FINAL

Site-Specific Work Plan for the Passive Diffusion Bag Sampler Demonstration at the former Richards-Gebaur AFB, Missouri

Prepared For

U.S. Department of the Army, Corps of Engineers,
Omaha District
Omaha, Nebraska

Contract 44650-99-D-005
Delivery Order DK01

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September 2002

FINAL

SITE-SPECIFIC WORK PLAN FOR THE PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION AT THE FORMER RICHARDS-GEBAUR AFB, MISSOURI

September 2002

Prepared for:

U.S. Army Corps of Engineers, Omaha District

and

Air Force Center for Environmental Excellence
Technology Transfer Division

and

Air Force Base Conversion Agency

CONTRACT NO. F44650-99-D-0005

Delivery Order DK01

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

Page

LIST OF ACRONYMS AND ABBREVIATIONS

ADC	Air Defense Command
AFB	Air Force Base
AFBCA	Air Force Base Conversion Agency
AFCC	Air Force Communications Command
AFCEE/ERT	Air Force Center for Environmental Excellence, Technology Transfer Division
ASL	Applied Science Laboratories
AST	aboveground storage tank
bgs	below ground surface
BRAC	Base Realignment and Closure
COC	contaminant of concern
DCE	dichloroethene
DoD	Department of Defense
ft/day	feet per day
ft/year	feet per year
GSA	General Services Administration
HASP	Health and Safety Plan
MCL	maximum contaminant level
MNO	monitoring network optimization
Parsons	Parsons Engineering Science, Inc.
PCE	tetrachloroethene
PDBS	passive diffusion bag sampler
POL	petroleum, oil, and lubricants
QAPP	Quality Assurance Project Plan
QGM	Quarterly Groundwater Monitoring
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
RPO	remedial process optimization
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TCE	trichloroethene
USACE	US Department of the Army, Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Project Description and Location

On 22 January 2002, Parsons Engineering Science, Inc. (Parsons) was awarded delivery order DK01 under US Department of the Army, Corps of Engineers (USACE) Contract Number F44650-99-D-0005 to provide services, technical labor-hours, and materials to support Remedial Process Optimization (RPO) evaluations and demonstrate the effectiveness of Passive Diffusion Bag Samplers (PDBSs) for sampling volatile organic compounds (VOCs) in existing groundwater monitoring programs at selected Base Realignment and Closure (BRAC) sites administered by the Air Force Base Conversion Agency (AFBCA). The Technology Transfer Division of the Air Force Center for Environmental Excellence (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 VOCs.

This site-specific work plan is for the demonstration of the PDBS technology at the former Richards-Gebaur Air Force Base (AFB), Missouri. The project location will include six sites (SS03, SS06, SS09, SS012, ST05, and ST011) located throughout the former base.

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 Objectives

The PDBS demonstration at Richards-Gebaur AFB has three primary objectives:

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

- Statistically compare groundwater analytical results for VOCs obtained using the current (conventional) sampling method (i.e., bailing) with results obtained using the PDB sampling method. VOC results from the scheduled October 2002 Quarterly Groundwater Monitoring (QGM) event will be compared to the results obtained using the PDBS method; and

- Compare the costs of PDB and conventional sampling.

Vertical contaminant profiles will be developed by placing PDBSs at discrete depths within the saturated screened interval of each monitoring well included in the demonstration, and analyzing the resulting samples for VOCs. The resulting information will aid the Base in evaluating contaminant migration and fate in the saturated zone, and will allow optimization of the basewide groundwater sampling and analysis program. 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.

A secondary objective of this project is to perform a monitoring network optimization (MNO) at Richards-Gebaur AFB using a three-tiered optimization approach. This approach consists of a qualitative evaluation, an evaluation of temporal trends in contaminant concentrations, and a spatial statistical analysis. The evaluation assesses the frequency of monitoring, as well as the number and location of wells in the monitoring network to determine an efficient and effective monitoring network for the site. Ultimately, recommendations are developed to optimize the groundwater monitoring program.

1.3 Scope

The sampling demonstration at Richards-Gebaur AFB 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 in mid-September 2002 to provide adequate equilibration time before the current sampling contractor for Richards-Gebaur AFB (CH2MHill) begins the scheduled QGM sampling event on or about 7 October 2002. To the extent feasible, the PDBSs will be retrieved immediately prior to the conventional QGM sampling at the selected locations 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 Draft BRAC PDBS Project Work Plan (Parsons, 2002).

For the MNO, 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. A maximum of 30 monitoring wells at this installation will be evaluated as part of this task. Parsons will coordinate with Richards-Gebaur 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 Richards-Gebaur AFB.

1.4 Document Organization

This work plan is organized into seven sections, including this introduction, and two appendices. The site descriptions summarized from CH2MHill (2001 and 2002) are presented in Section 2. Section 3 presents the scope of the PDBS investigation at Richards-Gebaur 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 Program Health and Safety Plan (HASP) (Parsons, 2002). Appendix B presents selected groundwater sampling procedures from the Final Richards-Gebaur Air Force Base Basewide Remedial Investigation/Feasibility Study (RI/FS) Work Plan (CH2MHill, 1999).

2.0 SITE DESCRIPTION

2.1 Location and Description of Richards-Gebaur AFB

Richards-Gebaur AFB is located approximately 18 miles south of downtown Kansas City, Missouri (Figure 2.1). The Base is bordered by Kansas City on the north and west, and the city of Belton on the east and south.

Richards-Gebaur AFB was originally a municipal airport for the City of Kansas City known as Grandview Airport. The airport was leased by the Central Air Defense Command (ADC) in 1952, and by 1953 the property was conveyed to the United States government. The Base was renamed Richards-Gebaur AFB in 1957. In 1970 the Air Force Communications Command (AFCC) relocated its headquarters from Scott AFB to Richards-Gebaur AFB and remained there until 1977 when the Military Airlift Command took control of the Base. In 1980, the Air Force Reserve assumed control of the Base and transferred about 80 percent of the property to the General Services Administration (GSA). The GSA subsequently transferred various portions of the property to the Kansas City Aviation Department, the Federal Aviation Administration, the City of Belton, the Department of the Navy, and the Department of the Army. A lease with the Kansas City Aviation Department has allowed joint use of the airport since 1985.

Richards-Gebaur AFB was selected for closure under the Defense Base Closure and Realignment Act of 1991 and was accepted for closure on 12 July 1991. Richards-Gebaur AFB presently comprises 426 acres. The site layout is shown on Figure 2.2.

Diffusion sampling will be performed at six sites at Richards-Gebaur AFB. Following are descriptions and operational histories of each site summarized from the Draft Richards-Gebaur AFB Basewide Remedial Investigation (CH2MHill, 2001) and the Draft Basewide Remedial Investigation Report Addendum, Richards-Gebaur AFB (CH2MHill, 2002).

<u>Site SS 003 – Oil Saturated Area</u> Site SS 003 is located in the southern portion of Richards-Gebaur AFB, south of 155th Street and southwest of Building 704 (Figure 2.2). The site comprises roughly 1.4 acres. From the mid-1950s to the late 1980s, the site was used to store waste oil products generated by routine maintenance of the Motor Pool vehicles.

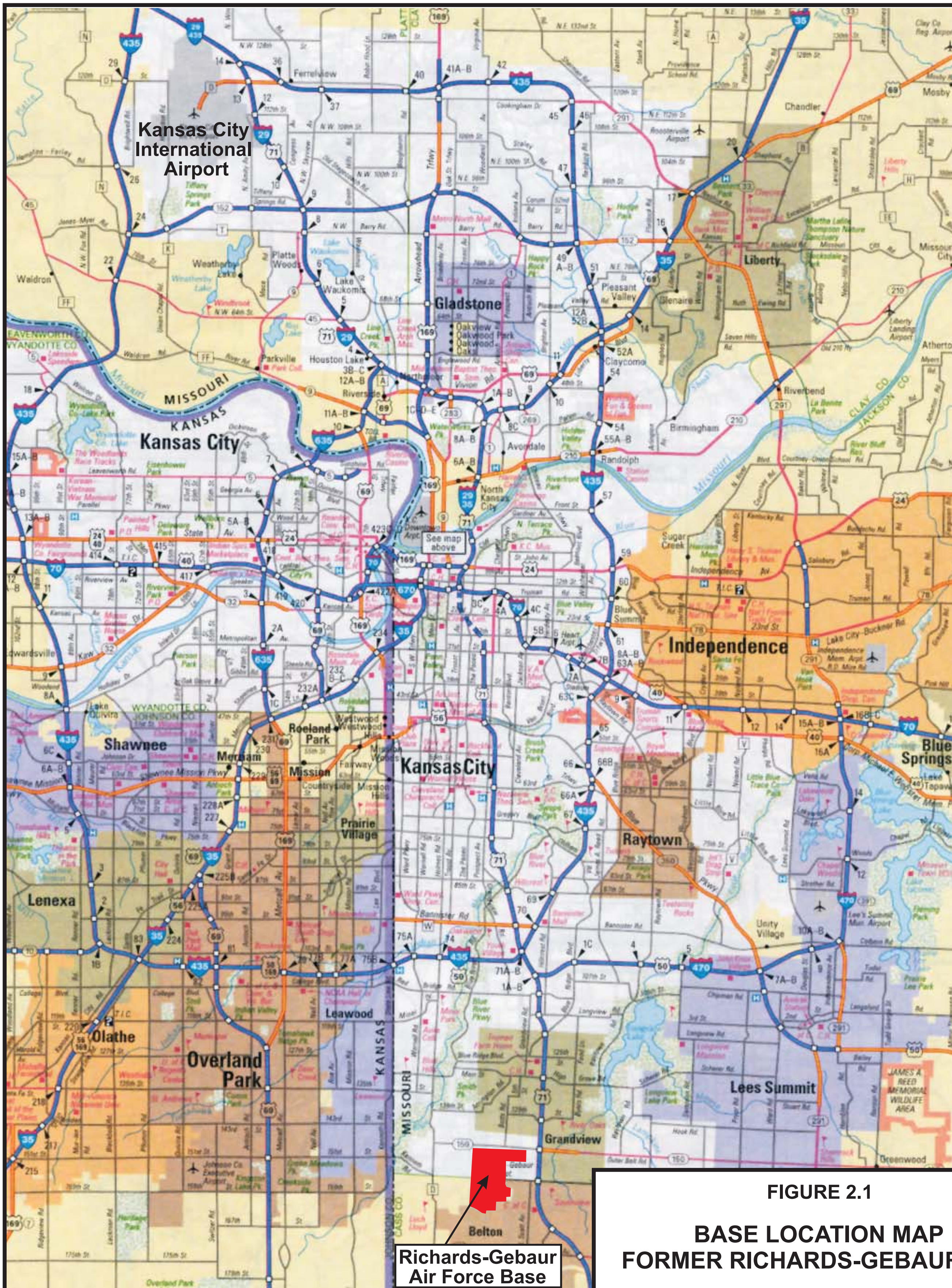

FIGURE 2.1

BASE LOCATION MAP
FORMER RICHARDS-GEBAUR AFB

Passive Diffusion Bag Sampler
Demonstration
Richards-Gebaur AFB, Missouri

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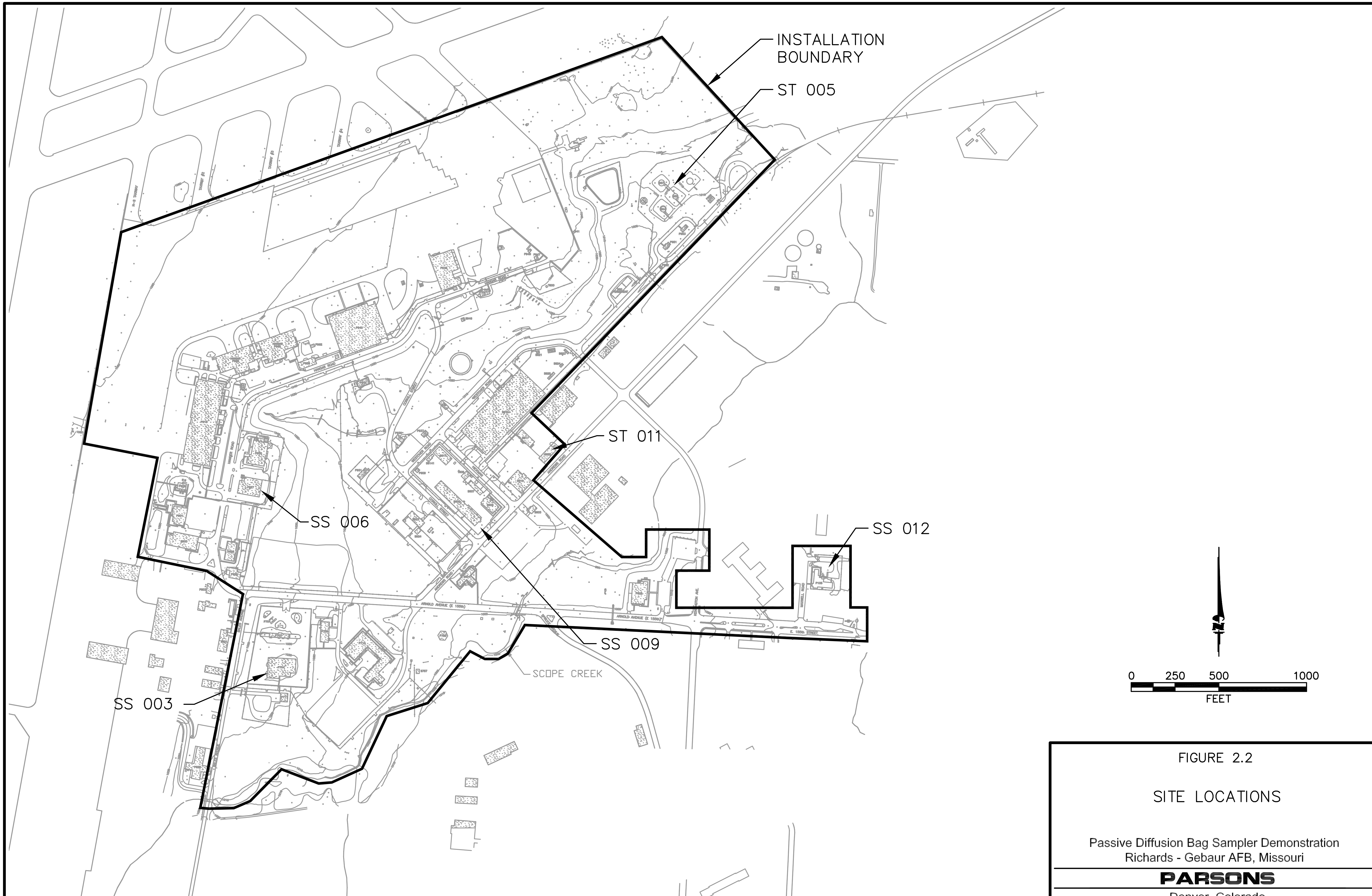


FIGURE 2.2

SITE LOCATIONS

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS

Denver, Colorado

Site SS 006 - Hazardous Material Storage Area Site SS006 is located in the west central portion of Richards-Gebaur AFB, east of Hanger Road and north of 155th Street (Figure 2.2). SS 006 is situated northeast of Building 927 and slopes downhill to the east away from the former hazardous materials storage area. Building 927 was used as an aircraft engine and propeller maintenance shop from 1957 to 1994. An area outside the rear of the building was used to store bulk supplies of degreasers, solvents, oils and other common workshop materials.

Site SS 009 - Fire Valve Area Site SS009 is located in the southeastern portion of Richards-Gebaur AFB, adjacent to the southwest side of Building 605. Building 605 was part of the Civil Engineering Complex and was in use by the Air Force from 1955 until 1994. During these years, the building was used for various purposes, including a Carpenter Shop, Interior and Exterior Heat Shop, Roads and Grounds Shop, and Sanitation Shop. Reportedly, no activities at the complex involved the storage or handling of bulk hazardous waste materials.

Site SS 012 – Former Communications Facility at Building 105 Site SS 012 is located in the southeastern part of Richards-Gebaur AFB, northeast of the intersection of 155th Street and Maxwell Avenue (Figure 2.2). A diesel underground storage tank (UST) used to fuel a backup generator, was removed in 1988 and replaced by an aboveground storage tank (AST). The AST was subsequently drained and removed from the site in 2001.

Site ST 005 - Petroleum, Oil, and Lubricants (POL) storage yard Site ST 005 is located east of the flightline and west of Andrews Road, in the northeastern portion of Richards-Gebaur AFB (Figure 2.2). The site is a former AST farm that was the main receiving, storage, and dispensing facility for various fuels, oils and lubricants used by Richards-Gebaur AFB and its support services.

Site ST011 (formerly designated Site CS 004) - former UST location Site ST 011 is located in the east-central portion of Richards-Gebaur AFB (Figure 2.2). The site lies at the northwest corner of Building 620. The former UST was used between 1966 and 1988 to receive waste liquids from the adjacent Air Force fuel testing laboratories. The UST at Building 620 was removed in 1988.

2.2 Geology and Hydrogeology

Varying degrees of erosion have resulted in differences in hydrogeologic conditions at each of the six sites selected for the PDBS Demonstration. In general, subsurface conditions consist of unconsolidated, silty clay overlying shale and/or limestone bedrock. In descending order, the stratigraphic order of bedrock underlying Richards-Gebaur AFB is as follows:

- Argentine Limestone Formation,
- Lane Shale Formation,
- Raytown Limestone Member of the Iola Formation,
- Chanute Shale Formation, and

- Argentine Limestone Member of the Wyandotte Formation.

The varying geology at each site influences local hydrogeologic conditions as described in the following subsections.

Site SS03 - Subsurface material at SS 003 generally consists of 15 to 20 feet of silty clay overlying a minimum of 10 feet of weathered shale. The shale belongs to the Lane Formation, and is underlain by the Raytown Limestone Member of the Iola Formation.

Groundwater beneath SS 003 occurs at depths between 12 to 15 feet below ground surface (bgs), and is thought to flow along the silty clay/shale interface. Based on aquifer test results and hydraulic gradients measured at the site, groundwater flow in the weathered shale is toward the east and southeast at velocities estimated to range from 0.0022 to 0.028 feet per day (ft/day).

Site SS 006 - Subsurface material beneath the higher, eastern portion of Site SS 006 consists of 2 to 10 feet of silty clay overburden, underlain by 2 to 5 feet of fractured, solution-weathered limestone of the Argentine Member of the Wyandotte Formation. The limestone layer is missing from the central and western portions of the site and the silty clay directly overlies weathered Lane Shale.

Groundwater beneath Site SS 003 occurs at depths between 12 to 15 feet bgs, and is thought to flow through fractures in the transition zone between the fractured limestone and upper weathered shale. Groundwater in this zone flows generally toward the southeast at velocities estimated to range from 0.045 to 0.21 ft/day.

Site SS09 - Subsurface material at Site SS 009 generally consists of 10 to 13 feet of silty clay overlying 6 to 8 feet of Raytown Limestone. Thin remnants of the shale are described between the silty clay and limestone. The Chanute Shale Formation was noted beneath the Raytown Limestone at the bottom of several boreholes.

During drilling, groundwater was noted at the silty clay/weathered shale contact and the contact between the weathered shale and Raytown Limestone. Groundwater flows toward the south through the silty clay at a velocity on the order of 0.00015 feet per year (ft/yr). Flow velocity in the underlying limestone is estimated to be in the range of 0.00023 and 0.0027 ft/day. An upward hydraulic gradient has been observed in well pairs at SS009. Water levels measured in the deep wells have been as much as 5 feet above levels measured in the shallow wells of each pair.

Site SS012 - Subsurface materials at Site SS 012 generally consists of about 14 feet of silty clay overlying the limestone of the Raytown Member of the Iola Formation. In the northeast portion of the site, the limestone is missing and the silty clay directly overlies the Chanute Shale.

Groundwater beneath Site SS 012 occurs at depths between about 6 to 15 feet bgs, and flows along the interface between the silty clay and underlying bedrock. Groundwater flows radially away from the site toward the north and east because the site is located on a topographic high. Flow velocities at the clay/bedrock interface are estimated to range from 0.0022 to 0.031 ft/day.

Site ST 005 - Subsurface material at Site ST 005 generally consists of 5 to 10 feet of silty clay underlain by 5 to 10 feet of weathered Lane Shale, and a minimum of 5 feet of Raytown Limestone. The Chanute Shale was observed to underlie the limestone in a few borings.

Groundwater beneath Site ST 005 occurs at depths between 8 to 16 feet bgs, and is thought to flow through both the silty clay/shale interface and the underlying limestone. Groundwater in these two zones appears to be hydraulically connected as evidenced by little water level differences measured in nested wells. Based on aquifer test results and hydraulic gradients measured at the site, flow velocities in both zones were estimated to be 0.019 ft/day. Groundwater flow direction is toward the southeast.

Site ST 011 - Subsurface material at Site ST 011 generally consists of 16 feet of silty clay and weathered shale underlain by 3 to 5 feet of Raytown Limestone. The Chanute Shale was observed to underlie the limestone.

Groundwater beneath Site ST 011 occurs at depths between about 8 and 11 feet bgs. Flow is toward the southeast through both the silty clay/shale interface and the underlying limestone. Groundwater flow velocities in the silty clay/weathered shale zone are estimated to range from 0.0044 to 0.014 ft/day. In the underlying limestone, the flow velocity was estimated to be about 0.42 ft/day.

2.3 Nature and Extent of Contamination

The contaminants of concern (COCs) in groundwater beneath the AFBCA property at Richards-Gebaur AFB are primarily tetrachloroethene (PCE), trichloroethene (TCE), 1,1-dichloroethene (DCE), cis-1,2-DCE, and vinyl chloride. At each of the six PDBS sites, concentrations of COCs in groundwater exceeding maximum contaminant levels (MCLs) are generally confined to each site (i.e., contamination at concentrations exceeding MCLs does not migrate off-site). Maximum concentrations of each COC detected in groundwater samples collected from each of the six sites in April 2002 are presented in Table 2.1.

3.0 SCOPE OF PDBS DEMONSTRATION

An estimated total of 60 samples will be collected from 37 monitoring wells located at Richards-Gebaur AFB as part of this project. The 37 monitoring wells have been chosen because they 1) are located on the six sites selected for the PDBS demonstration, 2) are sampled for VOCs, and 3) are included in the QGM event scheduled for October 2002. 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 3.6.

3.1 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 CH2MHill beginning on or about 7 October 2002. Monitoring wells were selected based primarily on VOC concentrations detected during previous sampling events.

TABLE 2.1
MAXIMUM GROUNDWATER COC CONCENTRATIONS, APRIL 2002
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
RICHARDS-GEBAUR AFB, MISSOURI

	Maximum Site Concentration (μg/L)[a/]				
Site ID	PCE	TCE	1,1-DCE	cis-1,2-DCE	Vinyl Chloride
SS03	---[b/]	12.2	---	17.1	---
SS06	---	912 J[c/]	5.1	120	17.7
SS09	4.5	6.8	9.2	32.1	10.1
SS012	13.9 J	766	38.1 J	35.5	13.9 J
ST05	---	1230	1.3	2.5	---
ST011	---	23.8	---	53.3	8.3

[a/] μg/L = micrograms per liter; PCE = tetrachloroethene; TCE = trichloroethene; ,1-DCE = 1,1-dichloroethene; and cis-1, 2-DCE = cis 1, 2-dichloroethene

[b/] --- = not detected.

[c/] J = Estimated value.

TABLE 3.1
SAMPLING LOCATION SUMMARY
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
RICHARDS-GEBAUR AFB, MISSOURI

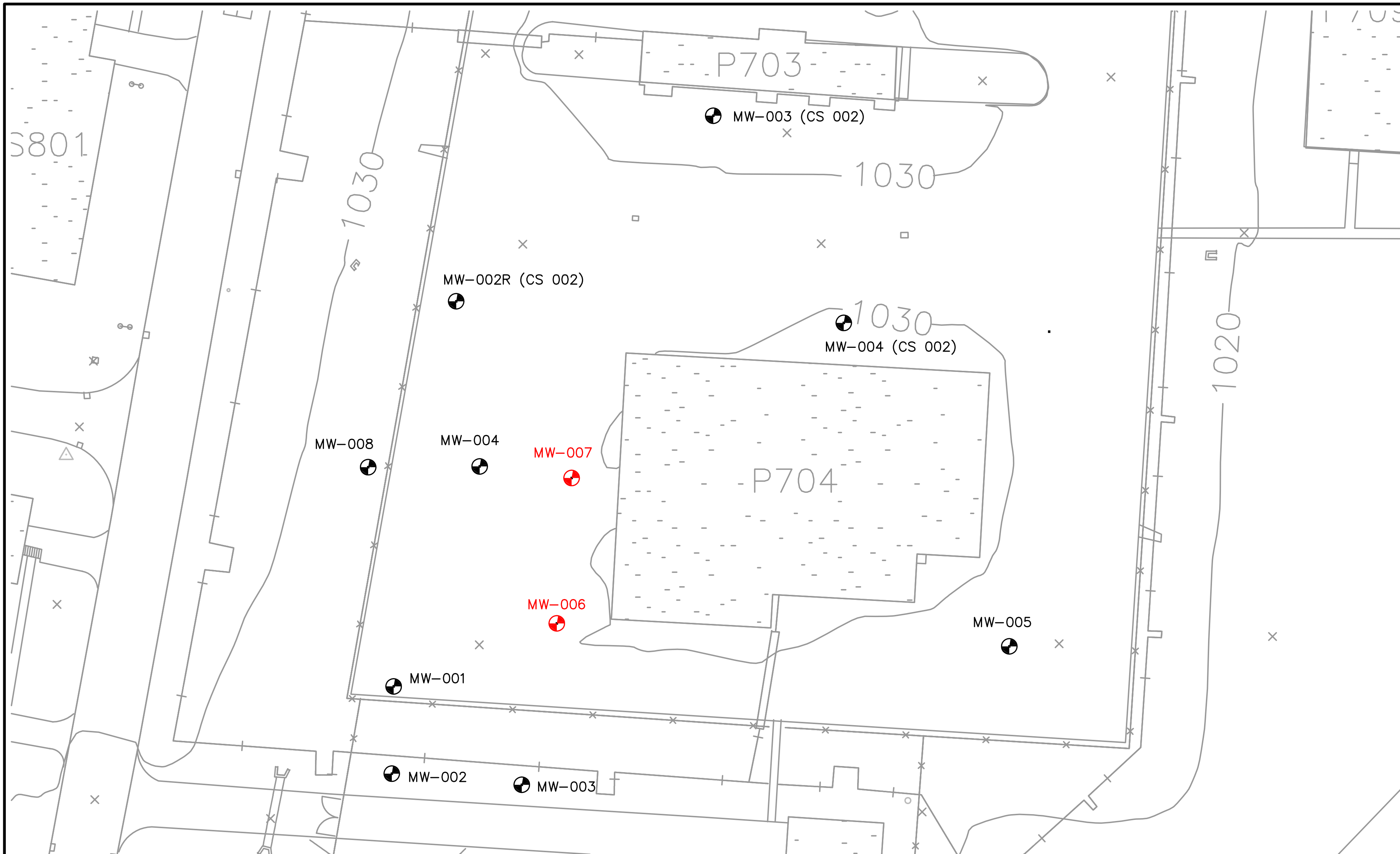
											COC Concentration (µg/L)[c/] Reported During April 2002 QGM Event						
Well ID	Total Depth (ft btoc)[a/]	Well Diameter (inches)	Screened Interval (ft btoc)	Well Stick-up (feet)	Screen Length (feet)	Top of Casing Elevation (ft amsl)[b/]	Aquifer Unit	Depth to Water October 2001 (ft btoc)	Water column Length in Oct. 2001 (feet)	Estimated Number of PDBSs	TCE	1,1 DCE	cis, 1,2 DCE	PCE	Vinyl Chloride	trans-1,2-DCE	1,1-DCA
SITE SS 003																	
SS 003-MW06	22.00	2	11.50 - 21.50	-0.45	10.0	1,030.16	weathered shale	7.90	13.15	3	7.3	---	5.8	---	---	---	---
SS 003-MW07	23.50	2	13.00 - 23.00	-0.45	10.0	1,030.16	weathered shale	6.94	15.61	3	12.2	---	17.1	---	---	---	---
SITE SS 006															---	---	---
SS 006-MW05	15.50	2	10.30 - 15.30	2.71	5.0	1,053.17	weathered shale / limestone	9.32	8.69	2	165	---	54.6	---	---	3.8	---
SS 006-MW11	10.50	2	5.50 - 10.50	2.71	5.0	1,043.72	weathered shale	8.60	4.61	1	251	---	96.3	---	---	9	---
SS 006-MW12	12.00	2	6.50 - 11.50	2.93	5.0	1,047.76	weathered shale	8.30	6.13	2	73.1	---	72.9	---	---	10.2	---
SS 006-MW14	12.00	2	6.50 - 11.50	2.64	5.0	1,027.57	weathered shale	12.19	1.95	1	78.2	---	6.4	---	---	---	---
SS 006-MW15	12.00	2	6.50 - 11.50	2.70	5.0	1,025.83	weathered shale	10.31	3.89	1	173	---	3.7	---	---	---	---
SS 006-MW18	11.00	2	5.50 - 10.50	2.92	5.0	1,046.94	weathered shale	5.45	7.97	2	20	---	34.3	---	---	---	---
SS 006-MW20	16.50	2	11.00 - 16.00	-0.50	5.0	1,011.40	silty clay / shale	4.30	11.20	2	912 J[d/]	5.1	120	---	17.7	65.3	---
SITE SS 009																	
SS 009-MW05	14.50	2	9.20 - 14.20	-0.37	5.0	1,012.86	silty clay / weathered shale	12.70	1.13	1	---	---	---	3.5	---	---	0.82
SS 009-MW06	24.00	2	18.70 - 23.70	-0.39	5.0	1,012.83	limestone	7.32	15.99	2	---	---	4	---	---	---	1.8
SS 009-MW09	24.00	2	11.20 - 16.20	-0.93	5.0	1,012.39	silty clay / weathered shale	11.84	3.43	1	6.8	9.2	32.1	4.5	10.1	6.8	---
SITE SS 012											---	---		---	---	---	---
SS 012-MW001	15.50	2	10.00 - 15.00	-0.48	5.00	1010.80	silty clay overburden	6.34	8.18	2	189	---	35.5	1.6	4.7	---	0.77
SS 012-MW002	12.50	2	7.00 - 12.00	3.08	5.00	1011.76	silty clay overburden	13.40	1.68	1	766	---	33.9	---	---	---	---
SS 012-MW003	15.00	2	9.50 - 14.50	-0.19	5.00	1009.79	silty clay overburden	7.52	6.79	2	16.6 J	38.1 J	185	13.9 J	13.9 J	---	---
SS 012-MW008	15.25	2	10.00 - 15.00	2.42	5.00	1009.60	silty clay overburden	15.18	2.24	1	289	---	5.5	---	---	---	---
SS 012-MW009	13.00	2	7.50 - 12.50	2.09	5.00	1008.57	silty clay overburden	14.20	0.39	1	46.3	---	---	---	---	---	---
SS 012-MW012	10.00	2	7.00 - 10.00	2.87	3.00	998.77	silty clay/weathered shale	11.92	0.95	1	124	---	14.4	---	---	---	---
SITE ST 005																	
ST 005-MW03	13.00	2	5.00 - 12.50	2.50	7.5	1,007.67	silty clay / limestone	8.38	6.62	2	201	---	---	---	---	---	---
ST 005-MW10	22.50	2	17.20 - 22.20	2.58	5.0	1,008.65	limestone / shale	8.87	15.91	2	12.6	---	---	---	---	---	---
ST 005-MW11	22.50	2	17.20 - 22.20	2.85	5.0	1,007.82	silty clay / limestone	11.42	13.63	2	7.8	---	---	---	---	---	---
ST 005-MW12	11.50	2	6.20 - 11.20	2.85	5.0	1,007.92	weathered shale / limestone	8.25	5.80	2	105	---	---	---	---	---	---
ST 005-MW13	24.50	2	19.20 - 24.20	2.68	5.0	1,008.93	limestone / shale	9.47	17.41	2	51.8	---	---	---	---	---	---
ST 005-MW14	13.00	2	7.70 - 12.70	2.17	5.0	1,008.33	weathered shale / limestone	8.37	6.50	2	71.4	---	---	---	---	---	---
ST 005-MW16	14.50	2	9.20 - 14.20	2.68	5.0	1,009.52	weathered shale	9.68	7.20	2	1.9	---	---	---	---	---	---
ST 005-MW18	20.50	2	15.20 - 20.20	2.82	5.0	1,014.51	weathered shale	14.26	8.76	2	1230	1.3	2.5	---	---	---	---
ST 005-MW20	10.00	2	4.50 - 9.50	2.79	5.0	1,007.73	silty clay	11.83	0.46	1	61.5	---	27.4	---	---	---	---
ST 005-MW21	10.50	2	4.50 - 9.50	2.69	5.0	1,007.10	silty clay	8.11	4.08	1	7.8	---	---	---	---	---	---
ST 005-MW22	23.00	2	17.50 - 22.50	2.68	5.0	1,016.81	weathered shale	15.40	9.78	2	3.2	---	---	---	---	---	---
SITE ST 011																	
ST 011-MW01	16.50	2	11.00 - 16.00	-0.48	5.0	1005.39	silty clay	8.78	6.74	2	---	---	18.1	---	1.8	---	---
ST 011-MW03	16.50	2	11.00 - 16.00	-0.61	5.0	1005.28	silty clay	8.60	6.79	2	1.2	---	113	---	8.3	8.8	---
ST 011-MW06	23.00	2	20.00 - 23.00	-0.31	3.0	1004.85	limestone	8.08	14.61	1	23.8	---	5.1	---	---	---	---
ST 011-MW07	23.50	2	20.50 - 23.50	-0.63	3.0	1005.11	limestone	8.19	14.68	1	5.7	---	53.3	---	4.6	4.9	---
ST 011-MW08	23.00	2	20.00 - 23.00	-0.41	3.0	1005.49	limestone	8.72	13.87	1	---	---	31.4	---	4.1	1.6	---
ST 011-MW09	19.00	2	13.50 - 18.50	-0.40	5.0	1005.72	silty clay/weathered shale	9.43	8.67	2	---	---	3.3	---	---	---	---
ST 011-MW10	22.90	2	19.50 - 22.50	-0.40	3.0	1005.78	limestone	9.36	12.74	1	---	---	1.6	---	---	---	---
ST 011-MW16	17.50	2	20.00 - 23.00	-0.52	3.0	1005.11	silty clay/weathered shale	10.67	11.81	1	---	---	5.3	---	3.8	2	---

[a/] ft btoc = feet below top of casing.

[b/] ft amsl = feet above mean sea level.

[c/] µg/L = Micrograms per liter.

[d/] J = Estimated value.



LEGEND

MW-007	WELLS SELECTED FOR PDBS DEMONSTRATION
MW-005	SITE MONITORING WELLS

FIGURE 3.1

PDBS WELL LOCATIONS
SITE SS 003 – OIL
SATURATED AREA

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS
Denver, Colorado

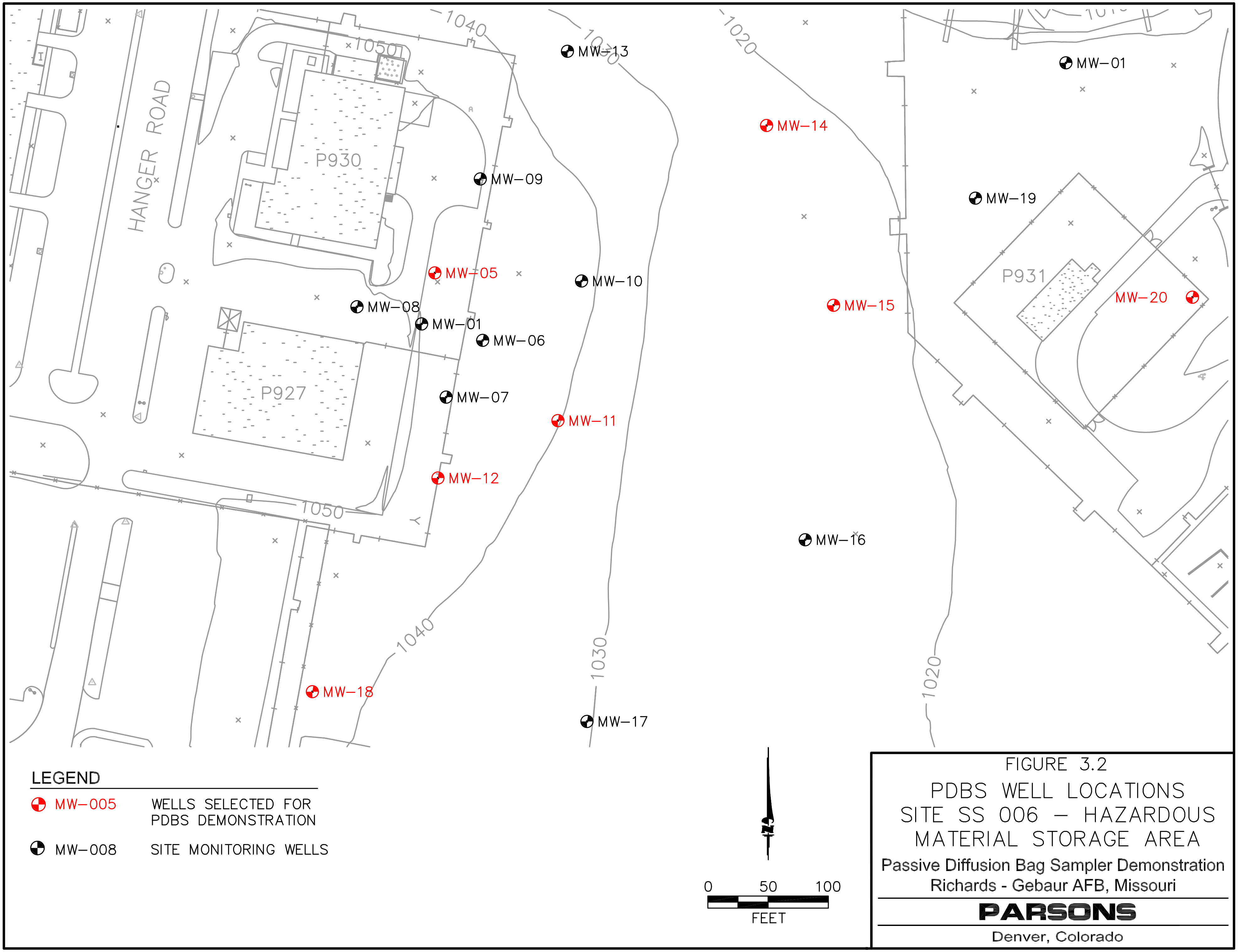
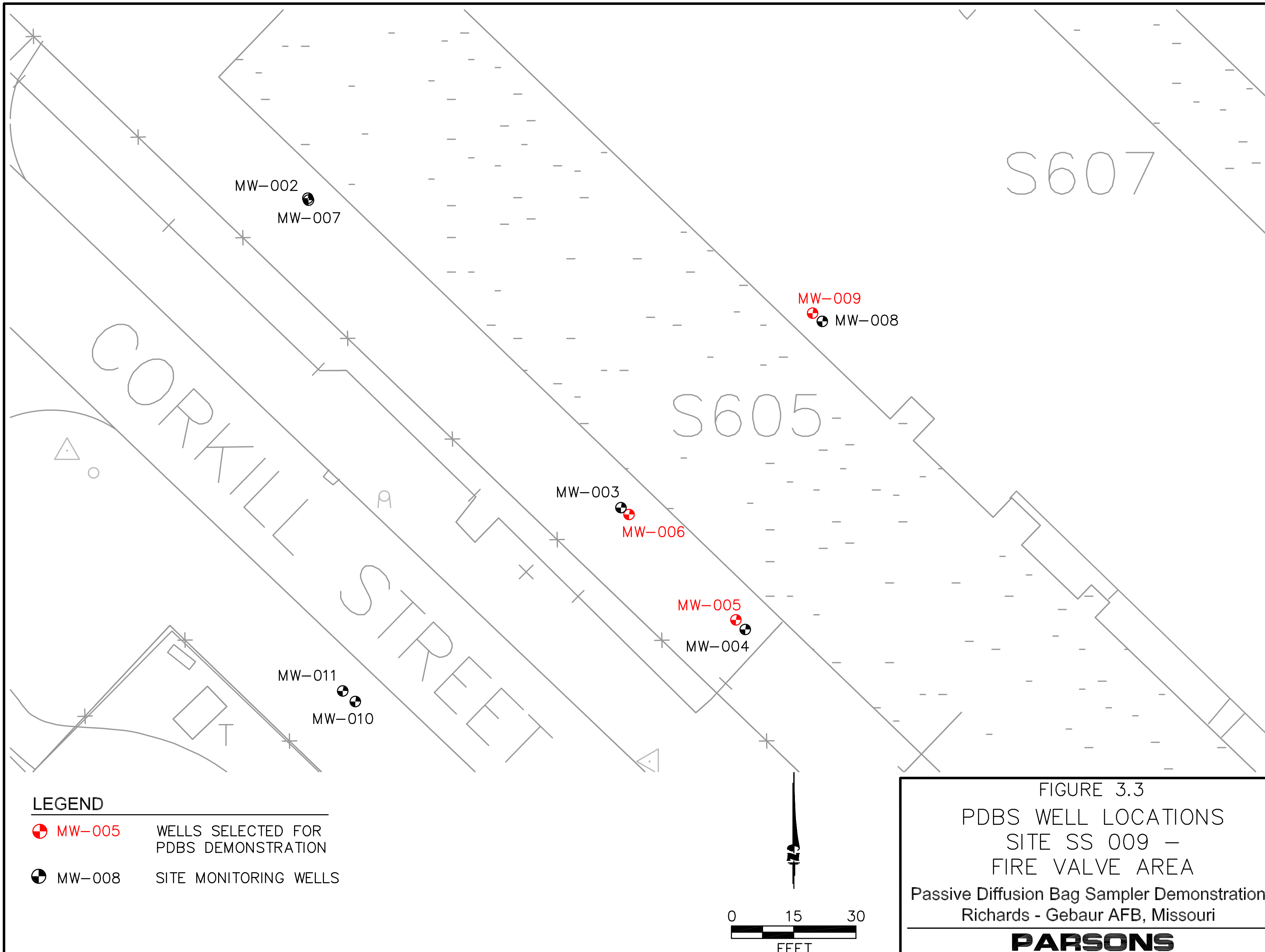


FIGURE 3.2

PDBS WELL LOCATIONS
SITE SS 006 – HAZARDOUS
MATERIAL STORAGE AREA

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS
Denver, Colorado



LEGEND

MW-005	WELLS SELECTED FOR PDBS DEMONSTRATION
MW-008	SITE MONITORING WELLS

FIGURE 3.3
PDBS WELL LOCATIONS
SITE SS 009 –
FIRE VALVE AREA

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS
Denver, Colorado

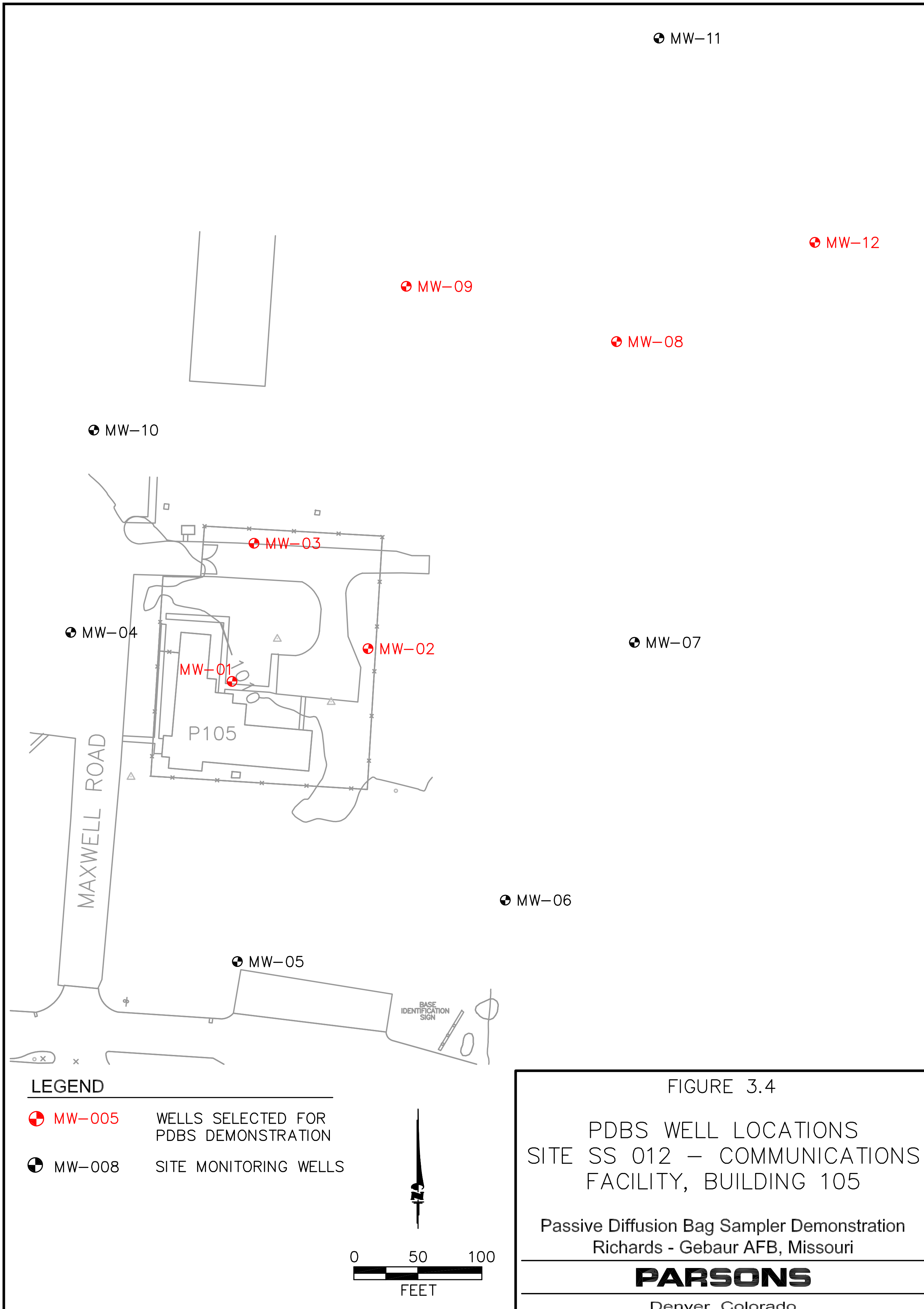


FIGURE 3.4

PDBS WELL LOCATIONS
SITE SS 012 – COMMUNICATIONS
FACILITY, BUILDING 105

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS

Denver, Colorado

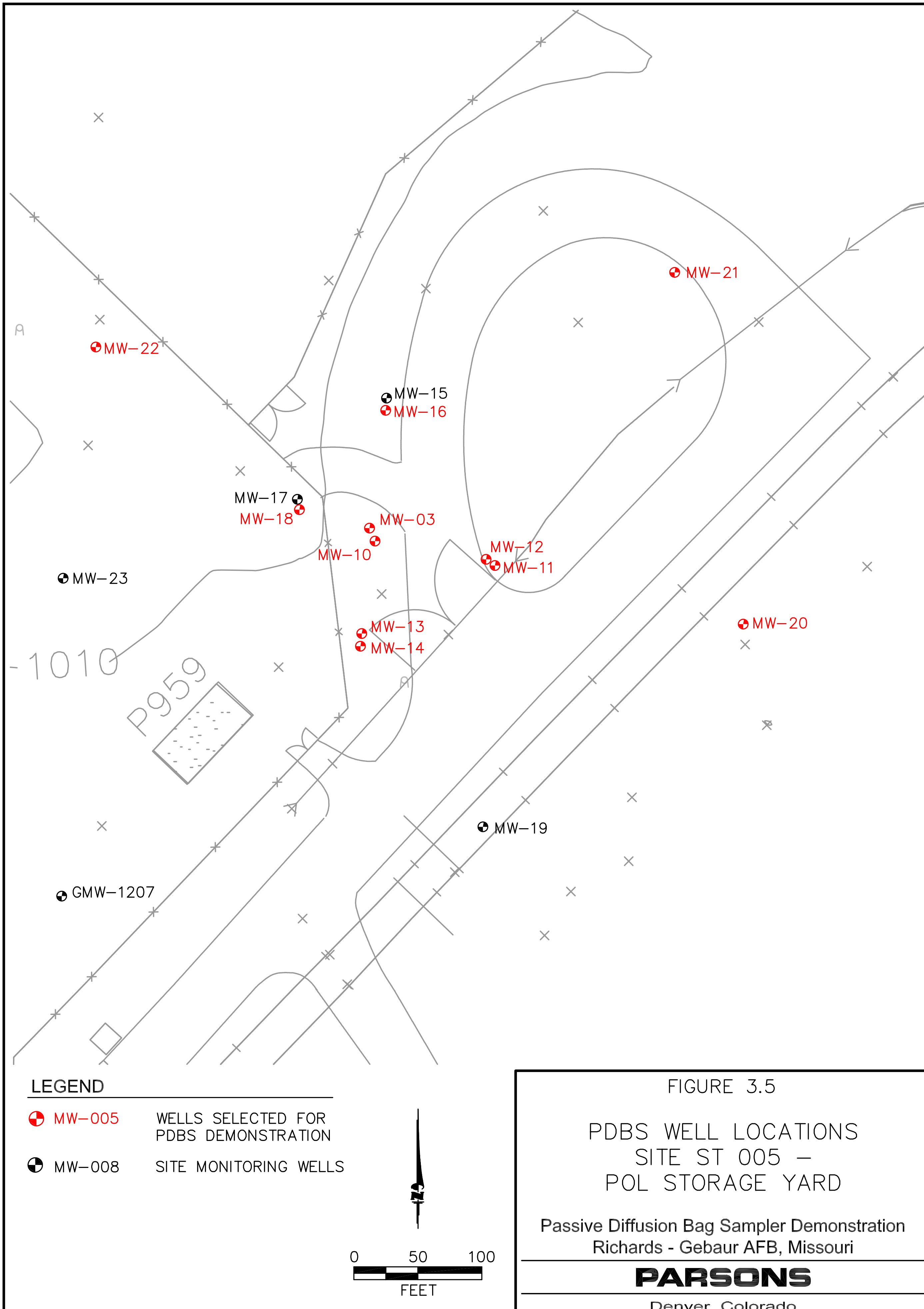


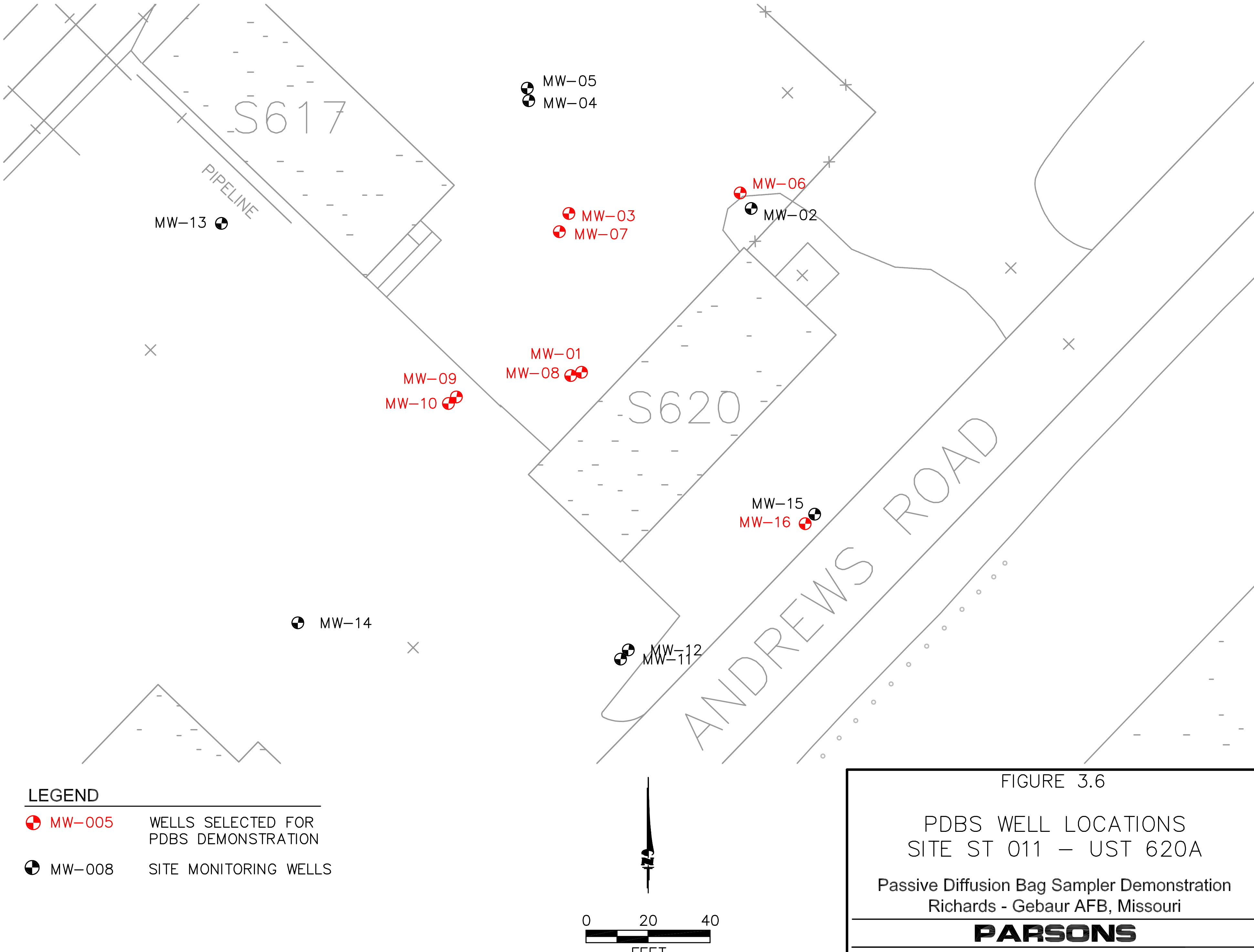
FIGURE 3.5

PDBS WELL LOCATIONS
SITE ST 005 –
POL STORAGE YARD

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS

Denver, Colorado



LEGEND

MW–005 WELLS SELECTED FOR PDBS DEMONSTRATION

MW–008 SITE MONITORING WELLS

FIGURE 3.6

PDBS WELL LOCATIONS
SITE ST 011 – UST 620A

Passive Diffusion Bag Sampler Demonstration
Richards - Gebaur AFB, Missouri

PARSONS

Denver, Colorado

PDBSs deployed during this investigation will be installed and retrieved in general accordance with the diffusion sampler installation and recovery standard operating procedures (SOPs) presented in Appendix B of the AFBCA PDBS Project Work Plan (Parsons, 2002). 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. Seven of the wells (SS 006-MW14, SS 009-MW05, SS 012-MW002, SS 012-MW008, SS 012-MW009, SS 012-MW012, and ST 005-MW20) listed in Table 3.1 had less than 2.5 feet of saturated screen during the October 2001 QGM event. Typically, a minimum of 2.5 feet is required for deployment of one PDBS (to allow the length of the PDB sampler [1.5 feet] plus one foot of "cover" water during the deployment period). Depending on the length of saturated screen calculated in these (or other) wells during the PDBS deployment, PDB samplers may not be deployed in some of the wells listed in Table 3.1. The PDBSs will be collected prior to the October 2002 conventional QGM event to be performed by CH2MHill.

Sample aliquots from PDBSs installed in the 37 wells targeted for sampling will be shipped to Applied Science Lab (ASL) in Corvalis, Oregon for VOC analysis using US Environmental Protection Agency (USEPA) Method 8260B. This is the same laboratory and analytical method that will be used by CH2MHill for their conventional sampling of the same wells. The analyses will be performed in accordance with the Quality Assurance Project Plan (QAPP) included as Appendix C of the Final Richards-Gebaur Air Foirce Base Basewide RI/FS Work Plan (CH2MHill, 1999). 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 rinseate,
- 1 pre-installation source water blank, and
- Approximately 4 trip blanks (1 per cooler of samples).

The sampling and analysis plan (SAP) included in the Final Richards-Gebaur Air Foirce Base Basewide RI/FS Work Plan. (CH2MHill, 1999) will be adopted as the site-specific SAP for the PDBS demonstration where appropriate. Portions of Appendix B from this site-specific SAP (which presents SOPs for groundwater level measurements, equipment decontamination, and waste handling procedures) are presented in Appendix B of this work plan. The PDBS-specific methods and procedures outlined in the AFBCA Program SAP (Parsons, 2002) will be adhered to during all PDBS-related activities at Richards-Gebaur AFB.

3.2 Analytical Results Comparison/Evaluation

Analytical results for groundwater samples collected using the PDBS and conventional techniques will be compared, and the results will be evaluated. Typically, if maximum concentrations from the PDBSs are higher than concentrations in samples collected using the conventional method, it is probable that the PDBS concentrations are more representative of ambient groundwater chemistry conditions than are the conventional-sampling data (Vroblesky, 2001). Considering this guidance, if the maximum analytical result obtained using PDB sampling 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. If, however, the conventional method produces VOC results that are higher by a predetermined amount than the concentrations reported for the PDBSs, then the PDBS method 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, 2001).

Analytical results for all 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:

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

Where:

abs = absolute value

D = diffusion sampler result

C = conventional sample result.

Therefore, multiple RPD values may be computed for each well, despite the fact that there will only one conventional sampling result. Each RPD value will be compared to the acceptance criteria to determine whether it is within the acceptable range.

For this investigation, an RPD of less than 30 will be considered to demonstrate good correlation between sample results. In summary, the PDBS acceptance criteria that will be used are:

- If at least one PDBS result for a given well is equal to or greater than the conventional sampling result, PDBS will be deemed appropriate for use in that well.

- If either the PDBS or the conventional sample result is greater than three times the laboratory reporting limit (RL), and the PDBS result is less than the conventional result, an RPD of 30 will be used as the acceptance criterion.

- If both the PDBS and conventional sample results are less than three times the laboratory RL, a value of ± the lowest RL will be used as the range of acceptance between the two values.

4.0 PROJECT ORGANIZATION

Addresses and telephone numbers of the Richards-Gebaur AFB PDBS project team are as follows:

Name	Title	Address	Phone/Email	Fax
Rafael Vazquez	AFCEE POC	AFCEE/ERT 3207 Sidney Brooks Brooks AFB, TX 78235-5344	(210) 536-1431 email: rafael.vazquez@brooks.af.mil	(210) 536-4330
Mark Mercier	USACE Project Manager	USACE, Omaha District CENWO-PM-HC 106 So. 15th St. Omaha, NE 68102	(402) 221-7664 email: mark.a.mercier@usace.army.mil	(402) 221-7796
David Becker	USACE POC	USACE CENWO-HXG 12565 West Center Road Omaha, NE 68144	(402) 697-2655 email: dave.becker@usace.army.mil	(402) 697-2595
Ed Bishop	Parsons Program Manager	Parsons 10521 Rosehaven Street; Two Flint Hill Fairfax VA 22030	(703) 591-7575 email: edward.bishop@parsons.com	(703) 591-1305
Eieleen Buckley	Parsons Program Administrator	Parsons 10521 Rosehaven Street; Two Flint Hill Fairfax VA 22030	(703) 591-7575 email: eieleen.buckley@parsons.com	(703) 591-1305
Peter Guest	Parsons Project Manager	Parsons 1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 831-8100 email: peter.guest@parsons.com	(303) 831-8208
Doug Downey	Parsons Technical Director for PDBS	Parsons 1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1915 email: doug.downey@parsons.com	(303) 831-8208
John Anthony	Parsons Technical Director for MNO	Parsons 1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-1910 email: john.anthony@parsons.com	(303) 831-8208
John Tunks	Parsons PDBS Task Manager	Parsons 1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 764-8740 email: john.tunks@parsons.com	(303) 831-8208
Jim McInnes	Parsons Site Manager	Parsons 1700 Broadway, Suite 900 Denver, Colorado 80290	(303) 388-1382 cell – (303) 961-5356 email: jim.mcinnes@parsons.com	(303) 831-8208
Bradley P. Varhol	PDBS Vendor	EON Products, Inc. P.O. Box 390246 Snellville, GA 30039	(800) 474-2490 web site: www.eonpro.com email: sales@eonpro.com	(770) 978-8661
Paul Carroll	AFBCA POC for Richards-Gebaur	9801 Reese Blvd. N. Ste 300 Lubbock TX. 79416	(806) 885-5010 email: pcarroll@afbda1.hq.af.mil	(806) 885-5022
Ning Li	CH2MHill POC	CH2MHill. 727 North First Street, Suite 400 St, Louis, MO 63102	(314) 421-0313 x 264 email: nli@ch2m.com	(314) 421-3927
Bob Zuiss	BAH POC and Richards-Gebaur AFB Site Contact	15471 Hangar Road Kansas City, MO. 64147	(816) 348-2511 email: zuiss_robert@bah.com	(816) 348-2515
Kathy McKinley	Applied Science Lab Project Manager	2300 NW Walnut Blvd Corvallis, OR 97330-3538	(541) 752-4271 email: kmckinle@CH2M.com	(541) 752-0276

5.0 SCHEDULE

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

- Submittal of the Draft Site-Specific PDBS Work Plan: 30 August 2002.

- Receipt of Draft Site-Specific PDBS Work Plan Comments: 6 September 2002.
- Submittal of the Final Site-Specific PDBS Work Plan: 16 September 2002.
- Install PDB samplers at Richards-Gebaur AFB: 17 and 18 September 2002.
- Retrieve PDBS samplers at Richards-Gebaur AFB: 07 and 08 October 2002.
- Submittal of the Preliminary Internal Draft Site-Specific PDBS Report: February 2003.

6.0 REPORTING

The site-specific results report will provide a table identifying the location and depth for each PDBS collected. The analytical results collected by Parsons as part of this study will be compared to conventional-sampling analytical results collected by CH2MHill using the procedures described in Section 3.2. The results of the statistical comparisons will be clearly and logically presented in the site-specific results report. Comparison methods will include calculation of RPDs between PDB and conventional sampling results. In addition, the relative costs of PDB and conventional groundwater sampling will be compared.

The report will include a qualitative review of data sets when the correlation criteria for a well or compound are met in less than 70 percent of the comparisons. The purpose of this review will be to attempt to determine the most likely reason(s) for the lack of correlation. The arbitrary threshold value of 70 percent is not intended to indicate success or failure of PDBS, but rather to focus further review on those wells or analytes where a lower correlation was observed. If there are wells or compounds for which the correlation criteria were not as consistently met, and it is not clear that the poor correlation was due to a one-time, explainable occurrence (e.g., air bubbles in the sample vials for a particular sample), then the report will likely state that further evaluation of those wells/compounds should be performed before the PDBS method is used for those wells/compounds. The draft version of this report will be distributed according to the schedule shown in Section 5.0.

7.0 REFERENCES

CH2MHill, 2002. Draft Basewide Remedial Investigation (RI) Report Addendum, Richards-Gebaur Air Force Base, Missouri. July.

CH2MHill, 2001. Basewide Remedial Investigation Report, Volume I: RI Report, Richards-Gebaur Air Force Base, Missouri.

CH2MHill, 1999. Final Richards-Gebaur Air Force Base Basewide Remedial Investigation / Feasibility Study (RI/FS) Work Plan. October.

Parsons, 2002. Draft Work Plan for the Air Force Base Conversion Agency Passive Diffusion Sampler Demonstration. February.

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 REMEDIAL PROCESS OPTIMIZATION SUPPORT AND DEMONSTRATION OF PASSIVE DIFFUSION BAG SAMPLING TECHNOLOGY AT SEVERAL DEPARTMENT OF DEFENSE INSTALLATIONS

AT

RICHARDS-GEBAUR AIR FORCE BASE
MISSOURI

August 2002

Prepared by:

PARSONS
1700 Broadway, Suite 900
Denver, Colorado 80290

Reviewed and Approved By:

	Name	Date
Project Manager	Alan R. Hicks	8/29/02
Office Health and Safety Representative	Timothy S Mustard, CIH	8/28/02

1.0 INTRODUCTION

This addendum modifies the existing Program Health and Safety Plan (HASP) entitled *Program Health and Safety Plan for Remedial Process Optimization Support and Demonstration of Passive Diffusion Bag Sampling Technology at Several Department of Defense Installations* (Parsons Engineering Science, Inc., [Parsons] 2002) for the evaluation of the use of passive diffusion bag samplers (PDBSs) in existing groundwater monitoring programs at selected U.S. Air Force (USAF) and other Department of Defense installations across the United States. This work is being performed under contract number F44650-99-D-005 Delivery Order DK01, for the U.S. Department of the Army, Corps of Engineers, Omaha District, and Air Force Base Conversion Agency (AFBCA), Roslyn, Virginia.

This addendum to the Program HASP was prepared to address the upcoming tasks at Sites SS003, SS006, SS012, ST005, and ST011 (formerly CS004) at Richards-Gebaur Air Force Base (AFB) in Missouri. 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 HASP 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 Sampling at the Former Richards-Gebaur AFB, New Hampshire (*Parsons, 2002).

4.0 PROJECT TEAM ORGANIZATION

The project team assigned to the PDBS demonstration activities at the former Richards-Gebaur AFB is identified in the Program HASP. The following personnel also will be involved in this project.

Mr. Peter Guest	Project Manager
Mr. John Hicks	Task Manager
Mr. John Tunks	Site Manager
Mr. John Tunks	Site Health and Safety Officer
Mr. Tom Dragoo	Alternate Site Health and Safety Officers
Mr. Paul Carroll	Richards-Gebaur AFB Contact (AFBCA)

Mr. Bob Zuiss	Richards-Gebaur AFB Contact (Booz•Allen & Hamilton, Inc.)

5.0 HAZARD EVALUATION

5.1 Chemical Hazards

The primary contaminants of concern at the various sites are benzene, dichlorobenzenes, and chlorinated compounds including trichloroethene (TCE), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-DCE, tetrachloroethane (PCE), and vinyl chloride. 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 the former Richards-Gebaur AFB include hazards associated with motor vehicles; slip, trip, and fall hazards; noise; and heat and/or cold exposure. These hazards are discussed in the Program HASP.

5.3 Biohazards

The following is in addition to the information presented in the Program HASP.

West Nile virus is spread by the bite of an infected mosquito, and can infect people, horses, many types of birds, and some other animals. Most people who become infected with West Nile virus will have either no symptoms or only mild ones. On rare occasions, West Nile virus infection can result in a severe and sometimes fatal illness known as West Nile encephalitis (an inflammation of the brain). The risk of severe disease is higher for persons 50 years of age and older. There is no evidence to suggest that West Nile virus can be spread from person to person or from animal to person.

Human illness from West Nile virus is rare, even in areas where the virus has been reported. The chance that any one person is going to become ill from a mosquito bite is low. You can further reduce your chances of becoming ill by protecting yourself from mosquito bites. To avoid mosquito bites, apply insect repellent containing DEET (N,N-diethyl-meta-toluamide) when you're outdoors. When possible, wear long-sleeved clothes and long pants treated with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing. Do not apply repellents containing permethrin directly to exposed skin. If you spray your clothing, there is no need to spray repellent containing DEET on the skin under your clothing. Also, consider staying indoors at dawn, dusk, and in the early evening, which are peak mosquito biting times.

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
Site/Medical Emergency	911
Richards-Gebaur AFB Fire Department	911 or (816) 763-3900
Police Department	911 or (816) 331-5522
Poison Control Center	911 or (800) 441-0040
AFBCA Contacts: Paul Carroll	(806) 885-5010
Booz•Allen & Hamilton Contact: Bob Zuiss	(816) 348-2511

Medical Emergency: (Figure 6.1)

Hospital Name	Saint Joseph Health Center
Address	1000 Carondelet Dr., Kansas City, MO 64114
Telephone Number	911 or (816) 942-4400
Ambulance	911

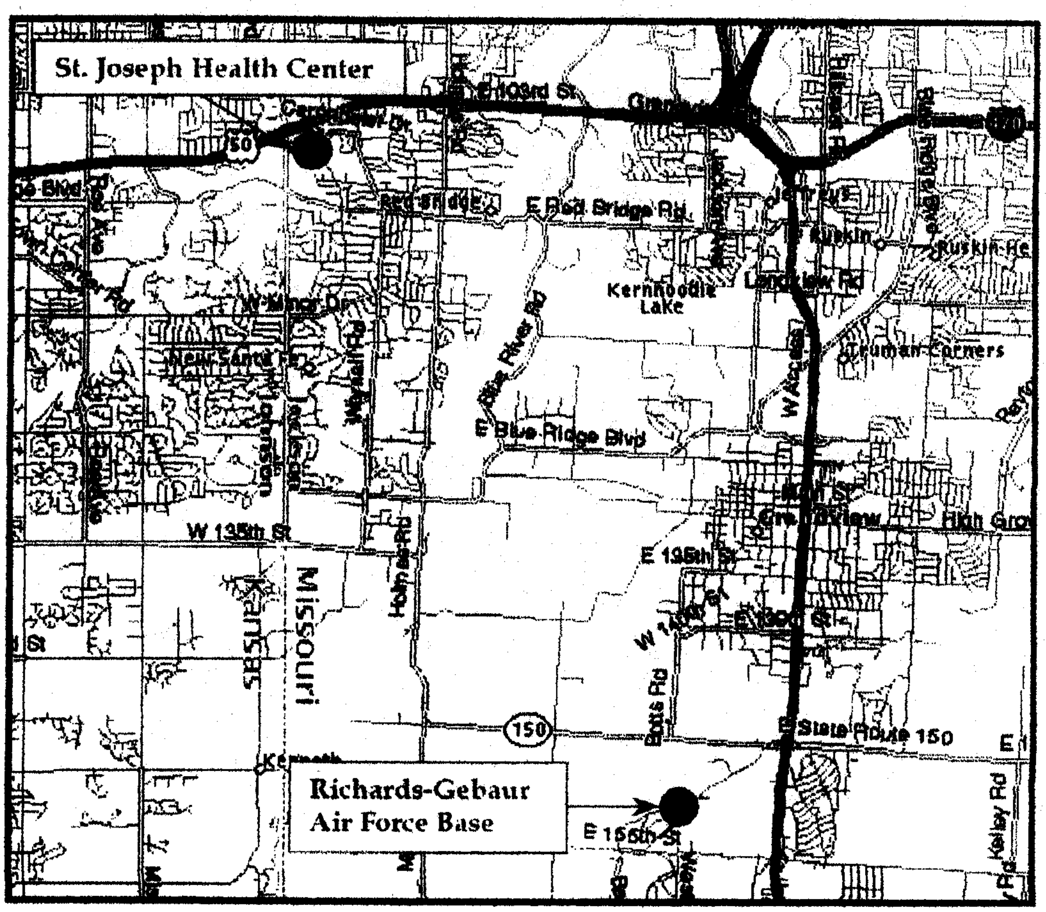
Parsons Contacts	Telephone Number
Peter Guest Project Manager	(303) 831-8100 or 764-1919 (Work)
John Hicks Task Manager	(303) 831-8100 or 764-1941 (Work) (303) 279-3698 (Home)
Tim Mustard, CIH Program Health and Safety Manager	(303) 831-8100 or 764-8810 (Work) (303) 450-9778 (Home)
Ed Grunwald, CIH Corporate 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)
Parsons 24-Hour Emergency Contact Service	(866) 727-1411 (toll free)

FIGURE 6.1

Base Emergency Hospital Routes for Richards-Gebaur AFB

Starting From: 1	Arriving At: 2	Distance:	Approximate Travel Time:
Richards-Gebaur Air Force Base 15411 Andrews Road Kansas City, MO 64147	St. Joseph Health Center 1000 Carondelet Dr Kansas City, MO 64114	10.9 miles	18 mins

	Directions	miles
1.	Start out going Northeast on ANDREWS RD towards E 147TH ST.	0.6
2.	Turn RIGHT onto E 147TH ST.	0.2
3.	Stay straight to go onto E SR-150.	0.1
4.	Turn LEFT to take the US-71 NORTH ramp towards KANSAS CITY.	0.2
5.	Merge onto US-71 N.	4.8
6.	Take the I-435 WEST/US-50/I-470 EAST exit towards LEE'S SUMMIT/WICHITA.	0.1
7.	Take the I-435 WEST/US-50 WEST exit on left towards WICHITA.	1.0
8.	Merge onto US-50 W.	3.3
9.	Take the STATE LINE ROAD exit	0.2
10.	Turn LEFT onto STATE LINE RD.	0.2
11.	Turn LEFT onto CARONDELET DR.	



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

The personal protection level prescribed for field activities at the former Richards-Gebaur 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 following will be used to select respiratory protection at each of the sites.

If sustained air-monitoring readings in the worker-breathing zone indicate vapor concentrations greater than background for 30 seconds or longer, the field crew will be forced to evacuate and ventilate the area until readings are less than 1 part per million (ppm) in the worker-breathing zone. If ventilation is inadequate, air samples will be taken to confirm or deny the existence of the contaminants of concern and/or the crew will upgrade to Level B respiratory protection. These air samples will be sent to a lab to be analyzed by US Environmental Protection Agency (USEPA) Compendium Method TO-14 or the equivalent. Decisions for further actions and for levels of respiratory protection will be made after consulting with the project manager and program health and safety manager.

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

8.0 FREQUENCY AND TYPES OF AIR MONITORING

A photoionization detector (PID) with an 11.7 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 11.7 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-Dichlorobenzene (o-DCB)	50 (ceiling) [h/]	25	200	2-50	9.06	Colorless, to pale-yellow, liquid herbicide with a pleasant, aromatic odor. Irritates eyes, skin, nose, and mucous membranes. Causes liver and kidney damage and skin blisters. Mutagen, experimental teratogen, and questionable carcinogen.
1,4-Dichlorobenzene (p-DCB)	75	10	150	15-30	8.98	Colorless or white, crystalline, solid insecticide with mothball-like odor. Irritates eyes, skin, and respiratory tract. Causes eye swelling, profuse runny nose, headaches, anorexia, nausea, vomiting, low-weight, jaundice, and cirrhosis. In animals, causes liver and kidney cancer. Mutagen, experimental teratogen, and carcinogen.
1,1-Dichloroethane (DCA)	100	100	3,000	120	11.06	Colorless, oily liquid with chloroform-like odor and hot saccharine taste. Irritates skin. Causes CNS depression and kidney, lung, and liver damage. Experimental teratogen and questionable carcinogen.
1,1-Dichloroethene (DCE) (Vinylidene Chloride)	1	5	NA [i/]	NA	10.00	Colorless liquid or gas (>89°F) with a mild, sweet, chloroform-like odor. Irritates eyes, skin, and throat. Causes dizziness, headaches, nausea, shortness of breath, liver and kidney dysfunctions, and lung inflammation. Mutagen 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.
Perchlorethylene (Tetrachloroethene or PCE)	25 [j/]	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, kidney, and CNS damage. In animals, causes liver tumors. Mutagen, experimental teratogen, and carcinogen.
Trichloroethene (TCE)	50	50	1,000	21.4-400	9.45	Clear, colorless or blue liquid with chloroform-like odor. Irritates skin 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 and kidney cancer. Mutagen, experimental teratogen, and 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
Vinyl Chloride	1 (29 CFR 1910.1017) [f/]	1	NA	260	9.99	Colorless gas (liquid<7°F) with a pleasant odor at high concentrations. 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 (liquid). Also attacks lymphatic system. Mutagen, experimental teratogen, and carcinogen.

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), 2001 *TVLs® and BEIs®.*

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/ (ceiling) = Ceiling concentration which should not be exceeded at any time.

i/ NA = Not available.

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

APPENDIX B

SAMPLING AND ANALYSIS PLAN FIELD PROCEDURES

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water)
- Distilled, organic-free water
- 2.5% (W/W) Alconox® and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Alconox® and water, scrub brushes, squirt bottles for Alconox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Phthalate-free gloves
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in Alconox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Alconox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Alconox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.
3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.
4. Remove respirator (if worn).
5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Spread plastic on the ground to keep hoses from touching the ground
3. Turn off pump after sampling. Remove pump from well and place pump in decontamination tube, making sure that tubing does not touch the ground
4. Turn pump back on and pump 1 gallon of Alconox® solution through the sampling pump.
5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of potable water.
7. Rinse with 1 gallon of ASTM Type II Reagent-Grade Water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.

4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with a potable water/Alconox® solution.

5. Rinse with potable water.

6. Rinse with ASTM Type II Reagent-Grade water.

7. If equipment has come in contact with oil or grease, rinse the equipment with pesticide-grade methanol followed by pesticide-grade hexane (DO NOT USE ACETONE).

8. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.

2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Alconox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with Alconox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of Alconox®, methanol, and ASTM Type II Reagent-Grade water.
- Do not use acetone for decontamination.

- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials, or investigation-derived waste (IDW), generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are potentially hazardous affixed.

The drum contents will be sampled to determine the disposal requirements of the

IDW. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Constituents of concern
- Date that accumulation began
- Date that accumulation ended
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the number of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to a centralized drum storage area by the drilling service subcontractor.

IDW in the central storage area will be characterized and disposed offsite by a commercial firm under subcontract. Disposal methods shall be in accordance with applicable solid waste, hazardous waste, and water quality regulations.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. Prior to disposal to the sanitary sewer system, contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

Check that representative samples of the containerized materials are obtained and all drums are appropriately labeled according to the contents.

Water Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on-staff gages in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers.

II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the protective casing. If no reference is clearly visible, measure the depth to water from the northern edge of the riser. If access to the top of the riser is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also measure and record the three following readings: (1) the depth of the piezometer or well; (2) the distance from the reference point to the top of the protective casing; and (3) the distance to the surface of the concrete pad or to ground. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = Wl_a + (\text{Free-product thickness} \times 0.80)$$

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

0.80 = Specific gravity of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gages will be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution or 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gage is installed at a location exposed to wind.

IV. Attachments

None.

V. Key Checks

Before each use, verify that the battery is charged by pressing the test button on the water-level meter. Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Decontaminate interface probe or water-level meter thoroughly between wells. Leave the unit turned off when not in use.