Final

Secondary Investigation Addendum Work Plan
OMS #28 – Pit 2
Alabama National Guard OMS
1622 South Broad Street
Mobile, Alabama

Facility ID#: 14587-097-012257
UST Incident #93-02-15

Prepared for:

U.S. Army Corps of Engineers, Mobile District
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List of Acronyms

ADEM	Alabama Department of Environmental Management
AFB	Air Force Base
ALARNG	Alabama Army National Guard
ARBCA	Alabama Risk Based Corrective Action
ASTM	American Society for Testing and Materials
AVGAS	Aviation gasoline
BGS	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Chain-of-custody or Chemical of concern
DOD	Department of Defense
DPT	Direct-push technology
EPA	Environmental Protection Agency
FOD	Foreign objects and debris
ft	Feet
GC/MS	Gas chromatography/mass spectrometry
HSA	Hollow-stem auger
ICPES	Inductively coupled plasma emission spectroscopy
IDW	Investigation-derived waste
ISL	Initial screening level
MCL	Maximum contaminant level
MS/MSD	Matrix spike/matrix spike duplicate
MSL	Mean sea level
MTBE	Methyl-tert-butyl ether
NA	Not available
OD	Outer diameter
OSHA	Occupational Safety and Health Administration
PAHs	Polyaromatic hydrocarbons
PEL	Personal exposure limit
PI	Preliminary investigation
PID	Photoionization detector
POC	Point of compliance or point of contact
PM	Project manager
PPE	Personal protective equipment
PRG	Preliminary remediation goal
QA/QC	Quality assurance/quality control
QAPP	Quality assurance project plan
QCSR	Quality control summary report
RBSL	Risk based screening level
RI	Remedial investigation

List of Acronyms (Continued)

SI	Secondary investigation
SOP	Standard operating procedure
SSHP	Site safety and health plan
TPH	Total petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VOA	Volatile organic analysis
VOCs	Volatile organic compounds

1.0 Introduction

The purpose of this work plan is to describe the activities and procedures to be used in completing a Secondary Investigation (SI) at Organizational Maintenance Shop (OMS) #28 – Pit 2, at 1622 South Broad St., Mobile, AL [UTM 16 398184E 3391744N (WGS84/NAD83)]. Bechtel-S Corporation has been contracted by the US Army Corps of Engineers, Mobile District (USACE-Mobile) to characterize the nature and extent of groundwater contamination at the site, prior to completing a risk-based corrective action evaluation of OMS #28 – Pit 2. This additional site characterization is required because recent groundwater sampling indicates that contamination now extends beyond the network of monitoring wells at the site and may include traces of free-phase hydrocarbons. Activities discussed in this work plan are being performed under USACE Contract No. DACA01-01-D-0027, Delivery Order Number 14, Modification 001.

This plan includes a discussion of the previous investigation activities at the site, a brief summary of background data on the environmental setting; an evaluation of data gaps and data quality objectives; and planned sampling and analysis procedures. This plan references but does not duplicate materials in the February 2004 Data Acquisition Plan for OMS #28 (Bechtel-S, 2004) as well as the site safety and health plan (SSHP) previously developed for work at the nearby Brookley Field Sites 22 and 27 (Bechtel-S, 2002). Standard operating procedures (SOPs) for SI activities at OMS #28 are included as attachments.

1.1 Background

The Alabama Army National Guard OMS is located in the city of Mobile, Mobile County, Alabama. The facility is located near downtown Mobile, between Interstate 10 and Mobile Bay. Figure 1-1 shows the general location of the OMS. The area is relatively flat with an elevation of 20-30 feet above mean sea level (MSL). Four storage tanks have been removed from three separate locations at the facility. A site location map is shown in Figure 1-2.

Following tank removal at pit 2 in October 1992, a preliminary investigation was performed for pit 2 in October 1993, but did not fully determine the extent of soil or groundwater contamination. A secondary investigation of pit 2 was completed in December 1994, establishing the extent of soil and groundwater contamination at the site. The 1994 Secondary Investigation was followed by quarterly groundwater monitoring in 1995. Groundwater monitoring continued

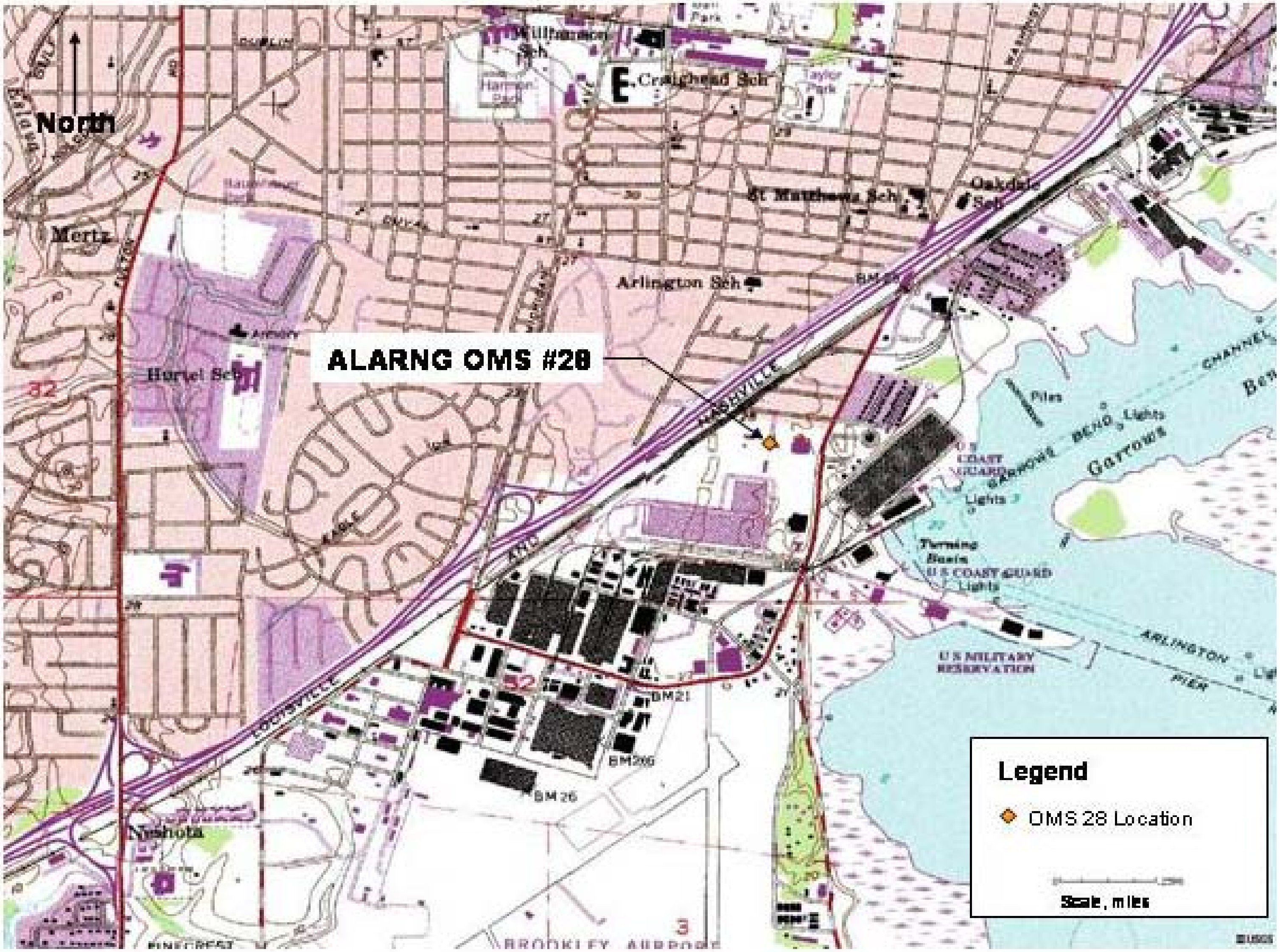


Figure 1-1. OMS #28 Vicinity Map

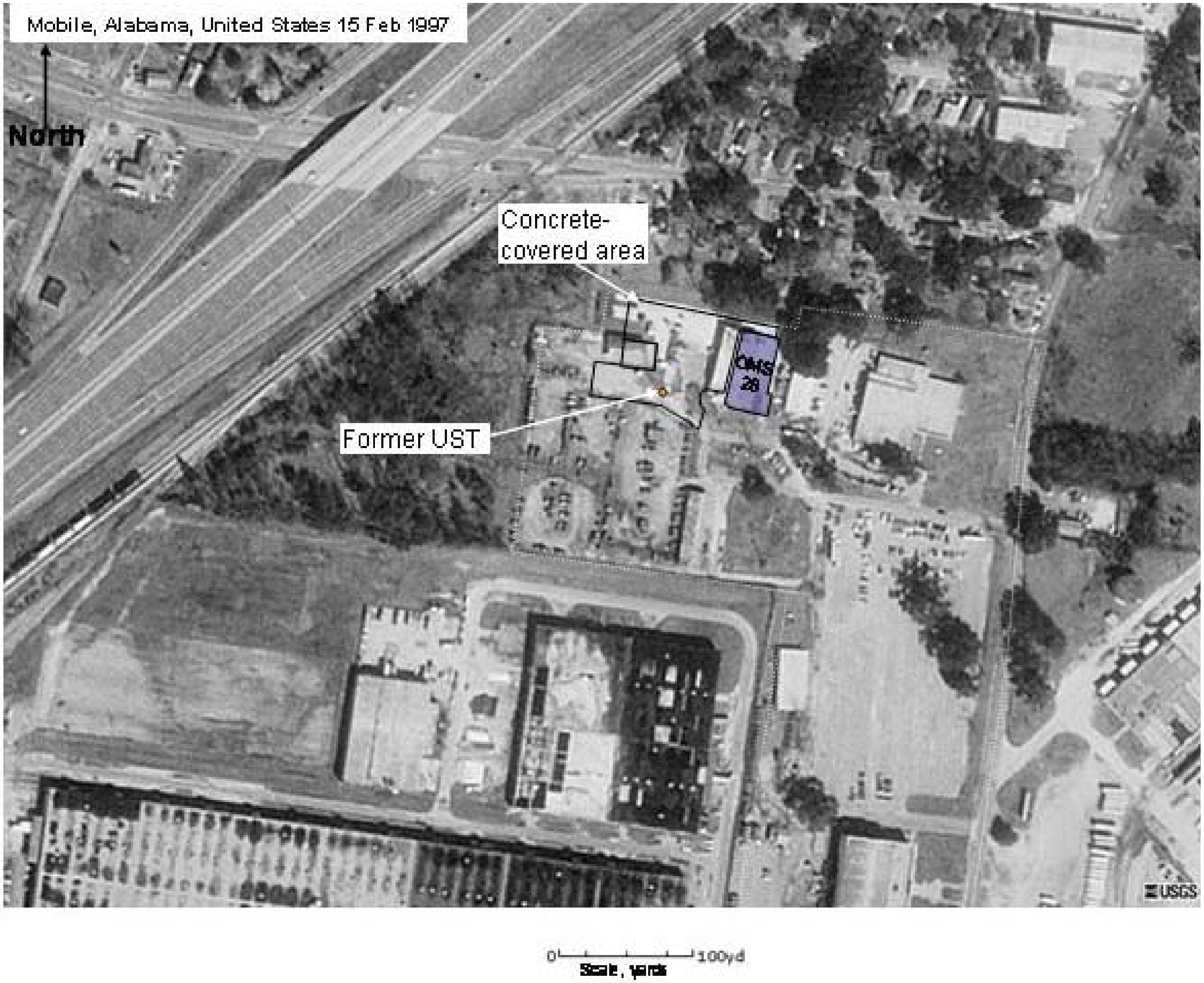


Figure 1-2. OMS #28 Site Map

on a roughly semi-annual basis through 1997. An additional set of groundwater samples was collected in October 2001. Bechtel-S was contracted to complete a risk-based assessment of the site in 2003 and sampled existing wells on site in March 2004.

1.2 Geology and Hydrogeology

The regional geology and hydrogeology in the vicinity of ALARNG OMS are described in the *Final Data Acquisition Plan* for OMS #28 (Bechtel-S, 2004). Geologic units outcropping near the OMS range from Tertiary to Quaternary Age. Quaternary alluvial and terrace deposits overlie Tertiary deposits adjacent to the floodplains of the larger streams and rivers, and along Mobile Bay.

The major aquifers in the vicinity of the OMS include the Miocene, Pliocene-Pleistocene (also known as the Citronelle), and the alluvial-coastal aquifers. Although these aquifers represent different lithological units, they generally respond as a single hydrogeologic unit to large or long-term stresses (BCM, 1999). However, at a smaller scale there may be little hydraulic connection between units.

Groundwater at OMS #28 is found 2 to 5 feet below ground surface. Locally, the aquifer consists of fine sand. Groundwater flow is to the west to northwest across the site. All wells on site are completed across the water table. No site-specific data on deeper hydrogeological units is available.

1.3 Previous Investigations at OMS 28 Pit #2

Site investigation activities and results are summarized in Table 1-1. A more detailed presentation of investigations at OMS #28 Pit 2 is presented in the ARBCA Data Acquisition Plan (Bechtel-S, 2004). Only the most recent results from the Bechtel-S sampling effort are presented in detail in this document to support the need for additional site characterization work, which is described in Section 2. Groundwater monitoring at OMS #28 between 1992 and 2001 has consistently documented BTEX contamination in MW-1 in excess of ADEM Initial Screening Levels (ISLs), trace levels of contamination in MW-3, and no detectable contamination in downgradient wells MW-5 and -6.

Table 1-1. Summary of Previous Investigations: OMS 28 Pit #2

Source	Primary Activities	Major Findings
UST Closure Report (CWA, Nov. 1992)	• Tank, piping, and 50 yd^3 soil excavated • Subsurface soil samples collected while installing 4 monitoring wells • Excavated soil spread in thin layer on ground surface	• Sidewall and bottom samples indicate TPH concentrations between <10 and 49 mg/kg • Composite samples of excavated soil contain up to 427 mg/kg TPH • Soil boring samples indicate 26.6 mg/kg TPH at 5 ft bgs in MW-1 and <10 mg/kg in all other borings
Preliminary Investigation Report (PELA, Dec. 1993)	• 4 monitoring wells sampled for benzene, toluene, ethylbenzene, and xylene (BTEX) and poly-cyclic aromatic hydrocarbons (PAHs)	• MW-1 groundwater contains 10,300 ug/L BTEX and 537 ug/L PAHs • MW-3 groundwater contains 24 ug/L BTEX and 9 ug/L PAHs • Extent of soil contamination not defined
Secondary Investigation Report (PELA, Dec. 1994)	• One hand auger soil boring sampled TPH • 4 existing and 2 new monitoring wells sampled for benzene, toluene, ethylbenzene, and xylene (BTEX), PAHs, and lead • Water level surveys to determine groundwater flow direction	• TPH < 10 mg/kg in soil; extent of soil contamination defined • BTEX at 27,840 and naphthalene at 353 ug/L in MW-1 • Trace levels of BTEX in MW-3 • Lead concentrations exceeding MCL in 5 of 6 wells • No organic contaminants detected in new wells; extent of groundwater contamination defined. • Groundwater gradient 0.006 ft/ft to west
Groundwater Monitoring Report (ACT, Jan 1996)	• Four quarters of groundwater sampling and analysis for BTEX, with PAHs and lead for fourth quarter samples only.	• Reported concentrations of BTEX in MW-1 are substantially lower than previous results and generally increase over the course of the monitoring period. Napthalene detected in MW-1 and MW-3. Lead exceeds MCL in all wells.
Groundwater Monitoring Reports, PELA, 1997	• Two rounds of sampling at all wells for BTEX, and dissolved oxygen. MTBE included in July analyses.	• BTEX concentrations in MW-1 much higher than measured by ACT, but lower than results from Secondary Investigation and declining over time.
Fax from STL Pensacola to Mr. Craig Holloway, dated 11/6/01	• BTEX analyses reported for six wells sampled on 10/03/03	• Results indicate a gradual decline in concentrations of all contaminants in MW-1 except ethylbenzene since 1997 sampling. Benzene and ethylbenzene exceed MCLs.
ARBCA Data Acquisition, Bechtel-S Corp., 2004	• Groundwater sampling from existing wells for BTEX, PAH and lead; aquifer tests • Soil geotechnical sampling	• Benzene detected > MCLs in MW-1 and 5 • Trace amounts of LNAPL detected in MW-1 • Continued decline in BTEX concentrations; benzene and ethylbenzene still above MCLs

Site conditions have changed considerably between the 2001 sampling event and March 2004. A 1992 drawing of the site indicates an asphalt parking area immediately around OMS #28 with ‘stone and grass parking’ and grassed areas around Pit #2. By 2004, the entire area west of OMS #28 to the fence line west of Pit #2 had been paved in concrete. OMS #28 personnel indicated that the concrete was placed shortly after the 2001 groundwater sampling.

The 2004 sampling results indicate that the area of groundwater contamination exceeding ISLs has expanded to include MW-1 and the downgradient well MW-6, as shown in Figure 1-3. Soil and groundwater samples were collected at OMS# 28 by Bechtel-S personnel on March 9 - 11, 2004 using a bladder pump and low-stress groundwater sampling techniques. Samples were collected from wells MW-1, -2, -3, -5, and -6 (MW-4 was apparently destroyed during paving operations). Results are summarized in Table 1-2. The March 2004 data indicate that the area of groundwater contamination exceeding ISLs now extends beyond the furthest downgradient monitoring locations. Aquifer slug tests were also conducted on MW-1, -2, -3, and -6. Sampling log sheets and slug test analyses are presented in Attachment A.

Table 1-2. OMS #28 Groundwater Monitoring Results, March 2004

(All results in ug/L, except as noted)

Analyte	MW-1	MW-2	MW-3	MW-5	MW-6
Benzene	**200**	ND	ND	ND	**23**
Ethylbenzene	**750**	ND	1.2 J	ND	1.4 J
Toluene	140	ND	0.21 J	ND	0.55 J
Xylenes	1121	ND	1.8 J	ND	1.4 J
Napthalene	**76**	ND	0.60 JP	0.40 JP	**28**
Lead	2.0 JB	3.0 JB	4.0 JB	2.0 JB	ND
Hydraulic Conductivity, ft/day	0.2	0.4	0.1	NA	0.1

J = Estimated result
P = Second column result exceeds method criteria
B = Analyte detected in method blank at concentration similar to sample
ND = Not detected
NA = Not analyzed

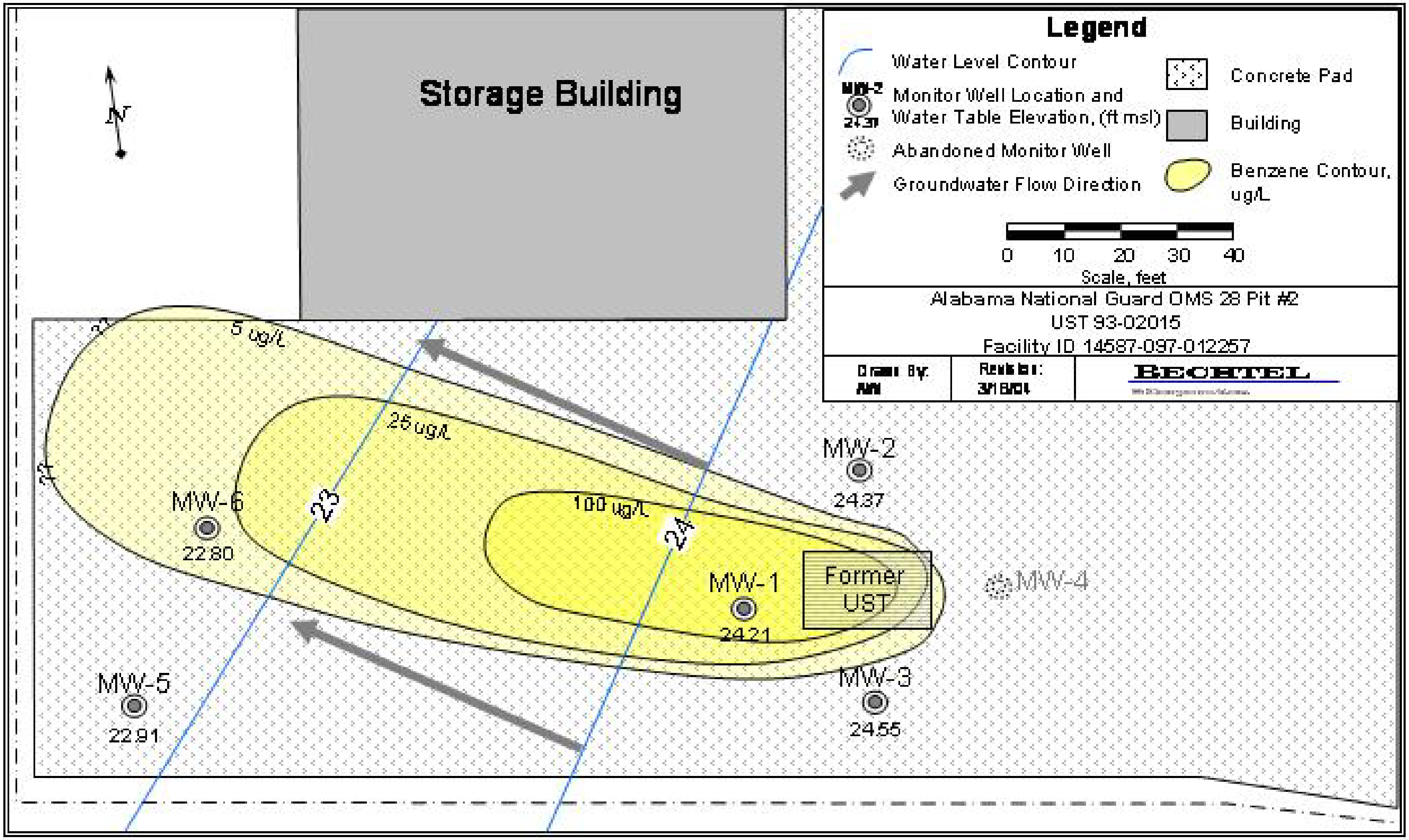


Figure 1-3. Extent of Groundwater Contamination, March 2004

BTEX concentrations in groundwater at MW-1continue to gradually decline over time (Figure 1-4); but the contaminants benzene, ethylbenzene and naphthalene remain above ISLs. In addition, the purge water collected from MW-1 during the March 2004 groundwater sampling contained trace quantities of light non-aqueous phase liquid (LNAPL) hydrocarbons, present as red-orange globules. While the total volume of non-aqueous phase hydrocarbons recovered was less than 5 ml, the presence of even a small volume of mobile LNAPL suggests that a residual saturation of LNAPL is present in the aquifer around MW-1. This residual (i.e. non-mobile) LNAPL could amount to as much as 2% to 3% by volume, representing a significant continuing source of dissolved-phase hydrocarbons. The presence of such a hydrocarbon source is consistent with the long-term persistence of groundwater contamination at the site.

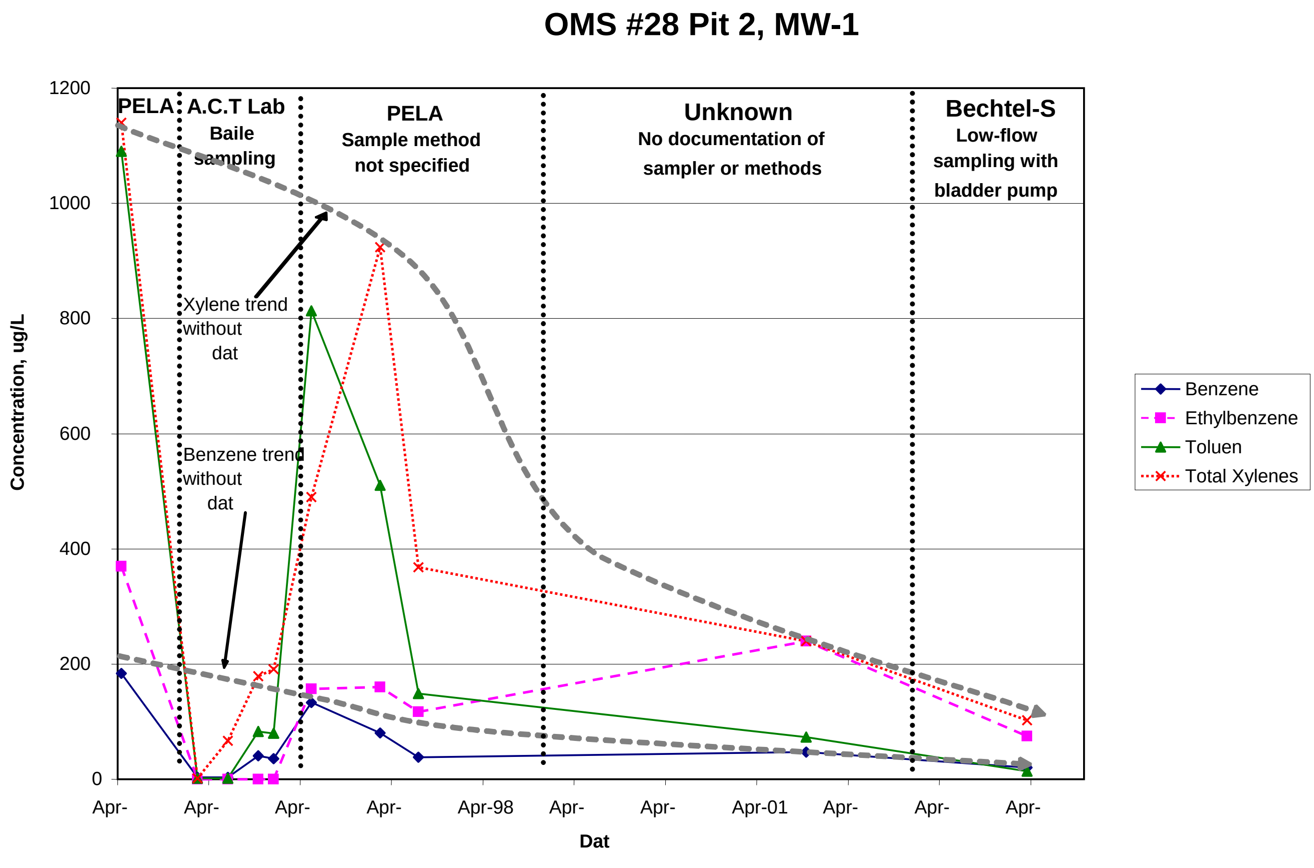


Figure 1-4. Trends in Contaminant Concentrations in MW-1

The concrete covering the site appears to have reduced gas exchange between the atmosphere and the groundwater, limiting degradation of dissolved hydrocarbons, and allowing the plume to spread further downgradient. Dissolved oxygen concentrations in groundwater measured in February and July 1997 ranged from 6.0 to 9.0 ppm. Dissolved oxygen concentrations were marginally lower in wells MW-1 and MW-3, the two wells in which organic contaminants have been detected at levels exceeding regulatory thresholds, although dissolved oxygen concentrations appear to have been sufficient to sustain oxidative metabolism of petroleum hydrocarbons by aerobic micro-organisms in the subsurface before the concrete was placed. The 2004 dissolved oxygen concentrations indicate very limited biodegradation capacity downgradient of the former tank location after the site was covered by concrete. The 2004 dissolved oxygen concentrations ranged from 0.37 mg/L to 2.04 mg/L after purging standing water from the wells. These measurements suggest that dissolved oxygen levels in the groundwater have been reduced following concrete placement, although without documentation of monitor well purging procedures during the previous sampling events it is not known whether the 1997 data represents dissolved oxygen measurements on standing water in the monitor wells or in fresh formation water.

2.0 Investigation Approach

This section discusses data quality objectives for the planned investigation. Data quality objectives (DQOs) ensure that the data collected are of sufficient quality and quantity to be legally defensible under regulatory requirements. The DQO process results in the reduction of uncertainty associated with remedial design and response actions. Three steps can be identified in the process: a) identifying decision types; b) identifying data needs; and c) specifying data collection.

2.1 Decision Types

Previous investigations indicate the presence of groundwater contamination at OMS 28 Pit #2 at concentrations exceeding ADEM ISLs and federal MCLs, but the extent of groundwater contamination and the presence or absence of LNAPL is not currently determined. ADEM UST guidance (ADEM, Nov. 2001) indicates that before proceeding through the ARBCA process it is necessary to determine to the extent of groundwater contamination and remove LNAPL, if present. After completing these steps, the site will return to the ARBCA process to determine site-specific tolerance limits (SSTLs), which then provide the basis for determining whether remedial action is required at the site and, if so, what remedy is most appropriate.

2.2 Data Needs

Bechtel-S Corp. will perform Secondary Investigation activities OMS #28 Pit 2 to define the nature and extent of contamination in accordance with the ADEM rules. Key components of the investigation include:

Define groundwater areas impacted by COCs appropriate to the type of product released. Groundwater grab samples will be collected downgradient of the concrete covered area west of Pit #2 to define the extent of the plume. A new monitoring well will be installed at or near the downgradient edge of the plume. A new monitoring well will be installed to replace upgradient well MW-4. All new and existing monitoring wells will be sampled for the COCs BTEX, MTBE, PAHs, and lead to verify the extent of groundwater contamination.

Define nature of contamination. The presence of LNAPL in MW-1 will be assessed in greater detail. The well will be pumped both using standard low-flow purging techniques and, following sample collection, using higher flow rates to induce greater stress on the aquifer. Any LNAPL removed from the well will be documented in photographs.

Assess potential for natural attenuation. Groundwater chemistry will be evaluated to indicate if natural attenuation processes are active, especially in the area downgradient of the concrete cover.

Determine the hydraulic properties of the site. Water levels will be measured at all new and existing wells on site, as well as at one or more piezometers installed during the course of plume definition. All new and existing wells will be surveyed to confirm elevation and location data following concrete placement at the site. Flow rates will be estimated from site specific data on gradient and hydraulic conductivity.

2.3 Data Collection

The data quality objectives for this investigation will assure that data collected are of sufficient quality to support site closure decisions or regulatory actions. This work plan identifies the information and the types of data required to assess the nature and extent of contamination at OMS #28 Pit 2.

Specific quality objectives for data to be collected are as follows:

- Potentiometric mapping –water levels in existing monitoring wells will be measured to +/- 0.01 ft vertical to confirm the direction of groundwater movement.
- Define nature and extent of groundwater contamination – Groundwater grab samples and groundwater samples from new and existing monitoring wells at OMS #28 will be used to determine the extent of contamination. Groundwater grab samples will be collected using direct-push techniques (SOP B-1). Monitor well samples will be collected using the low-stress sampling technique (SOP B-2) to ensure that they accurately represent subsurface conditions. Groundwater grab samples will be analyzed by Severn-Trent Laboratories, Mobile, AL (STL-Mobile), while monitor well samples will be analyzed by STL-Pensacola. Field and laboratory QA/QC procedures for groundwater sampling and analysis are detailed in Section 3. All analytical methods will provide detection limits and reporting limits at or below ½ their respective ADEM ISLs for UST sites, except as noted in Table 2-1. No LNAPL analysis is planned.
- Assess natural attenuation potential - Field measurements of dissolved oxygen, electrical conductivity, pH, oxidation-reduction potential, temperature, and turbidity will be collected during purging to document site environmental conditions with respect to natural attenuation reactions and assess groundwater sampling procedures. Field instrument calibration will be checked before use and recorded in field log books.

All field work, data evaluation, and reporting will be conducted by a professional geologist licensed in the State of Alabama.

Table 2-1. Laboratory Reporting Limits for OMS 28 Pit #2

COC	ADEM Groundwater ISLs (ug/L)	Target Groundwater RL (ug/L)	Laboratory RL (ug/L)	RL Meets Req?
Benzene	5	2.50	1.0	Y
Toluene	1000	500	5.0	Y
Ethylbenzene	700	350	1.0	Y
Xylenes (Total)	10,000	5000	2.0	Y
Methyl-tert-Butyl-Ether	20	10	1.0	Y
Anthracene	43.4	21.7	1.0	Y
Benzo(a)anthracene	1.17	0.585	0.2	Y
Benzo(a)pyrene	0.2	0.1	0.2	N
Benzo(b)fluoranthene	1.17	0.585	0.2	Y
Benzo(g,h,i)perylene	0.7	0.35	1.0	N
Benzo(k)fluoranthene	0.8	0.4	0.5	N
Chrysene	1.6	0.8	1.0	N
Fluoranthene	206	103	1.0	Y
Fluorene	1460	730	1.0	Y
Naphthalene	20	10	1.0	Y
Phenanthrene	1000	500	1.0	Y
Pyrene	135	67.5	1.0	Y
Lead	15	7.5	5	Y

General Analytical Notes:

- All laboratory reports will comply with USACE EM 200-1-3 specifications
- All analytical reports will list both detection limits and reporting limits for all analytes
- All analytes that are not detected at a concentration equal to or greater than the reporting limit will be reported as “U” or “ND”
- Where STL Pensacola cannot meet the target reporting limits, the laboratory RL is shown on the right. If additional analytical problems are encountered with project samples, then ADEM and the project management must be notified to discuss alternative procedures.

In addition to these SI activities, Bechtel-S is scoped to perform additional services that will be governed by this work plan. These include 1) a multi-phase vacuum extraction event to remove LNAPL, if its presence is confirmed; and 2) a second round of groundwater monitoring for BTEX/MTBE, PAHs, and lead at all monitoring wells on site. Although these activities are not part of the Secondary Investigation *per se,* they are addressed in this work plan to provide consistent data quality and field implementation processes.

3.0 Sampling and Analysis Plan

This sampling and analysis plan details the sampling and analysis matrix for the acquisition of additional soil and groundwater data at OMS #28 Pit 2. All SOPs utilized for this investigation are documented in Attachment B. The quality assurance and quality control (QA/QC) procedures for collecting, handling, and analyzing samples are specified in this section.

3.1 Groundwater Grab Sampling and Analysis

Groundwater grab samples will be collected from up to 10 locations west of the area of known groundwater contamination. Samples will be collected using direct-push techniques. A pilot hole will be hand augered to just above the water table. The probe rod will be manually driven approximately four feet into the saturated zone and the drive rod will be retracted to expose the screen. A tubing check-valve pump will be used to collect groundwater samples from the probe rod. Water quality parameters will be measured before sampling, but well purging criteria for low-stress groundwater sampling will not be applied to groundwater grab samples. Groundwater grab samples will be analyzed for VOCs by Method 8260B only by STL-Mobile with a next-day turn-around time.

3.2 Monitor Well Installation and Development

Shallow monitoring wells will be installed in one upgradient and one downgradient location. The upgradient monitor well will be installed in the grassy area in the front of the OMS #28 main entrance. The downgradient well location will be based on the results of the groundwater grab samples. The well will be located at or near the downgradient margin of the BTEX plume, and is intended to confirm the extent of contamination exceeding ISLs and serve as point of compliance monitoring location. Both new monitoring wells will have a 10 ft screen interval intercepting the water table and will have a total depth of approximately 14 feet. Both wells will be completed with a flush-mount surface protection. Detailed monitor well installation and development SOPs are included in Attachment B.

3.3 Monitor Well Sampling and Groundwater Analysis

Five (5) existing and two new monitoring wells will be sampled once as part of the SI and a second time to ensure plume definition and to demonstrate that free product has been addressed. SI groundwater analytical results will be used to confirm the extent of COCs on-site, including upgradient, source area, downgradient and point-of compliance locations.

All groundwater samples will be analyzed for the parameters listed in Table 3-1. Monitor well purging and sampling will be conducted in accordance with the low-stress procedure (SOP B1.0). Groundwater samples will be collected, preserved, and stored according to procedures presented in Table 3-2. All groundwater samples collected from monitoring wells will be analyzed by Severn Trent Laboratories, Pensacola (STL-Pensacola).

Table 3-1. Summary of Groundwater Sampling Activities, OMS 28 Pit#2

Media	Analyte	Method	Field Samples	Trip Blanks	Field Duplicates	Rinsate Blanks	MS/ MSD
Groundwater Grab Samples	VOCs	SW 8260B	10	1			1
Monitor Well Samples (per sample event)	VOCs	SW 8260B	7	1	1	1	1
	SVOCs	SW 8310 or 8270	7	NA	1	1	1
	Lead	SW 6010B	7	NA	1	1	1

NA Not applicable

Table 3-2. Summary of Sample Handling Requirements OMS 28 Pit #2

Media	Reference Method	Parameter	Method Type	Container Type, No., and Volume	Preservation and Storage Requirements	Maximum Holding Time (Preparation)	Maximum Holding Time (Analysis)
Groundwater	SW846 8260B	BTEX/ MTBE	GC/MS	(3) 40 mL VOA vials[a]	Refrigerate at 4ºC, pH<2 with HCl	N/A	7 days (14 days for samples preserved with HCl to pH<2)
	SW846 8310 or 8270	PAHs	GC/MS	(1) 1 L amber glass bottle	Refrigerate at 4ºC, keep in dark	7 days to extract	40 days following extraction
	SW846 6010B	Lead	ICAPES	(1) 500 mL HDPE bottle	pH <2 with HNO_3, 4 º C	6 months	6 months

[a] Extra sample must be collected for matrix spike/matrix spike duplicate (MS/MSD) analysis.

BTEX Benzene, toluene, ethylbenzene, and xylene
GC/MS Gas Chromatography/Mass Spectrometry
PAHs Polyaromatic hydrocarbons
HDPE High density polyethylene
VOA Volatile organic analytes
ICPES Inductively coupled plasma emission spectroscopy
N/A Not applicable

After analytical samples are collected from MW-1, the well will be purged at a higher rate (>1L/min) to induce greater stress on the aquifer and mobilize additional LNAPL, if present. This purge rate will be maintained for 30 minutes, or until the water level in the well is drawn down to the pump intake level, whichever comes first. Any LNAPL produced will be collected and photographed, and the total volume of LNAPL and water produced will be recorded.

3.4 Piezometer Installation

Up to two piezometers will be installed at locations where groundwater grab samples are collected for the purpose of further defining groundwater gradient across the site. The piezometers will be constructed of 1 inch PVC screen five feet in length and a 1-inch PVC casing. The piezometer screen will be driven to a depth such that the water table crosses the screen opening. The total depth of the piezometer(s) will be less than 10 feet. A light-duty flush-mount surface protection will be set in a cement pad to hold the piezometer in place, and the top of the piezometer will be sealed with a PVC cap. Piezometer construction is shown in Figure 3-1.

3.5 Multi-Phase Extraction

A multi-phase groundwater/LNAPL extraction will be performed by EcoVac Services at MW-1 if groundwater sampling confirms the presence of LNAPL. The multi-phase extraction will be conducted for 8 hours, until the vacuum truck reaches its capacity, or until the supplemental fuel (propane) supply is exhausted, whichever is first. Two additional hours are allocated for set-up, breakdown and gauging, as well as for offloading at the disposal facility.

The multi-phase extraction process simultaneously removes vapors, free product, and groundwater from the subsurface. It volatilizes adsorbed and free phase VOCs through a process similar to soil vapor extraction, but with a much higher vacuum and radius of influence. The vacuum extraction also treats adsorbed phase VOCs existing within the "smear zone" (i.e. the zone of seasonal or climatic groundwater fluctuation) that act as a source for dissolved phase VOCs. The vacuum dewaters the smear zone and exposes it to vapor extraction, helping to reduce dissolved phase VOC concentrations. Importantly, vacuum extraction also introduces oxygen to the vadose and saturated zones, thereby enhancing aerobic biodegradation.

Offgas treatment utilizing a computer controlled dual (i.e. two engine) internal combustion engine (DICE) will be implemented.

EcoVac Services will collect the following data during the course of extraction:

- VOC removal rate and total removal (mass and volume)
- Flow rates

• Extraction well vacuum pressures

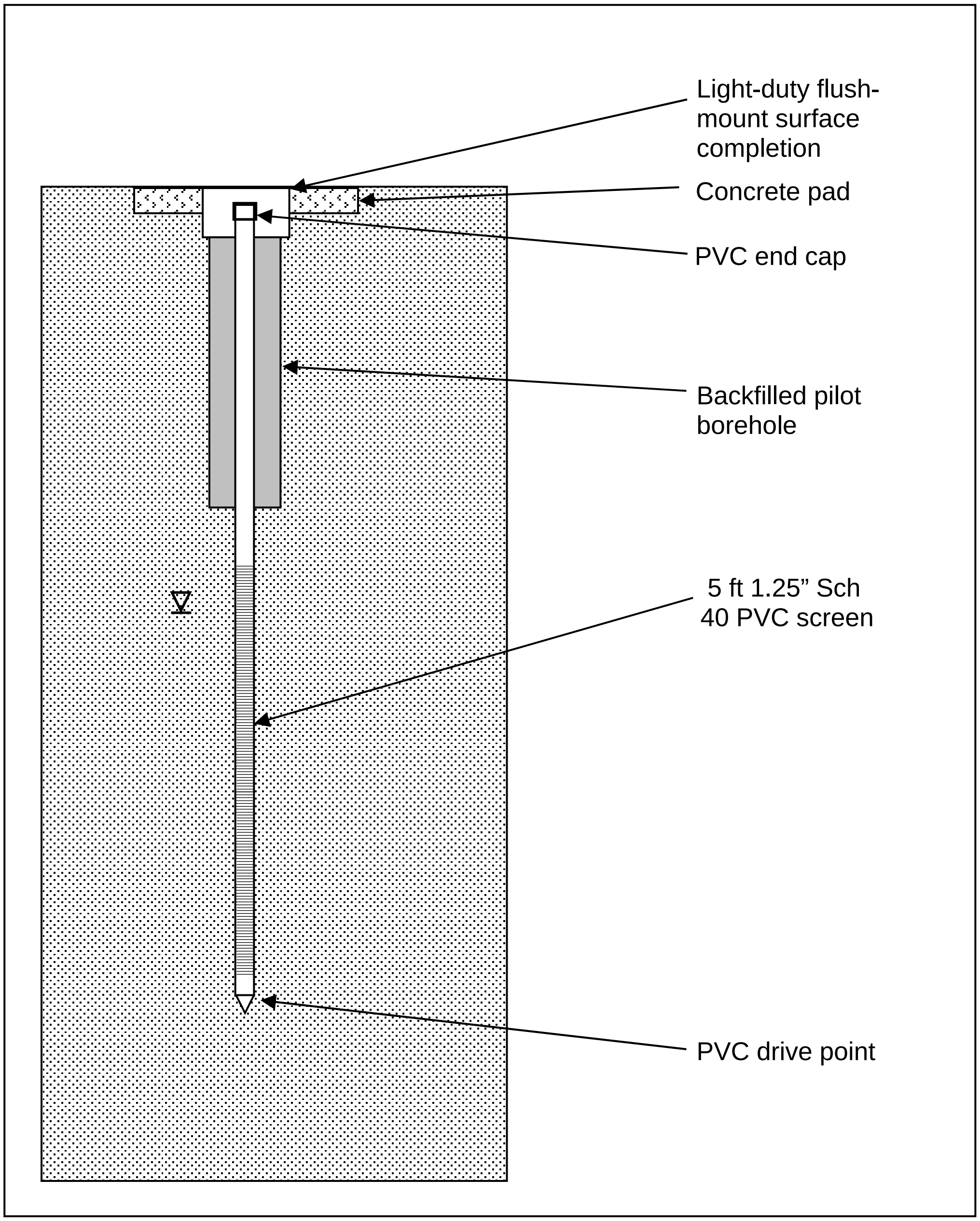


Figure 3-1. Piezometer Construction

- Offgas concentrations
- Groundwater and free product recoveries
- Groundwater/product levels (before and after extraction)
- Limited vacuum influence and groundwater level drawdown data

3.6 Field QA/QC

In addition to the sample tracking procedures contained in Section 3.7, field QA/QC will include field instrument calibration, compliance with sample holding times, collecting field QC samples, and daily reviews by the field geologist. Three types of field QC samples will be collected during this investigation: trip blanks, field duplicates, and rinsate blanks, as outlined in Tables 3-1 and 3-2.

The laboratory address and contact are as follows:

Severn Trent Laboratories
ATTN: Stephanie Akers
STL Pensacola, FL.
3355 McLemore Drive, Pensacola, FL 32514

Phone: 850-474-1001, x6201
Fax : 850-478-2671
e-mail: SAkers@stl-inc.com

A letter verifying USACE laboratory certification is included as Attachment C.

3.6.1 Trip Blanks

A trip blank is a VOA sample bottle filled in the laboratory with distilled water, maintained at 4°C, transported to the site, handled like a sample, and returned to the laboratory for analysis. Trip blanks will not be opened in the field. One trip blank will accompany every cooler of water samples sent to STL's Pensacola laboratory for analysis. This blank shall be analyzed for BTEX/MTBE only.

3.6.2 Field Duplicates

Field duplicates are two samples collected independently at a sampling location during a single act of sampling. Field duplicates will be identified so that the laboratory personnel are unable to distinguish them from normal field samples. The field log book should indicate the identification of these duplicate samples for future reference. Field duplicate samples will be collected and analyzed at a 10% frequency per parameter or a minimum of one per site.

3.6.3 Matrix Spike/ Matrix Spike Duplicates

Matrix spike/matrix spike duplicates (MS/MSD) are collected at a sampling location during a single act of sampling and are used to evaluate laboratory recovery and quantification of COCs. MS/MSD samples will handled as normal samples and spiked in the laboratory. The field log book and sample labels should identify these duplicate samples for laboratory reference. MS/MSD pairs will be collected and analyzed at a 5% frequency per parameter or a minimum of one per site.

3.6.4 Rinsate Blanks

A rinsate blank is a sample collected from distilled water used to rinse sampling equipment following decontamination. One rinsate blank will be collected for each analytical method. The rinsate blank will be collected following sampling in the source area. The rinsate blank will be maintained at 4°C and shipped to the laboratory for analysis.

3.7 Sample Handling, Documentation, and Analysis

Sample control and identification, data recording, and chain-of-custody documentation after samples are collected will be conducted according to procedures specified below.

At the time of sampling, respective media sampling logs will be used to record information about each sample collected. Information recorded in the field sampling logbook will include physical appearance of samples, field observations, the results of field analyses, sampling methods, and materials used. After sample collection, a label specifying the following will be affixed to each sample container:

- Site name;
- Unique field identification number;
- Date and time of sample collection;
- Sample matrix;
- Sample preservation;
- Type of analysis to be performed; and
- Project number.

An example label and custody seal is shown in Figure 3-2. Labeled samples will be checked for proper identification and completeness, and cross-checked with sample information described in the field sampling logbook and the chain-of-custody form before they are placed in coolers for shipment. This is the point at which the chain of custody procedure begins. A chain of custody form (Figure 3-3) will accompany each shipment of samples from the field to the laboratory to establish the documentation necessary to trace sample possession.

Location ID:	**Sample ID:**
Sample Matrix:	**Client:**
Date/Time:	**Sampler:**
Analysis:	**Comments:**

CUSTODY SEAL

____

IMPORTANT! BEFORE OPENING NOTE IF CONTAINER HAS BEEN TAMPERED WITH

Figure 3-2. Example Sample Label and Custody Seal

Sample numbers are used to track each sample from the time of collection to when it is entered into the chain of custody forms and shipped off-site. Identification numbers will be recorded in all field documentation and used to trace each sample back to site, sampling location, sample media, and date of collection. These unique sample numbers will be used to identify the sample during collection, shipping, storage, analysis, data validation, and reporting.

Distinct numbers will be assigned to samples according to the identification code for OMS 28, using the format:

ABC-DE23-(4-5) FGH

Where:
A = Site identification (A for ALARNG OMS)
BC = Site abbreviation (28 for OMS #28)
DE = Matrix (SB for soil, DP for direct push groundwater, MW for monitor well, etc).

Chain of Custody Record			
XYZ Laboratories	Report To:	Invoice To:	PO#
	Company:	Company:	Report Number
	Address:	Address:	
	City:	City:	Fax #:
	Attn:	Attn:	
Project Name/Location	Requested Turn-Around Time 14 day____ 7 day____ 1 day_____		
	Comments/Special Requests		
Project No.			
Sampled By:	Temp/Condition of Cooler:		Analyses Requested

Sample Number	Collected Date	Collected Time	Solid	Liquid	Sample Identification	Number of Containers	Sample Volume								Temp. and Condition of Sample	Preserved?	Remarks		

Relinquished By (Signature)	Date	Received By (Signature)	Date	Relinquished By (Signature)	Date	Received by Lab (Signature)	
Relinquished By (Print)		Received By (Print)		Relinquished By (Print)		Received by Lab (Print)	
Carrier		Air Bill No.		Carrier Phone #		Report Due Date:	

Figure 3-3. Example Chain of Custody Form

23 = Sample location
(4-5) = Sample depth interval, if applicable
FGH = QA type (MS for matrix spike, MSD for matrix spike duplicate, RB for rinsate blank, etc)

All samples will be stored in coolers on ice from collection until analysis. Protective packing such as bubble wrap will be used to minimize the potential of sample bottle breakage during transport and to assure that samples do not freeze

3.8 Utility Clearance

Utility clearance is required before any direct push or drilling activities can begin. Alabama One-Call (1-800-292-8525) must be contacted to locate utilities at the site. Alabama One-Call must be contacted at least 48-hours prior to drilling. Alabama One-Call will need a site map, location information and address, including the nearest street intersection. Before Alabama One-Call personnel visit the site, all drilling locations must be outlined in white paint so that the required locations can be cleared. Inspection of drilling sites by Alabama One-Call personnel will be coordinated with a site visit by the Project Geologist. After the site is cleared for drilling, work must be completed within a 2-week period.

3.9 Disposal of Investigation-Derived Waste

Monitoring well purge water will be containerized in drums and stored on pallets at the nearby staging area on Brookley Field, pending receipt of analytical results. The investigation is expected to generate less than 30 gallons of IDW. IDW from well purging will be disposed at the US Environmental Services facility (4230-A Halls Mill Road, Mobile, AL (251) 662-3500). Recovered fluid from the multi-phase extraction will be characterized and disposed as a non-hazardous, nonregulated waste at IWS (Mobile, Alabama) at a rate of $0.143/gallon (includes EcoVac Services' markup). A 1,000 gallon minimum charge may be imposed by the disposal facility. Other IDW (Tyvek suits, gloves, used containers, etc) will be containerized and disposed off site according to applicable regulations. The USACE POC will meet with the disposal contractor and sign waste manifests once arrangements have been made for disposition of IDW.

4.0 Reporting

Reporting will be conducted in accordance with the USACE and ADEM guidance, including ADEM Admin. Code R.335-1-6-15. A Secondary Investigation Addendum report will be prepared using the format shown in the ADEM UST Release Investigation and Corrective Action Guidance Manual, Section V. The report will detail the investigation findings about the nature and extent of site contamination and recommendations for any additional action that may be necessary. A data validation section will be included in the report that will:

- Identify field duplicates and blanks and match them with associated field samples.
- Include "Cooler Receipt" forms noting any sample handling problems
- Provide complete laboratory data reports, indicating sample concentrations, detection and reporting limits, and sample dilutions
- List laboratory blank sample and surrogate sample results and associated control limits, and identify any analytical flagging required for field results.
- Report matrix spike/matrix spike duplicate and laboratory duplicate sample results and control limits with corresponding field sample results for MS/ MSD pairs.

A separate data acquisition report (DAR) will be prepared detailing the data collected to complete the ARBCA, including the results of the multiphase extraction and the subsequent round of groundwater monitoring.

An electronic copy of each final report will be submitted on CD with each hard copy. The CD will include all files contained in the hard copy, although the laboratory data files may be in a database format rather than the page layout provided in the hard copy report.

Document distribution is shown in Table 4-1.

Table 4-1. OMS 28 Pit #2 Report Distribution

	USACE	ADEM	ALARNG
Draft Work Plan	1	1	1
Final Work Plan	1	2	1
Draft SI Report	1	1	1
Final SI Report	1	2	1
Draft DAR	2	0	1

Final DAR	1	2	1

5.0 Project Schedule

Table 5-1 shows the proposed schedule for conducting secondary investigation activities at OMS 28 Pit #2. As required by ADEM, in their letter dated 14 September 2004, the Draft SI Addendum Report and the Draft ARBCA Data Acquisition Report will be submitted on or before 28 February 2005.

Table 5-1. Project Schedule

Work Effort	Date
Work Plan	
Submit draft plan	6/18/2004
Receive USACE comments on draft plan	7/19/2004
Submit final work plan	9/28/2004
Groundwater Sampling	
Groundwater grab samples	10/04/2004
Monitor well installation	10/06/2004
Monitor well development	10/08/2004
Monitor well sampling, Round 1	11/05/2004
Multiphase extraction	12/03/2004
Monitor well sampling, Round 2	2/03/2005
Data validation	2/20/2005
Reporting	
Submit draft SI report (includes QCS section)	2/28/2005
Receive comments on draft report	2/25/2005
Submit final SI report	3/15/2005
Submit draft DAR	2/28/2005
Receive USACE comments on draft DAR	3/15/2005
Submit final DAR	4/01/2005

6.0 Site Safety and Health Plan

This investigation will adopt the Site-Safety and Health Plan prepared for the USACE for similar work at nearby Brookley Field Sites 22 and 28 (Bechtel-S Corp, January 2003). A Certified Industrial Hygienist has reviewed, approved and signed this SSHP. This SSHP includes health and safety planning for all anticipated site activities and meets the Occupational Safety and Health Administration (OSHA) requirements of 29 CFR Section 1910. 120, applicable sections of 29 CFR Part 1926, and EM 385-1.

7.0 References

ADEM, 1995. *Alabama Underground Storage Tank Release Investigation and Corrective Action Guidance Manual*. May 1995

ADEM 1998a. Letter from Stephanie Carter to Ms Rita Reeves, Alabama Armory Commission, "RE: Groundwater Monitoring Reports dated March 6, 1997 and September 5 1997" dated 9 February, 1998.

ADEM 1998b. *Alabama Risk-Based Corrective Action for Underground Storage Tanks Guidance Manual*. April 1998

ADEM 2001. *Alabama Risk-Based Corrective Action for Underground Storage Tanks Guidance Manual*. November 2001.

ADEM 2001. *ARBCA Alabama Risk-Based Corrective Action Guidance Manual.* December 2001.

ADEM, 2004. Letter from John Pierce, UST Corrective Action Section, to LTC Brian Barrontine, Alabama Army National Guard Environmental Division, RE: Authorization To Implement Secondary Investigation Addendum Work Plan, OMS #28 Pit-2, dated 14 September 2004.

Analytical Chemical Testing Laboratory, Inc, 1996. *Groundwater Monitoring Report, Fourth Quarter Sampling Event, Alabama National Guard Armory OMS #28 &29 – Pit #2*. January 1996.

Anderson, Keith E., *Groundwater Handbook*, 1920.

Bechtel-S Corp, 2003. *Final Work Plan and Site Safety And Health Plan For Investigation Activities, Sites 22 and 27, Brookley Field AFB, AL.* January 2003.

BCM Engineers, 1999. *Draft Final Site Investigation Report for the Former Brookley Field Air Force Base (AFB)*, 1999.

CWA Group, Inc. 1992. *UST Closure Site Assessment Report, The Amory Commission of Alabama OMS #28 and 29 – Pit #1, Pit #2 and Pit #3.* Report dated November 10, 1992.

Foster Wheeler Environmental, August 2001. *Final Preliminary Investigation Report for Sites 22 And 27, Former Brookley Field Air Force Base Mobile, Alabama*

P.E. LaMoreaux and Associates, Inc, 1993. *Preliminary Investigation Report, OMS #28 Pit #2.* Report dated Dec. 7 1993.

P.E. LaMoreaux and Associates, Inc, 1994. *Underground Storage Tank Secondary Investigation Report, Alabama National Guard Armory OMS #28 and 29 - Pit #2.* Report dated Dec. 7 1994.

P.E. LaMoreaux and Associates, Inc, 1996. Letter to Mr. Tim Young, ADEM, "RE: OMS 28 and 29, Pit #2" dated July 3, 1997.

P.E. LaMoreaux and Associates, Inc, 1997a. Letter to Mr. Tim Young, ADEM, "RE: OMS 28 and 29, Pit #2" dated March 6, 1997.

P.E. LaMoreaux and Associates, Inc, 1997b. Letter to Ms. Stephanie Carter, ADEM, "RE: OMS 28 and 29, Pit #2" dated Sept. 5, 1997.

Puls, W.P. and M.J. Barcelona, USEPA Groundwater Issue Paper: *Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures*, EPA/5440/5-95/504, April 1996.

Attachment A

MARCH 2004
SOIL AND GROUNDWATER ANALYSIS AND AQUIFER TEST RESULTS

Attachment B

STANDARD OPERATING PROCEDURES

B1 Low-Stress Groundwater Sampling

B2 Decontamination Procedures

B3 Water Level Measurement

B4 Sample Control and Documentation

B5 Direct-Push Sampling

B6 Monitor Well Installation

B7 Monitor Well Development

B1.0 Low-Stress (Minimal Drawdown) Groundwater Sampling SOP

B1.1 Purpose

The purpose of this standard operating procedure (SOP) is to describe a low-stress (minimal drawdown) procedure for groundwater sampling. It is to be used in conjunction with United States Army Corps of Engineer approved procedures contained in this workplan.

B1.2 Discussion

This SOP is based on procedures described in the United States Environmental Protection Agency (EPA) Groundwater Issue paper EPA/540/S-95/504, which is entitled "Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures" (Puls and Barcelona, April 1996) and the EPA Region 1 SOP "Low Stress (Low Flow) Purging and Sampling Procedure for The Collection of Ground Water Samples from Monitoring Wells," dated 30 July 1996. The primary objective of low-stress purging and sampling is to consistently collect representative groundwater samples without altering water chemistry. Low-stress purging and sampling techniques help to reduce high turbidity levels that may adversely affect sample quality, which commonly occurs with conventional techniques that use bailers or high-speed pumps.

B1.3 Procedure

B1.3.1 Well Purging

A well must be purged with a pump prior to sampling to assure that true formation water is sampled instead of stagnant casing water. Suitable pumps for low-flow (minimal drawdown) purging and sampling include bladder pumps, electrical submersible pumps, and gas driven pumps. Bladder pumps are preferred by the USACE when VOCs are to be sampled, and will be used at OMS #28.

The pump must have an easily adjustable flow rate that is sustainable at flows as low as 0.1 liter/minute. The flow rate is adjusted by the combined use of the pump's frequency control box and hydraulic head differences caused by raising and lowering the tubing height above ground.

Teflon tubing is preferred for sampling VOCs, but polyethylene tubing is acceptable for single use provided it is included in equipment blanks or otherwise demonstrated to not contribute contaminants to the samples.

The disposable polyethylene tubing, which is discarded after its initial use, also decreases the possibility of cross contamination between wells. Sampling devices such as bailers and lift foot-valve samplers that cause repeated sediment disturbance and mixing of stagnant water in the casing with dynamic water in the screened interval are unacceptable.

To minimize sediment disturbance and water mixing, the pump will be slowly lowered through the water column to screen midpoint (or slightly above) for wells screened below the water table and to at least two feet below the water table for wells screened at the water table interface. In addition, the pump and water level meter will be placed in the well as far in advance as possible, will be placed at least two feet from the bottom of the well, and will not touch the bottom. If a measurement of sediment thickness in the well sump is needed, it will be taken after the well has been sampled.

Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize. Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

Water quality indicator parameters will be measured every three to five minutes by instruments contained in an in-line flow-through cell attached to the pump. Purging will be considered complete when parameters stabilize for at least three consecutive readings within the following limits: 1ºC for temperature, ± 0.1 pH, ± 0.01 mS/cm for conductivity, ± 10 mV or 10% (which ever is less) for redox potential, ± 10% turbidity, and ± 10% dissolved oxygen. An attempt will be made to purge until turbidity drops below 10 NTU, but this is not a requirement. Removal of a specific volume of water is also not required, provided all water quality parameters are stable as noted above. Figure A1-1 contains a groundwater sampling log for recording water quality indicator parameters and sample information.

Wells will not be dewatered or purged dry, which can cause aeration as groundwater cascades back into the well. Wells screened at the water table interface with slow recharge that results in significant drawdown (greater than four inches) while purging at the lowest possible rate will be pumped at a rate 100 mL/min for a minimum of 1 hour, unless drawdown exceeds 2 ft, then allowed to recharge to the static water level and sampled. It will not be necessary at this point to achieve stabilization of the water quality indicator parameters. If a drawdown of >2 ft occurs in a well screened at the water table interface , purging will be stopped to allow the well to recover before sampling. For wells screened below the water table, a greater drawdown during purging may be acceptable, at the discretion of the Project Geologist. The project manager will be notified if any wells produce less than 100 ml/min to discuss alternate sampling strategies.

During subsequent low stress sampling events, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake depth and extraction rate (use final pump dial setting information) from previous event(s).

B1.3.2 Sample Collection

All samples will be collected from the pump system unless federal, state, or local regulations or guidance stipulate other methodology. After water quality indicator parameters stabilize, groundwater samples will be collected immediately. However, in-line monitoring equipment must be removed prior to sample collection. During sample collection, the pumping rate will remain the same or lower than the purging rate to minimize aeration, bubble formation, or turbulent filling of sample bottles.

During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples: (1) add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing; (2) insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing; (3) collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

B1.4 References

Puls, W.P. and M. J. Barcelona, April 1996, U.S. EPA Groundwater Issue Paper: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504, Washington, DC.

USACE, 2001 Requirements for Preparation of Sampling and Analysis Plans. EM-200-3-1, 1 Feb. 2001.

EPA, Region 1; “SOP GW 0001, Low Stress (Low Flow) SOP” Revision Number 2. July 30, 1996

GROUNDWATER SAMPLING LOG

Sheet ____of ____

PROJECT:			**WELL ID:**
PERFORMED BY:	**SAMPLER:**	**LOG DATE:**	**SAMPLE TIME:**
WATER LEVEL **Initial: Final:**	**TOTAL DEPTH:**	**PURGE METHOD:**	**FLOW RATE:**

Time	**Cum. Volume (Liters)**	**Water Quality Parameters**						**Water Level**	**Pump Setting**	**Comments**
		Temp. (ºC)	**pH**	**Cond. (mS/cm)**	**Turb. (NTU)**	**D.O. (mg/L)**	**Redox (mV)**	**(feet)**	**(HZ)**	

Sample ID	**Matrix**	**Preservative**	**Analyses**	**Sample Code**

Remarks

Figure B1-1. Groundwater Sampling Log

B2.0 DECONTAMINATION PROCEDURES SOP

B2.1 Purpose

The purpose of this SOP is to describe methods for the decontamination of field equipment potentially contaminated during sample collection activities.

B2.2 Discussion

This SOP describes the procedures to be used to decontaminate sampling equipment in the field after use. Refer to the project work plan (e.g., Rl/FS Work Plan, SI Work Plan, UST Investigation Work Plan, etc.) which covers the specific type of environmental investigation you are conducting, the types of samples that will be collected, and the types of equipment to be used and decontaminated. Decontamination is performed as a QA measure and safety precaution. It prevents cross-contamination among samples and helps maintain a clean working environment for the safety of all field personnel.

Decontamination is mainly achieved by rinsing with liquids including soap or detergent solutions, tap water, deionized water, and isopropanol. After being cleaned, equipment is allowed to air dry. If time constraints will not allow for complete air drying, the equipment should be rinsed with copious amounts of analyte-free water. Equipment may then be reused immediately. Steam cleaning should be used whenever visible contamination exists on large machinery/vehicles.

One of the primary responsibilities of the Supervising Geologist is to assure that proper decontamination procedures are followed. The Supervising Geologist is also responsible for ensuring that all waste materials produced as a result of the cleaning procedures are stored or disposed of properly. It is the responsibility of all personnel involved with sample collection or decontamination to maintain a clean working environment and to ensure that contaminants are not negligently introduced into the environment.

B2.3 Procedures

B2.3.1 Office Preparation

Before leaving the office to begin field operations personnel should:

- Review the project work plan and SOPs.
- Coordinate schedules/actions with the facility/installation/site staff.

- Obtain appropriate permission for property access.
- Assemble the equipment and supplies listed in B2.7.
- Notify the analytical laboratory of the decontamination blank sample and the approximate arrival date.
- Contact the carrier that will transport the sample to obtain information on regulations and specifications.
- Obtain a logbook from the QA officer.
- There are no forms required to document decontamination procedures and the degree of decontamination attained.

B2.3.2 Field Preparation

After arriving in the field, personnel should:

- Assemble containers and equipment for decontamination; and

- Decontaminate all equipment before use if not previously decontaminated under controlled conditions.

B2.4 Operation

Once a piece of equipment has been used, it must be decontaminated before it can be reused. If the protective wrapping on a piece of pre-cleaned equipment has been torn, or if there is any question about its cleanliness, the equipment should be considered contaminated and undergo the full decontamination procedures before it is used.

Adequate supplies of rinsing liquids and all materials should be available. Equipment cleaning should be performed in the same level of protective clothing required for sampling activities unless a different level of protection is specified in the SSHP.

The procedure for all field decontamination of equipment follows:

- Remove any solid particles from the equipment or material by brushing and then rinsing with available tap water. For drilling equipment, steam cleaning is necessary. The purpose of the initial step is to remove gross contamination.
- Wash equipment with a brush and a phosphate-free detergent solution.
- Rinse with tap water.
- For organic contaminants, an optional rinse with isopropanol may be necessary to dissolve and remove coatings of organic contaminants.

- Rinse thoroughly with potable water.
- Double rinse with deionized water.
- Allow equipment to air dry thoroughly.
- If the equipment must be reused before the isopropanol evaporates, should be rinsed thoroughly with copious amounts of deionized water.
- Unless the equipment is going to be used immediately, it must be wrapped in new aluminum foil, shiny side out, to keep it clean until needed. For large bulky equipment, new plastic sheeting can be substituted for the aluminum foil.

The alcohol rinse should be omitted for any equipment such as plastic well sounding tapes, PVC slugs, etc. Solvents should not be used on any type of non-Teflon plastic equipment which will contact an environmental sample or be introduced into a monitoring well.

If cleaned under controlled conditions at a warehouse or laboratory, wrapped in aluminum foil for protection, and then brought to the field, the equipment must not be used if the aluminum foil is torn. Under these circumstances, the equipment should be considered to be contaminated and must be decontaminated before use. If this pre-cleaned equipment is not used, it must be decontaminated under controlled conditions before return to the equipment stock for reuse at another site. This requirement applies even if the aluminum foil is not torn. This requirement can be waived if, after being decontaminated under controlled conditions and wrapped in aluminum foil, the equipment is heat sealed in plastic. In this case, if the equipment is not used, the plastic can be rinsed with water and the equipment can be returned to equipment stock.

Decontamination under controlled conditions is by procedures which are slightly different from the aforementioned procedures. The differences are listed below:

- The phosphate-free detergent solution should be hot;
- The tap water rinse should be with hot water;
- For glass and Teflon sampling equipment, a rinse with at least a 10 percent nitric acid solution should be added after the tap water rinse step; and
- An additional tap water rinse should be added after the dilute acid rinse.

The decontamination of drilling, hydrocone, and DPT equipment will be performed as follows:

- Drilling rig engine and power head as well as the DPT will be steam cleaned and rinsed with tap water prior to arrival on-site. Drill equipment will be decontaminated between each sampling site as discussed above. The DPT probes will be disassembled and steam cleaned.

B2.5 Post-Operation

B2.5.1 Field

Before leaving the field, personnel should:

- Decontaminate as much sampling equipment as possible and properly dispose of expendable items that cannot be decontaminated. Heavily contaminated equipment should not be returned to the office or warehouse but should at least be field cleaned (e.g., detergent wash and tap water rinse) before it is returned. Proper disposal may involve on-site draining of liquids and solids into approved containers for subsequent disposal. Expensive items like machinery may require a more advanced analysis of decontamination options.
- Prepare the final decontamination blank sample; document it according to SOP A9.0, Sample Control and Documentation; and ship it to the analytical laboratory.
- Store containers of solutions produced during decontamination in a secure area.
- Dispose of any soiled materials as designated in the project work plan.

B2.5.2 Office

After returning to the office, personnel should:

- Deliver original logbooks to the site manager for technical review. The site manager will review and transmit these items to the document control officer (copies to the sites).
- Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.
- Contact the analytical laboratory to ensure that the sample arrives safely and instructions for analyses are clearly understood.
- After receiving the result of the laboratory analyses, arrange for the disposal of wastes generated during the investigation.

B2.6 Sources

EPA. 1991. Environmental Compliance Branch. Standard Operating Procedures and Quality Assurance Manual (SOPQAM), U. S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

NIOSH, OSHA, USCG and EPA. 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. Prepared by the National Institute for Occupational

Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and the U.S. Environmental Protection Agency (EPA). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, NIOSH report, October 1985. Washington, D.C.: U.S. Government Printing Office.

B2.7 Equipment and Supplies Checklist Attachment

______ Decontamination solutions pre-selected by the laboratory

______ Cleaning liquids: soap or detergent solutions, tap water, deionized water, organic-free water, and isopropanol

______ Cleaning brushes

______ Cleaning containers: plastic bucket and stainless steel or high-density polyethylene pans

______ Waste storage containers: drums and plastic bags

______ Logbook

B3.0 WATER LEVEL MEASUREMENT SOP

B3.1 Purpose

To determine the depth-to-water in an open borehole, cased borehole, or monitoring well.

B3.2 Discussion

This SOP will describe the general procedures followed when measuring the water levels in monitoring wells. These measurements are used to generate piezometric surface maps and to augment Base-wide groundwater modeling efforts. The water table is subject fluctuation due to recharge from surface precipitation events. The time for infiltration to impact the phreatic surface is dependent upon several factors, including amount of precipitation, surface slope, surface covering material (i.e. pavement or grass), and subsurface soil type in the vadose zone. Due to this variability, measurements should not be taken until the water table surface has stabilized following a recharge event. At sites with shallow groundwater, measurements should be taken a minimum of 48 hours after a significant precipitation has occurred. For the purposes of gathering modeling or piezometric data, measurements at different locations should be taken within a 24-hour period.

When data is gathered from many wells, it is sometimes necessary to employ several teams to complete water level measurement in the 24-hour period. When this is done, the measuring devices will be calibrated so that water level measurements can be corrected for minor differences in tape length. When measurements are taken, the actual reading on the instrument will be recorded. Calibration corrections will be made at a later time. This procedure will reduce errors introduced by faulty corrections in the field. The calibration procedure is described in Section B3.4.1.

A registered land surveyor (RLS) has established the elevations of the top-of-casing points. These elevations are referenced to Mean Sea Level (msl), specifically to the National Geodetic Vertical Datum of 1983. All water level and total depth measurements will be taken with reference to the top-of-casing points, to an accuracy of 0.01 ft. For new well installations, a north point will be placed on the well casing after completion and all measurements will be referenced to this point. The elevation of this point will be established by an RLS at a later time.

Water level measurements will be taken before and after well development and groundwater sampling activities and recorded on the relevant log sheets. A tabulated list of water surface elevations will be included in the Draft and Final reports to be submitted to USACE and the Base.

B3.3 Procedures

B3.3.1 Office Preparation

1. Review the FSP, SSHP, and relevant SOPs.

2. Determine if the site requires use of protective clothing and equipment.

3. Coordinate schedules/actions with the Base staff.

4. Obtain appropriate permission for property access.

5. Assemble necessary equipment and supplies listed in Attachment B7.5.1 and any required protective equipment.

B3.3.1. 1 Documentation

- Obtain a logbook from the QA officer.
- Record results of equipment check in the logbook.
- Obtain a sufficient number of the appropriate data collection forms (see attachments to this SOP).
- Consult the Field Team Leader for a current list of location IDs and sample numbers used in the completion of forms and sample documentation.
- Record the most recent calibration date for the water level measuring device in the logbook.

B3.3.1.2 Field Preparation

1. Locate monitoring wells to be measured and check wells for proper ID tag.

2. Obtain keys for well locks from BEC or responsible party.

3. Decontaminate all equipment before taking the first measurement and between measurement intervals.

4. When taking a number of water level measurements, it is preferable to start at those wells that are the least contaminated and proceed to those wells that are the most contaminated.

5. Calibrate measuring instruments if using more than one. Calibration procedures are:

   a. Compare all instruments to a steel tape to determine which instrument is most nearly accurate. This will be the reference instrument. Record this information in logbook.

   b. Measure a clean well with the reference instrument. Record this measurement in logbook.

   c. Measure the same well with each instrument. Record each measurement.

   d. Subtract each measurement from the reference measurement. The difference will be the correction for each instrument. Record the correction for each measurement.

B3.3.2 Operation

1. Whenever a water level is measured, enter a description of the sampling location and record of the measured value onto the Groundwater Level Data form (Attachment B3..2) or the Groundwater Level and NAPL Thickness Data form (Attachment B3.3). Use the latter form when a POL product is floating on the static water in the well.

2. Check well for proper ID tag and record access in the logbook.

3. Unlock the well cover and remove the PVC cap.

4. Inspect well, noting any deterioration, damage, or apparent tampering. Notify the Base Environmental Coordinator (BEC) or the USACE-PM if any repairs are necessary.

5. Before each measurement, decontaminate the water-level and oil/water interface probes as outlined in SOP B2.

6. Lower the oil/water interface probe into the well to check for floating product. If POL is present, record the thickness and water level on NAPL Thickness Data form and note POL presence in Field Log.

7. If POL is not detected, lower the electronic probe into the well until water is encountered and note the depth on the calibrated tape relative to the surveyed reference point. This measurement should be made to the nearest 0.01.

8. Repeat the water-level measurement until two consecutive measurements agree within 0.01 foot.

9. Sound the total depth of the well by lowering the probe to the bottom of the well. If an oil/water interface probe is used to measure total depth of the well, adjust to account for the extra length on the indicator tip past the sensor.

10. Record the depth to water and adjusted total well depth on the appropriate form or Field Log Book.

11. Decontaminate probe and the entire length of the water-level indicator which entered the well.

12. Cap and lock the well if no more activities will occur.

B3.3.3 Post-Operation

B3.3.3.1 Field

1. Ensure that all equipment is accounted for and decontaminated.

2. Restore site to pre-sampling conditions as specified in work plan.

3. Make sure the monitoring well ID tag is properly affixed and visible.

B3.3.3.2 Documentation

1. Complete logbook entries, verify the accuracy of the entries, and sign/initial all pages.

2. Review data forms for completeness.

B3.3.3.3 Office

1. Perform tape calibration adjustments to measurements, if necessary.

2. Convert all water level measurements to Mean Sea Level (msl) elevations.

3. Deliver original forms, logbooks, and list of adjusted and converted elevations to Field Team Leader for technical review. He will review, sign forms, and transmit the USACE Project Geologist.

4. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items.

B3.4 Sources

U.S. Environmental Protection Agency. RCRA Groundwater Monitoring Technical Enforcement Guidance Document. Unnumbered document. U.S. Government Printing Office, Washington, D.C., 1986.

B3.5 Attachments

Attachment B3. 1 Equipment and Supplies Checklist

Attachment B3.2 Groundwater Level Data Form

Attachment B3. 3 Groundwater Level and NAPL Thickness Data Form

ATTACHMENT B3.1

EQUIPMENT AND SUPPLIES LIST

_____Site map showing well locations

_____Oil/water interface probe Electronic water level probe

_____Weighted nylon tape graduated in 0.01 ft

_____Plastic sheeting

_____Decontamination solutions

_____Keys to well locks

_____Non-water-soluble black ink pens

ATTACHMENT B3. 2

GROUNDWATER LEVEL DATA FORM

Groundwater Level Data				
Date:				
Location ID	Log Time	Depth to Water (ft)	Total Depth (ft)`	Comments

ATTACHMENT B3.3

GROUNDWATER LEVEL AND NAPL THICKNESS FORM

Groundwater Level and NAPL Thickness Data					
Date:					
Location ID	Log Time	Depth to Water (ft)	Depth to NAPL (ft)	Total Depth (ft)	Comments

B4.0 SAMPLE CONTROL AND DOCUMENTATION SOP

B4.1 Purpose

The purpose of this SOP is to define the steps necessary for sample control and identification, data recording, and chain-of-custody documentation.

B4.2 Discussion

This SOP contains specific details concerning sarnple control and documentation. Refer to the project work plan (e.g., RI/FS Work Plan, SI Work Plan, UST Investigation Work Plan, etc,) which covers the specific type of environmental investigation you are conducting, the type of samples to be collected, and the destination of the collected samples. Collection and measurement of samples and documentation of data will be performed as described in specific SOPs.

This SOP describes the methodology of sample control and docurnentation for all projects. Sample control and documentation are necessary to ensure the defensibility of data and to verify the quality and quantity of work performed in the field. Accountable documents include logbooks, data collection forms, correspondence, sample labels or tags, chain-or-custody reports, photographs, and analytical records. Indelible black ink must be used in recording all data.

Logbooks are supervised by the QA officer. There may be several logbooks for each project (e.g., separate logbooks for recording general field activities, for recording sarnpling activities. and for recording instrument calibration activities). The QA officer is responsible for numbering the logbooks and assigning them to individuals designated to conduct project-specific tasks. All information pertinent to a field activity must be entered into a logbook, including uncompleted work. All project logbooks are turned over to the document control officer at the end of each work period and to a central file at the end of the field activity.

All QC numbered logbooks are to be bound with consecutively numbered pages. Indelible black ink is used for recording all data. Logbook pages and data should never be removed. To change an incorrect entry, the individual shall draw a line through the entry, write the change above or adjacent to the entry, and date and initial the change. If anyone other than the person to whom the logbook is assigned makes an entry, that person shall date and sign the entry.

All pertinent information concerning sampling activity (e.g., date, site. ID number, and location) shall be recorded in the logbook. Field conditions, weather conditions, and any unusual circumstances should also be recorded. Notes should be as descriptive and inclusive as possible. A person reading the entries should be able to reconstruct the sampling situation from the recorded information. Language should be objective, factual, and free of comments of a personal nature and inappropriate terrninology.

B4.3 Procedures

Before every operation, a review of this SOP is required. This SOP and other pertinent SOPs contain information on the performance of field activities. They should be consulted for specific information regarding equipment and supplies; sample collection, preservation, packaging, and shipping; decontamination procedures; and documentation requirements.

B4.3.1 Preparation

B4.3.1.1 Office

Before leaving the office to begin field operations, personnel should:

- Review the project work plan and appropriate SOPs.
- Coordinate schedules/actions with the facility/installation/site staff.
- Obtain appropriate permission for property access.
- Assemble the equipment and supplies listed in Attachment B4.5.1. Ensure proper operation of all sampling equipment.
- Notify the analytical laboratory of sample types, the number of samples, and the approximate arrival date.
- Contact the carrier that will transport samples to obtain information on regulations and specifications.
- Obtain a logbook from the QA officer.
- Record results of the equipment check in the appropriate logbook.
- Obtain a sufficient number of the appropriate data collection forms (see index of SOPs).

- Consult the data administrator for a current list of information management codes, locations IDs, and sample numbers used in the completion of data forms.

B4.3.1.2 Field

Preparation for field activities requires organizing sample bottles, labels, and documentation in an orderly, systematic manner to ensure consistency and traceability of all data. The following activities should be completed before a sample is collected:

- Record all pertinent information (e.g., date, site, ID number, and location) in the logbook. Note field conditions, unusual circumstances, and weather conditions.
- Fill out information on the sample identification label and attach the label to a sample bottle, and
- Complete initial information required on data collection forms.

B4.3.2 Field Operations

During field operations which involve the collection of any types of samples, the following support activities must be performed.

B4.3.2.1 Sample Identification

A numbering system must be developed for each environmental investigation to identify each well; boring location; and samples taken during water, sediment, and soil sampling programs. This numbering system must provide a tracking procedure to allow data retrieval and ensure that sample identifiers are not duplicated. The most important aspect of any sample numbering system which is developed is ensuring the uniqueness of an individual sample number. Such a sample numbering system is described below. A listing of the sample identification numbers will be maintained by the project data administrator and the field supervisor will ensure that it is universally applied to samples collected during a given project.

Sample Numbering System

A distinct sample number shall be created as per the following identification code or other code specified in the project specific work plan:

ABCl2-DE34(56)-78

Where:

- A (alpha)=Base identification (eg. B for Brookley);
- BC (alpha) = Site abbreviation;
- 12 (numeric) = Site number;
- DE (alpha) = matrix type;
- 34 (numeric) = sample location;
- (56) (numeric) = sample depth, where applicable; and
- 78 (numeric) = sampling round.

Matrix type shall be represented by:

- Soil gas samples = SG;
- Hydrocone groundwater samples = HC;
- Monitoring well groundwater samples = GW;
- Surface water samples = SW;
- Surface soil samples = SS;
- Subsurface soils/soil boring samples = SB; and
- Sediment samples = SD.

B4.3.2.2 Completing the Logbook

Personnel should enter all information pertinent to a field activity in a bound logbook with consecutively numbered pages. If the information is not included on a data collection form, entries in the logbook should include, at a minimurn, the following:

- Date and time of entry;
- Purpose of sampling;
- Name and address of field contact;
- Site identification;

- Type of process producing waste (if known);
- Type of waste (sludge or wastewater);
- Description of sample waste components and concentrations;
- Sample identifier and size of sample taken;
- Description of sampling point;
- Sample collection date and time;
- Collector's sample identification number(s) and/or name;
- References to the sampling site (e.g., maps or photographs);
- Field observations and sampling locations;
- Associated field measurements;
- Method of sample collection, preservation techniques, and any deviations or anomalies noted;
- Transfer of a logbook to individuals designated for specific tasks of the project; and
- Any uncompleted work.

Because sampling situations vary, notes are to be as descriptive and inclusive as possible so that a person reading the entries would be able to reconstruct the sampling situation from the recorded information. Entries should include language that is objective, factual, and free of comments of a personal nature or any other inappropriate terminology. If anyone other than the person to whom the logbook was assigned makes an entry, this person should date and sign the entry. Logbook pages should never be removed. Mistakes should be corrected with a single line through the mistake, the new information added above the line or adjacent to the change, and the change should be initialed and dated.

B4.3.2.3 Taking Photographs

Photographs provide the most accurate record of the field worker's observations. They can be significant during future inspections, informal meetings, and hearings. A photograph must be documented to be a valid representation of an existing situation. For each photograph taken, the items listed below should be recorded in the logbook and on the back of each processed photograph.

- Date and time;
- Signature of photographer;

- Name and identification number of site;
- Type of camera, lens, F-stop, shutter speed, and film used (e.g., 35mrn color film);
- General direction faced and description of the subject;
- Distance from photographer to object;
- Location at the site; and
- Sequential number of the photograph and the roll number.

Photographs of each site may be taken before and after the field investigation to document site restoration. Remarks regarding the content of a photograph could jeopardize its value as legal evidence. Therefore, comrnents should be limited to the photograph's location. Photographs should be taken with a perspective similar to that afforded by the naked eye. Telephoto or wide-angle shots cannot be used in enforcement proceedings.

In addition to the information recorded in the logbook and on the backs of the photographs, certain information should be entered on a site plan or field sketch. A circle should be drawn on the plan which indicates the position of the photographer. The sequential nurnber of the photograph (roll number-photo number) should be entered in the circle. A line with an arrowhead should extend from the circle in the direction the photographer was facing. The absence of a line/arrowhead indicates that the photographer was facing down at that location. The transfer of this information to a drawing in the final report will greatly will aid the reader of any report containing the photographs in visualizing what the photograph is depicting.

B4.3.2.4 Completing Sample Labels/Seals

All samples should be sealed immediately after collection. The samples shou]d then be labeled by one of the methods described below. All labeling must be done with indelible black ink.

Soil and water sample identification labels or tags may be used to identify sample containers and may be filled out before collection to minimize the handling of the sample containers. Attachment B4.5.2, Sample Label and Custody Seals, provides examples of a common sample label and seal which may be used while Attachment B4.5.4 gives instructions for completing this label and seal. These labels are examples only. Other labels or seals may be substituted as long as they contain, at a minimum, the information listed on the examples.

The use of an etching tool to mark sarnple containers in the field, rather than immediately applying a sample label or tag may be appropriate. This avoids possible label contarnination problems and subsequent decontamination difficulties. When etching is used, the data intended for the sample label should be recorded in the logbook. Following decontamination of the sample containers, the information is transcribed onto the label and seal which are then attached to the decontaminated and dry sample containers. The custody seal is to be attached to the sample container in a manner such that if the sarnple container is opened and/or tempered with, that it will be evident by the condition of the seal (e.g., it will be torn or broken).

B4.3.2.5 Collecting and Inventorying Samples

A minimum number of persons should be involved in collecting and handling samples. Refer to the guidelines established in this SOP. As samples are collected, data collection forms should be completed with the date, time, and the sample collector(s) signature or initials. The liquid level in all containers should be marked with waterproof black ink. This requirement is not necessary for completely filled volatile organic compounds (VOC) septum vials. The marking of the liquid level indicates to the laboratory if the sample container may have leaked, been tampered with, or spilled hazardous materials. The chain-of-custody form (see Attachment B4.5.3) is used to inventory all samples collected in the field. Instructions for completing the form are contained in Attachment B4.5.4, Data Form Completion.

B4.3.2.6 Chain-of-Custody

Objectives

The primary objective of the chain-of-custody procedure is to create an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis and introduction as evidence. A sample is in someone's custody when one of the criteria listed below has been satisfied:

- The sample is in one's actual possession;
- The sample is in one's view after being in one's physical possession;
- The sample is in one's physical possession and is then locked up so that no one can tamper with it; or
- The sample is kept in a secured area that is restricted to authorized personnel.

Completing the Chain-of-Custody Form

Chain-of-custody forms will be filled out and will accompany every sample shipping container. All personnel involved with sample handling and transfer will be trained in the importance of the chain-of-custody process and each field sampler involved in the field investigations will be experienced with the procedures for properly and completely filling out a chain-of-custody form.

The chain-of-custody process will be initiated upon sample collection. The field sampler that signs the chain-of-custody form will be responsible for the samples until they are transferred to the custody of a laboratory or another custodian. Each chain-ofcustody form will be filled out in indelible black ink. Any errors will be crossed out with a single line, initialed, and dated by the field sampler filling out the form. Once the form has been completed, all remaining field sample number spaces will be crossed through to prevent unauthorized addition of sample information. All sampling location information must be augmented by referenced information in the field logbook and on field boring logs.

Transfer of Custody and Shipment

As sample custody is transferred, the persons both relinquishing and receiving the samples will sign, date, and note the time on the form. Minimizing the number of custodians in the chain of possession will reduce the number of custody records. Common couriers involved in shipping processes will not sign the chain-of-custody forms; only field samplers and laboratory personnel will be involved in sample custody. Attachment B4.5.3 is an example of the type of chain-of-custody form that will be used by contractor personnel performing field sampling operations. Each chain-of-custody form will include the name and address of the facility, the name and address of the contracting firm conducting the sampling, each sample number included in the shipping container, the signature of the sample collector. the date and time of collection, the sarnple media, the sample location (borehole or well number), the number and type of containers included for each sample, requested analytical method(s), signatures of all persons involved in sample custody, and dates and times of possession.

The method of shipment, courier name, and airbill number will be entered in the first "received by" block of the chain-of-custody form for each shipment of samples. Each shipment of samples will be accompanied by a chain-of-custody record (possibly multiple forms). Chain-of-custody forms will be sealed in plastic bags and taped to the inside of the closure of the shipping container after the field custodian has detached the appropriate copy of the form(s). For shipments consisting of multiple shipping containers, the plastic bag containing the chain-of-custody record will be sealed in a plastic bag and taped to the inside of the closure of a container which will be marked 1 of 1. The remaining shipping containers will be marked 1 of 2, 1 of 3, etc. Each airbill number will be recorded in the field sampling logbook and a copy of all airbills will be retained as part of the perrnanent chain-of-custody record documentation. The original chain-of-custody form(s) will accompany the sample shipment to the laboratory.

Upon receipt at the analytical laboratory, the laboratory sample custodian will check the temperature of the samples and note it on the laboratory sample receiving form. Custody is not technically transferred to the laboratory until the sample custodian for the laboratory signs the chain-of-custody record. The laboratory will keep a copy of the chain-of-custody record in their files, and the original will be returned with the analytical results from the laboratory.

B4.3.4 Post-Operation

B4.3.4.1 Field

Before leaving the field, personnel should:

- Verify that all sample bottles have been correctly identified and labels have all necessary information (e.g., location, time, and date).
- Cross-check filled sample boules in possession against those recorded in the logbook. Maintain custody of filled sample bottles by keeping them in actual possession, within view, locked or sealed up to prevent tampering, or transferring them to a secure area.
- Prepare samples for transport.
- Record data and any uncompleted work in the logbook.
- Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.
- Document sample on the chain-of-custody form (see Attachment A9.5.3).
- Review data collection forms for completeness.

B4.3.4.2 Office

After returning to the office, personnel should:

- Deliver original forms and logbooks to the site manager for technical review. The site manager will review, sign forms, and transmit these items to the document control officer (copies to the files).
- Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.
- Contact the analytical laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

B4.4 Source

EPA. 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document. U.S. Environmental Protection Agency document. Washington, D.C.: U.S. Government Printing Office.

B4.5 Attachments

B4.5.1 Equipment and Supplies Checklist

B4.5.2 Example Sample Label and Custody Seal

B4.5.3 Chain-of-Custody Form Completion

B4.5.4 Data Form Completion

ATTACHMENT B4.5.1

EQUIPMENT AND SUPPLIES CHECKLIST

______Logbooks

______Chain-of-custody forrns

______Soil and water sarnple identification labels and seals

______Indelible black pens

______Rolls of unexposed film

______Camera

______Data forms

ATTACHMENT B4.5.2

EXAMPLE LABEL AND CHAIN-OF-CUSTODY SEAL

Example Sample Label

Date:	**Time:**
Project ID:	**Location ID:**
Sample ID:	**Sample Type:**
Client :	**Sampler:**
Analysis :	**Preservative:**
Comments:	

CUSTODY SEAL:
IMPORTANT! BEFORE OPENING
NOTE IF CONTAINER HAS BEEN TAMPERED WITH

Released By:___________________________ Date:______Time:_____

ATTACHMENT B4.5.3

CHAIN-OF-CUSTODY FORM COMPLETION

The following explains each of the data fields on the chain-of-custody form (See page 3-8 of this Work Plan):

- Project Name/Location - Enter the narne of the project and the geographical location of the facility/site.
- Samplers - Enter the signature and printed name of the samplers
- Remarks - Enter any remarks pertaining to the project or to a group of samples.
- Field Sample I.D. - Enter the sample identifier as explained in the project-specific work plan
- Date - Enter the sample collection date in the format DD-MM. The year is entered at the top of the column.
- Time - Enter the sample collection time in military format (HH-MM).
- Comp/Grab - indicate if the sample was a composite or a grab.
- Sample Type/matrix - Enter the indicated sample matrix codes.
- Number of Containers - Enter the total number of containers collected for the individual sample.
- Analyses - Circle the parameter grouping for which analysis is requested and enter the total number of containers collected for that grouping in the column.
- Remarks - Enter the tag or label number if serialized forms are used, in addition to any remarks specific to that sample such as preservation method, etc.
- Relinquished By/Date-Time/Received By - Enter the printed names, signatures, and date and time in these blocks each time the custody of the sample changes hands. Additionally, QA sample chain-of-custody forms must include the MRD _LIMS#, if applicable.

ATTACHMENT B4.5.4

DATA FORM COMPLETION

All data forms will be completed using an indelible black ink pen (not a felttip pen). Make an entry in each blank. Where there is no data entry, the following will be entered: "UNK" for unknown, "NA" for not applicable, or "ND" for not done. If any procedure was not performed as prescribed, the reason for the change or omission on the forrn will be provided. To change an entry, the person making the change will draw a single line through mistake, add the correct information above it or adjacent to it, and initial the change.

B5.0 DIRECT-PUSH GROUNDWATER SAMPLING SOP

B5.1 Purpose

The purpose of this SOP is to outline the methods used for in-situ screening surveys for contaminant plumes. In-situ screening surveys are used to determine the presence and approximate extent of volatile organic contaminants in groundwater. Information obtained during direct-push groundwater surveys may enhance the use of conventional methods for defining subsurface contamination by optimizing placement of monitoring wells, soil borings, and other sampling points.

B5.2 Discussion

The project work plan (e.g., RI/FS Work Plan, UST Investigation Work Plan. etc.) contains specific details about the procedures, equipment, and sampling frequency for DPT groundwater surveys. Refer to this work plan for the type of measurements to be collected and the location of the survey/sampling area.

In-situ screening using the DPT is conducted by driving a groundwater sampling probe to the surficial aquifer, and collecting groundwater samples. This method reduces the number of monitoring wells required for plume delineation. The groundwater sample collected from the DPT probe is analyzed on-site using a portable GC.

The DPT technique provides an advantage over the soil gas probe method in that a direct sample of the groundwater can be obtained thereby producing more representative data than an indirect measurement of soil-gas. The DPT technique is more cost effective than the installation of monitoring wells. It cannot entirely replace the soil sampling and monitoring well installation, but will reduce the ultimate number of wells required for delineating the contaminant plume prior to permanent well placement.

The DPT methods greatly reduce:

- Personnel exposure to potentially hazardous substances;
- The amount of waste soils and water which are generated; and
- The amount of volatilization of compounds from the soil and groundwater into the atmosphere.

The following QA procedures apply to all in-situ screening instruments used during data acquisition:

- All data transmittals will be documented on a standard chain-of-custody form (See SOP for Sample Control and Documentation). Copies of the chain-of-custody form are to be maintained by the field manager.
- All field screening instruments will be operated according to operating instructions supplied by the manufacturer.

- Battery voltage levels for all field screening instruments are to be monitored each day throughout the survey. Battery packs will be charged or replaced when voltage levels are below the level specified by analytical equipment manufacturers.
- All instruments will be calibrated annually by the manufacturer. Calibration records are to be maintained in the office where the instrument is stored betvveen investigations. A copy of the calibration records should be kept with the equipment at all times. Additional calibrations may be necessary if field measurements indicate possible instrument malfunction.
- Qualified personnel will calibrate on-site screening equipment at the beginning and end of each day of operation. Calibration will be conducted in accordance with the manufacturer's specifications. All calibration records are to be maintained in the instrument logbook noting date, time, calibration readings, and operator's name for each entry. The logbook will be kept with the equipment at all times. Additional calibrations may be necessary if field measurements indicate possible instrument malfunction or contamination.
- All screening instrurnents that come in contact with the sample or sample media should be decontaminated in accordance with the manufacturer's recommendations and SOP B2.0, Decontamination Procedures.

B5.3 Procedures

B5.3.1 Office Preparation

Before leaving the office to begin field activities, personnel should:

- Review the site-specific field sampling plan, and Quality Assurance Project Plan;
- Coordinate schedules/actions with the facilityinstallation/site staff;
- Obtain appropriate permission or property access and location of any buried utilities;
- Ensure the proper operation and calibration of all survey equipment, as appropriate, using the equipment manuals provided by the equipment manufacturer;
- Obtain a logbook from the QA officer;
- Record results of the equipment check in the logbook:
- Obtain a sufficient number of the appropriate data collection forms; and
- Obtain a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

B5.3.2 Field Preparation

After arriving in the field to begin field operations, personnel should:

- Verify that the survey operator has the required equipment for the appropriate screening methods used. Be sure all the equipment, including support equipment is complete, operational and decontaminated.
- Establish grid and/or stake sampling location(s).
- Most screening instruments will be calibrated at the factory on a periodic basis, depending on the manufacturer's recommendation. However, calibration checks for certain instruments can be conducted in the field. Perform accuracy and reproductibility checks in the field by reoccupying base-stations at periodic time intervals.

B5.3.3 Field Operations

Determining Sampling Locations

Sampling point placement will follow a systematic approach of selection and spacing. Initial sampling points will be chosen near areas where groundwater contamination is suspected or has previously been identified and also in areas that are expected to not be contaminated. Later sampling points will be selected, based on analytical results from the initial sampling points and on anticipated groundwater flow directions. Subsequent samples will be collected between, and if possible beyond, the initial sampling points at locations determined by the relative VOC concentrations measured in prior samples. Sampling will proceed radially outward from the areas of highest contamination until the plume boundary is delineated and the potential source of contamination is indicated.

Sampling Method

The DPT groundwater sampler is designed to collect water samples without monitoring well installation. After the sample is pushed to the desired sampling depth, the sampler's screen is exposed and sample collection will begin. Water enters the sample chamber under natural hydrostatic pressure. The sample is collected using a small-diameter bailer, or alternative method selected by the Supervising Geologist.

Following collection, the groundwater samples will be analyzed on-site using a mobile field GC. Availability of analytical results shortly after sample collection will allow subsequent sampling points to be selected on the basis of field results, thereby determining the plume's extent with a minimum number of samples.

B5.3.4 Decontamination

Sample probes, detachable drive points, probe connectors, tygon tubing, and adapters will be decontaminated with a Liquinox and tap water wash and a final rinse of distilled water. To avoid contaminating probes, points, etc. with target compounds, no volatile organic solvents will be used in the decontamination procedure. Sample syringes will be flushed with a Liquinox and water solution. and given a final rinse with isopropanol.

B5.3.5 Sample Analysis

Groundwater samples for this project will be analyzed off-site by a COE certified laboratory. Duplicates and blanks required by the QA plan will be collected at specified times and intervals, and syringe blanks will be run after highly contaminated samples. In total, approximately 15 percent of all samples will be duplicates and blanks.

B5.4 Post-Operation

B5.4.1 Field

Before leaving the field for return to the office, personnel should:

- Decontaminate all sampling equipment which has come into contact with contaminated soil or wastes (see SOP B2.0, Equipment Decontamination).
- Make sure all survey locations are staked and the location ID readily visible on the location stake. Install permanent brass survey markers if required.
- Record all observations and notes concerning any uncompleted work in the logbook.
- Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.
- Review data collection forms for completeness.

B5.4.2 Office

After returning to the office, personnel should:

- Deliver original forms and logbooks to the site manager for technical review. The site manager will review, sign forms, and transmit these items to the document control officer (copies to the files).
- Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

B5.5 Sources

EPA. 1991. Environmental Compliance Branch. Standard Operating Procedures and Qualitv Assurance Manual (SOPQAM), U. S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

EPA. 1987. A Compendium of Superfund Field Operations Methods. U.S. Environmental Protection Agency, Vlashington, DC, EPA1540/P87/001.

"Description of Field Services Schedule for Cone Penetrometry Testing", Environmental Management Corporation, Maitland, FL.

B6.0 MONITORING WELL INSTALLATION SOP

B6.1 Purpose

The purpose of this SOP is to describe the procedures for installing monitoring wells to aid in the delineation of potential migration pathways of subsurface contaminant migration. These operations allow for the collection of groundwater samples representative of the aquifer being sampled.

B6.2 Discussion

This SOP contains specific details about the procedures and equipment necessary to properly install and develop monitoring wells. Refer to the project work plan (e.g. RI/FS Work Plan, SI Work Plan, UST Investigation Work Plan, etc,) which covers the specific type of environmental investigation being conducted for the purpose and types of monitoring wells to be installed.

Monitoring wells will be installed to properly assess the extent of potential groundwater contamination. All monitoring wells will be constructed in a manner that complies with all applicable federal, state, and local regulations. The number of monitoring wells to be installed during an assessment will be discussed in a site-specific scope of work.

Attachment B6.5.1 contains schematics (monitoring well construction logs) of the types of monitoring wells that might be completed during groundwater contamination investigations. Monitoring well construction logs will be used to record data regarding the construction of each well including the project name, well identification, type of screen and casing material, slot size of screen, elevation of screened interval (in reference to NGVD datum), depth of installation (to + 0.1 ft), type of end plug, date of installation, well diameter, surface elevation (in reference to msl), name of geologist and driller responsible for installation, materials and thickness of filter pack and annular sealant, surface seal construction. type of protective casing and cap, and groundwater elevation in the well (+ 0.1 ft in reference to msl). Monitoring well construction logs will be completed following well construction and elevation surveys.

B6.3 Procedures

B6.3.1 Office Preparation

Before leaving the office to begin field activities, personnel should:

- Review the project work plan and associated documentation for a specific operation and obtain all information related to the purpose and intent of the field program. This documentation may include but is not limited to:
    - The scope of work described in the project work plan;
    - Previous reports related to the site;
    - Reports related to the area;
    - Site maps;
    - Area maps;
    - Access agreements;
    - The drilling subcontractor's work plan if drilling has not yet been performed;
    - Copies of all drilling logs if the boreholes have been completed;
    - Data collection and equipment checklists; and
    - Associated SOPs.
- Contact facility/installation/site staff, members of the community (in coordination with facility/installation/site staff), and subcontractors before work is initiated. During the initial contact, permission to enter private property or security areas should be obtained. Field personnel are expected to maintain a good working relationship with the client, community, and subcontractors.
- Obtain and test all equipment needed for the task (See checklist in Attachment B6.7.2).
- Obtain a logbook from the QA officer to record/document all observations concerning pre-operation drill rig inspections, drilling operations, soil or rock core loggings.
- Obtain a sufficient number of the appropriate data collection forms such as drilling logs, etc.
- Obtain a current list of information management codes such as drilling location IDs. The information management code numbers used in data entry are assigned by the data administrator. This system is necessary to avoid duplication of site identifiers or inaccurate entries. Because the list of codes is continually being updated, SOPs cannot be revised each time a new list is produced.

B6.3.2 Field Preparation

Upon arriving in the field, but before the start of site operations, personnel should:

- Verify that the appropriate supplies for monitoring well installation, as specified in the drill specifications of the drilling contract are present on-site;
- Verify that all printing inks have been removed from the well screens and riser pipes; and
- Verify that sufficient containers (drums, etc.) are present on-site to containerize all of the monitoring well development water.

B6.4 Field Operations

Each well installed will be constructed of either a Schedule 40 polyvinyl chloride (PVC) two inch or four inch continuous wrapped screen attached to a PVC riser for wells installed down to 50 feet below ground surface, or a Schedule 80 PVC, 2 inch O.D., 5-foot continuous wrapped screen attached to a Schedule 80 PVC riser for wells installed at depths greater than 50 feet. All screen and casing will be flush-threaded. In shallow well installations, the top of the well screen will be placed above the top of the water table to allow for seasonal fluctuations; screen length and well depth will be determined prior to or during an assessment and discussed in a site-specific scope of work that must be approved by the appropriate state before monitoring well installation activities commence.

B6.4.1 Decontamination of Well Construction Materials

Before installation, all printing inks must be removed from the well screens and riser pipes. It is often necessary to use sand-paper for this procedure. Removal of the printing inks must be followed by the decontamination procedures provided below:

- Wash equipment with a brush and a phosphate-free detergent solution,
- Rinse with tap water;
- For organic contaminants, an optional rinse with a solvent (pesticide grade isopropanol or acetone) may be necessary to dissolve and remove coatings of organic contaminants;
- Rinse thoroughly with distilled water;
- Rinse with pesticide-grade isopropanol;

- Allow to air dry thoroughly;
- If the screens/risers must be used before all of the isopropanol can evaporate, they should be rinsed thoroughly with copious amounts of deionized water; and
- Unless the screens/risers are going to be used immediately, they are to be wrapped in new aluminum foil, shiny side out, or new plastic sheeting to prevent contamination of the equipment until it is needed.

B6.4.2 Monitoring Well Installation

B6.4.2.1 Drilling Equipment and Materials

All drilling will be accomplished using the hollow-stem auger method. This method performs well in unconsolidated sediments, allows the rig to operate without the use of drilling fluids, and permits ease of collection for relatively undisturbed formation samples. For the depths and geology involved, this drilling method will provide fast and efficient performance. The hollow-stem auger rig will use five-foot sections of at least 8 inch O.D. and 6.25-inch I.D. hollow-stem auger flight. In borings that will receive monitoring wells, the boring diameter will be such that there will be at least two (2) inches of annular space between the formation exposed at the boring wall and the outside diameter of the centered well casing. In areas of flowing or heaving sands plugs may be required on the center of the auger bit to facilitate placement of the well screen.

B6.5 Drilling Procedures

The exact location and depth of test wells for each site will be determined in the field by the Supervising Geologist in consultation with the USACE or field representative. Field drilling operations and logistics will be coordinated with the USACE and local authorities.

Soil samples will be collected continuously from the ground surface to the top of the water table at each site for the purpose of describing subsurface geology. During completion of soil borings or monitoring wells, drill cuttings from the water table to total depth of boring will be logged. All borehole lithological descriptions will be made by the geologist on site and recorded on the borehole lithologic form.

The total depths of each well and the screened interval will be decided by the on-site geologist on a site-by-site basis. The depths and construction of each well will depend on the geology and groundwater conditions encountered during drilling.

B6.6 Well Installation

For shallow wells, upon reaching a depth of approximately 10 feet below the water table, each well will be installed to provide representative water samples from the uppermost water bearing zone. At a minimum, a two inch annular space must remain after placement of the screen and casing. Before placement of the screen and casing, the borehole depth should be verified with a weighted surveyor tape. The length of the screen will be installed above and below the water table to allow for water table fluctuation and to collect a light non-aqueous phase layer, if present. For deeper wells, screens will be set at predetermined depths to monitor groundwater conditions within the interval screened.

In areas with heaving sands, a plug may be placed in the bit of the auger to prevent sand from filling in around the screen and permit well completion at the target depth. After sufficient sand is placed inside the casing to stabilize the hole, the plug is knocked out of the auger bit so that the augers can be pulled as the filter pack is placed around the screen.

B6.7 Well Screen and Casing

The screened intervals for shallow monitoring wells (less than 50-ft depths) will consist of two-inch diameter O.D., Schedule 40 PVC continuous wrap screens design which meets ASTM F 480-81. The screen slot size will be selected by the Supervising Geologist based on the anticipated lithology. The screened section will be joined to a 2-inch diameter, Schedule 40 PVC (which also meets ASTM F 48081), flush threaded casing. The casing will extend from the top of the screen to at least ground surface. The material lengths selected will be based on site-specific groundwater conditions encountered (a 10-foot screen is recommended). The screen will be capped with a threaded PVC cap or plug at the bottom, and all connections will be flush jointed and threaded and use o-ring seals. Groundwater monitoring wells installed past the 50-ft depth will consist of 5-ft long, 2-inch O.D. Schedule 80, continuous wrap screens, joined to a 2 inch Schedule 80 PVC casing.

Since all well screen and casing materials will be centered in the borehole through the use of the hollow stem auger drilling method, centralizers will not be necessary for the alignment of shallow wells. Monitoring wells must pass a plumbness test; on deeper monitoring wells, centralizers may be necessary to insure plumbness, especially with two-inch pipes. Prior to installation, the casing and screen sections will be thoroughly washed with potable water using a high-temperature, high-pressure sprayer. No solvent PVC or other glue will be used in the construction of the wells.

B6.8 Filter Pack

A sand filter pack will be tremied into the annulus between the well casing d the augers (or borehole wall) until the sand pack is approximately one to two feet above the top of the screen. While the sand is being tremied, checks for well alignment will be made to ensure that the well is centered in the borehole. The augers will be slowly removed as the sand pack is tremied in until the bottom of the lead auger is just above the top of the sand pack. The pack will consist of washed and bagged rounded sand with a grain size distribution selected by the Supervising Geologist, based on the anticipated lithology. The filter pack will be surged for 5-10 minutes after placement. The depth from ground surface to the top of the sand pack will be checked with a weighted tape and additional sand added as necessary and surging repeated before placing the bentonite seal.

B6.9 Bentonite Seal

Bentonite pellets or volclay grout will be placed above the sand/filter pack to a minimum thickness of 3 feet to provide an adequate seal. For shallow well installation the bentonite will be poured into place through the augers. Augers will be retracted and measurements will be made to ensure proper seal placement. Following the emplacement of the bentonite pellets, potable water will be introduced into the borehole, and the pellets will be allowed to hydrate for at least 2 hours if using volclay grout or 8 hours if using a cement bentonite grout to seal the remaining portion of the annulus over the bentonite seal.

B6.10 Grout Mixture

Neat cement or volclay grout will be emplaced from above the top of the bentonite seal to land surface. Cement grout shall consist of a mixture of not more than 7 gallons of water and 3 pounds of powdered bentonite to each 94-pound sack of Portland Cement (ASTM C 150) (~3% bentonite). A tremie pipe will be used to emplace the grout. The tremie pipe shall be plugged at the bottom and perforated or slotted on the sides to prevent grout from penetrating the bentonite seal. Grouting procedures will continue through auger retraction until undiluted grout flows from the boring at the ground surface. Final grout level will be 2 ft bgs or below the frost line, which ever is greater. The remainder of the annular space will be filled with concrete during the installation of the protective casing and surface pad.

B6.11 Surface Completions of Monitor Wells

Decisions will be made in the field as to the type of surface completion, flush-mount or aboveground, for all wells. The Field Task Leader will evaluate the site conditions to determine the type of surface completion required for each well. Aboveground completion of wells (stick-ups) will be appropriate in locations where wells have been constructed in topographically low or poorly drained areas and entry of surface runoff into the wellhead is possible. In traffic areas and at locations where surface runoff entry into the well head is not a consideration, flush-mount wells will be installed. Flush-mount wells are specified for Brookley Site 22.

For aboveground completion, the riser pipe will extend a minimum of 2.5 feet above the ground surface. A steel outer protective casing, equipped with a hinged locking cap, will be installed while the surface pad is being poured. The pad cannot be poured until the grout seal has cured for a minimum of 24 hours. Initially, concrete is poured into the remaining 2 feet or greater of annular space. The protective casing is then pushed at least 2 feet into the concrete. The remainder of the form for the pad will be filled with concrete. The pad will be a minimum of 3' x 3' x 6" and will extend a minimum of two inches below grade to prevent under-washing by surface water flow, and will be sloped away from the protective casing in all directions. Concrete should then be added to the space between the well casing and the protective casing until the level of the concrete inside the protective casing is at or above the surface concrete pad. After the concrete has cured, two weep holes will be drilled into the protective casing immediately above the concrete surface. These weep holes will be a minimum of 1/4 inch diameter to allow the drainage of water which may accumulate inside the protective casing. If the monitoring wells are located in high-vehicular traffic areas, surface protective posts should be installed. These posts should be made from three-to four-inch diameter steel pipes, extend at least 2 feet into a concrete footing and at least three feet above the ground surface, and be filled with concrete for additional strength.

For flush-mount wells, each well will be equipped with a locking cap and an outer protective flush-mount casing. The casing for all wells will be set approximately 1 to 2 in below the ground surface to allow for installation of the flush-mount security casing. The flush-mount casing will be set in a cement pad (approximately 2.5 x 2.5 ft) with a 1 to 2 in upward slope above ground surface to ensure that surface water flows away from the well. The pad will not be poured until the grout seal has cured for at least 24 hours.

Temporary, secure, and watertight caps will be provided for incomplete wells or open boreholes anytime active construction or development operations are halted. Upon completion, wells will be equipped with keyed-alike locks to match other monitoring wells at the installation. Monitor well completion diagrams will be submitted to the USACE PM within 10 calendar days after monitor well installation is completed or as specified under contract requirements.

B6.12 Post Operation

B6.12.1 Field

After the completion of field operations and before returning to the office, personnel should:

- Ensure that all equipment is accounted for, decontaminated (See SOP B2.0, Equipment Decontamination), and ready for shipment.

- Restore the site to the pre-well installation conditions as specified in the project work plan. Restoration may include repair of damage to the land surface (tire ruts) or private property (fences), as well as restoration anticipated at the time the project work plan was prepared (for example, re-vegetation or borehole abandonment).
- Complete any remaining documentation. This may consist of, but is not limited to:
  - Recording any restoration work in the logbook.
  - Recording any uncompleted work in the logbook. This additional recording may include drilling that could not be performed, wells that could not be installed, and/or damage that could not be repaired.
  - Completing logbook entries, verifying the accuracy of entries, and signing/initialing any pages for which this was not done during field activities. If any of this signing/initialing is done at the end of field activities. The date it is performed should also be noted by each new entry.
  - Reviewing data collection forms for completeness.

B6.12.2 Office

Immediately after returning to the office, personnel should:

- Deliver original forms and logbooks to the site manager for technical review. The site manager will review, sign forms, and transmit these items to the document control officer (copies to the files).
- Inventory equipment and supplies.
- Repair or replace all broken or damaged equipment.
- Replace expendable items.
- Return equipment to the equipment manager and report incidents of malfunction or damage.

B6.13 Sources

EPA. 1991. Environmental Compliance Branch. Standard Operating Procedures and Quality Assurance Manual (SOPQAM), U. S. Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia.

Korte, Nic, and Peter Kearl. 1985. Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition. U.S. Department of Energy Report

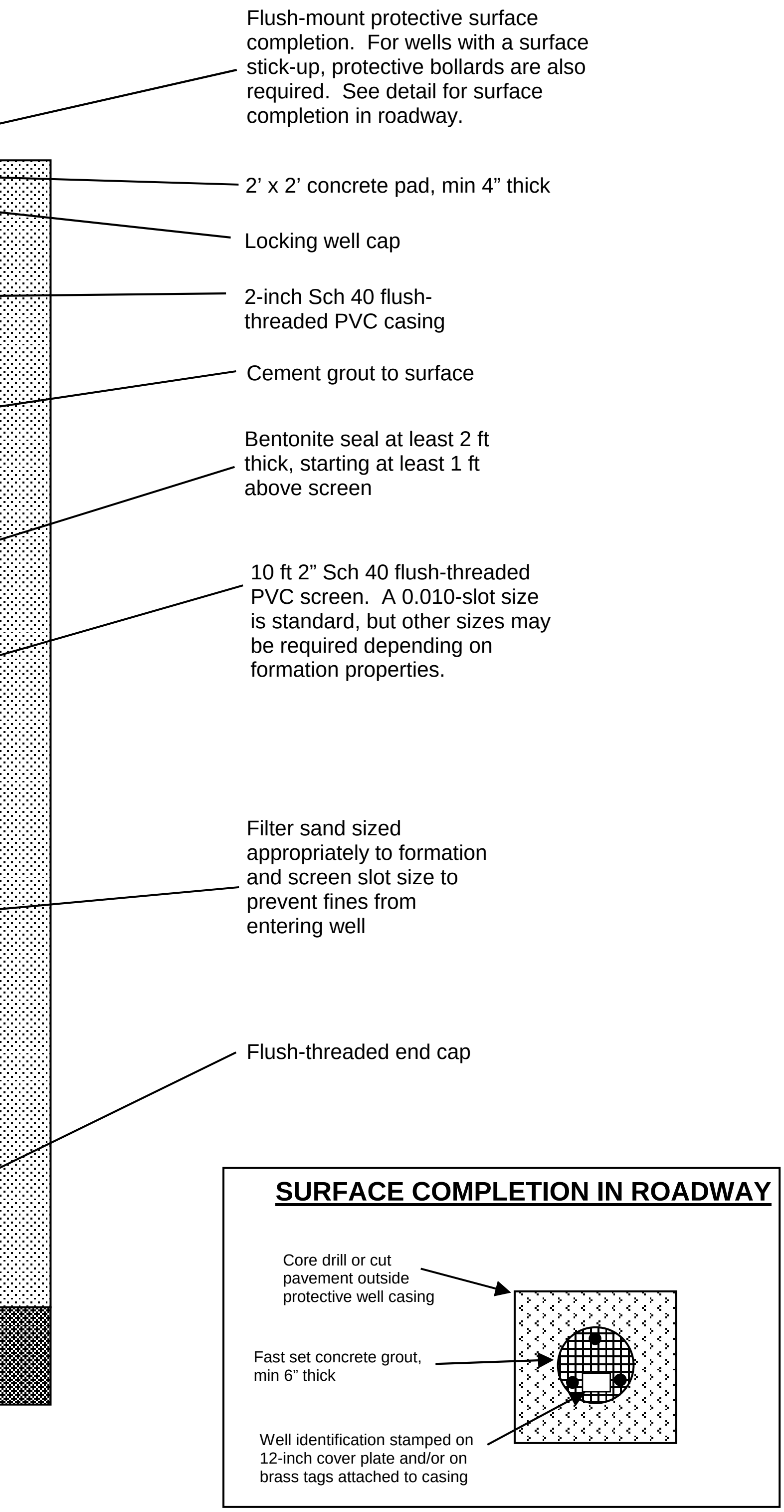
GJ/TMC-08. Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colorado.

B6.14 Attachments

B6.7.1 Monitoring Well Schematic

B6.7.2 Equipment and Supplies Checklist

B6.7.1 Monitoring Well Schematic



ATTACHMENT B6.7.2

EQUIPMENT AND SUPPLIES CHECKLIST

_____Logbooks

_____Well schematic sheets

_____Weighted tapes

_____Well sounders

_____Safety equipment

B7.0 MONITORING WELL DEVELOPMENT SOP

B7.1 Purpose

The purpose of developing new monitoring wells is to remove the residual materials that may have been introduced during well installation and that may remain in the wells after installation has been completed. Development is also done to try to re-establish the natural hydraulic flow conditions of the formation, disturbed by well construction, in the immediate vicinity of the well and to facilitate hydraulic communication between the screened formation and the monitoring well.

B7.2 Discussion

The Scope of Work, Work Plan, and associated documents contain details about the method and equipment to be used for developing the monitoring well. Collection and measurement of samples and documentation of data will be performed as described in the associated procedures.

Monitoring well development removes the fines from the well or aquifer formation near the screen and corrects damage that occurs during drilling. All well installation procedures create a skin on the borehole wall. Over pumping and surging are the primary methods used for developing monitoring wells. These methods are discussed below.

- Over pumping involves pumping the well down as low as possible and allowing it to refill. The increased velocities created by refilling remove fines. This method is not very effective, because the water flow is in one direction and at relatively low velocities.
- Surging involves raising and lowering a surge or swab block inside the well. The resulting motion of the water removes the borehole skin and fines from the formation. The fines and water must occasionally be removed from the well with a sand bailer to prevent sand locking of the surge block. The rubber seals on the surge block are the same diameter as the inside of the well or l/2 inch smaller if surging is conducted inside the screened interval. A 3-ft stroke is typical.

Well development generally will be accomplished by the use of two pumps. A manually operated pump (e.g. a Brainard-Kilman (BK) hand pump) will be used to remove formation water laden with silt and fines from filter pack sand following an initial 10-20 minute period of surging. A Grundfos Redi-flo 2 pump, which is a submersible variable-speed electric pump, will then be used to evacuate the remainder of the required volumes. Repeated cycles of surging, hand-pumping, and submersible pumping may be required to meet water quality criteria to complete well development.

The impellers on the Grundfos Redi-flo 2 pump are subject to wear when silty water is pumped. This is why the BK hand pump will be used to remove the silty water. For shallow wells and where small volumes of development water are anticipated, hand pumps alone may be adequate for well development. Alternate pumps may be used under the direction of the Supervising Geologist and USACE Project Geologist.

Development of Brookley Field wells will use Waterra ™ hand-powered inertial pumps. Because of the shallow depth to groundwater in these water-table wells, these pumps should be adequate and are simple and inexpensive.

B7.3 Procedures

The following are general procedures for developing a groundwater monitoring well.

B7.3.1 Preparation

B7.3.1.1 Office

1. Review the Work Plan and relevant SOPs.

2. Coordinate schedules/actions with Base personnel.

3. Obtain appropriate permission for property access.

4. Assemble the equipment and supplies listed in Attachment Al1.5.1. Ensure the proper operation of all sampling equipment.

5. If samples are to be collected for analyses, notify the laboratory of sample types, the number of samples, and the approximate arrival date. In addition, contact the carrier that will transport samples to obtain information on regulations and specifications.

6. Ensure that water treatment system is operational (if applicable) and make transport arrangements so that drums or a mobile tank are available to collect development water. This may include the purchase of fabric filters and new activated carbon canisters.

B7.3.1.2 Documentation

1. Obtain a logbook from the QA officer.

2. Record results of the equipment check in the logbook.

3. Obtain a sufficient number of the well development logs.

4. Consult the data administrator for a current list of information management codes, location IDs, and sample numbers used in the completion of data forms.

B7.3.1.3 Field

1. Decontaminate all equipment before developing each well according to Appendix B2.O, Decontamination Procedures unless dedicated pumps and tubing are being used.

2. Assemble containers for the temporary storage of water produced during well development. The containers must be structurally sound, compatible with anticipated contaminants, and field manageable. Truck-mounted tanks may be required for this operation.

3. If treatment of development water is required, ensure that Water Conditioning System is operational within the parameters required. This may include inspection of the holding tank, pump, piping, fabric filters, carbon canister, and associated piping. Ensure that effluent line is inserted into the Base sanitary sewer connection.

B7.3.2 Operation

Perform the development as soon as practical after well installation, but <u>no sooner than 48 hrs</u> after grouting is completed. Do not use any dispersing agents, acids, or disinfectants to enhance the development of the well. Do not add water to aid development except under the special conditions defined below. If problems or unusual conditions are encountered, notify the Field Supervisor as soon as possible.

1. Assemble the necessary equipment on a plastic sheet outside of the splash range.

2. Record pertinent information in the logbook and on the Well Completion Information form.

3. Measure depth-to-water and the total depth of the monitoring well according to SOP for Water Level Measurement.

4. Develop the well until the well is free of sediment and the appropriate volumes of water have been removed. Sediment-free is loosely defined as 10 NTU as measured with a turbidity meter. If the well is not free of sediment after the appropriate volumes of water have been removed, continue until twice the appropriate volume of water has been removed. Do not exceed twice the volume without consulting the USACE Project Geologist.

    -- Note the initial color, clarity, and odor of the water.

    -- Measure and record the initial pH, temperature, and specific conductance of the water.

    -- If required, containerize all water produced by development in contaminated areas or areas suspected of contamination. This is done by pumping development water from the well into drums or a truck-mounted mobile tank. When the volume in the mobile tank reaches approximately ¾ capacity, the development water should be transferred into the stationary holding tank for conditioning prior to disposal. This transfer should be entered into the Water Conditioning System Transfer Log-in Sheet.

    -- Remove 5 times the standing water volume in the well (well screen and casing plus saturated annulus). If recharge is so slow that 5 volumes can not be removed in one day or the water is not sediment-free after this 5-volume removal, the field team leader will discuss the situation with the USACE Project Geologist. A COE-approved alternate procedure for verifying that the well is properly developed will be implemented.

    -- If it is determined that excessive sediments are present in the well, and are not removed effectively by the pump, bailers will be used to evacuate sediments

-- Do not add water to the well to assist development without prior approval by the USACE Project Geologist. If a well cannot be cleaned of mud to produce formation water because the aquifer yields insufficient water, small amounts of potable water may need to be injected to clean up this poorly yielding well. This may be accomplished by dumping in buckets of water. It is essential that at least 5 times the amount of water injected must be produced back from the well in order to assure that all injected water is removed from the formation. When most of the bentonite is out, continue development with formation water only.

-- Temperature, pH, specific conductivity, and turbidity (NTU) will be measured during development activities and recorded on the Well Development Log (see Attachment). A minimum of one reading per well volume will be taken. Development will continue until these parameters have stabilized (e.g., less than 0.2 pH units or 10% change for the other parameters between four consecutive readings) and the water is clear and free of sediment as defined above. If the parameters have not stabilized after four hours of continuous development activities, then the USACE Project Geologist will be consulted.

-- During development pumping, a maximum flow rate will be determined by filling a 5-gallon bucket with effluent water from the pump. This process will be timed with a stop watch, and an average flow rate will be calculated. The pump speed should be increased to the maximum pumping rate that the aquifer can sustain. The flow rate will be recorded in the "Remarks" section of the Well Development Log (see Attachment). Water generated during this process will be placed into the portable tank for later disposal.

-- Note the final color, clarity, and odor of the water.

-- Measure and record the final pH, temperature, and specific conductance of the water.

-- Complete the appropriate data entry requirements on the Monitoring Well Construction Diagram form to document well development.

The data entry requirements are:

1. Name of project and site, well identification number, and dates.

2. Date, time, and elevation of the static water level and bottom of well before development.

3. Method used for development, to include equipment, size, type, and make of bailer and/or pump used during development.

4. Time spent developing the well by each method, to include the typical pumping rate if a pump was used in development.

5. Volume and physical character of water removed, to include changes during development in clarity, color, particulates, and odor.

6. Volume and source of any water added to the well, and chemical analyses of the added water.

7. Volume and physical character of sediment removed, to include changes during development in color and odor.

8. Clarity of water before, during, and after development, and depth of any sediment which settles to the bottom of the jar containing the last one liter of water withdrawn from the well during development.

9. Total depth of well and the static water level immediately after development.

10. Readings of pH, specific conductance, temperature, and turbidity taken before, during, and after development.

11. Names and job title of individuals developing well.

12. Name and/or description of the disposal facility for waters removed during development.

B7.3.3 Post-Operation

B7.3.3.1 Field

1. Ensure that all equipment is accounted for, decontaminated (see SOP for Decontamination Procedures), and ready for shipment.

2. Restore the site to the pre-sampling conditions.

3. Make sure all monitoring well locations are properly staked, the location ID tag is readily visible on the protective casing, and the lock is secured.

B7.3.3.2 Documentation

1. Record cleanup and hole abandonment procedures and any uncompleted work (like site restoration or long-term monitoring) in the logbook.

2. Complete logbook entries, verify the accuracy of entries, and sign/initial all pages.

3. Review data collection forms for completeness.

B7.3.3.3 Office

1. Enter the well development activities on the Daily Quality Control Report. Facsimiles of this report, along with the completed Well Development Log, will be transmitted to the USACE Project Geologist on a daily basis or as required.

2. Inventory equipment and supplies. Repair or replace all broken or damaged equipment. Replace expendable items. Return equipment to the equipment manager and report incidents of malfunction or damage.

3. If samples have been collected for analysis, contact the laboratory to ensure that samples arrived safely and instructions for sample analyses are clearly understood.

B7.4 Sources

Barcelona, M.J., J.P. Gibb, J.A. Helfrich, and E.E. Garske. 1985. "Practical Guide to Groundwater Sampling". U.S. Environmental Protection Agency report EPA160012-85/104. Washington, D.C.: U.S. Government Printing Office.

Driscoll, Fletcher G., 1986. Groundwater and Wells. Johnson Filtration Systems, Inc., St. Paul, Minnesota.

Gass, Tyler E., 1986. "Monitor Well Development", Water Well Journal 40, no. 1: 52-55.

Schalla, Ronald, and Robert W. Landick, 1986. "A New Valved and Air-Vented Plunger for Developing Small Diameter Monitor Wells", Ground Water Monitoring Review 6, no. 2: 77-80.

Standard Operating Procedures and Quality Assurance Manual. U.S Environmental Protection Agency, Region IV, Environmental Services Division, Athens, Georgia. February 1, 1991.

B7.5 Attachments

B7.5.1 Equipment and Supplies Checklist

B7.5.3 Well Development Log

Attachment B7.5.1

WELL DEVELOPMENT EQUIPMENT AND SUPPLIES CHECKLIST

_____pH meter

______Temperature meter

______Electrical conductivity meter

______Turbidity meter

______Distilled water

______Stopwatch

______Water level measurement probe

______Plastic sheet

______5-gallon bucket

______Clear 1-litre bottle

WELL DEVELOPMENT LOG

Sheet ____of ____

PROJECT:		**WELL ID:**	
Performed By:	**Signature:**	**Completion Date:**	**Development Date:**
Water Level **Initial:** **Final:**		**Develop Method:**	**Total Vol. Dev. Water:**
Total Depth:	**Screen Interval**	**Top:**	**Bottom:**
Wetted Volume: **(0.16 gal/ft 2” casing + 0.87 gal/ft sand pack for 8” borehole)**			

Time	Cum. Volume (Liters)	Water Quality Parameters						Water Level	Comments
		Temp. (ºC)	pH	Cond. (mS/cm)	Turb. (NTU)	D.O. (mg/L)	Redox (mV)	(feet)	

Remarks

Attachment B7.5.3

Attachment C

USACE Laboratory Validation

Severn Trent Laboratories, Pensacola FL

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
HTRW CENTER OF EXPERTISE
12565 WEST CENTER ROAD
OMAHA, NEBRASKA 68144-3869

REPLY TO
ATTENTION OF:

July 16, 2003

Hazardous, Toxic and Radioactive Waste
Center of Expertise

Kelly Hered
STL Pensacola
3355 McLemore Drive
Pensacola, FL 32514

Dear Ms. Hered:

This correspondence addresses the recent evaluation of STL Pensacola of Pensacola, FL by the U.S. Army Corps of Engineers (USACE) for chemical analysis in support of the USACE Hazardous, Toxic and Radioactive Waste Program.

Your laboratory is now validated for the parameters listed below:

METHOD[1]	PARAMETERS	MATRIX[1]
300.0/9056	Anions[5]	Water[3]
300.0/9056	Anions[5]	Solids[3]
8151A	Herbicides	Water[3]
8151A	Herbicides	Solids[3]
3510C/3520C/8081A	Organochlorine Pesticides	Water[3]
3540B/3550B/3541/8081A	Organochlorine Pesticides	Solids[3]
3510C/3520C/8082	Polychlorinated Biphenyls	Water[3]
3540B/3550B/3541/8082	Polychlorinated Biphenyls	Solids[3]
3510C/3520C/8270C	Semivolatile Organics	Water[3]
3540B/3550B/3541/8270C	Semivolatile Organics	Solids[3]
3010A/6010B/7000A	TAL Metals[4]	Water[3]
3050B/6010B/7000A	TAL Metals[4]	Solids[3]
9060	Total Organic Carbon	Water[3]
9060M	Total Organic Carbon	Solids[3]
5030B/5035/8260B	Volatile Organics	Water[3]
5030B/5035/8260B	Volatile Organics	Solids[3

Remarks: 1) Sample preparation methods have been added to reflect program policy change.

2) 'Solids' includes soils, sediments, and solid waste.

3) The laboratory has successfully analyzed a Proficiency Testing sample for this method/matrix.

4) TAL Metals: Aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

5) Anions: Chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate.

Enclosed for your information is a copy of the Laboratory Inspection and Evaluation Report. Your laboratory has responded to the deficiencies as noted in the report. No further responses are necessary.

Based on the successful analysis of the National Environmental Laboratory Accreditation Conference Proficiency Testing samples for the appropriate fields of testing, the results of the laboratory inspection, and your Corrective Action Report, your laboratory will be validated for sample analysis by the methods listed above. The evaluation, which was conducted for your facility, is based substantially on ISO Guide 25 (General Requirements for the Competence of Testing Laboratories) and USACE Engineering Manual (EM) 200-1-3, Appendix I (Shell for Analytical Chemistry Requirements). The period of validation is 24 months and expires on July 16, 2005.

The USACE reserves the right to conduct additional laboratory inspections or to suspend validation status for any or all of the listed parameters if deemed necessary. It should be noted that your laboratory may not subcontract USACE analytical work to any other laboratory location without the approval of this office. This laboratory validation does not guarantee the delivery of any analytical samples from a USACE Contracting Officer Representative.

Any questions or comments can be directed to Richard Kissinger at (402) 697-2569. General questions regarding laboratory validation may be directed to the Laboratory Validation Coordinator at (402) 697-2574.

Sincerely,

Marcia C. Davies

Marcia C. Davies, Ph.D.
Director, USACE Hazardous,
Toxic and Radioactive Waste
Center of Expertise

Enclosure