FINAL

SITE-SPECIFIC WORK PLAN FOR THE PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION AT MARCH ARB, CALIFORNIA

June 2001

Prepared for:

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

CONTRACT NO. F41624-00-8024
Task Order No. 0024

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TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AFBCA	Air Force Base Conversion Agency
AFB	Air Force Base
AFCEE/ERT	Air Force Center for Environmental Excellence, Technology Transfer Division
AFRC	Air Force Reserve Command
ANOVA	analysis of variance
ARB	Air Reserve Base
bgs	below ground surface
BRAC	Base Realignment and Closure
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
OU	operable unit
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
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 Task Order (TO) 24 under Air Force Center for Environmental Excellence (AFCEE) contract F41624-00-D-8024 to demonstrate the use of passive diffusion bag samplers (PDBSs) in existing groundwater monitoring programs at selected Department of Defense (DoD) installations. The site of the PDBS demonstration outlined in this work plan is March Air Reserve Base (ARB), California. The PDBS work at this Base Realignment and Closure (BRAC) installation is being funded by the Air Force Base Conversion Agency (AFBCA). The Technology Transfer Division of AFCEE (AFCEE/ERT) has initiated the PDBS demonstration to introduce this technology to multiple 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 March ARB 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., micropurge) 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 multiple 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 March ARB.

1.3 Scope

The March ARB 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 week of May 28, 2001 to provide adequate equilibration time before the incumbent environmental contractor for March ARB (Montgomery Watson) obtains their samples from the same wells. The PDBSs will be retrieved during the week of June 11, 2001, 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 AFBCA 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 March ARB site description is presented in Section 2. Section 3 presents the scope of the PDBS investigation at March ARB. 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 March Air Reserve Base

The Defense Base Closure and Realignment Commission recommended March Air Force Base (AFB) for realignment in 1993. The former AFB was subsequently converted to an ARB administered by the Air Force Reserve Command (AFRC) in April 1996, when most active duty Air Force units left the Base. The former March AFB occupied 6,594 acres in western Riverside County in Southern California. The portion of March AFB retained for military use by AFRC is the cantonment area, designated as March ARB. The remainder of the former March AFB is administered by the AFBCA; the PDBS demonstration will be focused on this area. Wells in the cantonment area will not be sampled using PDBSs.

Forty-three IRP sites have been identified at the former March AFB. These sites have been organized into three operable units (OUs). OU 1 sites are located in the eastern portion of the Main Base; OU 2 sites are dispersed through the north and central portions of the Main Base and West March (west of I-215), and OU 3 comprises the Panero aircraft fueling system.

2.2 Geology and Hydrogeology

Ground surface elevations at the Base range from about 1,480 feet above mean sea level (msl) in the southeast to 1,550 feet above msl in the northwest. Subsurface investigations at the Main Base have shown that most of the sediments underlying the Base consist of laterally discontinuous, interbedded fine- to medium-grained sands, silts, and lean clays, with minor amounts of gravel. These sediments have been interpreted as alluvial fans or plains (Tetra Tech, 1997). Bedrock, consisting primarily of monzonite and granodiorite, is exposed at the ground surface in the western portion of the Base and is present approximately 300 feet below ground surface (bgs) in the southeastern corner of the Base.

The aquifer system underlying March ARB consists of water-bearing zones that vary laterally in number, thickness, and composition. Field data collected during previous investigations suggest that the aquifers are semi-confined to confined, including the shallowest water-bearing zones; water table aquifers have been identified only in limited areas.

According to the basewide conceptual hydrogeologic model, three general aquifer units have been identified at March ARB (Tetra Tech, 1999). These units are described in terms of both elevation and general hydraulic conductivity as follows:

- Aquifer Unit A is a generally low hydraulic conductivity unit present between the water table and 1,460 feet msl, although isolated wells in Unit A have moderate to high hydraulic conductivity. Unit A is present from the northern boundary of March ARB and pinches out near the central eastern boundary of March ARB.

- Aquifer Unit B is a relatively high hydraulic conductivity unit located between the 1,460 feet msl and 1,400 feet msl. Because Unit A pinches out near the central eastern portion of the Base, Unit B is the first water-bearing aquifer unit encountered in the southeast portions of the Base. However, Unit B also pinches out in off-Base areas, and against bedrock highs.

- Aquifer Unit C is a low to moderate hydraulic conductivity unit present below 1,400 feet msl. It is present in areas where bedrock is relatively deep in the central and southeast portions of the Base, and is the first water-bearing zone encountered in off-Base areas to the southeast.

2.3 Chemicals of Concern

VOCs in groundwater that have exceeded regulatory limits at March ARB consist primarily of chlorinated solvents and fuel-related compounds (e.g., BTEX). Tetrachloroethene (PCE) and trichloroethene (TCE) are the chlorinated solvents of primary concern. Specific information regarding the primary VOCs detected in each of the monitoring wells targeted for sampling using PDBS is contained in Section 3.

3.0 SCOPE OF PDBS DEMONSTRATION

An estimated total of 115 passive diffusion samplers will be installed in 20 monitoring wells at March ARB 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 Figure 3.1.

TABLE 3.1
SAMPLING LOCATION SUMMARY
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
MARCH ARB, CALIFORNIA

Well ID	Primary or Alternate	Top of Casing Elevation (ft amsl)	Screened Interval (ft btoc)	Screen Length (ft)	Historic Groundwater Elevation (ft btoc)	Most Recent Groundwater Elevation (ft btoc)	Expected Saturated Screen Length (ft)	Expected Number of Samplers	Dedicated Pump?	Most Recent PCE (ppb)	Most Recent TCE (ppb)	Most Recent BTEX (ppb)	Comments/Criteria
4MW6	Primary	1514.29	28.7 - 77.7	49	30.9 - 40.6	32.7	45	15	No	2.25	0.43	107	
4MW11	Primary	1523.20	35.0 - 75.0	40	23.9 - 44.3	23.9	40	13	No	2	0.4	0	
4MW13	Primary	1509.85	32.0 - 72.0	40	37.5 - 48.8	41.2	31	10	No	2.2	1	0	
4MW19	Primary	1513.29	33.0 - 73.0	40	39.6 - 49.8	41.4	32	10	No	1	0	0	
4MW21	Primary	1516.20	37.3 - 47.3	10	19.8 - 35.8	19.8	10	3	No	18	2.8	0	
4MW22	Primary	1507.93	37.3 - 57.3	20	25.9 - 32.9	26.2	20	6	No	4.6	1	0	
4MW25A	Primary	1509.43	170.6 - 180.6	10	24.3 - 27.4	24.3	10	3	No	22	3	0	
4MW26A	Primary	1510.43	200.5 - 210.5	10	16.1 - 20.0	16.1	10	3	No	8.9	0.9	0	
4MW27A	Primary	1511.31	265.0 - 275.0	10	17.5 - 59.9	17.5	10	3	No	4	1	0	
550MW1	Primary	1536.82	45.0 - 60.0	15	32.3 - 43.7	32.3	15	5	No	0	0	18060	
550MW3	Primary	1537.08	53.0 - 63.0	10	32.9 - 44.4	32.9	10	3	No	0	0	0	Historic benzene up to 85 ppb
550MW4	Primary	1537.40	80.0 - 90.0	10	32.9 - 38.0	32.9	10	3	No	0	0.5	0	
550MW5	Primary	1536.21	60.0 - 70.0	10	32.2 - 37.3	32.2	10	3	No	0	0	0.3	
550MW6	Primary	1537.49	65.0 - 75.0	10	32.6 - 37.8	32.6	10	3	No	0	0	7.6	
550MW7	Primary	1536.57	60.0 - 70.0	10	31.7 - 38.9	31.7	10	3	No	0	0	0.4	
550MW8	Primary	1534.40	35.0 - 50.0	15	31.5 - 36.4	31.5	15	5	No	0	0	349	
550MW9	Primary	1537.89	60.0 - 70.0	10	32.7 - 37.8	32.7	10	3	No	0	0.3	0.5	
5M12MW1	Primary	1536.08	55.0 - 75.0	20	34.1 - 56.2	34.1	20	6	No	0	3	0	
5M12MW3	Primary	1542.56	64.1 - 84.1	20	39.9 - 63.3	39.9	20	6	No	0	7	0	
CTMW14	Primary	1553.65	50.0 - 80.0	30	46.7 - 57.8	47.0	30	10	No	0	0	857.6	
550MW2	Alternate	1536.79	40.0 - 55.0	15	32.4 - 43.9	32.4	15	5	No	0	0	0	Historic benzene up to 29 ppb
4MW20	Alternate	1515.94	26.5 - 46.5	20	17.5 - 35.8	17.5	20	6	No	0	0	0	Historic TCE up to 16 ppb
6M4MW24	Alternate	1529.17	39.0 - 59.0	20	28.1 - 42.5	28.1	20	6	No	0	0	0	Historic PCE up to 2.4 ppb
5M12MW5	Alternate	1538.72	55.0 - 75.0	20	36.0 - 57.8	36.0	20	6	No	0	0	0	Historic benzene up tp 2 ppb
4MW28A	Alternate	1508.11	220.0 - 230.0	10	31.4 - 38.6	31.4	10	3	No	0	0	0	PCE detected once at 2 ppb, no other VOCs
5M6MW5	Alternate	1696.33	36.6 - 56.6	20	38.1 - 46.9	46.4	10	3	No	0	0	0	Isolated 5-well site, all NDs
6M6MW3	Alternate	1688.13	22.6 - 42.6	20	25.9 - 31.8	31.8	11	3	No	0	0	0	Isolated 5-well site, all NDs
6M6MW5	Alternate	1644.31	19.1 - 39.5	20.4	23.8 - 44.2	24.1	15	4	No	0	0	0	Isolated 5-well site, all NDs
6M6MW6	Alternate	1644.39	19.3 - 39.7	20.4	23.9 - 25.5	25.1	15	4	No	0	0	0	Isolated 5-well site, all NDs
6M6MW7	Alternate	1647.94	21.2 - 41.6	20.4	26.2 - 27.7	26.6	15	4	No	0	0	0	Isolated 5-well site, all NDs
4MW5	Alternate	1514.21	118.0 - 149.5	31.5	31.4 - 37.5	33.2	32	10	Yes	0.7	0	0	
CTMW13	Alternate	1555.41	50.0 - 80.0	30	48.6 - 60.1	49.0	30	10	Yes	0	0	0.4	Isolated 3-well site, long screen, pump
CTMW15	Alternate	1555.61	51.9 - 81.9	30	49.7 - 60.2	49.9	30	10	Yes	0	0.3	0	Isolated 3-well site, long screen, pump
4MW29	Alternate	1519.24	50.0 - 60.0	10	29.9 - 30.8	29.9	10	3	No	0	0	0	No VOCs ever
4MW30	Alternate	1519.18	85.0 - 95.0	10	30.0 - 30.8	30.0	10	3	No	0	0	0	No VOCs ever

Notes:

S:\ES\CAD\739731\01DN0137.dwg, 05/23/01 at 13:44

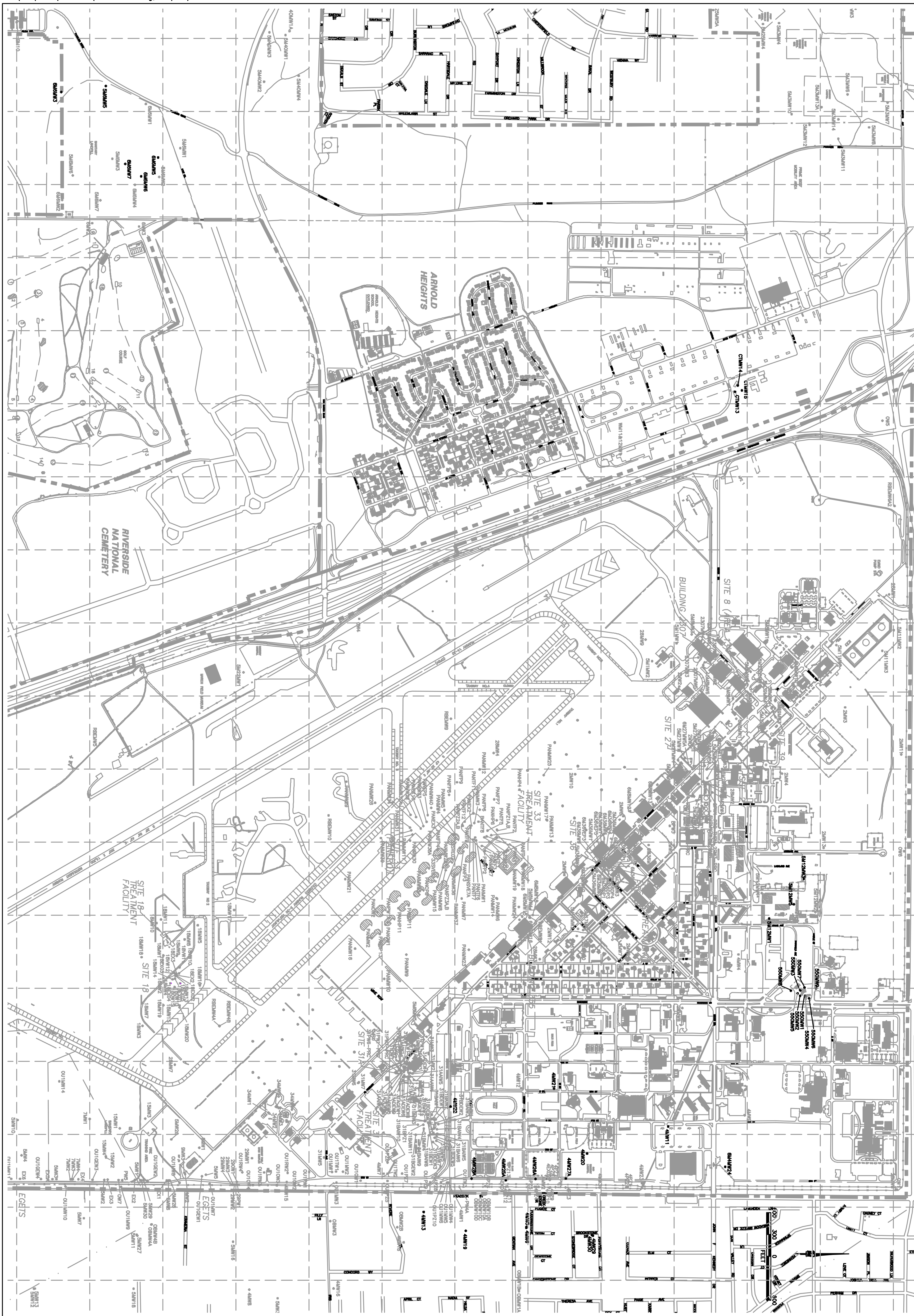

FIGURE 1 REV 0	**FIGURE 3.1** **SITE LAYOUT AND** **WELL LOCATIONS**	**PASSIVE DIFFUSION** **BAG SAMPLER** **DEMONSTRATION** MARCH ARB, CA	**PARSONS** Denver, Colorado (303) 831-8100

Job No.(job #)						
Designed						
Drawn						
Checked						
Reviewed						
Approved						
Reg No						

3.1 Field Activities

Monitoring wells selected for VOC sampling using the PDBS technique (Table 3.1) were chosen from a list of 35 AFBCA monitoring wells targeted for sampling by Montgomery Watson during the LTM sampling event scheduled to begin in May 2001. The anticipated saturated screened interval for each of these wells was calculated using historic groundwater elevation and well completion information. The total number of PDB samplers to be placed in each well was then determined and summed for all the wells. If all of the AFBCA wells were included in the PDBS demonstration, a total of 195 samplers would need to be deployed, or 60 more than was originally scoped for the March ARB PDBS demonstration (Parsons, 2001). Twenty of the 35 AFBCA wells to be sampled were reported to contain very low (less than 1 ppb) concentrations of individual VOCs at the time they were previously sampled. All but five (550MW3, 550MW4, 550MW5, 550MW7, and 550MW9) of these wells were eliminated from consideration for the PDBS demonstration to:

1. Demonstrate the use of PDB samplers across a wide range of contaminant concentrations, and

2. Maintain the original number of samplers scoped for the PDBS demonstration.

The 20 wells selected for the PDBS demonstration are distributed across 3 general areas as described below.

- 8 wells at the Building 550 Underground Storage Tank (UST) gasoline-contaminated site where the primary contaminant of concern (COC) is BTEX (Montgomery Watson, 2000),

- 11 wells distributed across the northeastern portion of March ARB designated as either Landfill or Plume Monitoring Wells where the primary COCs are chlorinated solvents (Montgomery Watson, 2000), and

- 1 well located in the northwestern portion of March ARB monitoring a UST diesel-fuel-contaminated site where the primary COC is benzene (Montgomery Watson, 2000).

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 AFBCA 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 EMAX Laboratory (EMAX) in Torrance, California for VOC analysis using USEPA Method 8260B. This same laboratory will be used by Montgomery Watson 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 source water blank;
- 1 pre-installation equipment blank; and
- 1 trip blank per cooler of samples.

A limited target analyte list for Method SW8260B will be reported for all AFBCA wells and is presented in Table 3.2. These reporting procedures are identical to those that will be used for the LTM event performed by Montgomery Watson. The Quality Assurance Program Plan (QAPP) for the LTM program at March ARB (Montgomery Watson, 2000) will be adopted as the site-specific addendum to the PDBS QAPP as appropriate.

3.2 Contaminant Profiling

Per the AFBCA 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 AFBCA PDBS Project Work Plan (Parsons, 2001) are not appropriate for use at March ARB 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 March ARB. Rather, sample aliquots will be collected from all PDBSs to be installed and shipped to EMAX for analysis. Thus, vertical profiling of VOC concentrations within each well will be completed using fixed-based laboratory analyses rather than field-screening methods.

3.3 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

TABLE 3.2
LABORATORY TARGET ANALYTE LIST
PASSIVE DIFFUSION BAG SAMPLER DEMONSTRATION
MARCH ARB, CALIFORNIA

Method	**Analyte**	**Practical Quantitation Limit (µg/L)[a/]**
SW8260B	Benzene	0.4
	Carbon tetrachloride	0.5
	Chlorobenzene	0.4
	Chloroform	1.0
	1,1-Dichloroethane	0.4
	1,2-Dichloroethane	0.5
	1,1-Dichloroethene	0.5
	cis-1,2-Dichloroethene	0.5
	trans-1,2-dichloroethene	0.6
	Ethylbenzene	0.6
	Methyl-tert-butyl Ether	0.5
	Tetrachloroethene	0.5
	Toluene	1.1
	Trichloroethene	0.5
	Vinyl Chloride	0.5
	m,p-Xylenes	1.0
	o-Xylene	0.5

[a/] µg/L = micrograms per liter.

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.

4.0 PROJECT ORGANIZATION

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

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5.0 SCHEDULE

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

- Submittal of the Draft March ARB PDBS Work Plan to commenting parties: May 23, 2001
- Receipt of Draft March ARB PDBS Work Plan Comments: May 25, 2001
- Submittal of the Final March ARB PDBS Work Plan: June 28, 2001
- Install PDBS samplers in monitoring wells at March ARB: May 29 - 30, 2001
- Remove PDBS samplers from monitoring wells at March ARB: June 12 - 13, 2001
- Preparation of the Draft March ARB PDBS Report: July 16 - August 17, 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

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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