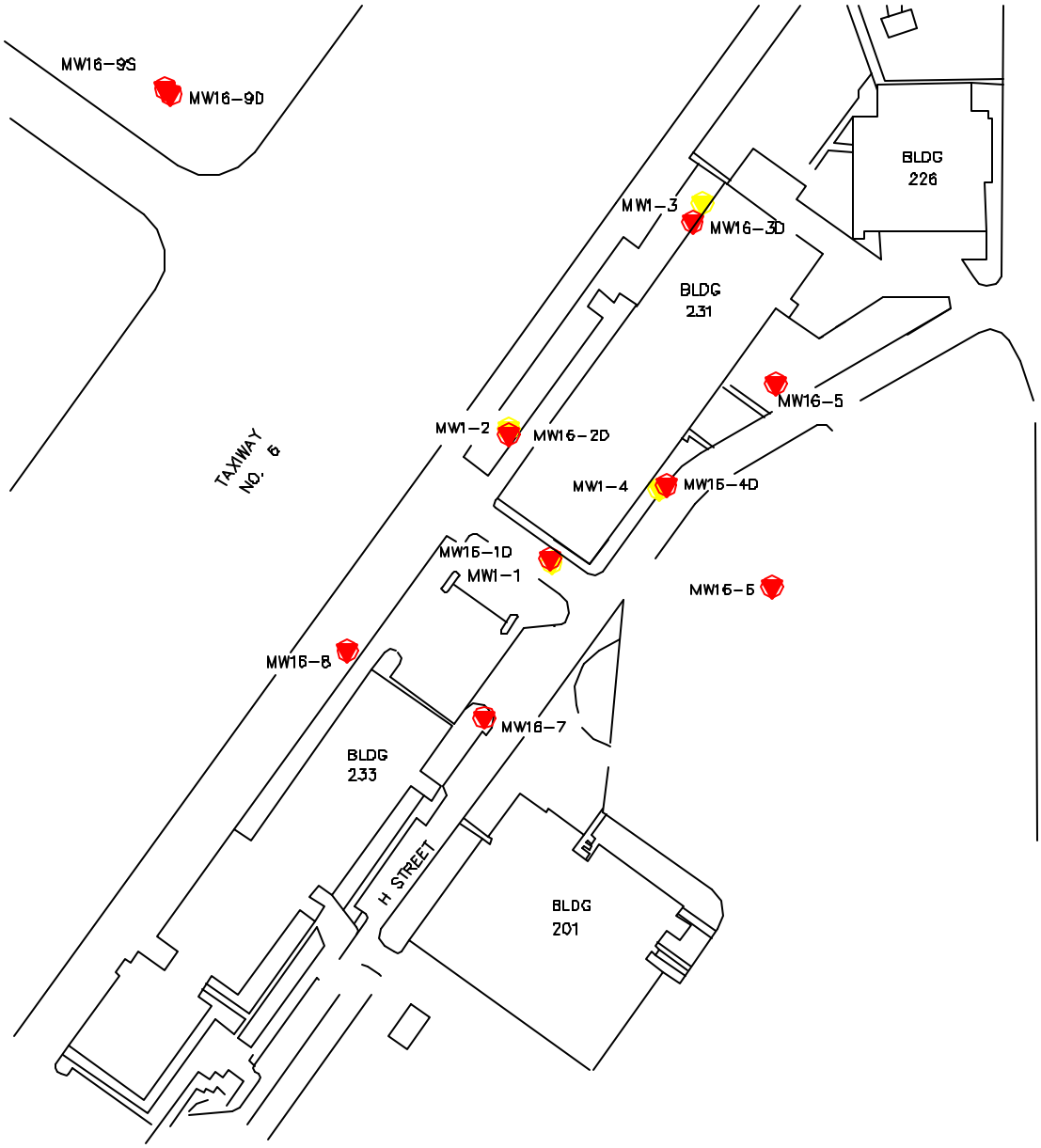
Notes:
TCE = Trichloroethene; cis-1,2-DCE = cis-1,2-Dichloroethene; PCE = Tetrachloroethene;
MTBE = Methyl Tertiary Butyl Ether; Xylenes = total xylenes.

[a/] ft = feet; in = inches.

[b/] TOC = top of casing; µg/L = micrograms per liter.

[c/] NA = not available.

[d/] ND = not detected. If no COCs were detected during the most recent sampling, data is provided for the most recent event with detections.



LEGEND

- MW 1-3 — MONITORING WELL
- MW [1-1] — MONITORING WELL SELECTED FOR VOC SAMPLING USING PDBS TECHNIQUE

80' 40' 0' 80' 160'

SCALE: 1" = 160'

FIGURE 3.1

MONITORING WELL LOCATIONS
SWMU 16/SWMU 37

PASSIVE DIFFUSION BAG
SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

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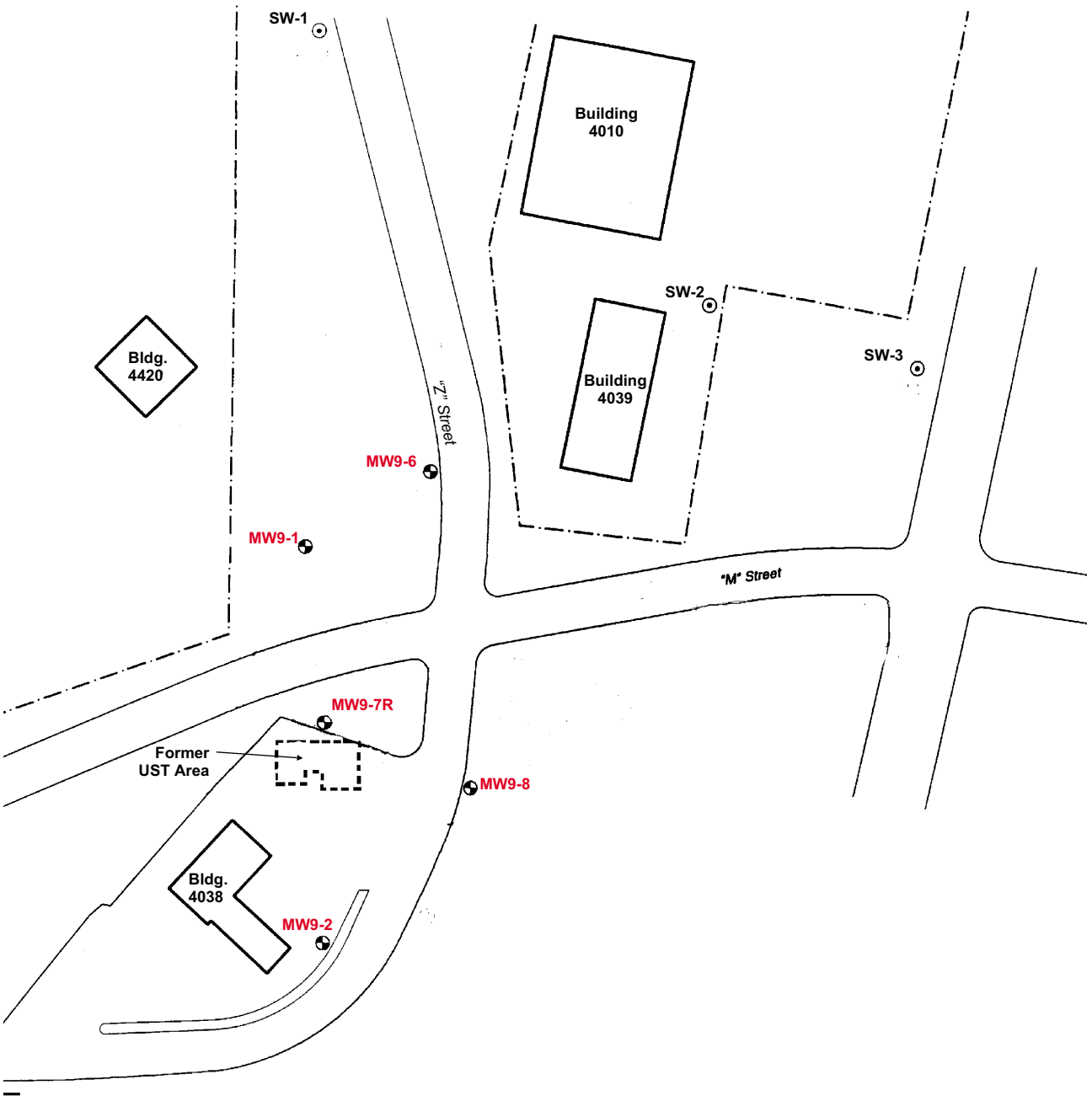

LEGEND

- Monitoring well
- Sentry well
- Fence
- MW9-2 — Monitoring well selected for VOC sampling using PDBS technique

SCALE (ft.)
0 40 80

FIGURE 3.2

MONITORING WELL LOCATIONS SWMU 66

Permeable Diffusion Bag
Sampler Demonstration
Keesler AFB, Mississippi

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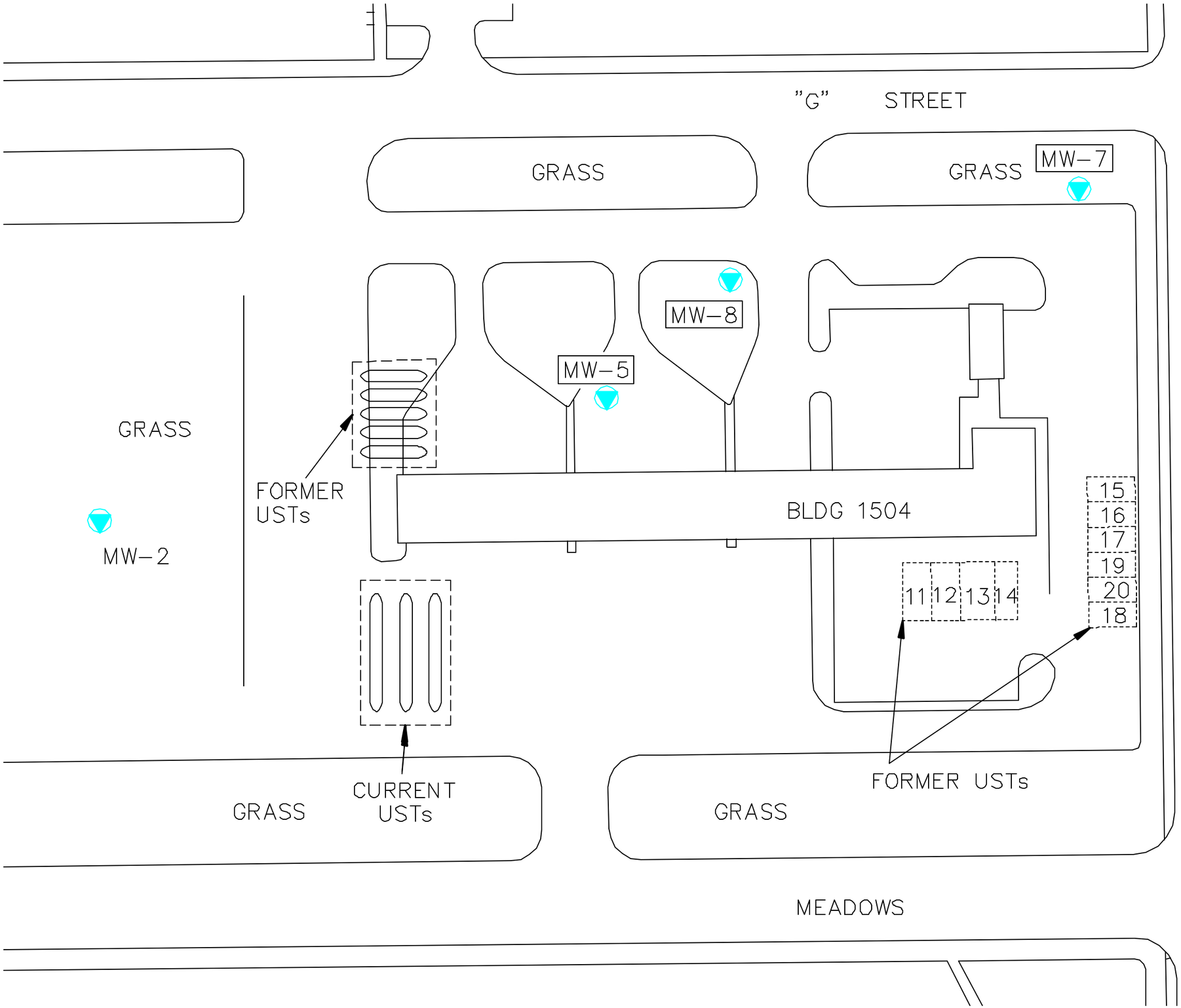

LEGEND

MW-2 MONITORING WELL

MW-5 MONITORING WELL SELECTED FOR VOC SAMPLING USING PDBS TECHNIQUE

N

30' 15' 0' 30' 60'

SCALE: 1" = 60'

FIGURE 3.3

MONITORING WELL LOCATIONS
AOC-A/FACILITY 1504

PASSIVE DIFFUSION BAG
SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

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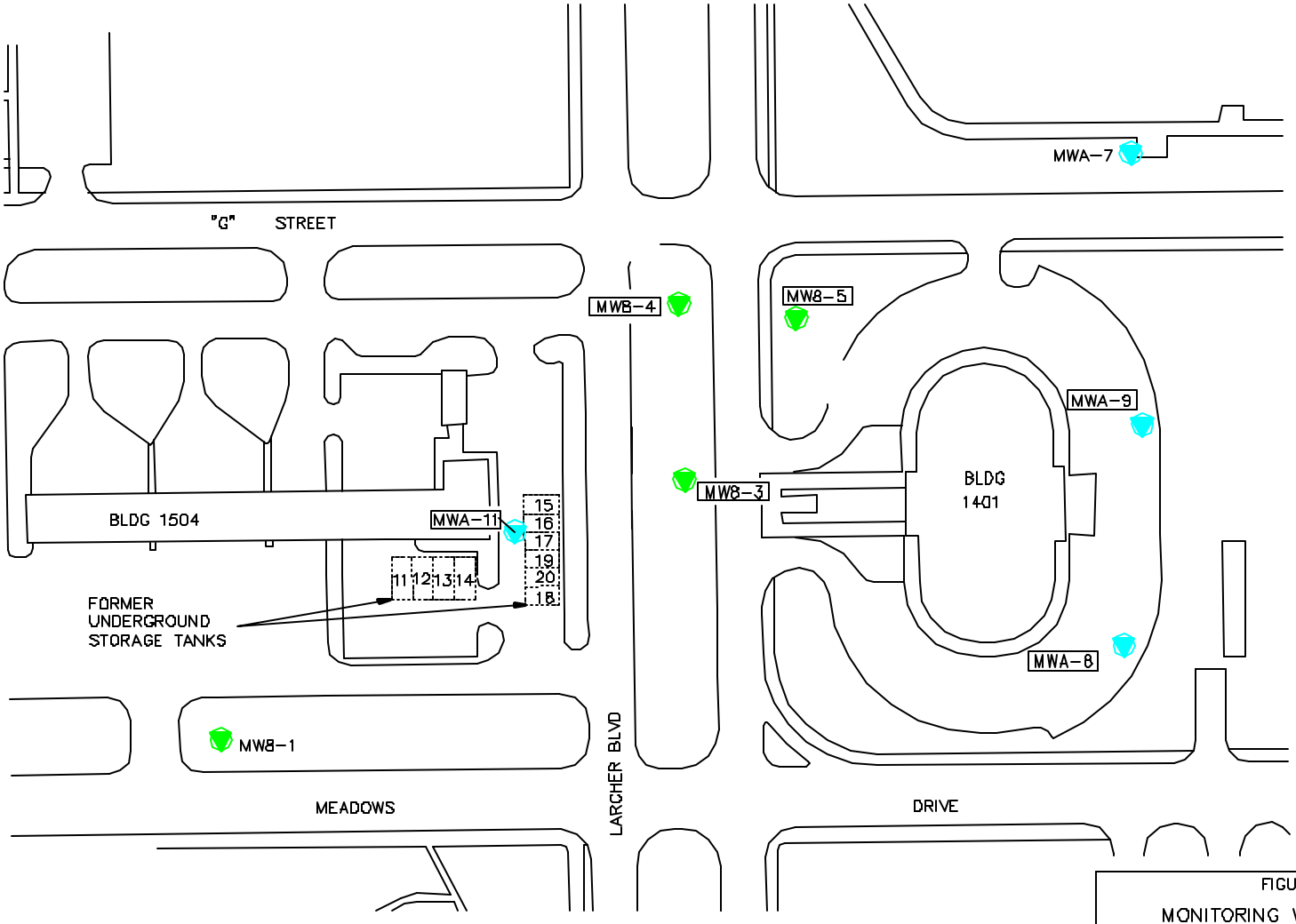

FIGURE 3.4

MONITORING WELL LOCATIONS
AOC-A/BX SERVICE STATION

PASSIVE DIFFUSION BAG
SAMPLER DEMONSTRATION
KEESLER AFB, MISSISSIPPI

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for analysis of the samples collected via conventional techniques during the LTM event starting in May 2001. Field quality control samples will be collected at the following frequencies:

- 10 percent field duplicates;
- 5 percent matrix spikes and matrix spike duplicates;
- 1 pre-installation equipment blank; and
- 1 trip blank per cooler of samples.

The reported compounds for samples collected at the BX and AAFES Service Stations and SWMU 66 will include only BTEX and MTBE. The full target analyte list for Method SW8260B will be reported for SWMU 16/37 samples. These reporting procedures are identical to those that will be used for the LTM event performed by the Parsons Atlanta office. The Quality Assurance Program Plan (QAPP) for the LTM program at Keesler AFB will be adopted as the site-specific addendum to the PDBS QAPP as appropriate.

3.1.2 Contaminant Profiling

Per the AFILEV project work plan (Parsons, 2001), contaminant profiling within the screened intervals of the LTM wells was intended to be conducted using field-screening methods, with only the sample exhibiting the highest VOC concentrations based on the field screening being submitted for laboratory analysis. However, the field test kits for fuel hydrocarbon and chlorinated solvents specified in the AFILEV PDBS Project Work Plan (Parsons, 2001) are not appropriate for use at Keesler AFB because recently reported VOC concentrations in several of the monitoring wells are below the minimum quantitation limits of the field test kits.

Therefore, the field test kits will not be used to screen groundwater samples at Keesler AFB. Rather, sample aliquots will be collected from all PDBSs to be installed and shipped to STL for analysis. Thus, vertical profiling of VOC concentrations within each well will be completed using fixed-based laboratory analyses rather than field-screening methods.

3.1.3 Analytical Results Comparison/Evaluation

Analytical results for groundwater samples collected using the PDBSs and using conventional techniques will be compared, and the results will be evaluated. Typically, if maximum concentrations from the PDBS are higher than concentrations in samples collected using the conventional method, it is probable that the concentrations from the PDBS are more representative of ambient groundwater chemistry conditions than are the conventional-sampling data (Vroblesky, 2000). If, however, the conventional method produces VOC results that are higher by a predetermined amount than the concentrations reported for the PDBS, then the PDBS may not adequately represent local ambient groundwater conditions. In this case, the difference may be due to a variety of factors, including hydraulic and chemical heterogeneity within the saturated screened interval of

the well, vertical flow of groundwater within the well, and/or the relative permeability of the well screen with respect to the surrounding aquifer matrix (Vroblesky, 2000).

Considering the above guidance, if the maximum analytical result obtained using the PDBS is greater than or equal to the conventional sampling result, it will indicate that the PDBS method is appropriate for use in that particular well and no further comparison of results will be performed. However, if the maximum PDBS result is less than the conventional sampling result, further comparison of the two sets of results will be undertaken. In this instance, analytical results for samples collected using the diffusion samplers will be compared to results from the conventional sampling using relative-percent-difference (RPD), as defined by the following equation:

$$RPD = 100*[abs(D-C)]/[(D+C)/2]$$

Where:

abs = absolute value

D = diffusion sampler result

C = conventional sample result.

For this investigation, an RPD of less than 15 (McClellan AFB, 2000) will be considered to demonstrate good correlation between sample results. Calculated RPDs in excess of 15 will be reviewed individually in an attempt to determine the reason for the variance.

3.2 Monitoring Network Optimization Evaluation

A portion of the groundwater monitoring network at this installation will be evaluated using both qualitative assessments and a geographical information system (GIS)-based algorithm that performs statistically based temporal and spatial analyses of monitoring-well information. Locations and completion intervals of individual monitoring wells and sampling points will be examined, and the informational contribution of each well or sampling point to the network will be weighed against the cost of monitoring at that point. Monitoring protocols and analytical methods also will be evaluated. Where warranted, recommendations will be developed for optimization of the portion of the monitoring network that is evaluated. Methods to be used in the evaluation will include, but are not limited to, qualitative hydrogeologic and hydrochemical analyses, application of statistical optimization techniques, and application of decision-logic structures.

Parsons will coordinate with Keesler AFB to determine which wells to include in the evaluation. The results of the evaluation will be included in the Site-Specific Diffusion Sampler Demonstration Report for Keesler AFB.

4.0 PROJECT ORGANIZATION

Addresses and telephone numbers of the Keesler PDBS management and support team are as follows:

Name	Title	Address	Phone/Email	Fax
Dr. Javier Santillan	AFCEE COR	AFCEE/ERT 3207 North Road Brooks AFB, TX 78235-5363	(210) 536-5207 email: javier.santillan@hqafcee.brooks.af.mil	(210) 536-4330
Mr. Jack Sullivan	Parsons ES Program Manager	Parsons ES, Inc. 901 N.E. Loop 410 Suite 610 San Antonio, TX 78209	(210) 828-4900 email: jack.sullivan@parsons. com	(210) 828-9440
Ms. Linda Murray	Parsons ES TO/Project Manager	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1904 email: linda.murray@parsons.com	(303) 831-8208
Mr. Doug Downey	Parsons ES Technical Director for PDBS	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1915 email: doug.downey@parsons.com	(303) 831-8208
Mr. John Anthony	Parsons ES Technical Director for Statistics	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1910 email: john.anthony@parsons.com	(303) 831-8208
Mr. John Hicks	Parsons ES PDBS Task Manager	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1941 email: john.hicks@parsons.com	(303) 831-8208
Mr. John Tunks	Parsons ES PDBS Deputy Task Manager	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-8740 email: john.tunks@parsons.com	(303) 831-8208
Ms. Lynette Lamenskie	Parsons ES Site Manager	1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1983 email: lynette.lamenskie@parsons.com	(303) 831-8208
Mr. Bradley P. Varhol	PDBS Vendor	EON Product, Inc. P.O. Box 390246 Snellville, GA 30039	(800) 474-2490 web site: www.eonpro.com email: sales@eonpro.com	(770) 978-8661
Ms. Lisa Noble	Keesler AFB Point of Contact	81st CES/CEV 508 L Street Keesler AFB, MS 39534-2115	(228) 377-8255 email: lisa.noble@keesler.af.mil	(228)377-8255

Name	Title	Address	Phone/Email	Fax
Mr. Ross Surrency	Parsons - Atlanta , LTM Field Team Leader	5390 Triangle Pkwy – STE 100 Norcross, GA 30092	(770) 446-4900 Email: ross.surrency@parsons.com	(770) 446-4910
Mr. Jimmy Duncan	Parsons-Atlanta, PM for Keesler LTM	5390 Triangle Pkwy – STE 100 Norcross, GA 30092	(740) 373-4071 email: jimmy.duncan@parsons.com	(770) 446-4910
Ms. Linda Wolfe	STL, Inc.	STL Savannah 5102 LaRoche Avenue Savannah, Georgia 31404	(912) 354-7858 email: lwolfe@stl-inc.com	(912) 351-3673

5.0 SCHEDULE

Work performed as part of this demonstration at Keesler AFB will be completed according to the schedule summarized below.

- Submittal of the Draft Keesler AFB PDBS Work Plan to commenting parties: May 16, 2001
- Receipt of Draft Keesler AFB PDBS Work Plan Comments: May 18, 2001
- Submittal of the Final Keesler AFB PDBS Work Plan: May 25, 2001
- Install PDBS samplers in monitoring wells at Keesler AFB: May 23-24, 2001
- Remove PDBS samplers from monitoring wells at Keesler AFB: June 6 - 7, 2001
- Preparation of the Draft Keesler AFB PDBS Report: July 9 - August 10, 2001

6.0 REPORTING

The site-specific results report will provide a map and accompanying table identifying the location and depth for each PDBS sample collected. Analytical results collected as part of this study will be compared to conventional-sampling analytical results collected by Parsons in a scientifically defensible manner using statistical analyses. The results of the statistical comparisons will be presented in a clear and logical manner in the results report. Statistical methods will include calculation of RPDs between PDBS and conventional sampling results, and possibly parametric or non-parametric analysis of variance (ANOVA) tests. The draft version of this report will be distributed according to the schedule presented in Section 5.

7.0 REFERENCES

Brown, G.F., V.M. Foster, R.W., Adams, E.W. Reed, and H.O. Padgett. 1944. Geology and Ground Water Resources of the Coastal Area in Mississippi. Mississippi State Geological Survey Bulletin 60.

McClellan AFB. 2000. Final Passive Diffusion Membrane Samplers Technology Application Analysis Report. National Environmental Technology Test Sites (NETTS). August.

Parsons Engineering Science (Parsons). 1998. Draft Final RCRA Facility Investigation, SWMU 16/37, Keesler Air Force Base, Mississippi. May

Parsons. 1999a. *Final Corrective Action Plan for the Risk-Based Closure of the Base Exchange Service Station, Area of Concern – A (ST-06)*. Keesler Air Force Base, Mississippi. April.

Parsons. 1999b. RCRA Facility Investigation, Keesler Air Force Base, Mississippi. April.

Parsons. 2001. *Draft Work Plan for the Air Force Environmental Directorate Passive Diffusion Sampler Demonstration*. April.

Vroblesky, D. A. 2001. *User's Guide for Polyethylene-Based Passive Diffusion Bag Samplers to Obtain Volatile Organic Compound Concentrations in Wells*. US Geological Survey Water-Resources Investigations Report 01-4060. Columbia, South Carolina.

APPENDIX A

HEALTH AND SAFETY PLAN ADDENDUM

ADDENDUM TO THE PROGRAM HEALTH AND SAFETY PLAN
FOR THE EVALUATION OF
PASSIVE DIFFUSION BAG SAMPLERS (PDBS)

AT

KEESLER AIR FORCE BASE
BILOXI, MISSISSIPPI

MAY 2001

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
1700 Broadway, Suite 900
Denver, Colorado 80290

Reviewed and Approved By:

	Name	Date
Project Manager	_____	_____
Office Health and Safety Representative	_____	_____

1.0 INTRODUCTION

This addendum modifies the existing program health and safety plan entitled *Program Health and Safety Plan for the Evaluation of Passive Diffusion Bag Samplers (PDBSs)* (Parsons Engineering Science, Inc., [Parsons] 2001) for the evaluation of the use of PDBSs in existing groundwater monitoring programs at selected Department of Defense installations across the United States. This work is being performed under contract number F41624-00-D-8024 Task Order 0024, Air Force Center for Environmental Excellence (AFCEE), Brooks Air Force Base.

This addendum to the program health and safety plan was prepared to address the upcoming tasks at Keesler Air Force Base (AFB) in Mississippi. Included or referenced in this addendum are the scope of services, site specific description and history, project team organization, hazard evaluation of physical hazards and of known or suspected chemicals, and emergency response information. All other applicable portions of the program health and safety plan remain in effect.

2.0 SCOPE OF SERVICES

Site activities will involve the placement of a water-filled diffusive membrane capsule in a well installation device at a specific depth in an existing groundwater monitoring well. The wells are located in various areas throughout the base. After a specified period of time, the water in the sampler is transferred to a sample container and submitted for laboratory analysis. No drilling or ground-intrusive activities are anticipated under the current scope of work.

3.0 SITE SPECIFIC DESCRIPTION HISTORY

The descriptions, history, and maps for the various sites are contained in the work plan entitled *Site-Specific Work Plan for the Passive Diffusion Bag Sampler Demonstration at Keesler AFB, Mississippi*.

4.0 PROJECT TEAM ORGANIZATION

The project team assigned to the PDBS demonstration activities at Keesler AFB is identified in the program health and safety plan. The following personnel will also be involved in this project.

Ms. Linda Murray	Project Manager
Mr. John Hicks	Task Manager
Ms. Lynette Lamenskie	Site Manager
Ms. Lynette Lamenskie	Site Health and Safety Officer
Ms. Lisa Noble	Keesler AFB Site Contact

5.0 HAZARD EVALUATION

5.1 Chemical Hazards

The primary contaminants of concern at the various sites are chlorinated solvents and the volatile hydrocarbon constituents benzene, toluene, ethylbenzene, and xylenes

(BTEX). Health hazard qualities for these and other compounds are presented in Table 5.1 at the end of this addendum. If other contaminants are found to exist at the site, this addendum will be modified to include the necessary information that will then be communicated to the onsite personnel.

5.2 Physical Hazards

Potential physical hazards at Keesler AFB include hazards associated motor vehicles; slip, trip, and fall hazards; noise; and heat exposure. These hazards are discussed in the program health and safety plan.

5.3 Biological Hazards

An abundance of red fire ants may be observed at Keesler AFB, especially in the vicinity of the existing monitoring wells. Do not stand on, place equipment on or otherwise disturb the anthills. It is also advisable to place a four foot square piece of plywood where personnel need to stand. An insect repellent may be used if it does not interfere with the desired groundwater sampling analyses. Latex booties taped at the top or Tyvek® suits may also be used. Frequent self-checks for crawling ants should also be performed.

6.0 EMERGENCY RESPONSE PLAN

6.1 Emergency Contacts

In the event of any emergency situation or unplanned occurrence requiring assistance, the appropriate contacts should be made from the list below. A list of emergency contacts must be posted at the site.

Contingency Contacts	**Telephone Number**
Base Fire Department	117 or (228) 377-3441
Base Police Department	117 or (228) 377-2916
Poison Control Center	(800) 962-1253
Site Contact: Lisa Noble	(228) 377-8255
Medical Emergency (on-base facility)	
Base Clinic	Keesler AFB Medical Clinic
Address	J Street
Telephone Number	117 or (228) 377-6555
Ambulance	117 or (228) 377-6555
Travel Time from Sites	5-10 minutes
Medical Emergency (off-base facility)	
Nearest Hospital	Biloxi Regional Medical Center

Address	150 Reynoir Street, Biloxi, MS
Telephone Number	911 or (601) 432-1571
Ambulance	911
Travel Time from Base	5-10 minutes

Directions to the Base Clinic: **(See attached map, Page 4)**

Directions to the Off-Base Hospital: **(See attached map, Page 5)**

Parsons ES Contacts	**Telephone Number**
Linda Murray Project Manager	(303) 831-8100 or 764-1904 (Work) (303) 279-9129 (Home)
John Hicks Task Manager	(303) 831-8100 or 764-1941 (Work) (303) 279-3698 (Home)
Tim Mustard, CIH Program Health and Safety Manager	(303) 831-8100 or 764-8810 (Work) (303) 450-9778 (Home)
Ed Grunwald, CIH Corporate Health and Safety Manager	(678) 969-2394 (Work) (404) 299-9970 (Home)
Judy Blakemore Assistant Program Health and Safety Manager	(303) 831-8100 or 764-8861 (Work) (303) 828-4028 (Home) (303) 817-9743 (Mobile)

7.0 LEVELS OF PROTECTION AND PERSONAL PROTECTIVE EQUIPMENT REQUIRED FOR SITE ACTIVITIES

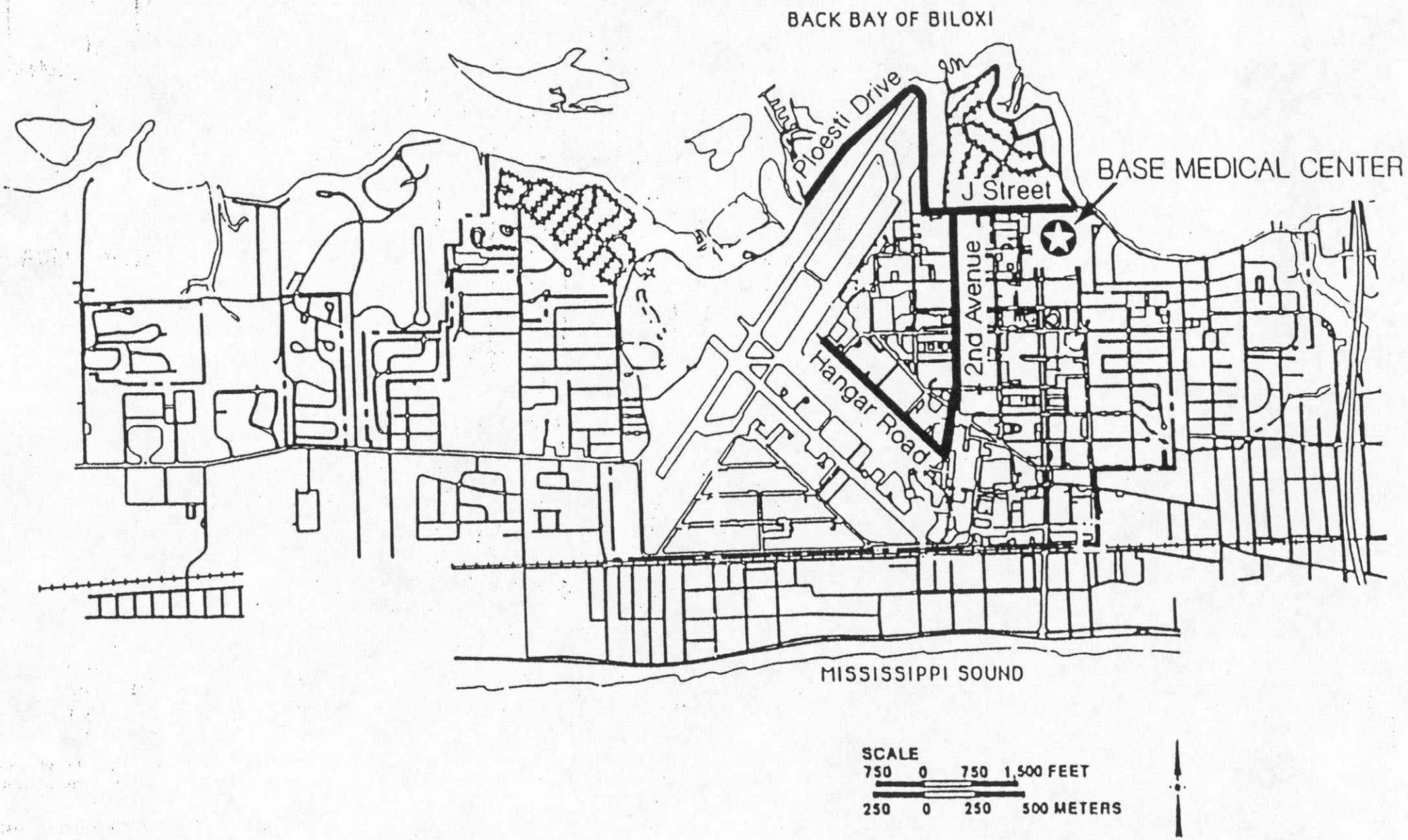
The personal protection level prescribed for field activities at Keesler AFB is Occupational Safety and Health Administration (OSHA) Level D with a contingency for the use of OSHA Level C or B, as site conditions require. The flow chart presented in Figure 7.1 of the program health and safety plan and this addendum will be used to select respiratory protection with the following comments and additions.

A sustained air monitoring reading in the worker breathing zone greater than or equal to 1 part per million (ppm) above background for 30 seconds or longer as indicated by the photoionization detector will require the use of a Dräger® tube or the equivalent to determine if vinyl chloride is present at a concentration greater to or equal to the permissible exposure limit (PEL) of 1 ppm.

If vinyl chloride is found to exist in the worker-breathing zone at concentrations above 1 ppm above background, additional work must be performed in OSHA Level B personal protective equipment (PPE) due to the inadequate warning properties of the compounds.

LOCATION OF MEDICAL CENTER

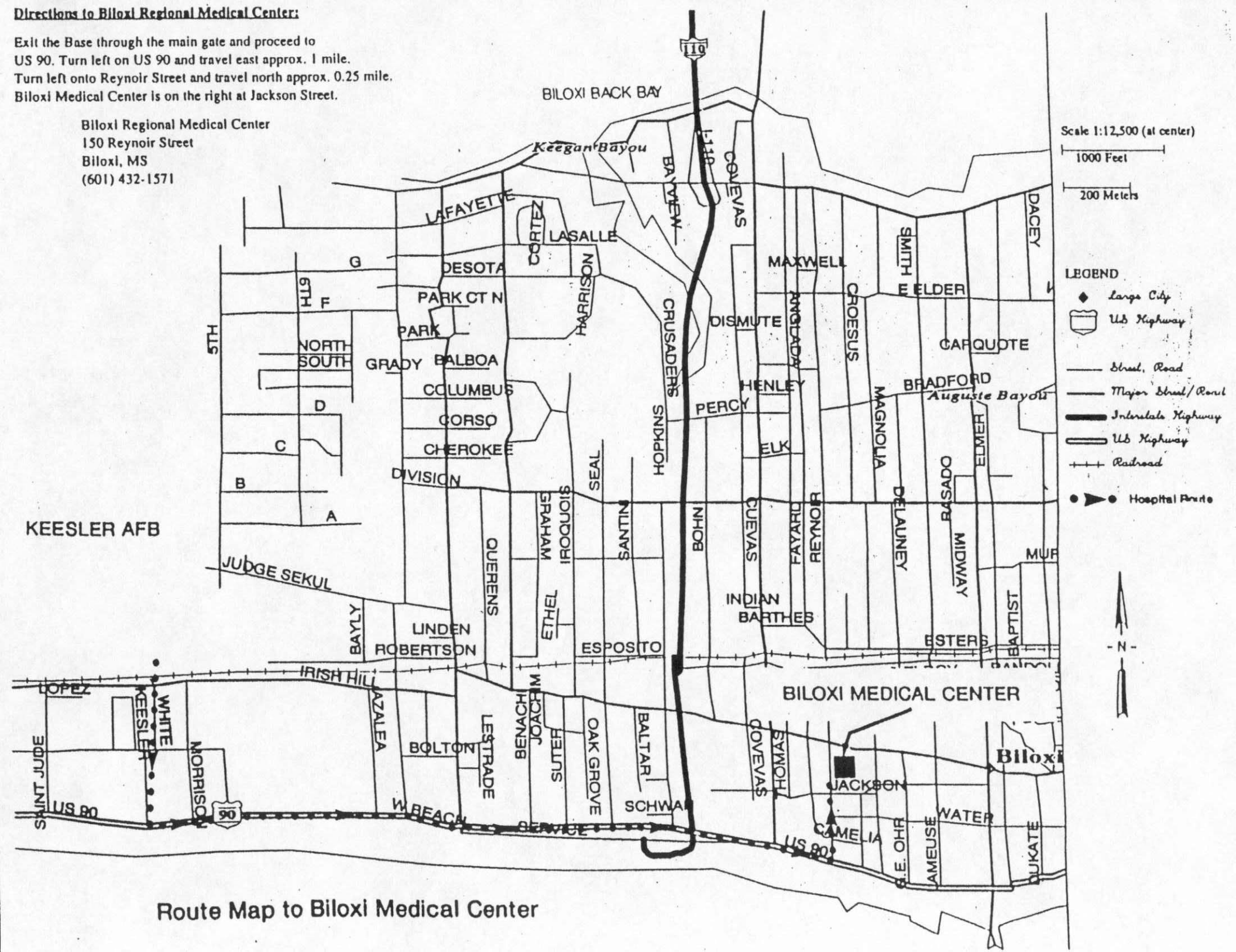
KEESLER AFB



Directions to Biloxi Regional Medical Center:

Exit the Base through the main gate and proceed to
US 90. Turn left on US 90 and travel east approx. 1 mile.
Turn left onto Reynoir Street and travel north approx. 0.25 mile.
Biloxi Medical Center is on the right at Jackson Street.

Biloxi Regional Medical Center
150 Reynoir Street
Biloxi, MS
(601) 432-1571



Route Map to Biloxi Medical Center

A reading of 5 part per million (ppm) above background in the worker breathing zone as indicated by the photoionization detector will require the use of a Dräger® tube or the equivalent to determine if benzene is present at a concentration greater than or equal to the PEL of 1 ppm. The flow chart presented in Figure 7.1 and appropriate text in the Program Health and Safety Plan (HASP) then will be used to select respiratory protection against volatile hydrocarbon constituents.

If sustained air-monitoring readings in the worker-breathing zone persist at or above 25 ppm, Dräger® tubes or the equivalent must be used to confirm or deny the presence of tetrachloroethene (PCE). Due to the inadequate warning properties of PCE, Level B protection must be used if concentrations of PCE exceed 25 ppm above background in the worker-breathing zone.

If PCE is not present, continue to monitor the air in the worker-breathing zone. If concentrations in the worker-breathing zone persist above 25 ppm above background as indicated by the PID, periodic use of the PCE Dräger® tubes must be used to confirm the absence of PCE.

If the PID indicates concentrations at or above 50 ppm above background in the worker-breathing zone, the screening process must be repeated with trichloroethene (TCE) Dräger® tubes to confirm or deny the presence of TCE.

Section 7 of the Program HASP contains guidelines for selection of PPE. PPE will be required when handling contaminated samples and when working with potentially contaminated materials. See Page 7-4 of the HASP for PPE to be used.

8.0 FREQUENCY AND TYPES OF AIR MONITORING

A photoionization detector (PID) with an 10.2 electron volts (eV) (HNU®) or equivalent lamp will be used for air monitoring during this project since the ionization potentials of the contaminants of concern are below 10.2 eV.

TABLE 5.1 HEALTH HAZARD QUALITIES OF HAZARDOUS SUBSTANCES OF CONCERN

Compound	PEL [a/] (ppm)	TLV [b/] (ppm)	IDLH [c/] (ppm)	Odor Threshold [d/] (ppm)	Ionization Potential [e/] (eV)	Physical Description/Health Effects/Symptoms
Benzene	1 (29 CFR 1910.1028) [f]	0.5 (skin) [g/]	500	4.7	9.24	Colorless to light-yellow liquid (solid<42°F) with an aromatic odor. Eye, nose, skin, and respiratory system irritant. Causes giddiness, headaches, nausea, staggered gait, fatigue, anorexia, exhaustion, dermatitis, bone marrow depression, and leukemia. Mutagen, experimental teratogen, and carcinogen.
1,2-Dichloroethene (DCE) (cis- and trans-isomers)	200	200	1,000	0.085-500	9.65	Colorless liquid (usually a mixture of cis- and trans- isomers), with a slightly acrid, chloroform-like odor. Irritates eyes and respiratory system. CNS depressant. Cis- isomer is a mutagen.
Ethylbenzene	100	100	800 (10% LEL) [h/]	0.25-200	8.76	Colorless liquid with an aromatic odor. Irritates eyes, skin, and muco membranes. Causes dermatitis, headaches, narcosis, and coma. Mutagen and experimental teratogen.
Perchlorethylene (Tetrachloroethene or PCE)	25 [i/]	25	150	5-50	9.32	Colorless liquid with a mild chloroform odor. Eye, nose, skin and throat irritant. Causes nausea, flushed face and neck, vertigo, dizziness, headaches, hallucinations, incoordination, drowsiness, coma, pulmonary changes, and skin redness. Cumulative liver, kidne and CNS damage. In animals, causes liver tumors. Mutagen, experimental teratogen, and carcinogen.
Toluene	100	50 (skin)	500	0.2-40 [j/]	8.82	Colorless liquid with sweet, pungent, benzene-like odor. Irritates eye and nose. Causes fatigue, weakness, dizziness, headaches, hallucinations or distorted perceptions, confusion, euphoria, dilated pupils, nervousness, tearing, muscle fatigue, insomnia, skin tingling, dermatitis, bone marrow changes, and liver and kidney damage. Mutagen and experimental teratogen.
Trichloroethene (TCE)	50	50	1,000	21.4-400	9.45	Clear, colorless or blue liquid with chloroform-like odor. Irritates sk and eyes. Causes fatigue, giddiness, headaches, vertigo, visual disturbances, tremors, nausea, vomiting, drowsiness, dermatitis, skin tingling, cardiac arrhythmia, and liver injury. In animals, causes liver kidney cancer. Mutagen, experimental teratogen, and carcinogen.
Vinyl Chloride	1 (29 CFR 1910.1017) [f/]	5	NA [k/]	260	9.99	Colorless gas (liquid<7°F) with a pleasant odor at high concentration Severe irritant to skin, eyes, and mucous membranes. Causes weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or blue skin on the extremities, liver cancer, and frostbite (liqu Also attacks lymphatic system. Mutagen, experimental teratogen, an carcinogen.

TABLE 5.1 HEALTH HAZARD QUALITIES OF HAZARDOUS SUBSTANCES OF CONCERN

Compound	PEL [a/] (ppm)	TLV [b/] (ppm)	IDLH [c/] (ppm)	Odor Threshold [d/] (ppm)	Ionization Potential [e.] (eV)	Physical Description/Health Effects/Symptoms
Xylene (o-, m-, and p-isomers)	100	100	900	0.05-200 [j/]	8.56 8.44 (p)	Colorless liquid with aromatic odor. P-isomer is a solid <56°F. Irrita eyes, skin, nose, and throat. Causes dizziness, drowsiness, staggered gait, incoordination, irritability, excitement, corneal irregularities, conjunctivitis, dermatitis, anorexia, nausea, vomiting, abdominal pair and olfactory and pulmonary changes. Also targets blood, liver, and kidneys. Mutagen and experimental teratogen.

a/ PEL = Permissible Exposure Limit. OSHA-enforced average air concentration to which a worker may be exposed for an 8-hour workday without harm. Expressed as parts per million (ppm) unless noted otherwise. PELs are published in the *NIOSH Pocket Guide to Chemical Hazards*, 1997. Some states (such as California) may have more restrictive PELs. Check state regulations.

b/ TLV = Threshold Limit Value - Time-Weighted Average. Average air concentration (same definition as PEL, above) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH), *TVLs® and BEIs®* (1999).

c/ IDLH = Immediately Dangerous to Life or Health. Air concentration at which an unprotected worker can escape without debilitating injury or health effects. Expressed as ppm unless noted otherwise. IDLH values are published in the *NIOSH Pocket Guide to Chemical Hazards*, 1997.

d/ When a range is given, use the highest concentration.

e/ Ionization Potential, measured in electron volts (eV), used to determine if field air monitoring equipment can detect substance. Values are published in the *NIOSH Pocket Guide to Chemical Hazards*, June 1997.

f/ Refer to expanded rules for this compound.

g/ (skin) = Refers to the potential contribution to the overall exposure by the cutaneous route.

h/ Indicates that the IDLH value was based on 10% of the lower explosive limit for safety considerations, even though relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations *(NIOSH Pocket Guide to Chemical Hazards, 1997).*

i/ NIOSH recommends reducing exposure to the lowest feasible concentration, and limiting the number of workers exposed.

j/ Olfactory fatigue has been reported for the compound and odor may not serve as an adequate warning property.

k/ NA = Not available.