

APPENDIX D

FIELD SAMPLING PLAN (FSP)

SAUER DUMP SITE
DUNDALK, BALTIMORE COUNTY, MARYLAND

Response Action Plan

October 13, 2006





FIELD SAMPLING PLAN

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Sauer Dump Site Coalition

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
ARAR	applicable or relevant and appropriate requirement
ASL	Active Sanitary Landfill
AST	above ground storage tank
ASTM	American Society for Testing and Materials
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CGI	combustible gas indicator
cm/sec	centimeters per second
COC	chain-of-custody
COR	Contracting Officer's Representative
DNAPL	Dense Non-Aqueous Phase Liquid
DO	dissolved oxygen
DOD	Department of Defense
DOT	Department of Transportation
DPDO	Defense Property Disposal Office
DPW	Department of Public Works
EPTFE	expanded polytetrafluoroethylene
FID	flame ionization detector
FPF	field parameter form
FSP	field sampling plan
ft-msl	feet above mean sea level
GC/MS	gas chromatograph/mass spectrometer
GPS	Global positioning system
HASP	Health and Safety Plan
HCl	Hydrochloric Acid
HD	horizontal dipole
Hg	mercury
HSA	hollow stem auger



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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
I.D.	inner diameter
ID	identification
IDW	investigation-derived wastes
IRP	Installation Restoration Program
LNAPL	Light Non-Aqueous Phase Liquid
m	meters
MDE	Maryland Department of the Environment
MEK	methyl ethyl ketone
mg	milligrams
ml/min	milliliters per minute
NGVD 28	National Geodetic Vertical Datum of 1928
NOAA	National Oceanographic and Aeronautic Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NTU	nephelometric turbidity unit
O.D.	outside diameter
ORP	oxidation reduction potential
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PPE	personal protective equipment
ppm	parts per million
PPNDP	Passively-Placed Narrow Diameter Point
PQL	Practical Quantitation Limit
PVC	polyvinyl chloride
PWRC	Patuxent Wildlife Research Center
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act



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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Description
SARA	Superfund Amendments and Reauthorization Act of 1986
SI	Site Investigation
SOP	standard operating procedure
SPT	Standard Penetration Test
STP	Sewage Treatment Plant
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TEPH	total extractable petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
TVPH	total volatile petroleum hydrocarbons
USCS	Unified Soil Classification System
USEPA	U.S. Environmental Protection Agency
UTM NAD 27	Universal Transverse Mercation North American Datum of 1927
VD	vertical dipole
VOC	volatile organic compound

1.0 INTRODUCTION

The field work and data evaluation will follow U.S. Environmental Protection Agency (USEPA) guidance documents developed for activities performed under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Furthermore, procedures will be performed in accordance with Maryland Department of the Environment (MDE).

This Field Sampling Plan (FSP) is intended to provide field procedures to collect information for the Extent of Contamination Study.

Procedures described in this document fully comply with the Health and Safety Plan (HASP) and Quality Assurance Project Plan (QAPP).

1.1 FIELD SAMPLING PLAN

The FSP is organized into five sections as follows:

- **Section 1.0 - Introduction:** Presents FSP organization and site background and physical setting of Sauer Dump Site.
- **Section 2.0 - Sampling Plan Objectives:** Provides description of the objectives of the FSP.
- **Section 3.0 - Technical Approach for Sampling Activities:** Describes the procedures for field activities including geophysical surveys, including determination of a decontamination water source, installation and development of groundwater monitoring wells; sampling of monitoring wells; and direct push technology sampling; collection of surface soil, surface water, and sediment

samples; and hydrogeologic investigations. This section also describes the procedures for the disposal of investigation-derived waste including decontamination water, purge water, and personal protective equipment.

- **Section 4 - Sample Management and Analysis:** This section summarizes the procedures for post sampling activities (e.g., containerization, preservation of samples, and shipping). In addition, the general analytical program for Sauer Dump Site is presented.
- **Section 5 - References**
- **Appendix A: Standard Operating Procedures**

1.2 SITE BACKGROUND

The following sections present known information regarding the Sauer Dump Site. This includes information describing the, physical setting of the area. See the Response Action Plan (RAP) for summary of past activities possibly contributing to potential environmental problems.

1.3 PHYSICAL SETTING

1.3.1 Physical and Physiographic Setting

The site is located in Baltimore County, Maryland, approximately 5 miles east of Baltimore (Figure D1). The Site is located primarily on Parcel 425 and may include portions of Parcels 464, 503, 295, 574, and 137. It is surrounded on the east, north, and west by private, residential lots; and on the south by the Back River (Figure D2). The site is an inactive, privately owned, unpermitted, dump that is located on previously marshy land which was stabilized with fill material. EPA alleged that Mr. Sauer used the site as a salvage/dump yard. Contamination at the Site has been reported in the soils, groundwater, surface-water, and sediments

(ENSAT, 2002a; ENSAT, 2005).

Figure D1 shows the location of the Site on the Middle River United States Geologic Survey (USGS) 7.5-minute-series topographic map. The elevation of the Site ranges from approximately mean sea level to 17 feet above mean sea level (amsl). A mounded area, present in the western and central portions of the Site, exhibits irregular topography typically associated with dump sites (Figure D2). The topography along the eastern and southern portions of the Site is generally more level. A tidal wetland area is present along the southern border of the site. Non-tidal dominated wetlands are present on adjacent properties along the northwestern, southwestern, and southeastern borders (Figure D2).

As of August, 2006, the Site was observed to be heavily vegetated with tall grasses, reeds, trees, and scrub bushes. Accumulations of miscellaneous debris are observed across the site. The site is currently encompassed by a chain link fence to limit access.

See the RAP for more information on the Site setting.

1.3.2 Geology

The geology at the site is mapped as unconsolidated Quaternary age (recent) sedimentary deposits belonging to the Lowland Deposits Unit (MGS, 1968). This unit is characterized by inter-bedded gravels, sand, silt, and clay which vary in thickness from 0 to 150 feet and belong to the Coastal Plain Physiographic Provenance. Although no bedrock outcrops are observed at the former dump, the Site is likely underlain by Cretaceous age Potomac Group sedimentary rocks and

lies to the east of the Fall Line.

See the RAP for more information on Site geology.

1.3.3 Hydrogeology

Groundwater contour maps generated from on-site monitor wells indicate a groundwater flow from the central portions of the site toward the Back River and adjacent wetland areas (Figure 6 of the RAP). As seen in previous investigations the groundwater levels appear to be influenced by tidal variations, especially in wells closer to the Back River. Precipitation events appear to have a marked effect on the water levels of the more upland monitoring points and the pond.

See the RAP for more information on Site hydrogeology

2.0 SAMPLING PLAN OBJECTIVES

The objective of this FSP is to present the proposed technical approach for conducting field operations at the Sauer Dump Site. The purpose of the field investigation activities at the Sauer Dump Site is to collect data in support of the Extent of Contamination Study. The FSP details the standard operating procedures (SOPs) that will be followed for collecting the samples, the equipment which will be utilized for collection of the samples, sample preservation requirements, a list of the SW-846 analytical methodologies which will be used for analysis, and the quality control (QC) criteria that will be adhered to during performance of the field activities.

2.1 APPLICATION AND USE OF THE FIELD SAMPLING PLAN

This document is intended to be used as a foundation for the investigation activities performed by Malcolm Pirnie. The FSP is intended to fulfill all of the objectives outlined in Section 2.

In instances where an activity is new or significantly modified from its coverage in the FSP, QAPP, and HASP, a full description of field activities can be provided. If this activity will recur, an addendum to this document and the QAPP may be drafted

3.0 TECHNICAL APPROACH FOR SAMPLING ACTIVITIES

This section describes the methods to be used in conducting field activities at Sauer Dump Site. This work could include:

- pre-sampling Site reconnaissance,
- surface and subsurface soil sampling,
- surface water/sediment sampling,
- hydrogeologic investigations, and
- sample location and elevation survey.

This section also describes the collection procedures for field QC samples, the decontamination procedures for sampling and heavy equipment, and the management procedures for investigation-derived wastes (IDW).

3.1 *SITE RECONNAISSANCE*

A pre-sampling Site (Reconnaissance Survey) is an onsite inspection program, consisting of visual observations, and often the use of field monitoring instruments to identify potential health and safety threats and potential sampling locations for further evaluation during subsequent field activities.

Reconnaissance surveys will be performed in accordance with SOP 1 in Appendix A. The results of the reconnaissance survey will be used in preparing site-specific work plans. Therefore, the level of detail of the survey must be sufficient to identify appropriate onsite and offsite sampling locations for all potentially affected media. The reconnaissance survey will also locate potential physical hazards (e.g., sumps, swales, debris), establish site exclusion zones, location for personnel and heavy equipment decontamination, and identify any other site conditions significant to the

safe and efficient conduct of site work.

3.1.1 Planning

Planning for a Reconnaissance Survey begins with the collection and review of pertinent, available site data. The following types of information should be sought by the project personnel:

- The current status of the site (i.e., active or inactive).
- The location of any nearby or onsite potable or monitoring wells for sampling purposes.
- The topography, geology, and hydrogeology of the site.
- Accessibility to potential sampling locations.
- Records of past spills or leakage/environmental incidents.
- Previous sampling and analytical data.
- Previous manufacturing operations or records of historical activities.
- Migration/dispersal and toxicological characteristics of suspected site contaminants.
- Proximity to potentially affected populations or sensitive environments.
- Presence of site utilities (e.g., sanitary sewer, storm sewer).
- Presence of USTs, aboveground storage tanks (ASTs), dry wells, pad-mounted transformers, septic tanks, and drain fields.
- Presence of nearby surface water bodies.
- Potential for exposure to vapor contaminants.

If sufficient background information is available, a site sketch should be made showing the locations of pertinent features at and near the site. The sketch should

include the access routes, waste disposal areas, major surface water features, well locations, drainage patterns, nearby roads and residents, and proposed sampling locations. If site information is limited, a site sketch should be completed in the field prior to other activities.

3.1.2 Field Observations

It is important that all field personnel continually observe and analyze conditions at the site that may provide clues to the types of wastes present, the extent of contamination, and associated problems. All site observations will be documented for later use in evaluation of the analytical and field measurement of data. Although conditions may vary from site to site, the following observations should be made at each:

- The color, texture, size, and frequencies of soil stains.
- Appearance of water bodies, including color, turbidity, and the presence or absence of oil sheens.
- Presence of organic vapors or odors, including any readings from field monitoring equipment (e.g., photoionization detector [PID], flame ionization detector [FID]).
- Erosion at site, routes of contaminated runoff, appearance and condition of landfill face, exposure of buried drummed waste, and all other conditions at the site that may help to later determine the extent of migration of hazardous wastes present.
- Location of USTs, ASTs, dry wells, septic tanks, drain fields, pad-mounted transformers, and pipe discharge points.
- Photographs of major features at the site are an effective method of documentation, and therefore, an extensive photographic record should be

maintained for each site.

3.1.3 Sample Locations

Figure D3 provides a summary of the proposed sample locations. Table 10 in the RAP provides a summary of the proposed samples, sample depths, and analytical methods. Sediment and soil samples will be analyzed for lead and PCBs using methods EPA Method 6010 and EPA Method 8082 respectively. Lead will be analyzed for total concentrations. Groundwater and surface water samples will be analyzed for lead and total PCBs. Lead will be analyzed using EPA Method 6010 for both dissolved and total concentrations. PCBs will be analyzed using EPA Method 8082 from unfiltered field samples. No VOCs or SVOCs analysis will be conducted in the RAP.

3.2 SOIL SAMPLING

Soil samples may be collected to evaluate the impacts Sauer Dump Site to surface and subsurface soil.

Surface soil samples will be collected following the procedure presented in Section 3.2.1. Subsurface soil samples will be collected using procedures presented in Sections 3.2.2. Once collected, all surface and subsurface soil samples will be handled in the same manner. The soil sample will be field screened with a properly calibrated PID (VOCs only) or FID (VOCs only), and an XRF (lead). The RAP does not require VOC analysis. The following discussion is only intended if VOC sampling is required in the future. To field screen the soil sample, a decontaminated stainless-steel trowel will be used to make a cross-sectional slice(s) of the soil sample, or to score a longitudinal line the length of the soil sample deep enough to expose a porous surface. The 6-inch interval registering the highest PID or FID

measurement will be sampled for VOC analysis using a decontaminated small diameter coring device, such as a modified 10-30 mL disposable syringe or small diameter tube/plunger sampler. The sampling device will be capable of collecting 10±2 grams of soil from larger diameter core samplers (e.g., split-spoons) or from freshly exposed soils. In addition, the small diameter coring device will be capable of delivering the sample directly into a sample bottle containing methanol. Therefore, the outside diameter of the small diameter coring device will be smaller than the inner diameter of the sample bottle to avoid loss of sample and ease the soil transfer process.

Once VOC sampling is completed, or if soil samples are only being collected for non-VOC analyses, the following procedure will be followed. A sufficient amount of soil from the specified sampling interval will be placed on a decontaminated stainless-steel tray. After any rocks or organic matter have been removed, the soil will be homogenized using the coning and quartering method (American Society for Testing and Materials [ASTM] C702-80). In this method, the soil will be thoroughly mixed by turning the entire sample over three times using a stainless-steel trowel. Following the last turning, the entire sample will be shoveled into a conical pile in the middle of the tray. The conical pile will then be carefully flattened to a uniform thickness and diameter by pressing down the apex with the trowel. The flattened soil will be divided into four equal quarters. The sampling personnel will then make a determination as to whether the amount of soil on the tray is larger than the volume of the sample bottles. If the amount of soil is larger, one or two quarters will be discarded. If two quarters are discarded, opposite quarters will be selected. After removal of one or more quarters, the entire coning and quartering sequence will be repeated until the amount of soil on the tray is approximately equal to the volume of the sample bottles to be filled. Then, the required soil volumes will be placed in the sample bottles. In addition to samples collected for chemical analysis,

a certain percentage of the subsurface soil samples will undergo physical analysis as presented in Section 3.3.4.

3.2.1 Surface Soil

At most locations, surface soil samples will be collected from under the vegetative mat with a decontaminated stainless-steel bucket auger or stainless-steel trowel. If the 6-inch interval closest to the ground surface is composed mostly of organic debris, it will be discarded. The 0 to 6-inch interval will only be sampled for non-VOC analysis. Samples for VOC analysis will be collected from a 6-inch interval between 6 to 24 inches bgs. All surface soil samples will be collected in accordance with SOP 2 in Appendix A. The VOC sample fractions for soils may be collected using an Encore™ sampler. Three 5 gram samples will be collected per sample location as follows:

- A. Remove EnCore™ sampler from package and attach to the EnCore™ handle.
- B. Quickly collect a 5 gram sample.
- C. Attach cap.
- D. Fill out label and attach to sampler.

3.2.2 Subsurface Soil Sampling

Subsurface soil samples may be collected for physical and chemical analysis from soil borings and groundwater monitoring well borings. Subsurface soil sampling activities will proceed as follows:

- A. All boring/test pits/well drilling permits will be secured.
- B. Clearance of underground utilities will be obtained from Maryland One-Call.

- C. Water used for cleaning sampling equipment and decontaminating drilling equipment will be obtained from the approved water supply source. This source will be sampled and approved by USEPA before being used.

A site geologist will be present during all drilling and soil sample collection activities to maintain descriptive logs and collect appropriate samples for chemical and physical analysis. All drilling and sampling activities requiring the use of a drilling subcontractor will be performed by a Maryland licensed driller.

3.2.2.1 Boring Procedures

The hollow stem auger (HSA) method will be utilized at the Sauer Dump Site. An alternative technique, if debris or other obstacles prevent the use of HSA, will be recommended (e.g., backhoe pits) on an as-needed basis. The hollow stem auger method is described below.

Hollow Stem Auger

The HSA method (ASTM D1452-80) is another potential drilling method that may be used to drill the soil borings and monitoring wells borings at Sauer Dump Site. The HSA method utilizes continuous flight hollow augers with a cutter head mounted on the bottom of the lead auger. A plug is inserted into the hollow center of the cutter head to prevent soil from coming up inside the auger. This center plug has an attached bit that helps to advance the augers.

With the HSA method, soil borings and monitoring well borings will be initially drilled with 4.25-inch I.D. hollow stem augers for the purpose of collecting subsurface soil samples. For each boring that will be completed as a monitoring well, the borehole will be over-reamed prior to initiating well installation procedures. The size of the over-ream will depend on the size of the monitoring well to be installed (e.g., 2-inch,

4-inch, 6-inch). The increased diameter of the larger augers is necessary to prevent bridging of the filter pack during installation. Upon reaching total depth, the augers will be rotated until no additional cuttings are returned to the surface.

During the drilling process, all soil cuttings will be placed in 55-gallon Department of Transportation (DOT)-approved drums, visually inspected for physical description and signs of contamination (e.g., staining), and checked with a PID. These drums will be properly labeled, dated, and moved to a central storage area onsite. The results of the chemical analysis of soil samples collected from the borings along with PID readings from the cuttings will be used to evaluate possible disposal options for the containerized soil.

The breathing zone and the borehole will be monitored with a PID or FID during drilling activities to maintain a safe working environment and indicate potential contamination. Additional monitoring instruments will also be used to maintain safe drilling operations. These instruments include a real-time air monitor for checking airborne particulates (e.g., miniram) and a combustible gas indicator (CGI).

3.2.2.2 Collection Procedures for Subsurface Soil Samples

All soil borings, test pits and monitoring wells may be sampled at 2 to 5-ft intervals, if possible, as noted in site specific work plans that will be developed in the future. If sampling at 5-ft intervals is not possible because of the presence of hard rock material in the overburden, the boring will be advanced and sampling will be attempted at an interval where cuttings and drill rate indicate soil suitable for sampling.

The Standard Penetration Test (SPT) method (ASTM D1586-84) will be used for collecting subsurface soil samples. A 2-ft long by 3-inch I.D. decontaminated

stainless-steel split-spoon will be driven into the soil by dropping a 140-pound weight a distance of 30 inches. A 3-inch split-spoon is necessary to collect the volume of soil required for physical and chemical analysis. In cases, where soil samples are being collected solely for geotechnical analysis, a 1 3/8-inch I.D. split-spoon sampler will be used in accordance with the ASTM method. Samples collected solely for geotechnical analysis will be in accordance with SOP 3 in Appendix A. Subsurface soil samples will be collected in accordance with SOP 2 in Appendix A. If split-spoon refusal occurs (because of the presence of hard rock material in the overburden), the split-spoon will either be redriven or the boring will be advanced and sampling reattempted at an interval where the drill rate indicates soil suitable for SPT sampling. If an insufficient volume of soil was obtained due to spoon refusal and the above two options do not yield significant sample recovery, a second or third attempt will be made by abandoning the boring and moving the drill rig, usually within 10 ft of the original location.

Abandonment will be conducted in accordance with the procedures outlined below. Once the completion depth for the boring has been reached and all samples have been collected, the boring will either be completed as a groundwater monitoring well, as discussed in Section 3.6.2, or backfilled with native soil if the boring has not advanced either past the water table or to a depth of greater than 25 ft bgs.

3.2.2.3 Stratigraphic Characterization

During drilling of soil borings, excavation of test pits and monitoring wells, geologists will fully describe all activities in field boring logs. Information from the boring logs will be transferred to Field Drilling or Well Construction File forms as soon as possible following completion of the soil boring or monitoring well. The following data will be recorded in the boring logs at the drill site:

- A. Depths in feet and fractions thereof (tenths of a foot). Measurements will be entered on the data entry forms.
- B. Soil descriptions, in accordance with the Unified Soil Classification System (USCS) and prepared in the field by the attending site geologist, which include the following information:
- Classification
 - USCS symbol
 - Secondary components and estimated percentage
 - Color (using Munsell Soil Color Chart)
 - Plasticity
 - Consistency (cohesive soil) or density (noncohesive soil)
 - Moisture content
 - Texture/fabric/bedding
 - Depositional environment
- C. Cutting descriptions, including basic classification, secondary components, and other apparent parameters.
- D. Visual estimates of secondary soil constituents (If terms such as "trace," "some," or "several" are used, their quantitative meanings will be defined in a general legend).
- E. Length of sample recovered for each sample interval for split-spoon samples and any evidence of contamination in the sample (e.g., PID/FID readings).
- F. Blow counts, hammer weight, and length of fall for split-spoon samples.
- G. Estimated interval for each sample.
- H. Field instrument readings, (e.g., PID, FID).
- I. Depth to water first encountered during drilling and the method of

determination. (Any distinct water-bearing zones below the first zone also will be noted.)

- J. General description of the drilling equipment used, including the rod size, bit type, pump type, rig manufacturer, model, and drilling personnel.
- K. Drilling sequence.
- L. Any unusual problems.
- M. Start and completion dates of all borings, and a chronological time-sequence of all events (including daily drilling footage and quantities).
- N. Lithologic boundaries.

All soil borings will be accurately located on a detailed site map at the time of sample collection and marked with a numbered stake for future reference.

3.2.3 Geoprobe® Soil Sampling

Geoprobe® soil sampling involves hydraulically driving a 1.25-inch O.D. hollow stainless-steel probe rod into the ground. The probe rod contains a clean acetate sampling tube for collecting the soil sample. A rotating impact hammer is included to quickly penetrate concrete or asphalt pavement. Once the underlying soil is encountered, the probe rod is hydraulically driven to the desired sampling depth.

During the collection of discrete soil samples, the sampling tube remains completely sealed by a locked inner piston while the probe rod is driven to the desired depth. When the target depth is reached, a tool is inserted within the probe rod to the top of the sampling tube. The tool releases the inner piston from its locked position. The probe rod is then driven through the soil, filling the sampling tube. The probe rod is then withdrawn from the hole and the sample tube is

retrieved. The sample can then be removed from the tube and placed in sample bottles. Geoprobe® soil samples will be collected in accordance with **SOP 4** in Appendix A.

The use of Geoprobe® soil sampling has several advantages to conventional methods. Samples can be collected more quickly and in locations of limited access and under overhead utility lines. No cuttings are produced when advancing the sampling probes which eliminates the need for costly storage, sampling, and disposal. Geoprobe® sampling can also reduce the number of monitoring wells by screening samples to define the extent of a contaminant plume. The effective working depth of Geoprobe® sampling is approximately 40 ft bgs; however, depths in excess of 70 ft can be attained in fine-grained deposits.

3.2.4 Geotechnical Soil Sampling

Geotechnical analyses may be conducted (as needed) on a certain percentage of the subsurface soil samples collected from soil and borings. Soil samples will be selected for physical testing by the accordance with ASTM Method D1586-84. **SOP 3** of Appendix A describes the collection of soil samples for geotechnical testing.

In order to minimize the disturbance of the soil core, a continuous 12-inch interval of soil will be separated from a split-spoon. This continuous 12-inch core will be placed in a plastic air tight bag and labeled with boring number, sample depth, and orientation of the sample (i.e., top end of the sample or bottom end of the sample). The sealed bag will be placed in a cooler with cold, wet paper towels for storage and preservation. Each geotechnical soil sample will be analyzed for moisture content (ASTM D-2216), sieve grain size distribution (ASTM D-422) with hydrometer, Atterburg Limits (ASTM D-4318), bulk density (ASTM D-4253), permeability (ASTM D-5084), and specific gravity (ASTM D-854). Each sample will be assigned a USCS

symbol and description. The testing results will be used to describe the subsurface soils, verify the site geologist's field logs, and develop site-specific values for soil porosity and hydraulic conductivity in order to evaluate contaminant transport and effective remedial actions.

3.2.5 Soil Sampling from Test Pits

Based on site conditions and efforts from previous site investigations, soil samples may have to be collected from test pits. Test pits will be installed by the utilizing an excavator. Test pits will be dug in 2-foot increments. Depths of excavation will be verified with a surveyor's rod. Soil samples will be collected in accordance with **SOP 4** in Appendix A.

Upon completion of excavation activities, the soil will be placed back in the test pits and graded with the excavator.

3.3 SURFACE WATER SAMPLING

Surface water samples may be collected to evaluate the impacts of study sites on surface water bodies and drainage courses, such as streams and wetlands. To determine the impacts of a specific study site on surface water quality, samples will typically be collected from locations upstream and downstream of the channel segment into which the site drains. All surface water samples will be collected in accordance with **SOP 5** in Appendix A.

Water quality measurements will be collected during surface water sampling activities. The water quality measurements will include: pH, temperature, conductivity, dissolved oxygen (DO), turbidity, and oxidation reduction potential (ORP). The measurements will be made before and after the samples are collected.

If multiple surface water samples are to be collected from a surface water body,

samples will be collected from the furthest point downstream, moving upstream as the sampling progresses. Surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities. Only samples when turbidity values ≤ 10 NTU will be analyzed in the laboratory. All surface water sample locations will be marked on a site map. A description of the sampling point will be entered into the field logbook. The description will be adequate for the sampling point to be located in the future.

3.4 SEDIMENT SAMPLING

Sediment samples may be collected to evaluate the impact on the surrounding surface water bodies and drainage courses. Where specified (in almost all cases), sediment and surface water sampling locations will be the same. Chemical analyses will be the same for the sediment and surface water samples collected from the same location to aid in data comparison and evaluation.

To determine the impacts of a specific study site on sediment quality, samples will be collected from locations upstream and downstream of the channel segment into which the site drains. Sediment samples will be collected from the furthest point

downstream, moving upstream as the sampling progresses. Sediment sampling will be conducted in accordance with **SOP 6** in Appendix A.

3.4.1 Collection Procedures for Sediment Samples

Sediment samples will be collected from beneath the organic build-up or detritus material and decomposed organic material will be included in the sample. The decomposed organic material will be retained in the sample due to the potential for this interval to be impacted due to deposition and adsorption. Typical sampling depths may range from the top of sediment to a depth of one foot below the top of sediment. Samples will be collected with a decontaminated stainless-steel bucket auger, if there is little or no water on top of the sediment at the particular sampling location and if the water velocity is low. For sampling locations where the water velocity is high, a decontaminated stainless-steel corer or other device that eliminates sample washing will be used. This will ensure the integrity of the surface layer of sediment and minimize the loss of fine-grained material in the sediment.

3.5 HYDROGEOLOGIC INVESTIGATION

In order to assess the presence of groundwater contamination, a hydrogeologic investigation may be conducted at the Sauer Dump Site. The investigation may involve the installation of permanent groundwater monitoring wells, and collecting groundwater samples from permanent monitoring wells (both newly installed and existing). Permanent groundwater monitoring wells will be drilled using the boring procedures provided in Section 3.2.2.1. Sections 3.6.1 and 3.6.2 provide details for the design, construction, and installation of permanent groundwater monitoring wells. No new Monitoring Wells are currently planned for in the RAP.

Following installation, permanent monitoring wells will be developed following the procedures listed in Section 3.6.3. Permanent monitoring wells (newly installed and existing) will be sampled using either the conventional or low-flow sampling procedures presented in Sections 3.6.4 and 3.7.5, respectively. Sampling of the newly installed monitoring wells will begin no less than 14 days after completion of well development activities in order to allow sufficient time for aquifer equilibration. An oilwater interface probe will be used for detection of Dense Non-Aqueous Phase Liquids (DNAPLs) and Light Non-Aqueous Phase Liquids (LNAPLs) when sampling permanent monitoring wells.

Hydrogeologic investigations may also provide additional information on site-specific geology/hydrogeology and aid in establishing groundwater flow velocities and gradients. Static water level measurements are used in conjunction with aquifer testing data to estimate hydraulic conductivities and groundwater flow velocities. Collection of static water level measurements is described in Section 3.6.8.

3.5.1 Groundwater Monitoring Well Design and Construction

The actual depth of each monitoring well will depend on the aquifer unit that is to be investigated.

The size of the monitoring well to be installed (e.g., 2-inch, 4-inch) will be specified at future dates during the development of site-specific work plans. The following materials will be used in constructing permanent monitoring wells:

- A. Flush-threaded Schedule 40 PVC casing that conforms to the National Sanitation Foundation Standard 14 for potable water usage. The I.D. of the PVC casing will depend on the size of the monitoring well to be

installed (e.g., 4-inch, 6-inch). No PVC solvents or glues will be used. A 10-ft screen length, slot size 0.010 inch will be located at the base of the well. The 0.010 inch slot size will filter out the finer-grained material of the overburden soils and prevent them from entering the well. A water-tight lockable cap will be placed on top of the riser in each flush-mounted well. For aboveground monitoring wells, an oversized PVC cap will be placed on top of the riser pipe. For all monitoring wells greater than 100 ft, Schedule 80 PVC casing with centralizers may be used.

- B. A mixture in the ratio of 94 lbs. of Portland Type II neat cement, to 6-8 lbs. bentonite, to 8-10 gallons of water will be used to grout the annular space between the casing and the open borehole.
- C. Commercially available granular, powdered bentonite will be mixed with pre-sampled and approved water for making a bentonite slurry.
- D. Clean silica sand (Morie 1 size), will be used in the filter pack around the well screen, compatible with both the screen slot size and aquifer materials.
- E. A protective steel casing will be installed over the top of the PVC riser for monitoring wells finished above grade. The diameter of the protective casing will depend on the size of the monitoring well installed (e.g., 4-inch, 8-inch). The protective casing will extend approximately 2½ ft above land surface and will be seated 2½ ft into the well seal grout. It will be vented to the atmosphere via a hinged locking cap that will prevent entry of water, but will not be airtight. In accordance with the *Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports (March 1987)*, a ½-inch diameter drainage port will be installed, centered 1-inch above the level of the internal mortar collar. The steel casing and posts will be painted orange. Wells finished below grade

will have a flush-mounted manhole or valve-box type cover marked "monitoring well".

- F. All locks used to secure the monitoring wells will be keyed with the same key.

3.5.2 Groundwater Monitoring Well Installation

Once the drilling has reached the proper depth for well installation, the PVC monitoring well will be placed inside the temporary steel casing or the hollow stem auger. The permanent monitoring wells will be constructed (placement of sand filter pack, bentonite seal, and bentonite cement grout) inside the augers or drill casing as they are gradually removed to allow for proper placement of well construction materials.

When a monitoring well boring is completed, the site geologist will visually inspect the hole and decide on the depth of the well. All well installations will begin within 48 hours of boring completion, and, once begun, will continue uninterrupted until completed. All PVC casings and screens will be steam cleaned prior to installation to ensure that all residual materials are removed. The casings and screens will then be wrapped in clean polyethylene sheeting for transport. All well screens will have a solid bottom. Solid casing will extend from the top of the screen to approximately 2+ ft above land surface. If necessary, the borehole will be backfilled to the desired depth with bentonite grout. The grout will be pumped into the boring, under pressure, through a tremie pipe that discharges at the bottom of the boring. The filter pack will then be installed through a tremie pipe around the well screen to a height of approximately five feet above the top of the well screen. A bentonite slurry will then be placed above the filter pack to produce a minimum 5-ft thick bentonite seal using a tremie pipe. The bentonite slurry will have the following

composition: 50 lbs. of bentonite to 15-35 gallons of water. A grout-cement seal consisting of Portland Type II cement and granular bentonite will extend from the top of the bentonite seal to a depth of approximately six inches to one foot bgs. Grouting activities will be completed as a continuous operation in the presence of the site geologist. The grout will be pumped into the annular space under pressure using a tremie pipe placed at the top of the bentonite seal to ensure a continuous seal. After the grout-cement seal has set (approximately 24 hours), the seal will be checked for settlement and additional grout will be added to fill any depressions, if necessary. Once grouting operations are completed, a square concrete surface cover extending three ft in all directions will be placed from the top of the bentonite grout to 6 inches above the ground surface. An aboveground steel protective casing will be sealed in the cement surface cover for all aboveground finished monitoring wells. In addition, protective posts will be installed around the aboveground finished monitoring wells to prevent damage by vehicular traffic. The protective steel casing and posts for the aboveground finished monitoring wells will be painted orange. For monitoring wells located in heavy traffic areas, flushmounted covers will be installed and the PVC well casing will be finished bgs with a water-tight sealed lockable cap. The flush-mount covers will be marked "monitoring well" to distinguish them from fill ports for USTs. Following completion of all monitoring well installation activities, an ID plate will be affixed to each well.

An as-built construction diagram of the well installation will be included in the boring log and will show, by depth, the bottom of the boring, screen location, coupling location, granular filter pack, seals, grout, and height of riser above ground surface. The actual composition of the grout, seals, and granular backfill will be recorded on each log. The as-built diagrams will include the protective casing detail. The drilling subcontractor will complete the Form A (*Groundwater Monitoring Well*

Certification - As-Built Certification) and submit the original to MDE with a copy to the contractor.

3.5.3 Monitoring Well Development

Newly installed permanent monitoring wells will be developed by pumping the groundwater with a stainless-steel electric-powered submersible pump. The submersible pump intake will be placed below the water level and lowered as the water level drops. The pump will be surged to facilitate the removal of fine sediments at the bottom of the monitoring well. Polyethylene tubing, connected to the pump with stainless-steel clamps, will be used in purging the well. The tubing will be dedicated to each individual well and will be disposed of after use. If well yields cannot sustain the flow rate of the submersible pump, a dedicated bailer will be used to evacuate the well. Water will not be added to the well to aid in development, nor will any type of air-lift technique be used. Measurements of water quality parameters will be recorded every three to five minutes during monitoring well development. The water quality parameters will include: pH, temperature, conductivity, DO, turbidity, and ORP. Development water will be containerized in a portable polyethylene tank and transported to a central storage area, if analytical results for the subsurface soil samples indicate potential contamination. If there is no indication of potential contamination, the development water will be disposed of downgradient of the monitoring well on a grassy surface if it will not present a nuisance to day-to-day installation activities. The containerized well development water will be sampled and disposed of after consultation with the USEPA.

Well development will begin no sooner than 48 hours, but no later than seven days, after the cement surface covers are in place. Development will proceed until the following conditions are met:

- A. The well water is clear to the unaided eye.
- B. Stabilization of water quality parameters. Stabilization will be defined by the following variances between three successive readings: pH within \pm 0.1%; conductivity within \pm 3%; DO, ORP, and turbidity within \pm 10% (Puls et al., 1995); and temperature within \pm 1°C.
- C. At least three well volumes (including the saturated filter material in the annulus) plus the volume of water added during the drilling process (if any) have been removed from the well.
- D. Five well volumes have been purged, regardless of stabilization of the water quality parameters.
- E. Turbidity measurements are less than or equal to 5 nephelometric turbidity units (NTUs). If it is determined that it is not possible to achieve 5 NTUs, the appropriate NTU value will be assigned after consultation with the,USEPA Region III, and MDE.
- F. The sediment thickness remaining in the well is less than five percent of the screen length.

3.5.4 Conventional Groundwater Sampling

Sampling of new monitoring wells will begin no sooner than 14 days after completion of well development activities in order to allow sufficient time for

aquifer equilibration. The following procedures will be followed on the day of sampling:

- A. The depth to water and total depth of the well will be measured from the top of PVC casing from the pre-marked reference location. The mark will be used as the survey point to measure all water levels or total well depths for the well. The height of the water column in the well will then be calculated.
- B. All sampling equipment will be placed on polyethylene sheeting to prevent contact with the soil.
- C. Groundwater in the screen, well casing, and saturated annulus (filter pack) will be evacuated with a stainless-steel electric-powered submersible pump. The submersible pump intake will be placed below the water level and lowered as the water level drops. Polyethylene tubing, connected to the pump with stainless-steel clamps, will be used in purging the well. The tubing will be dedicated to each individual well and will be disposed of after use. If well yields cannot sustain the flow rate of the submersible pump, a dedicated Teflon® bailer will be used to evacuate the well. If the well purges to dryness, no additional water will be removed.
- D. Water quality parameters (i.e., pH, temperature, DO, conductivity, turbidity, and ORP) will be measured every three to five minutes during pre-sample purging. A monitoring well will be considered ready for sampling when the water quality parameters have stabilized. Water quality variances, which are subject to instrument accuracy, should be as follows: pH within ± 0.1 ; conductivity within $\pm 3\%$; ORP within ± 10 mV; DO and turbidity within $\pm 10\%$ (Puls et al., 1995); and temperature within $\pm 1^\circ\text{C}$ between three successive readings. Each well will be sampled after

the water level recovers to 80% of its static level or within two hours of purging.

- E. Pre-sample purge water will be containerized in a portable polyethylene tank and transported to a central storage area if analytical results for the subsurface soil samples indicate potential contamination. If there is no indication of potential contamination, the purge water will be disposed of downgradient of the monitoring well on a grassy surface if it will not present a nuisance to day-to-day installation activities.
- F. Sampling will be accomplished using a decontaminated Teflon® bailer. A Teflon®-coated wire leader approximately five feet in length will be attached to the bailer. Disposable nylon rope will be attached to the leader wire and will not come into contact with the water in the monitoring well. The bailer will be slowly lowered into the well so that the water column in the well is minimally impacted.
- G. Sample bottles will be filled in order of decreasing analyte volatility and preserved in accordance with the aqueous preservation procedures provided in Section 4.1.2.
- H. During sampling, primary objectives and considerations include minimizing sample disturbance, avoiding sample exposure to air and extraneous contamination, and preserving sample integrity throughout sample collection. Samples will be filtered at laboratory using standard method 3030b.

3.5.5 Low-flow Groundwater Sampling

Low-flow groundwater sampling minimizes the disturbance of any sediment in the monitoring well and the formation of any additional sediment. The goal of low-flow

sampling is to collect more representative samples by matching the intake velocity of the sampling device with the natural groundwater flow velocity, thereby reducing sample disturbances. The primary advantage of this procedure is the collection of low turbidity samples (i.e., samples with low concentrations of suspended particles) and the reduction of sample aeration, resulting in samples that are more representative of true aquifer conditions. Use of this technique also eliminates the need for collecting and analyzing filtered metal samples, thus saving time and analytical costs. Low flow sampling also, in most cases, reduces the volume of groundwater purged from the well and associated disposal issues. Low-flow groundwater sampling will be conducted in accordance with SOP 7 in Appendix A. This sampling procedure involves removing groundwater from a monitoring well using a variable speed stainless-steel electric-powered submersible pump placed at the screened interval. The pump intake will be kept at least two feet above the bottom of the monitoring well to prevent mobilization of any sediment present in the bottom of the well. The depth to which the pump is lowered and the sample collected will be recorded so that the pump can be placed in the same location during future sampling events.

Before pumping begins, the water level in the monitoring well will be measured. The water level will be measured at a minimum of every three to five minutes during pumping. Pumping rates will be less than 500 mL per minute. Ideally, a pumping rate will be maintained that results in a stabilized water level (less than 0.3 ft drawdown) in the monitoring well. Water quality parameters (i.e., pH, temperature, conductivity, DO, turbidity, and ORP) will be measured on three to five minute intervals. Stabilization will be defined by the following variances between three successive readings: ORP within ± 10 mV; turbidity and DO within $\pm 10\%$; conductivity within $\pm 3\%$; pH within ± 0.1 (Puls et al., 1995); and temperature within $\pm 1^\circ\text{C}$. If the water quality parameters do not stabilize, pre-sample purging will

continue until one well volume has been removed or a purge time of two hours has been exceeded. If drawdown in the monitoring well is greater than 0.3 ft, the pumping rate will be reduced to match the recharge rate of the well, taking care to maintain pump suction and avoid air entrainment in the tubing. In case of air entrainment occurring, the sample will be discarded. If drawdown continues despite reducing the pumping rate, then two alternative methods will be used:

1. The first alternate sampling method will consist of drawing the water level in the well down to some depth greater than 0.3 ft, but above the top of the screened interval where the aquifer's groundwater recharge rate equals the pumps discharge rate. This will be accomplished by increasing the groundwater pumping rate up to 500 milliliters per minute (mL/min) and constantly monitoring the change to the groundwater level in the well. Once the groundwater level in the well stabilizes (i.e., well reaches steady-state), the pumping rate and the water level in the well will remain constant while groundwater quality parameters are evaluated on three to five minute intervals for stabilization. At a minimum, three time the volume of the groundwater drawdown in the well will be removed prior to groundwater sampling. The volume of groundwater drawdown in the well will be calculated by subtracting the constant head level from the initial water level measured in the well prior to pump installation and multiplying the well drawdown length by 0.65 gallons, which is the amount of water contained in one foot of 4-inch I.D. PVC well casing.
2. If the recharge rate of the well is less than 50 to 80 mL/min, a second alternate groundwater sampling method will be used. In this method, purging should be interrupted when the water level drops to the top of the screened interval. Once the water level drops to the top of the screened interval, the

pump will be shut off and the groundwater recharge rate will be measured. If groundwater recharges at a rate greater than 0.5 foot over a 30 minute period, and the groundwater quality parameters have stabilized, the well will be allowed to recharge for a one to two hour period and groundwater sampling will begin. If the observed recharge rate is less than 0.5 foot over a 30 minute period, the pump will be removed from the well and groundwater will be allowed to recharge for a 24 hour period. After the groundwater has recharged, the well will be sampled by placing the low-flow pump at the mid-screen depth of the monitoring well.

If the sampling conditions mentioned above cannot be achieved, groundwater sampling will be collected using a Teflon bailer, as discussed in Section 3.7.4. Teflon® tubing, connected to the pump with stainless-steel clamps, will be used in collecting lowflow groundwater samples. The tubing will be dedicated to each individual well and will be disposed of after use. Sample bottles will be filled in order of decreasing analyte volatility and preserved according to the aqueous preservation procedures provided in Section 4.1.2. Samples will be collected at flowrates of between 100 and 250 mL/min provided that drawdown of the water level within the well does not exceed 0.3 ft. If the drawdown rate exceeds 0.3 ft and the pumping rate cannot be reduced without air entrainment occurring, the two alternate sampling methods mentioned above will be considered. The measurements for determining drawdown will be completed at 3 to 5 minute intervals. Entrainment of air in the tubing must not occur. The sequences associated with this event must be fully documented in the field logbook. VOC samples must be collected first and directly into pre-preserved sample containers. The amount of HCl required for preservation will be determined using an acid blank with well purge water prior to sampling each well. All containers should be filled by allowing the pump discharge to flow gently down the inside of the container with

minimal turbulence. Sample containers shall be filled in order of decreasing volatility.

3.5.6 Groundwater Monitoring Wells Inspection

Groundwater monitoring wells will be inspected in accordance with **SOP 8** in Appendix A. Sites with groundwater monitoring wells require periodic inspections of the wells to determine their integrity and functionality. If available, boring logs and well construction diagrams would be useful to review prior to conducting an inspection. In addition to periodic inspections on sites with established programs, inspections are important to gain information on the usefulness of wells where we are new to the site and/or the wells have not been regularly sampled. A simple checklist on a groundwater monitoring well inspection form can be used to record observations.

3.5.7 Static Water Level and Well-Depth Measurements

Static water level and well-depth measurements will be conducted in accordance with **SOP 9** in Appendix A. Static water level and well-depth measurements at newly installed and existing groundwater monitoring wells will be obtained using an electronic water level sounding device. Using a calibrated sounder, this procedure is accurate to ± 0.01 ft. The tape will be rinsed with water from the approved source, cloth-wiped, and allowed to air dry between consecutive water level measurements. All measurements of the depth to groundwater and well depth will be referenced to a permanently marked reference point on the monitoring wells (highest point on the top rim of the PVC casing). Prior to measurement, water levels in the monitoring wells will be allowed to stabilize for a minimum of 24 hours after well construction, development, or aquifer testing. Where possible, the work will proceed from the least to the most contaminated wells. The wells will be

opened and the headspace monitored with a PID or FID to determine the presence of VOCs. If a floating product layer is detected in the well, an oil/water interface probe will be used to measure the length of the product layer. Collection of static water level and well-depth measurements will be conducted in accordance with SOP 9 in Appendix A.

3.6 SAMPLING LOCATION AND ELEVATION SURVEY

A sampling location and elevation survey is performed in order to carry out engineering measurements and other surveying operations necessary to map sampling locations and their elevations.

Surveys should be completed by a surveyor who is licensed and registered in the State of Maryland. The latitude and longitude of each surveyed location will be tied to the Universal Transverse Mercation North American Datum of 1927 (UTM NAD 27) in m. Elevations for the natural ground surface

At each surveyed location will be determined using the National Geodetic Vertical Datum of 1928 (NGVD 28) in ft. Measurements should be third order accuracy. Temporary monuments will be set and referenced for future recovery. All monuments will be described in the surveyor's notes and will consist of a permanent mark scribed on sidewalks, paved roads, or curbs. Sufficient descriptions will be provided to facilitate their recovery.

The chronology of performing surveying operations to locate sampling stations is dependent on the nature of the sampling to be performed and the site conditions. Surveying operations to define horizontal and vertical locations of onsite sampling stations may be performed before or after sampling stations are established.

Typical scenarios of such circumstances are:

- Sampling grids will usually be staked out by the contractor Field Operations Leader prior to surveying. The grids should be staked to be easily visible for later surveying.
- Planned surface soil sampling locations can sometimes be staked out and measured for ground elevation by surveyors in advance of the sampling events.
- Unplanned surface soil sampling locations, or those which have been relocated a significant distance away from the planned location to suit site conditions, may be staked for identification by the sampling personnel, and subsequent determination of horizontal positions and ground surface elevations by a surveyor.

3.6.1 Soil Borings

Horizontal locations and ground surface elevations for borings and test pits are used to construct geologic sections or profiles. Horizontal locations (i.e., latitude and longitude) will be determined to ± 3.0 ft and ground surface elevations measured to ± 0.1 ft. The surveyors may stake the location in advance indicating the boring or test pit number, grid coordinates, and ground surface elevation on the stake. A tall witness stake or colored flag should be used to make the location more readily visible. A greater degree of layout accuracy may be required in confined areas, where the drilling or excavation must be performed carefully to avoid disturbances to underground facilities (i.e., utilities, tunnels, foundations, etc.).

3.6.2 Monitoring Wells

The horizontal location of monitoring wells will be determined to within ± 3.0 ft, while the elevations will be determined to within ± 0.01 ft. The surveyor will

measure the following three elevations: the top of the inner PVC casing, the top of the outer protective casing (on the lip, not the cap), and the ground surface elevation at the base of the concrete pad. Prior to the start of the survey, Field Team Leader should ensure that the surveyors are given the keys to the locking caps on the wells. The Field Team Leader will also instruct the surveyor to measure the elevation of the top of the inner PVC casing from the pre-marked point. This point will be used as a reference to measure subsequent groundwater elevations. The wellhead elevation and natural ground surface elevation will also be noted and recorded.

3.6.3 Surface Soil, Surface Water, and Sediment Sampling Locations

A Differential Global Positioning System (DGPS) will be used to establish the horizontal location of all surface soil, surface water, and sediment sampling locations. The DGPS unit used for the surveying will be a Trimble Pathfinder Pro XR system that collects real-time, differentially-corrected satellite data. According to the manufacturer, the accuracy of horizontal fixes from the Pathfinder Pro XR unit is plus/minus approximately 12 inches with no data post-processing. All survey data will be downloaded into Trimble's Microsoft Windows-based processing software for data manipulation and then into a CADD and or ArcGis map plotting.

3.7 DECONTAMINATION PROCEDURES FOR SAMPLING AND HEAVY EQUIPMENT

Decontamination of sampling and heavy equipment will follow MDE, and USEPA Region III guidance. An **SOP 10** for conducting decontamination operations is provided in Appendix A.

All decontamination-derived water will be placed in containers and may be

consolidated into mobile tanks based on volume. Soil or sludge wastes from decontamination of the drill rig or backhoe will be placed in 55-gallon drums and labeled. Once the drums are full, the containerized waste will be staged near the decon pad area for offsite disposal. Following receipt of the analytical results, the decontamination-derived wastewater will be disposed of after consultation with the USEPA. If the wastewater is uncontaminated, it will be released onto the ground at the contractor's decontamination pad. However, if the wastewater is contaminated, it will be transported an approved off-site facility.

3.7.1 Non-Aqueous Sampling Equipment

All surface soil, subsurface soil, sediment sampling equipment (e.g., stainless-steel bucket augers, split-spoons) will be decontaminated after each use according to the following procedure:

- A. Wash and scrub low-phosphate deter-gent (e.g., alconox).
- B. Rinse with pre-sampled and approved water.
- C. Rinse with 10% HNO₃ solution.
- D. Rinse with pre-sampled and approved water.
- E. Rinse with optima-grade methanol.
- F. Rinse with hexane (pesticide-grade or better).
- G. Rinse with demonstrated analyte-free distilled and deionized water (five times the volume of solvent used).
- H. Air dry.
- I. Wrap in aluminum foil (shiny side out).

Equipment used in field screening surveys (i.e. reconnaissance surveys) will be decontaminated using pre-sampled and approved water and a low phosphate

detergent (e.g., alconox) only. All split-spoon sampling devices used at the Sauer Dump Site are stainless steel. Therefore, a 10% nitric acid solution will be used in the decontamination sequence.

3.7.2 Aqueous Sampling Equipment

Submersible pumps will be used for pre-sample purging of monitoring wells in the conventional groundwater sampling methodology, as well as monitoring well sampling utilizing the low-flow method (see Section 3.6.5). The submersible pumps will be decontaminated at the beginning of each day and after each well is sampled according to the following procedure:

- A. Wash and flush approximately 5 gallons with pre-sampled and approved water through the pump.
- B. Wash and flush approximately 5 gallons of alconox (low phosphate detergent) through the pump.
- C. Wash and flush approximately 5 gallons of pre-sampled and approved water through the pump.
- D. Wash and flush approximately 5 gallons demonstrated analyte-free water through the pump.
- E. Air dry.
- F. Wrap with aluminum foil (shiny side out).

The decontamination procedure for aqueous sampling equipment (i.e., pumps) listed above is consistent with the "between well-decon" specified by EPA in the *Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling SOP (March 1998)*. All remaining aqueous sampling equipment will be decontaminated according to the procedure listed in Section 3.10.1. Examples of such equipment include: Teflon® bailers, stainless-steel pitchers, and tank sampling devices.

Dedicated Teflon® bailers will only be decontaminated prior to their first use.

3.7.3 Heavy Equipment

All heavy equipment, such as the drill rig and the backhoe will be decontaminated after each use with pre-sampled and approved water according to the following procedure. The decontamination procedure will include a high-pressure hot water wash, a high-pressure hot water rinse, and air drying. If the high pressure hot water wash is insufficient to clean the heavy equipment, the equipment will be washed with a low-phosphate detergent (e.g., alconox) and scrubbed with brushes. The equipment will then be rinsed with pre-sampled and approved water. Drilling equipment will be placed on clean polyethylene sheeting during transport and at the drill site. Decontamination of the heavy equipment will be performed at the contractor's decon pad. However, in the event that heavy equipment is potentially contaminated at a Sauer Dump Site, a temporary decon area will be constructed to provide gross decontamination of the heavy equipment. In addition, temporary decontamination pads will be established at study sites where work will be carried out for an extended period of time.

3.8 FIELD QUALITY CONTROL SAMPLES

3.8.1 Source Water

Source water will be used to decontaminate sampling equipment (e.g., stainless-steel trays, splitspoons) after each use. In order to ensure that the decontamination procedure will not cause cross contamination, the source water will be demonstrated analyte-free prior to performance of any environmental sampling. The criteria for analyte-free water will be determined by the detection limits of the laboratory methods used for analysis of the source water sample. Analytes in the source water should be less than the Practical Quantitation Limits (PQLs) for Target Compound List (TCL) Volatiles, TCL Semivolatiles, TCL

Pesticides/PCBs, Target Analyte List (TAL) Metals. In instances where analytes have been amended to the above lists, the detected concentrations must also be less than the PQL. Please note that it may not be possible to obtain water below the PQL for all metals. In addition, there are some site specific laboratory and screening methodologies that result in the following requirements for the source water:

The following common laboratory contaminants have allowable limits at 10 times the concentration detected in a blank (i.e., trip blank, rinse blank): methylene chloride, toluene, acetone, 2- butanone, and phthalate esters.

3.8.2 Field Duplicate Samples

Field duplicate samples will be used to provide sampling precision as well as analytical precision. Duplicate samples will be collected at a frequency of one duplicate per 20 samples per sampling technique collected for each medium. Duplicate samples are defined as samples collected simultaneously from the same source under identical conditions. Duplicates of the wipe and chip samples will be collected adjacent to the original location as co-located samples. For non-volatile fractions, field duplicates will be collected after homogenizing (i.e., coning and quartering) the sample. This will improve precision and incorporate the technique of coning and quartering into the field duplicate.

3.8.3 Rinse Blanks

Rinse blanks will be collected to determine whether the decontamination procedure has been adequately performed and that there is no cross-contamination of samples occurring due to the equipment or residual decontamination solutions. Rinse blanks will be collected at a rate of one per type of sampling equipment per decontamination event. This rate should not exceed one rinse blank per day. A consistent volume of demonstrated analyte-free distilled and deionized water will

be poured over the sampling equipment and collected in a sample container. Analysis of rinse blanks will be for all laboratory preservation procedures provided in Section 4.1.2.

3.8.4 Trip Blanks

Trip blanks will be used to determine if any onsite atmospheric contaminants are seeping into the sample bottles, or if any cross-contamination of samples is occurring during shipment or storage of sample containers.

Aqueous Trip blanks will be created onsite at Sauer Dump Site each day that aqueous samples will be collected for VOCs analysis. The aqueous trip blanks will consist of demonstrated analyte-free distilled and deionized water preserved with 1:1 HCl to a pH of less than 2 in 40 mL teflon-lined septum vials. The aqueous trip blanks will accompany the samples into the field prior to sampling, remain with the collected samples during the sampling sequence, accompany all aqueous VOC sample bottles shipped to the offsite laboratory, and remain with the samples at the offsite laboratory prior to analysis.

3.9 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

This section provides specific procedures to be followed in the containerization, handling, and disposal of IDW generated during sampling activities at Sauer Dump Site. Potential IDW which may be generated during field activities at Sauer Dump Site include: liquids, soil/sediment, and disposable field supplies (e.g., plastic sheeting, Tyvek®). The types of wastes included in each of these categories and the applicable handling and disposal procedures are described below and in **SOP 11** in Appendix A. All drums containing soil and sediment wastes and miscellaneous water and solid waste (e.g., personal protective equipment [PPE]) will be transported to the offsite disposal facility. All hazardous waste manifest forms will be signed by Sauer Dump Coalition personnel. Offsite transport and disposal will be

in accordance with applicable federal and MDE regulations.

The hazardous or nonhazardous classification of the wastes will be based on the sample analytical results from the Sauer Dump Site where the sampling activities were conducted. Additional analysis maybe required such as Toxicity Characteristic Leaching Procedure (TCLP). Consequently, IDW will be labeled to indicate the type of water, the study sites where the wastes were generated, and the date(s) the wastes were generated.

3.9.1 Liquid Wastes

Liquid wastes consist of water that may or may not be contaminated. Such wastes may be generated from the following activities:

- Well drilling and development,
- Pre-sample purging of monitoring wells, and
- Equipment decontamination.
- Wastes from well drilling, development, and purging will consist of groundwater, sometimes mixed with aquifer material or rock fragments that are removed from the well along with the water. The stationary tank will be used for storage of water from well drilling and development, and as well as decontamination water. Purge water will be discharged through a carbon bucket to the ground surface.
- Water from development and pre-sample purging of monitoring wells may be containerized depending on the analytical results of the soil samples collected during well installation. The water will be analyzed for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, the water also would be analyzed to determine if it is Resource Conservation and Recovery Act (RCRA) hazardous (refer to 40 CFR 261.20). If the water is hazardous, it must be transported offsite to a

permitted facility for treatment/disposal. Based on historic results, Malcolm Pirnie plans on discharging purge water through a carbon bucket to the ground surface.

3.9.2 Soil and Sediment Wastes

Soil or sediment wastes may be generated from drilling of boreholes or from soil borings and monitoring wells, development and purging of monitoring wells, test pit excavation, steam cleaning of heavy equipment, and sampling activities. Soil and sediment wastes will consist of natural soil particles ranging from clay to gravel in size, and rock cuttings generally 1-inch or smaller. They may be either uncontaminated or contaminated depending on their source. The handling and disposal procedures for soil/sediment wastes derived from drilling, development, or decontamination operations will involve the following steps:

- A. Place soil/sediment in 55-gallon steel drums. Visually inspect and check the soil with a PID and FID.
- B. Adequately label the drums with regard to the type of contents (e.g., drill cuttings), the date of generation, and the sites where the wastes were generated.
- C. Move the drums to a designated secure area for temporary storage.
- D. Use the analytical results from the environmental samples collected from the associated sites to decide whether the soil/sediment can be disposed of on the surface at its original location (or other - designated areas) or whether it requires special handling (i.e., as a hazardous waste).

Soil/sediment may be placed onsite provided that the following conditions are met.

- The soil/sediment is not considered contaminated.
- No potential to contaminate an uncontaminated aquifer exists.
- The disposal of soil/sediment will not erode/flow either offsite or onsite onto

uncontaminated areas.

- The potential to create a health hazard to adjoining property owners through airborne exposure is nonexistent.

3.9.3 Miscellaneous Wastes

All disposable sampling equipment (e.g., plastic sheeting, tubing, rope) as well as PPE will be sealed in plastic bags and placed in labeled 55-gallon steel drums. The labels will indicate the contents of the drum (i.e., PPE) and the date(s) the wastes were generated. Waste will be disposed by Sauer Dump Coalition.

4.0 SAMPLE MANAGEMENT AND ANALYSIS

The procedures described in this section ensure that once representative environmental samples are obtained, they are properly containerized, preserved, shipped, and otherwise handled in a manner that will maintain their chemical integrity. The use of these techniques will ensure the representativeness of a sample and significantly reduce the possibility of sample contamination from external sources. Additional information is also provided in the Sauer Dump Site Generic QAPP and the SOPs in **Appendix A**.

4.1 SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

4.1.1 Containers

All sample containers for both onsite and offsite laboratory analysis will be cleaned prior to use. These pre-cleaning requirements will meet or exceed USEPA requirements. The sample containers to be used for aqueous and soil samples are presented in **Tables 4-1 and 4-2**, respectively.

4.1.2 Sample Preservation and Holding Times

Chemical preservatives will be required for VOC aqueous samples to retard degradation during shipment and storage prior to laboratory analysis. Preservatives will be added to appropriate samples at the time of collection. In addition to chemical preservatives, all samples for chemical analysis will be transported to the laboratory in temperature controlled coolers. The types of preservation required for samples collected during field sampling activities at the Sauer Dump Site, as well as holding times, are contained in **Table 4-1** (aqueous) and **Table 4-2** (solid). Wet ice will be used to maintain the internal cooler temperature at $4^{\circ}\pm 2^{\circ}\text{C}$.

4.1.2.1 Preservation of Aqueous VOC Samples

Procedures for chemical preservation of aqueous VOC samples are described below:

1. Samples to be analyzed for TCL VOCs will be preserved by addition of the correct volume of 1:1 HCl to reduce the pH to less than 2.
2. Following sample collection, the sample bottle will be capped and the bottle gently agitated in order to homogenize the preservative throughout the sample and to ensure that no air bubbles are present.
3. If air bubbles are present, the sample bottle will be reopened and additional sample water added. Failure to chemically preserve the aqueous VOC sample fraction will reduce the holding time to 7 days.

4.1.2.2 Preservation of Aqueous Non-VOC Samples

Procedures for chemical preservation of aqueous non-VOC samples are described below:

1. All containers will come pre-preserved directly for the laboratory.
2. The sample bottle will be capped, and the bottle gently agitated in order to homogenize the preservative throughout the sample.

**TABLE 4-1
SAMPLE PRESERVATION, BOTTLE REQUIREMENTS,
AND HOLDING TIMES FOR AQUEOUS SAMPLES**

Analyte	Bottle Requirement/Volume	Required Headspace	Preservative	Holding Time
TAL Metals	1-Liter HDPE	10%	HNO ₃ to pH <2, Cool to 4°C	6 months, except Mercury (28 days)
Cyanide	1-Liter HDPE	10%	NaOH to pH >12, Cool to 4°C	14 days
TCL VOCs	40-mL amber glass	0%	HCl to pH < 2, Cool to 4°C	14 days
Hexavalent Chromium	1-Liter HDPE	0%	Cool 4°C	48 hours
TCL SVOCs (including PAHs)	1-Liter amber glass	10%	Cool to 4°C	7 days to extraction (40 days after extraction)
TCL Pesticides/PCBs	1-Liter amber glass	10%	Cool to 4°C, Store in the dark	7 days to extraction (40 days after extraction)

**TABLE 4-2
SAMPLE PRESERVATION, BOTTLE REQUIREMENTS,
AND HOLDING TIMES FOR SOIL AND SEDIMENT SAMPLES**

Analyte	Bottle Requirement/Volume	Required Headspace	Preservative	Holding Time
TAL Metals	250-mL amber glass	10%	Cool to 4°C	6 months, except Mercury (28 days)
Cyanide	250-mL amber glass	10%	Cool to 4°C	14 days
TCL VOCs	60-mL amber glass	NA	Cool to 4°C	14 days
TCL SVOCs	250-mL amber glass	10%	Cool to 4°C	14 days
TCL Pesticides/PCBs	250-mL amber glass	10%	Cool to 4°C	14 days (140 days after extraction)

4.1.2.3 *Preservation of Solid Samples*

Procedures for chemical preservation of soil/sediment samples for VOC analysis are described below:

1. Secure the cap of the sample bottle.
2. Document sampling sequence to specifications, including recording the sample date, time, and sampler's initial on the sample bottle. Do not attach any additional labels or tape to the sample bottles.
3. Store the sample bottles at 4°C±2°C. No chemical preservatives are necessary for soil/sediment samples collected for non-VOC analyses.

4.2 *SAMPLE DOCUMENTATION*

Accountability for a sample begins when the sample is collected from its natural environment. A bound field logbook will be maintained to record the acquisition of each sample. COC records for all environmental samples and field QC samples, laboratory results, and any other data generated as a result of sampling activities at Sauer Dump Site will be maintained on file. Copies will be provided for review by regulatory agencies as requested. Sampling locations will be noted on site drawings which will become part of the permanent project records. Monitoring well locations will be surveyed. Other sampling locations will be noted with respect to and referenced to permanent landmarks or site features (e.g., surface water samples) or, where necessary, will be taped off from permanent or semi-permanent site features (e.g., soil borings). This section describes the sample documentation which will be used at Sauer Dump Site

4.2.1 Field Logbook

Information pertinent to the sampling effort and field activities will be conducted in accordance with SOP 12 in Appendix A. Information pertinent to the sampling effort will be recorded in a bound logbook. Each page will be consecutively numbered. Entries will be made in indelible ink, and corrections will consist of line-out deletions that are initialed and dated. The outside cover of the field logbook will contain the installation name and the project-specific sampling event (e.g., Phase I surface soil sampling). In addition, the mailing address and a point-of-contact will be written in the front inside cover of the logbook. At a minimum, entries in a field logbook will include the following:

- Time and date of sample collection;
- Field sample number;
- Detailed description of the sampling location;
- Identification of sampler;
- Type of sample (e.g., groundwater, surface water, etc.)
- Requested analytes;
- Sampling methodology, including distinction between grab and composite sample;
- Sample preservation;
- QC samples associated with this sample;
- Sample shipment (e.g., name of the laboratory and cartage agent, i.e., Federal Express, United Parcel Service, etc.); Field measurements (e.g., PID, pH); and names of personnel conducting the sampling.

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so the sampling activity can be reconstructed without relying on the collector's memory.

SOP 11 in Appendix A describes the procedures and personnel responsibilities associated with recording field data at the Sauer Dump Site.

4.2.2 Sample Labeling

Each sample will be assigned a unique sequential number at the time of sampling, which will be permanently affixed to the sample container with polyethylene tape to prevent the loss of the label during shipment. Figure-4 illustrates an example of a sample label. The sample label will be filled out using indelible ink and will include the following information:

- Project name;
- Sample location/site ID;
- Sampling date and time;
- Analyses to be performed;
- Preservative; and
- Sampler.

Labels are to be acquired from the off-site laboratory which have the sample ID numbers preprinted. In cases where pre-printed labels are not used, field personnel will be required to write the sample ID on the samples label. The sample ID will consist of the media type (e.g., SS for surface soil, GW for groundwater), and a sequential sample number. For example, SS-9 would be the sample ID for surface soil sample #9 collected at the Sauer Dump Site. A more detailed discussion of the sample numbering scheme is provided in the Sauer Dump Site Generic QAPP.

4.2.3 Field Parameter Form

In addition to a field logbook, field parameter forms (FPFs) will be used to record information pertinent to the sampling effort. FPFs consist of duplicate pages which are consecutively numbered.

Entries will be made in indelible ink and corrections will consist of line-out deletions that are initialed and dated. At a minimum, entries on the FPF will include the following:

- Installation/site and area;
- Installation code;
- File name;
- Site type;
- Site ID;
- Field sample number;
- Laboratory ID;
- Date/Time (military format);
- Depth of sample collected and units;
- Sampling method;
- Identity of associated QC samples;
- Field measurements and calibration reference;
- Requested analytes;
- Sample container/number of containers;
- Preservation information; and
- Referenced location of sampling site.

4.3 SAMPLE CHAIN-OF-CUSTODY

A sample is considered to be in a person's custody if the sample is:

- In a person's actual possession;
- In view after being in a person's possession; and
- Locked up so that no one can tamper with it after having been in physical custody.

Evidence of sample custody shall be traceable from the time the cleaned sample containers leave the laboratory until filled sample containers are transmitted back to the onsite or offsite laboratory. To achieve this condition, custody seals and COC documentation will accompany all sample containers.

4.3.1 Custody Seals

After the cooler has been properly secured (see Section 4.4.1), custody seals will be placed across the hinges of the cooler in two places to ensure the integrity of the samples during shipment to the offsite laboratory. Custody seals will be signed and dated prior to shipment of the samples.

4.3.2 Chain-of-Custody

A COC form is a triplicate form which will be created at the time of sample collection and will include samples collected for offsite and onsite analysis. All environmental samples will be kept at 4°-2°C from the time of sample collection until analysis. The COC form will contain the following information:

- 10-digit project number;
- Project name;
- Contractor Point of Contact (name and phone number);
- Names of the samplers;
- Field sample IDs;
- Date of sample collection;
- Sampling times (military format) for all samples;
- Whether the sample is "grab" or "composite";
- Matrix sampled (e.g., soil, water);
- Sample location;
- Analyses to be performed;
- Total number of containers per analysis;

- Preservation requirements for each analysis; and
- The carrier service, airbill number, and analytical laboratory .

Samples designated for onsite or offsite analysis will be released by the contractor's Sample Manager and the pink copy of the COC will be retained and added to the project documentation. Upon completion of the COC, any unused space below the last row will be crossed out with a diagonal line. The contractor's Sample Manager will then sign and date the COC prior to relinquishing the form to the laboratory. An example of a COC form is provided in **SOP 11 in Appendix A**. Samples designated for offsite analysis will be packaged and shipped according to the procedures provided in Section 4.4.

4.4 SAMPLE PACKAGING AND SHIPMENT

This section describes the procedures that will be used for sample packaging and shipment.

4.4.1 Sample Packaging

Samples will be transferred to the offsite laboratory for analysis via waterproof plastic coolers. Before samples can be put in the cooler, any drains will be sealed with tape to prevent leaking. Each cooler will be packed in the following manner:

1. Ensure sample lids are tight.
2. Enclose each sample, properly identified and with a sealed lid, in a clear ziploc bag, and make sure that sample labels are visible.
3. Place about 3 inches of inert cushioning material (e.g., bubble wrap) in the bottom of the cooler.
4. Place all the samples inside a garbage bag and tie the bag.

5. Double bag and seal loose ice to prevent melting ice from soaking the packing material.
6. Place the ice outside the garbage bags containing the samples. Place sufficient ice in cooler to maintain the internal temperature at $4^{\circ}\pm 2^{\circ}\text{C}$ during transport.
7. Fill cooler with enough absorbent and packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped.
8. Any samples suspected to be of medium/high concentration or containing dioxin must be enclosed in a metal can with a clipped or sealable lid (e.g., paint cans). The samples should be cushioned inside the can with sufficient noncombustible, absorbent material (e.g., vermiculite) to prevent breakage and absorb leakage. Label the outer metal container with the sample number of the sample inside.
9. Enclose all sample documentation (i.e., FPFs, COCs) in a waterproof plastic bag and tape the bag to the underside of the cooler lid. If more than one cooler is being used, place all documentation in one cooler. Number the coolers and note on the sample documentation the cooler number in which each sample was shipped.
10. Tape the cooler shut with clear tape over the hinges and place tape over the cooler drain.
11. Seal coolers at a minimum of two locations with signed custody seals.
12. Attach completed shipping label to the top of the cooler.

4.4.2 Sample Shipment

Sample coolers will be shipped to arrive at the laboratory the morning after sampling (priority overnight) or will be sent by a courier to arrive the same day. The laboratory will be notified of the sample shipment and the estimated date of arrival of the samples being delivered.

4.5 *SAMPLE RECEIPT*

Samples delivered to the offsite analytical laboratory will be accepted by the laboratory technician. Samples can be accepted Monday through Friday. Special arrangements will be required if Saturday delivery is necessitated. COC for laboratory receipt will be established in the following manner:

1. The carrier and the time of arrival are documented in the daily receipt log. The number of items on the COC is checked with the actual number received to ensure that all samples arrived.
2. Notation is made as to whether the shipping container (cooler) was sealed with custody seals.
3. The cooler is opened, and the condition of the cooler is recorded on the Laboratory Cooler Receipt Form. The internal ambient temperature of the cooler is taken, and the samples are itemized. Deviations from the COCs or the RAP, if any, will be noted and reported to the laboratory QA Coordinator.
4. Lot numbers will be assigned to the samples. Reference to field numbers will be documented in the appropriate logbook. All data are entered into the computer tracking system, with analyses required by holding-time specified dates. Once the sample has been transmitted to the offsite laboratory, the following sequence of events will occur:

- The samples are recorded on the Sample Log-In Form to summarize all the information pertaining to the sample/order to instruct the laboratory on the proper analysis and reporting of samples.
- After the samples are logged in, they are assigned to the appropriate locked storage refrigerator.
- All transfers of samples into and out of storage are documented through internal laboratory COC.
- Samples remain in secured storage until removed for sample preparation or analysis.
- A refrigeration log must be generated by laboratory personnel to ensure refrigerators/freezers are operating at the appropriate temperature. The log must indicate the ambient internal temperature as well as the initials of the person recording the reading and the date. Should the temperature fluctuate outside of the specified holding time temperature range, corrective action must be taken immediately.

4.6 ANALYTICAL PROGRAM

In developing the general chemical analytical program at Sauer Dump Site, the following basic elements were considered:

- Identification of target compounds and associated degradation products with respect to historic operations, chemical usage, and the results of previous investigations.

USEPA SW-846 methods will be used for the chemical analysis of samples collected at Sauer Dump Site (see Table 4-3).

**TABLE 4-3
ANALYTICAL METHODS**

Parameter	USEPA SW846 Method Number
Inorganics	3010A/3050B/6010B/6020/7000
Mercury	7470A/7471A
VOCs	5030B/5035/8260B
SVOCs	3520C/3550C/8270C
Pesticides/PCBs	3520C/3550C/8081A/8082
Cyanide	9010B/9011/9012A
TCLP Metals	1311/3010A/6010B/7470A

Procedures within the following documents have been referenced:

- USEPA, *Test Methods for Evaluating Solid Waste* (SW-846 Methods, including Update III revisions) for TCL VOCs, SVOCs, pesticides/PCBs, TAL metals, cyanide, TVPH, TEPH, explosives;
- ASTM, Standard Method for the Particle-Size Analysis of Soils for Grain Size;
- USEPA, N-Hexane Extractable Material (HEM) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM) by Extraction and Gravimetry (Oil and Grease and Total Petroleum Hydrocarbons), EPA 821-B-94-004, October 1994.

Methods, specific analytes and respective quantitation limits, are provided in the Sauer Dump Site Generic QAPP.

5.0 REFERENCES

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Maryland Geological Survey, 1968. Geologic Map of Maryland. Scale 1:250,000.

Puls, Robert W., Robert M Powell, Bert Bledsoe, Don A. Clark, and Cynthia J. Paul., 1992. Metals in Groundwater: Sampling Artifacts and Reproducibility. *Hazardous Waste and Hazardous Materials*. Volume 9, No. 2.

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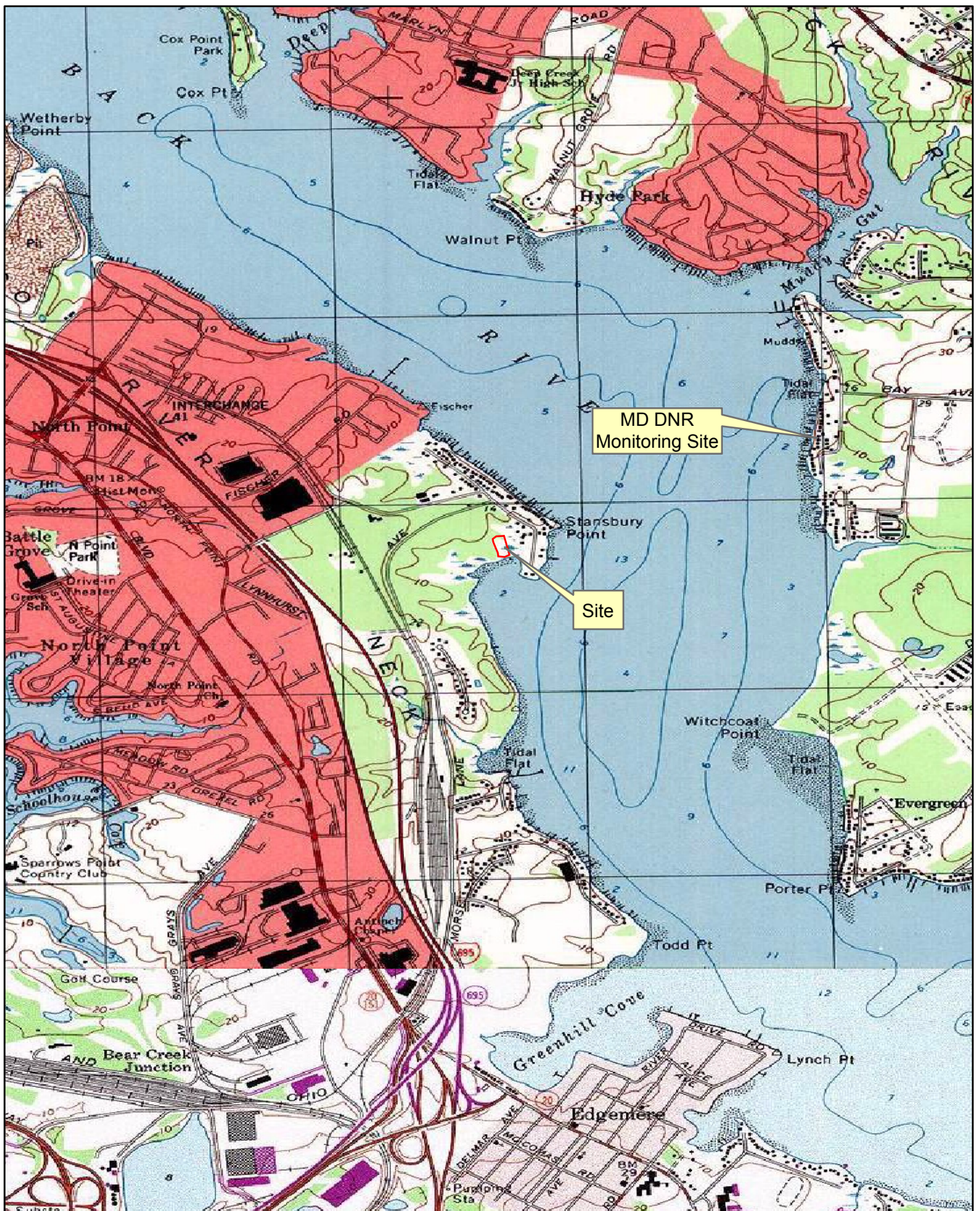
Wiedemeier, T.H., Swanson, M.A., Moutoux, D.E., and Gordon, E.K., 1996. Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater. For: Air Force Center for Environmental Excellence (AFCEE), Technology Transfer Division, Brooks Air Force Base, San Antonio, TX.

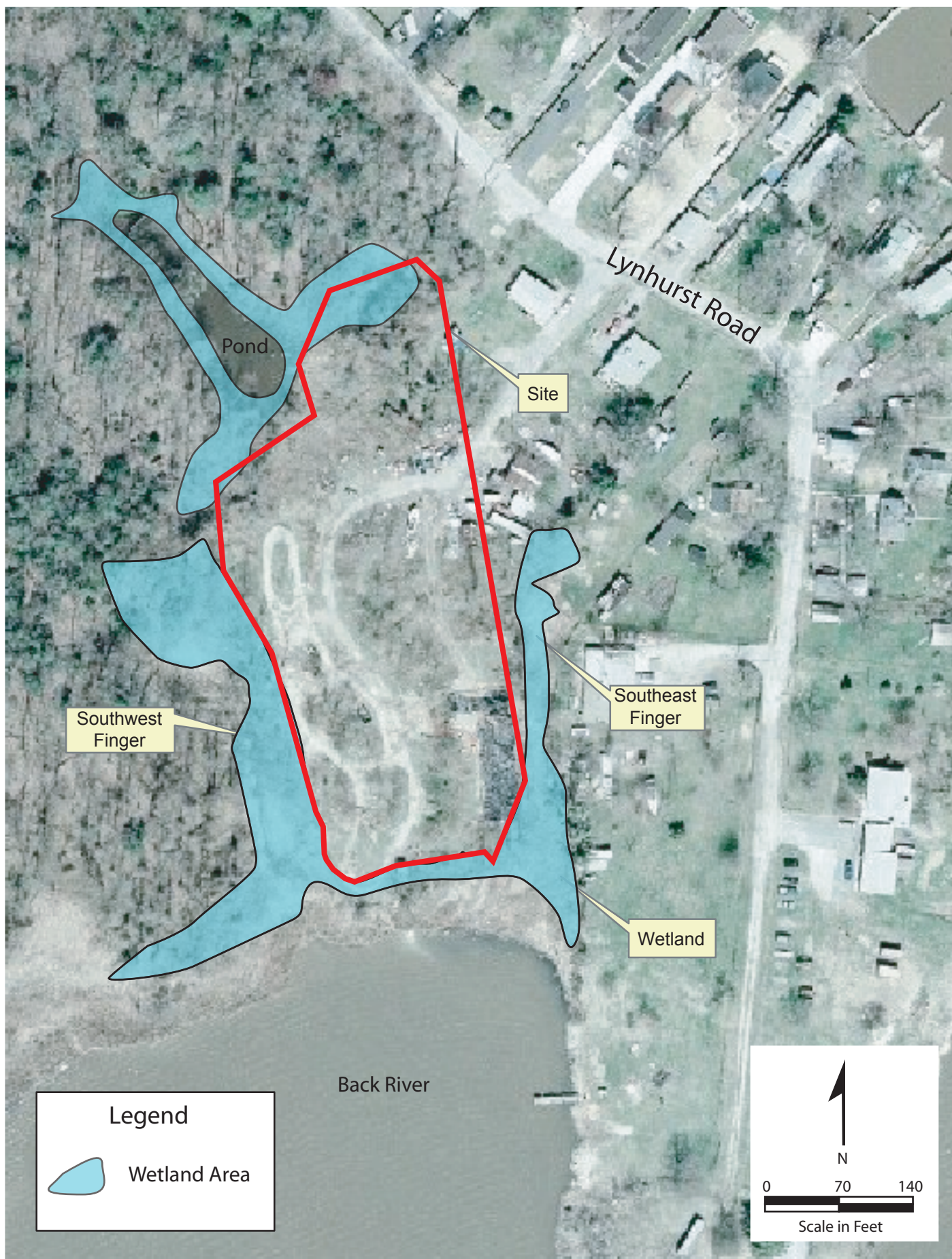
FIELD SAMPLING PLAN FIGURES

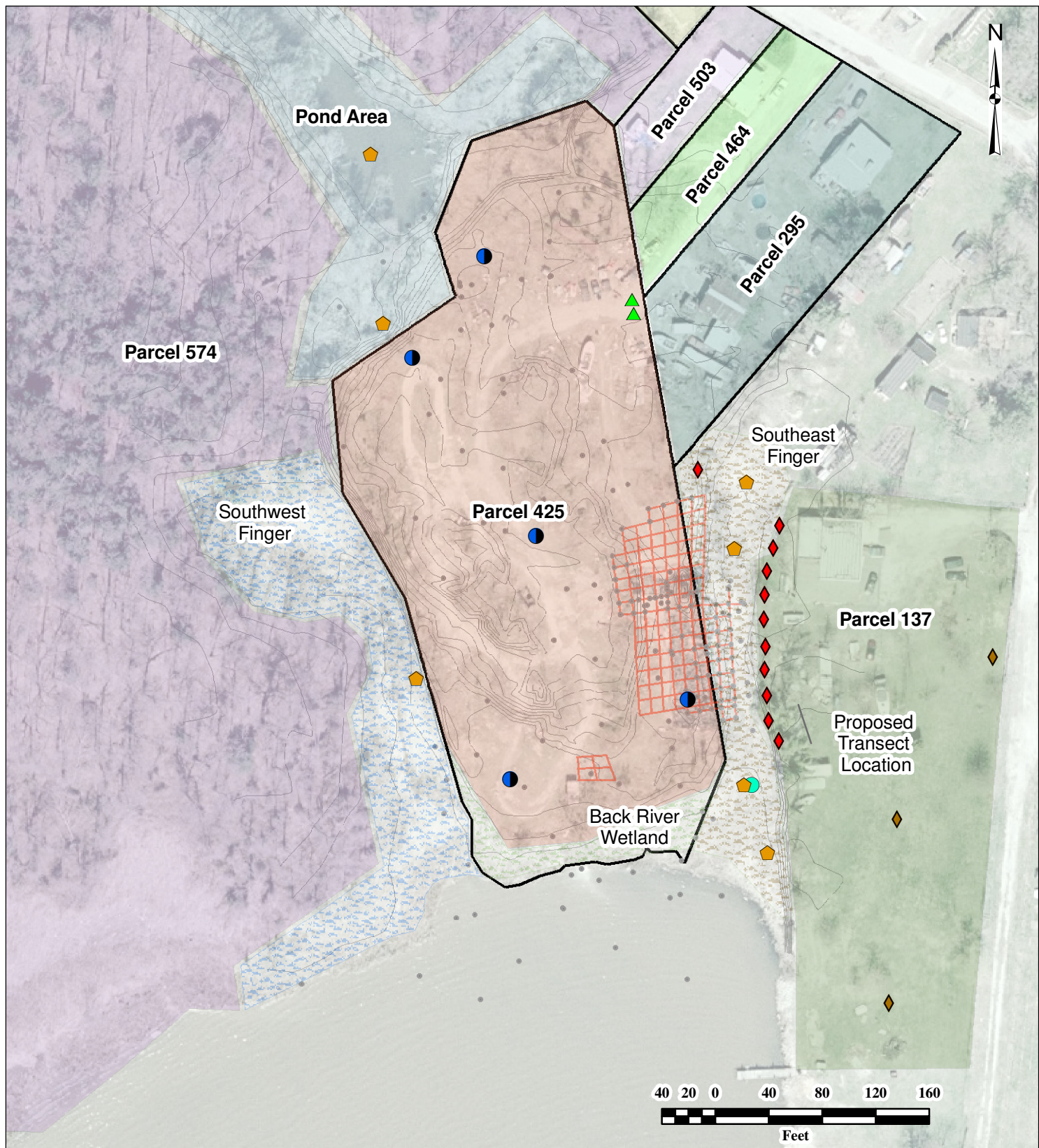
FIELD SAMPLING PLAN

Appendix A

Standard Operating Practices







LEGEND

- | | |
|--|---|
| ● Groundwater | ◆ Background Soil (Surface and Subsurface) |
| ⬠ Sediment | ◆ Soil (Surface and Subsurface) |
| ● Surface Water | ▲ Soil Surface |
| | • Previous Sample Locations |

Airphoto Source: Baltimore County

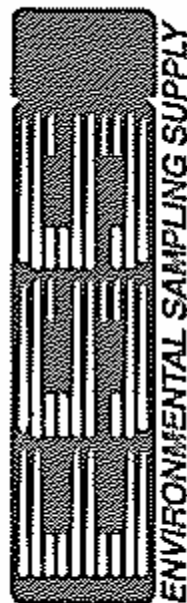
**MALCOLM
PIRNIE**

3101 Wilson Blvd.
Suite 550
Arlington, VA 22201

Proposed Samples
Response Action Plan
Sauer Dump

October 2006

Figure D3



LOT#

0104701Q

SAMPLE ID

SAMPLED BY

DATE

TIME

LOCATION

PRESERVATIVE

ANALYSIS

CLIENT

Oakland, CA • Houston, TX • Chicago, IL • Richmond, VA
(510) 562-4988 www.eessvlal.com (800) 233-8425

**MALCOLM
PIRNIE**

MALCOLM PIRNIE, INC
630 Freedom Business Center, STE 203
King of Prussia, PA

Example Sample Label

Sauer Dump

Figure D4

STANDARD OPERATING PROCEDURE 1 RECONNAISSANCE SURVEY

1.0 Scope and Application

This Standard Operating Procedure (SOP) provides a description of technical management guidance on the performance of reconnaissance surveys. Reconnaissance surveys are used to identify potential health and safety threats and prospective sampling locations for further evaluation during subsequent field activities.

The level of detail of the survey must be sufficient to identify appropriate sampling locations for all potentially affected media. The survey will also locate potential physical hazards (e.g., sumps, drywells, USTs), establish site exclusion zones, locations for personnel and heavy equipment decontamination, and identify any other site conditions significant to the safe and efficient conduct of site work.

Use of this SOP will provide Level I data for the implementation of risk assessments and site characterizations.

2.0 Materials

- a. Photoionization Detector (PID)
- b. Flame Ionization Detector (FID)
- c. Camera with rolls of film
- d. Site maps
- e. Log books
- f. Personal protective equipment.

3.0 Procedure

3.1 Planning

3.1.1 Planning for a reconnaissance survey begins with the collection and review of pertinent, available site data. The following types of information should be sought by the project personnel:

- The current status of the site (i.e., active or inactive).

- The location of any nearby or onsite potable or monitoring wells for sampling purposes.
- The topography, geology, and hydrogeology of the site.
- Accessibility to potential sampling locations.
- Records of past spills or leakage/environmental incidents.
- Previous sampling and analytical data.
- Previous manufacturing operations or records of historical activities.
- Migration/dispersal and toxicological characteristics of suspected site contaminants.
- Proximity to potentially affected populations or sensitive environments.
- Presence of site utilities (e.g., sanitary sewer, storm sewer).
- Presence of USTs, aboveground storage tanks (ASTs), dry wells, pad-mounted transformers, septic tanks, and drain fields.
- Presence of nearby surface water bodies.
- Potential for exposure to vapor contaminants.

3.1.2 If sufficient background information is available, a site sketch should be made showing the locations of pertinent features at and near the site. The sketch should include the access routes, waste disposal areas, major surface water features, well locations, drainage patterns, nearby roads and residents, and proposed sampling locations. If site information is limited, a site sketch should be completed in the field prior to other activities.

3.2 Field Observations

3.2.1 It is important that all field personnel continually observe and analyze conditions at the site that may provide clues to the types of wastes present, the extent of contamination, and associated problems. All site observations should be documented for later use in evaluation of the analytical and field

measurements of data. The following observations should be made at each site:

- The color, texture, size, and frequencies of soil stains.
- Appearance of water bodies, including color, turbidity, and the presence or absence of oil sheens.
- Presence of organic vapors or odors, including any readings from the field monitoring equipment (e.g., PID, FID).
- Erosion at site, routes of contaminated runoff, appearance and condition of landfill face, exposure of buried drummed waste, and all other conditions at the site that may help to later determine the extent of migration of hazardous wastes present.
- Location of USTs, ASTs, dry wells, septic tanks, drain fields, pad-mounted transformers, and pipe discharge points.

3.2.2 Photographs of major features at the site are an effective method of documentation, and therefore, an extensive photographic record should be maintained for each site.

4.0 Maintenance

Not Applicable.

5.0 Precautions

5.1 Refer to the Facility-Wide Health and Safety Plan for appropriate health and safety precautions.

6.0 References

FT 2.02. Reconnaissance Survey.

USEPA, 1987. A Compendium of Superfund Field Operations Methods. EPA/540/P-87/001, (OSWER Directive 9355.0-14), December 1987.

U.S. Army Corps of Engineers manual, EM 200-1-3 (f February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans."

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 2

PROCEDURE FOR SHALLOW AND DEEP SUBSURFACE SOIL SAMPLING

This document contains general Standard Operating Procedures which may need to be modified to suit individual project needs.

I. Introduction

This guideline is to provide information on soil sampling to be conducted at the [Site].

II. Definitions

Soil Samples. Environmental samples of potentially contaminated soil, where soil is defined as a layer of weathered, unconsolidated material; often defined as containing organic matter and being capable of supporting plant growth.

Grab Sample. A discrete soil sample representative of a specific location at a given point in time.

Transfer Device. Any instrument or vessel that contacts the sample during collection or transport (e.g., stainless steel trowel).

Auger. An auger consists of a T-handle attached to a stainless steel bucket (which generally has a 3-to 4-inch diameter) with an attached cutting edge that is twisted downward into the soil. The stainless steel bucket allows for collection of subsurface soils during augering.

III. Equipment

1. Ludlum model 44-10 2" x 2" NaI gamma scintillation detector
2. Ludlum model 44-9 GM Pancake detector
3. Ludlum model 12 ratemeter
4. Ludlum Model 43-5 zinc sulfide (ZnS(Ag)) detector
5. Ludlum Model 2221 scaler/ratemeter or Ludlum Model 2350 data logger
6. GM Pancake Detector
7. JMC Environmentalist's Subsoil Probe (ESP), or equivalent
8. 5-gram En Core[®] samplers

9. En Core[®] T-handle
10. Laptop computer
11. Digital camera
12. Global positioning system (GPS)
13. Stainless steel augers
14. T-handle and drill rods
15. Stainless steel bowls
16. Stainless steel trowels, scoops, and spatulas
17. Geoprobe Rig or equivalent
18. Tripod Rig or equivalent
19. Geoprobe Large Bore Soil Sampler
20. Standard Geoprobe Acetate Liners
21. Disposable gloves
22. Plastic zip-lock bags
23. Plastic garbage bags
24. Measuring tapes
25. Polyethylene sheeting
26. Aluminum foil
27. MiniRAE 10.6 eV photoionization detector (PID)
28. 8-oz glass sample jars
29. Topsoil or potting soil
30. Paper towels
31. Sample coolers
32. Ice

IV. Guidelines

Soil types at a hazardous waste site can vary considerably, both at the site surface and in the underlying strata. Soil variations affect the rate of contaminant migration via surface runoff and windblown transport of particulates, and affect the rate of contaminant migration downward through the soil. Sampling of the soil horizons above the ground water table can detect contaminants before they have migrated into the water table, and can help to quantify the amount of contaminants sorbed within the aquifer that have the potential to contribute to ground water contamination.

Most of the methods employed for soil sampling at hazardous waste sites are adaptations of techniques long employed by foundation engineers and geologists. For this site, the shallow subsurface soil samples will be collected using hand augers. Subsurface soil samples will either be collected with a Geoprobe 54LT rig, the JMC ESP, or equivalent.

SAMPLING PROTOCOL

1. Special Precautions for Sampling:

The following general precautions should be taken when sampling:

- A. Prior to entering the property, confirm with the person present (owner, tenant, landlord, etc.) that access to the property was granted.
- B. A clean pair of new, disposable gloves will be worn each time a different location is sampled and each time a new interval is sampled within the same auger hole. Gloves will be donned immediately prior to sampling.
- C. Sample containers for source samples or samples suspected of containing high concentrations of contaminants will be placed in separate plastic bags immediately after collection and decontamination of the outside of the container.
- D. All field personnel and field instruments will be "frisked out" with a ZnS(Ag) detector prior to leaving the sampling location. If radiological contamination is detected on field personnel and/or field instruments decontamination procedures will be followed.
- E. All used field equipment (trowel, bowls, etc.) to be decontaminated will be placed in plastic bags. All field waste (i.e., PPE, plastic sheeting, towels, etc.) to be disposed of will be placed in another plastic bag.
- F. If possible, one member of the field team will enter all field activity information into the field laptop, while the other member(s) collects all of the samples. All field activities will be documented.

- G. Sample collection activities will proceed progressively from the suspected least contaminated area to the suspected most contaminated area.
- H. Field personnel will use equipment constructed of stainless steel or carbon steel that has been properly decontaminated. The decontamination procedures will be followed.
- I. Quality control/quality assurance (QA/QC) samples will be collected according to QA/QC SOP.
- J. The chain of custody procedures described in COC SOP will be followed.
- K. The sample management procedures described in SOP will be followed.

2. Sample Collection:

Procedure for Shallow Subsurface Soil Sampling Using A Hand Auger

Hand augers are ideal for collecting shallow subsurface soils in cohesive soils such as silts and clays. In cohesive soils, a hand auger can be used to collect samples generally up to a depth of 4 ft. However, in rocky soils auger refusal is experienced almost immediately, as small stones will block and jam the cutting edge on the auger bucket. Procedures for use of the hand auger are as follows:

A. Chemical Samples

1. Prior to sample collection, record the soil sample location in the field laptop. Upload the surveyed map from the GIS/Database and mark the location on the map. Use a Global Positioning System (GPS) to locate the sample. If the GPS will not work on the property (e.g., too many overhead barriers), establish the location using a measuring tape. Take a picture of the sample location.
2. Record the field personnel and weather conditions in the laptop.

3. Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
4. Attach a decontaminated auger to a drill rod extension. Attach the "T" handle to the drill rod.
5. Clear the area to be sampled; remove surface vegetation, debris, or large stones prior to augering.
6. Begin augering. After augering down six inches, carefully withdraw the auger from the borehole. Collect the volatile organic (VOA) sample directly from the auger using the En Core[®] Sampler. Refer to page 7 of this SOP for the procedure on using the En Core[®] Sampler.
7. Place the auger over a decontaminated stainless steel bowl, and remove the remaining soil from the auger by lightly tapping the side of the auger with a stainless steel trowel.
8. Scan the soil in the bowl with the GM pancake detector and record the reading in the laptop. Cover the bowl with aluminum foil, making sure that there are no gaps.
9. Label the bowls (i.e., 0-6 in, 6-12 in, etc.) or keep them in sequential order on the plastic sheeting.
10. Replace the used auger with a decontaminated one and continue augering at six-inch intervals following steps 6, 7, 8, and 9 until the desired sampling depth (four feet) is reached or auger refusal is encountered. At this time there should be eight stainless steel bowls that contain respective soil samples from each of the six-inch sampling intervals.
11. Allow each bowl to off-gas for approximately 30 minutes, poke the PID probe through the foil, measure the VOA concentration in the headspace, and record each reading.
12. The sample will be collected from the interval with the highest PID reading. If all intervals have non-detect (or background) readings, the sample will be collected from the interval that exhibits evidence

of contamination (staining, unusual color, odor, or any other visible sign of potential chemical contamination). Record this characteristic(s) in the laptop. If none of the intervals exhibit evidence of contamination, the sample will be collected from the 6 to 12 inch interval.

13. Once the sampling interval has been determined, homogenize the soil (refer to page 11 of this SOP) in the bowl using a stainless steel trowel or scoop. Record the soil type and color in the laptop. The samples will be collected in the following order: semi-volatiles (BNAs)/pesticides/polychlorinated biphenyls (PCBs) and metals/cyanide (CN). The BNA/ pesticide/PCB sample will be collected into one 8-oz. glass jar and the metals/CN sample will be collected into another 8-oz. glass jar. Take a picture of sample collection activities.
14. Properly discard the volatile samples from the intervals not sampled.
15. Record the following information in the laptop: a) sample identification number; b) method of sample collection; c) date and time of sample collection; d) type of analyses; e) whether this is a QC sample (e.g., matrix spike, field duplicate, split sample); and f) field rinsates associated with this sample.
16. Decontaminate the exterior of all sample containers. Place all chemical samples in ziplock bags and place them on ice, or immediately submit the samples to the sample management officer.
17. Restore the void created by sample collection prior to leaving the sampling location. Use the soil from the intervals not sampled. Place the soil from the intervals back into the hole in order from the deepest interval to the shallowest interval. If necessary, commercially available potting soil or topsoil can be used to fill the void. Ensure that the area has been cleaned, and all sampling material has been removed.
18. When leaving the sample location, frisk all equipment and personnel with the ZnS(Ag) detector.

B. Radiological Samples

1. Prior to sample collection, record the soil sample location(s) in the field laptop. Upload the surveyed map from the GIS/Database and mark the location(s) on the map. Use a Global Positioning System (GPS) to locate the sample. If the GPS will not work on the property (e.g., too many overhead barriers), establish the location using a measuring tape. Take a picture of the sample location.
2. Review the adjacent downhole gamma logging boring information. Determine whether or not the gamma readings drop significantly (i.e., they are approaching background). If so, determine the depth where the drop occurs. Soil samples do not need to be collected from a property if all of the downhole logging results are $< 2 \times \text{UCL}$.
3. Record the field personnel and weather conditions in the laptop.
4. Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
5. Attach a decontaminated auger to a drill rod extension. Attach the "T" handle to the drill rod. For the radiological samples, only 2-inch diameter augers will be used.
6. Clear the area to be sampled; remove surface vegetation, debris, or large stones prior to augering.
7. Begin augering. After augering down six inches, carefully withdraw the auger from the borehole, place the auger over a decontaminated stainless steel bowl, and remove the soil from the auger by lightly tapping the side of the auger with a stainless steel trowel.
8. Label the bowls (i.e., 0-6 in, 6-12 in, etc.) or keep them in sequential order on the plastic sheeting.
9. Replace the used auger with a decontaminated one and continue augering at six-inch intervals following steps 6, 7, and 8 until the depth where the gamma readings in the adjacent downhole gamma

logging boring dropped significantly. If the readings do not drop significantly continue augering until a depth of four feet has been reached or auger refusal is encountered.

10. Homogenize the soil in each bowl using the procedure described on page 11 of this SOP. Scan the homogenized soil in each bowl with the GM pancake detector and record the reading in the laptop.
11. The sample will be collected from the interval that displays the highest screening level of gross radioactivity $\geq 2x$ UCL. Transfer the homogenized fraction into the appropriate sample container(s) using the same stainless steel trowel or scoop used throughout this entire procedure. The amount of soil required will be determined by the contract laboratory; however, one 8-oz. jar is usually sufficient. Record the soil type and color in the laptop. Take a photograph of the sample collection activities.
12. Record the following information in the laptop: a) sample identification number; b) method of sample collection; c) date and time of sample collection; d) type of analyses; e) whether this is a QC sample (e.g., matrix spike, field duplicate, split sample); and f) field rinsates associated with this sample.
13. Decontaminate the exterior of all sample containers.
14. Restore the void created by sample collection prior to leaving the sampling location. Use the soil from the intervals not sampled. Place the soil from the intervals back into the hole in order from the deepest interval to the shallowest interval. If necessary, commercially available potting soil or topsoil can be used to fill the void. Ensure that the area has been cleaned, and all sampling material has been removed.
15. When leaving the sample location, frisk all equipment and personnel with the ZnS(Ag) detector. If contamination is found, refer to SOP #.

Procedure for Subsurface Soil Sampling Using A Geoprobe 54LT rig, or equivalent

1. Prior to sample collection, record the soil sample location(s) in the field laptop. Upload the surveyed map from the GIS/Database and mark the location(s) on the map. Take a picture of the sample location.
2. Record the field personnel and weather conditions in the laptop.
3. Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
4. Clear the area to be sampled; remove surface vegetation, debris, or large stones prior to sampling.

Using all proper procedures the driller will complete steps 5 through 13

5. Place a 8' x 4' sheet of plywood adjacent to proposed sampling location. Maneuver Geoprobe 54LT rig on top of plywood sheeting.
6. Attach Large Bore Soil Sampler (Drive head, Piston Rod/Stop-Pin, decontaminated Sampler Tube with enclosed acetate sample liner, decontaminated Cutting shoe, and decontaminated Piston Tip) to the Geoprobe 54LT rig to form the Geoprobe drive assembly.
7. Place the Geoprobe drive assembly into a vertical position over the sample location.
8. For the initial sample section (i.e., 0-4 feet), remove the Piston Stop Pin and drive the Cutting Shoe to a depth of 4 feet below ground surface (bgs). Retract the Geoprobe drive assembly to the surface.
9. Remove the filled standard acetate sample liner from the Large Bore Soil Sampler and place the liner on dedicated polyethylene sheeting.

10. Re-assemble Large Bore Soil Sampler and position Geoprobe drive assembly into a vertical position above the sampling location. Drive the Large Bore Soil Sampler to a depth 4 feet bgs. Remove the Piston Stop Pin. Drive the Cutting Shoe 4 feet, from a depth of 4 to 8 feet bgs. Retract the Geoprobe drive assembly to the surface
11. Remove the filled standard acetate sample liner from the Large Bore Soil Sampler and place the liner on dedicated polyethylene sheeting
12. To collect additional samples from 8 to 20 feet, repeat steps 10 and 11 for sequential depth sections of 8 to 12, 12 to 16, and 16 to 20 feet, respectively.
13. After a depth of 20 feet has been reached or refusal is encountered, remove Geoprobe drive assembly and insert temporary PVC casing into borehole.
14. Perform downhole gamma logging of borehole according to procedures presented in SOP #. After review of downhole gamma logging results, the proposed sampling location will be identified. The four-foot section that bridges the highest subsurface downhole gamma activity level, that also exceeds action criteria, will be selected for sampling.
15. For the four-foot section identified, divide the contents into foot long sub-sections. Place the contents of each sub-section in a decontaminated stainless steel bowl and place the bowls in sequential order on the plastic sheeting.
16. Homogenize the soil in each bowl using the procedure described on page 11 of this SOP. Scan the homogenized soil in each bowl with the GM pancake detector and record the reading in the laptop.
17. The sample will be collected from the interval that displays the highest screening level of gross radioactivity. If all intervals have background readings, the sample will be collected from the interval that spans the highest downhole gamma logging measurement. Transfer the homogenized fraction into the appropriate sample

container(s) using the same stainless steel trowel or scoop used throughout this entire procedure. The amount of soil required will be determined by the contract laboratory; however, one 8-oz. jar is usually sufficient. Log the soil core using Unified Soil Classification System Procedures. Take a photograph of the sample collection activities.

18. If the downhole gamma readings show a count of 1200 cts/30 seconds or higher, an additional sample must be collected for Ecology and Environmental (E & E). The sample will be taken from the level directly below the deepest interval of 1200+ cts/30 seconds and will be archived for possible future analysis.
19. Record the following information in the laptop: a) sample identification number; b) method of sample collection; c) date and time of sample collection; d) type of analyses; e) whether this is a QC sample (e.g., matrix spike, field duplicate, split sample); and f) field rinsates associated with this sample. If an E & E sample is collected, the following should be recorded in the comments section: "Archive sample collected from X feet."
20. Decontaminate the exterior of all sample containers.
21. From each four-foot section/liner collect an archive soil sample will be collected from the most predominant soil type present in the four-foot interval. In an indelible marker, record the Borehole Number, depth of archive sample, date and time of collection on the archive sample bottle. Log the soil core using Unified Soil Classification System Procedures. The archive logging will be recorded in the comments fields within the field application program.
22. The driller will restore the void created by sample collection prior to leaving the sampling location. Bentonite pellets or fine sand will be used to fill the boring from a depth of 2 feet to 20 feet bgs. The top 2 feet of the boring will be filled with commercially available potting soil or topsoil. Ensure that the area has been cleaned, and all sampling material has been removed.

23. When leaving the sample location, frisk all equipment and personnel with the ZnS(Ag) detector. If contamination is found, refer to SOP #.

Procedure for Shallow Subsurface Soil Sampling Using A JMC ESP, or equivalent

1. Prior to sample collection, record the soil sample location(s) in the field laptop. Upload the surveyed map from the GIS/Database and mark the location(s) on the map. Take a picture of the sample location.
2. Record the field personnel and weather conditions in the laptop.
3. Place plastic sheeting on the ground around the sampling location to prevent cross-contamination.
4. Clear the area to be sampled; remove surface vegetation, debris, or large stones prior to sampling.
5. Take the JMC ESP and insert the liner into the top of the sampling tube.
6. Take the hammer assembly and insert the aluminum cylinder section of the guide rod into the top of the sampling tube, ensuring that the end of the hammer is in contact with the threaded collar adjacent to the aluminum cylinder. Place the flipper into the drive mode.
7. Place the ESP and hammer assembly into a vertical position over the sample location, ensuring that the flipper remains in the drive mode.
8. Raise the hammer approximately 12 to 18 inches and drive the hammer against the top of the sampling tube. Continue driving the sampling tube into the ground until the rubber bumper of the stop ring around the hammer comes in contact with the top of the ESP assembly. Note: if an obstruction is encountered, the tube will not move when the hammer assembly is dropped. If an obstruction is encountered, stop driving the sampling tube into the ground. If the

required sample depth has not been reached, move the sample location, decontaminate the sampling equipment, replace the liner, and repeat steps 5 through 8.

9. Once the stop ring comes in contact with the top of the ESP, depress the foot pedal and swing the flipper out of the way. Lift the black plastic handle and push the jack lever away from the ESP until the lever is approximately at a 45° angle from the ESP.
10. Keeping one foot on the ground, step on the jack lever, shift your weight from the foot on the jack lever to the foot on the ground, then press down on the handgrips. Repeat this procedure until the bottom of the hammer is visible. Remove the hammer assembly and continue jacking until the sampling tube is out of the ground.
11. Place the ESP horizontally and insert the dowel into the cutting end of the sampling tube in order to push out the soil core and liner.
12. To collect additional samples, repeat steps 5 through 11.
13. If an extension is needed, slide the lower portion of the master extension assembly into the upper end of the sampling tube and secure with a stainless steel pin. If additional extensions are required, remove the upper pin that connects the master extension with the aluminum adapter. Slide the female end of a regular extension over the exposed end of the aluminum adapter and secure with a stainless steel pin. Attach the master extension to the regular extension with a stainless steel pin.
14. Place the contents of each liner in a decontaminated stainless steel bowl and place the bowls in sequential order on the plastic sheeting.
15. Homogenize the soil in each bowl using the procedure described on page 11 of this SOP. Scan the homogenized soil in each bowl with the GM pancake detector and record the reading in the laptop.
16. The sample will be collected from the interval that displays the highest screening level of gross radioactivity. If all intervals have background readings, the sample will be collected from the interval

that spans the highest downhole gamma logging measurement. Transfer the homogenized fraction into the appropriate sample container(s) using the same stainless steel trowel or scoop used throughout this entire procedure. The amount of soil required will be determined by the contract laboratory; however, one 8-oz. jar is usually sufficient. Record the soil type and color in the laptop. Take a photograph of the sample collection activities.

17. Record the following information in the laptop: a) sample identification number; b) method of sample collection; c) date and time of sample collection; d) type of analyses; e) whether this is a QC sample (e.g., matrix spike, field duplicate, split sample); and f) field rinsates associated with this sample.
18. Decontaminate the exterior of all sample containers.
19. Restore the void created by sample collection prior to leaving the sampling location. Use the soil from the intervals not sampled. Place the soil from the intervals back into the hole in order from the deepest interval to the shallowest interval. If necessary, commercially available potting soil or topsoil can be used to fill the void. Ensure that the area has been cleaned, and all sampling material has been removed.
20. When leaving the sample location, frisk all equipment and personnel with the ZnS(Ag) detector. If contamination is found, refer to SOP number.

VOA Sample Collection Using the En Core® Sampler

1. Remove a 5-gram sampler and cap from package and position plunger rod so that the plunger can be moved freely from the top to the bottom of the coring/storage chamber. This is accomplished by pushing the plunger rod down until the small O-ring rests against the tabs. Note: The En Core® sampler is a single-use device.
2. Attach the T-handle to the sampler body by depressing the locking lever on the T-handle, placing the coring body (plunger end first) into the open end of the T-handle, aligning the slots on the coring body with the locking pins in the T-handle, and twisting the coring

body clockwise to lock pins in slots. The plunger should be positioned so that the bottom of the plunger is flush with the bottom of the coring body/storage chamber.

3. Using the T-handle, push the En Core[®] sampler into the soil in the stainless steel bowl until the coring body/storage chamber is completely full.
4. Verify that the coring/storage chamber is full by looking into the 5 gram viewing hole in the T-handle. The coring body/storage chamber is completely full if the small O-ring on the plunger rod is centered in the T-handle viewing hole.
5. Scrape a decontaminated spatula across the bottom of the coring body/storage chamber so the surface of the soil in the sampler is flush with the opening of the coring body/storage chamber.
6. Quickly wipe the external surface of the coring body/storage chamber with a clean paper towel.
7. After ensuring that the sealing surfaces are clean, cap the coring body/storage chamber while it is still on the T-handle. This is done by gently sliding the cap onto the coring body/storage chamber with a twisting motion.
8. Remove the T-handle from the sampler and lock the plunger into position by rotating the plunger rod.
9. Fill out sample label and attach to the cap of the En Core[®] sampler.
10. Place sampler in the protective moisture-proof zip-lock bag it came in.
11. Fill out sample information on bag and store bag on ice.
12. Repeat the above procedure using one more sampler. A total of two En Core[®] samplers will be collected per six-inch sampling interval.

Homogenization Procedure for the Collection of Non-VOA Soil Samples

1. Thoroughly mix the sample using the same stainless steel trowel or scoop, used during the sample collection. The soil in the bowl should be scraped from the sides, corner and bottom, rolled to the middle of the bowl and initially mixed.
2. The sample should be quartered and separated.
3. Each quarter should be mixed individually and then rolled to the center of the bowl.
4. Mix the entire sample again.

3. Sample Preservation:

Methods of sample preservation are relatively limited and are generally intended to retard biological action, and hydrolysis, and to reduce sorption effects. Preservation methods for soil samples are generally limited to no headspace in sample container (VOA samples only), refrigeration, and/or protection from light. Sample preservation procedures as outlined in the SOP for Sample Preservation will be followed.

V. References

ASTM D1452. Standard Practice Method for Soil Investigation and Sampling by Auger Borings. American Society for Testing and Materials, Philadelphia, Pennsylvania. June 12, 1980.

ASTM D1586. Standard Method for Penetration Test and Split-barrel Sampling of Soils. American Society for Testing and Materials, Philadelphia, Pennsylvania. September 11, 1984.

ASTM D6418. Standard Practice for Using the Disposable En Core® Sampler for Sampling and Storing Soil for Volatile Organic Analysis. American Society for Testing and Materials, West Conshohocken, Pennsylvania. June 10, 1999.

ASTM D4547. Standard Guide for Sampling Waste and Soils for Volatile Organic Compounds. American Society for Testing and Materials, West Conshohocken, Pennsylvania. September 10, 1998.

EPA, 1984 Characterization of Hazardous Waste Sites -- A Methods Manual, Volume 11, Available Sampling Methods, Second edition, Section 2.2, Soils, pp. 2-2 to 2-3. Section 2.2.1, Method II-1: Soil Sampling with a Spade and Scoop, p. 2-4. Section 2.2.2, Method II-2: Subsurface Solid Sampling with Auger and Thin-walled Tube Sampler, pp. 2-5 to 2-7.

Section 2.4.1, Method II-7: Sampling of Bulk Material with a Scoop or Trier, pp. 2-19 to 2-21. Environmental Monitoring Systems Laboratory, Office of Research and Development. U.S. Environmental Protection Agency, Las Vegas, Nevada. EPA-600/4-84-076. December 1984.

EPA, 1987. A Compendium of Superfund Field Operations Methods. Section 8.1.6.1.1: Hand augers, pp. 8.1-4 to 8.1-6. Section 8.1.6.2.1: Split-spoon Samplers, p. 8.1-20. Section 8.1.6.2.2: Thin-walled Tube Samplers, p. 8.1-21. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. U.S. Environmental Protection Agency, Washington, D.C. EPA/540/P-87/001. December 1987.

USACE, 1994. Requirements for the Preparation of Sampling and Analysis Plans. Appendix C: Environmental Sampling Instructions, pp. C-43 to C-49. September 1994.

JMC Environmentalist's Subsoil Probe Manual.

STANDARD OPERATING PROCEDURE 3 GEOTECHNICAL SOIL SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to provide a description of and technical management guidance on the collection of soil samples for geotechnical analyses. The analytical results will be used to describe the subsurface soils, to verify the Site Geologist's boring logs, and to develop site-specific values for soil porosity and hydraulic conductivity in order to evaluate contaminant transport and effective remedial actions, if necessary.

2.0 Materials

- a. Drilling rig and drilling equipment
- b. 1 3/8-inch I.D. split-spoon sampler
- c. 3.0-inch I.D. split-spoon sampler
- d. Stainless-steel trowel
- e. Zip-lock plastic bags
- f. Shipping containers (coolers)
- g. Tape measure
- h. Personal protective equipment
- i. Decontamination supplies

3.0 Procedure

3.1 Sample Collection

- 3.1.1 Subsurface soil samples will be collected in accordance with ASTM Method D1586 - Penetration Test and Split-Barrel Sampling (using a 1 3/8-inch inside diameter split-spoon sampler) and SOP D.1. In cases where soil samples are being collected solely for geotechnical analysis, a 1 3/8-inch I.D. split spoon will be used in accordance with the ASTM method. A 3-inch I.D. split spoon will be used to collect soil samples for geotechnical and chemical analyses from the same two foot interval. The 3-inch I.D. split spoon is necessary to collect a sufficient volume of soil for all analyses. When the larger spoons are used, they will be driven with a 300lb. hammer with an 18-inch drop.

3.2 Sample Handling

- 3.2.1 Upon retrieval of the split-spoon sampler, open the sampler and measure the recovery with a tape measure.
- 3.2.2 If there is sufficient recovery, the Site Geologist will select a continuous 12-inch interval for analysis. Use a clean stainless-steel trowel to separate a continuous 12-inch interval of soil. The 12-inch core will not be used for the collection of other samples.
- 3.2.3 Place the continuous 12-inch core into a plastic air-tight bag and seal the bag.
- 3.2.4 Label the bag with the boring number, sample depth and orientation of the sample (i.e., top end of sample and bottom end of sample).
- 3.2.5 Store the sealed bag(s) in a cooler with cold, wet paper towels for preservation.

3.3 Sample Analysis

- 3.3.1 Each geotechnical soil sample will be analyzed for the following parameters in accordance with their respective ASTM methods; moisture content (ASTM D 2216), sieve grain size distribution with hydrometer (ASTM D 422), Atterburg Limits (ASTM D 4318), bulk density (ASTM D 4253), permeability (ASTM D 5084) and specific gravity (ASTM D 854).

4.0 Maintenance

Not Applicable.

5.0 Precautions

- 5.1 Refer to the Facility-Wide Health and Safety Plan for appropriate health and safety precautions.

6.0 References

ASTM Method D 1586-84. Penetration Test and Split-Barrel Sampling of Soils.

SOP D.1. Soil Sampling.

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 4 GEOPROBE® SOIL SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to describe a procedure for the collection of subsurface soil samples using Geoprobe® equipment. The Geoprobe® method involves a hydraulically-driven soil sampling device mounted to the rear of a vehicle. The effective working depth of this tool is approximately 40 feet below grade; however, depths in excess of 70 feet can be attained in fine-grained deposits.

This SOP is based on the technical requirements described in the U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans." Use of this SOP will provide soil samples for definitive data for the implementation of site characterizations.

2.0 Materials

- a. Geoprobe® vehicle and associated equipment
- b. Clear acetate tubes
- c. Razor cutter
- d. Stainless-steel trowel
- e. Stainless-steel tray
- f. Measuring tape
- g. Sample bottles
- h. Sample coolers
- i. Personal protective equipment (PPE)
- j. Photoionization detector (PID)
- k. Flame Ionization Detector (FID)
- l. Radiation Meter
- m. Camera with film
- n. Field logbook

3.0 Procedure

- 3.1 Position the Geoprobe® vehicle over the sampling location.
- 3.2 If necessary, use the rotating impact hammer to penetrate concrete or asphalt pavement.

- 3.3 Attach the sample barrel, which is a hollow stainless-steel tube containing a clean acetate liner, to the leading probe rod. Hydraulically drive the drill rods, the sample barrel, and the hollow steel drive point into the ground using the hydraulic jack. If continuous sampling is not necessary, seal the sampling device by locking the inner piston.
- 3.4 Upon reaching the top of the desired sampling depth, insert a series of extension rods within the drive rods to the top of the sampling tube. The end of the lead extension rod will engage the top end of the sampling tube's inner piston and disengage it from its locked position.
- 3.5 Replace the drive cap onto the top probe rod and drive the tube through the soil to the completion depth. This action will force the soil into the acetate tube.
- 3.6 Withdraw the drill rods and the sample barrel from the hole.
- 3.7 Remove the acetate liner from the sample barrel.
- 3.8 Using a razor cutter, slice the acetate liner longitudinally.
- 3.9 Screen the subsurface soil samples with a properly calibrated PID, FID, and ionizing radiation meter.
- 3.10 The soil interval registering the highest PID or FID measurement will be sampled for VOCs analysis using a decontaminated small diameter coring device, such as a modified 10-30 mL disposable syringe or small diameter tube/ plunger sampler. If there are no PID/FID readings above background, sample collection for offsite analysis will be evaluated on a case by case basis. Sampling will be dependent upon the nature of the site (i.e., whether or not it contains organic compounds) and the type of activity that the sampling results will be used for (e.g., site characterization, closure). The sampling device will be capable of collecting 10±2 grams of soil from larger diameter core samplers (e.g., split spoons) or from freshly exposed soils. In addition, the small diameter coring device will be capable of delivering the sample directly into a sample bottle containing methanol. Therefore, the outside diameter of the small diameter coring device will be smaller than the inner diameter of the sample bottle to avoid loss of sample and ease the soil transfer process. SOP D.5 provides a detailed description for collection and methanol preservation of soil samples for VOC analysis.

- 3.11 Once VOC sampling is completed, or if soil samples are only being collected for non-VOC analyses, the following procedure will be followed. A sufficient amount of soil from the specified sampling interval will be placed on a decontaminated stainless-steel tray. After any rocks or organic matter have been removed, the soil will be homogenized using the coning and quartering method (ASTM C702-80). In this method, the soil will be thoroughly mixed by turning the entire sample over three times using a stainless-steel trowel. Following the last turning, the entire sample will be shoveled into the conical pile in the middle of the tray. The conical pile will then be carefully flattened to a uniform thickness and diameter by pressing down the apex with the trowel. The flattened soil will be divided into four equal quarters. The sampling personnel will then make a determination as whether the amount of soil on the tray is larger than the volume of the sample bottles. If the amount of the soil is larger, one or two quarters will be discarded. If two quarters are discarded, opposite quarters will be selected. After removal of one or more quarters, the entire coning and quartering sequence will be repeated until the amount of the soil on the tray is approximately equal to the volume of the sample bottles to be filled.
- 3.12 Place the homogenized soil into the appropriate sample bottles with a stainless-steel trowel.
- 3.13 Place the sample bottles into a sample cooler with ice. Samples should be cooled to approximately 4°C.

4.0 Maintenance

Not Applicable.

5.0 Precautions

- 5.1 The Geoprobe® method may be inappropriate in glacial deposits with pebbles, cobbles and boulders.
- 5.2 Refer to the Facility-Wide Health and Safety Plan for appropriate health and safety precautions.
- 5.3 Decontaminate the sampling equipment between sampling locations.

6.0 References

Kejr Engineering, 1995. Geoprobe® Systems 1995-96 Tools and Equipment Catalog - Appendix A & B Operating Instructions.

Nittany Geoscience Inc., Introduced to the Geoprobe®.

Weinstock, Eric A., 1992. Cost-Effective Options for Subsurface Soil, Soil Gas, and Groundwater Sampling, National Environmental Journal, November/December 1992.

U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans."

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 5 SURFACE WATER SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for sampling water. The procedure can be applied to the collection of surface water samples from streams, rivers, lakes, ponds, and other surface water bodies. Surface water samples provide an indication of the amount of contaminant in the surface water body.

If multiple surface water samples are to be collected from a surface water body, samples will be collected from the furthest point downstream, moving upstream as the sampling progresses. Surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities.

This SOP is based on the technical requirements described in the U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans." Use of this SOP will provide surface water samples for definitive data for the implementation of site characterizations and risk assessments.

2.0 Materials

- a. Sample bottles
- b. Stainless-steel pitcher
- c. Hydrolab® H₂O multiprobe or similar device for measuring pH, temperature, dissolved oxygen (DO), oxidation/reduction potential (ORP), turbidity, and conductivity
- d. 5-gallon buckets filled with concrete (for use as anchors)
- e. Global Positioning System (GPS)
- f. Personal flotation devices.

3.0 Procedure

Sample containers, with the exception of samples being collected for herbicides analysis, will be rinsed with the sample water prior to collection.

3.1 Collection of Shoreline Surface Water Samples

- 3.1.1 Remove the cap from the sample bottle(s).

- 3.1.2 Hold the bottle upside down, immerse the top of the bottle several inches under the water, then turn the bottle upright to fill. This will prevent floating debris or surface film from entering the sample.
- 3.1.3 Remove the bottle from the water, add the proper preservative, and cap.
- 3.1.4 Surface water samples should be immediately stored at 4°C.
- 3.1.5 Conductivity, pH, temperature, dissolved oxygen (DO), turbidity, and oxidation reduction potential (ORP) will be measured before and after sample collection using a Hydrolab® multiprobe. The Hydrolab® multiprobe will be calibrated before and after each day of sampling.
- 3.1.6 If it is possible to collect the sample directly into the sample bottle(s) (i.e., the surface water column is too shallow to completely submerge container and avoid floating debris, surface film, or sediment), collect the sample by using a stainless-steel pitcher as follows:
 - 3.1.7 Rinse the pitcher in the water to be collected, downstream of the sampling point.
 - 3.1.8 Dip the pitcher in the water, fill the pitcher, and transfer the water into the sampling bottle(s).
 - 3.1.9 Add the proper preservative and cap the sample bottle(s).
 - 3.1.10 For all surface water samples, mark the sampling locations on a site map. Photograph (if desired) and describe each location, and place a numbered stake above the visible high water mark on the bank closes to the sampling location. The photographs and descriptions must be adequate to allow the sampling location to be relocated at some future date.

3.2 Collection of Boat Surface Water Samples

- 3.3 If the water column is too turbid or deep to wade out to the sample location, the surface water samples will be collected from a stable, flat-bottomed boat as follows:

- 3.3.1 Position the boat adjacent to the sampling location using the outboard motor or paddles. The boat will have a large flat bottom area and a large open deck space. The sampling location will be approached from downstream without entraining additional sediment into the surface water sample.
- 3.3.2 Securely anchor the boat in a three point anchorage to prevent drifting. Anchors will consist of 5-gallong buckets filled with concrete and tied off with nylon rope.
- 3.3.3 Once the boat is motionless, the sample bottles will be filled by the direct submersion method described in Steps 3.1.1. through 3.1.5. above.
- 3.3.4 A Kemmerer sampler, weighted bottle sampler, or Bacon Bomb sampler may be used to collect deep samples, if necessary. If the surface water is stratified, the above sampling devices may also be used to collect samples from the different layers.
- 3.3.5 The GPS will be used to record the sampling locations.

4.0 Maintenance

- 4.1 Not applicable.

5.0 Precautions

- 5.1 All personnel on the boat will wear U.S. Guard Type III personal flotation devices. Refer to the Facility-Wide Health and Safety Plan (January 1997) for other appropriate health and safety precautions.
- 5.2 Decontaminate the sampling equipment between sampling locations.
- 5.3 Avoid disturbing the surface water during submersion of the sample bottles.
- 5.4 Refer to the Facility-Wide Health and Safety Plan for health and safety precautions.

6.0 References

U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001),
"Engineering and Design Requirements for the Preparation of Sampling and
Analysis Plans."

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 6 SEDIMENT SAMPLING

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for sampling sediments. This procedure can be applied to the collection of sediment samples from streams, rivers, lakes, ponds, and other surface water bodies. Sediment samples indicate the amount of contamination absorbed on sediment particles and/or the amount of wastes transported from the site.

If multiple sediment samples are to be collected from a surface water body, samples will be collected from the furthest point downstream, moving upstream as the sampling progress. Where applicable, surface water will be sampled before sediment to prevent the collection of fine-grained substrate, which may be introduced into the surface water from sediment sampling activities.

This SOP is based on the technical requirements described in the U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans." Use of this SOP will provide sediment samples for definitive data for the implementation of site characterizations and risk assessments.

2.0 Materials

- a. Stainless-steel pan
- b. Stainless-steel corer
- c. Stainless-steel trowel
- d. Stainless-steel bucket auger
- e. Sample bottles
- f. Photoionization detector (PID)
- g. Flame ionization detector (FID)
- h. Global Positioning System (GPS)

3.0 Procedure

3.1 Collection of Shoreline Sediment Samples

- 3.1.1 Samples will be taken with decontaminated stainless-steel bucket auger if there is little or no water on top of the sediment at the particular sampling location, and if the water velocity is

low. For sampling locations where the water above the sediment is greater than 4 inches in depth, or the water velocity is high, a decontaminated stainless-steel corer or other device that eliminates sample washing will be used. This will ensure the integrity of the surface layer of sediment and will minimize the loss of fine-grained material in the sediment.

- 3.1.2 All sediment samples will be screened with a properly calibrated PID, FID, and ionizing radiation detector. Sediment samples collected for all analyses except TCL volatile organics will be thoroughly homogenized before being placed in the sample containers. Rocks, twigs, and other debris will be removed from the sample prior to homogenization if they are not considered part of the sample. Samples for VOC analyses will be taken as individual grab samples, and will not be homogenized. They will be placed directly into 60-mL VOC sample bottles. Non-VOC samples will be homogenized by the coning and quartering method that is described below.
- 3.1.3 Following removal of rocks, twigs, leaves and other debris, the sediment will be removed from the sampling device and placed in a decontaminated stainless-steel pan and homogenized using the coning and quartering method. In this method, the sediment will be thoroughly mixed by turning the entire sample over three times using a stainless-steel trowel. Following the last turning, the entire sample will be shoveled into a conical pile in the middle of the pan. The conical pile will then be carefully flattened to a uniform thickness and diameter by pressing down the apex with the trowel. The flattened sediment will be divided into four equal quarters. The sampling personnel will then make a determination as to whether the amount of sediment in the pan is larger than the volume of the sample bottles. If the amount of sediment is larger, one or two quarters will be discarded. If two quarters are discarded, opposite quarters will be selected. After removal of one or more quarters, the entire coning and quartering sequence will be repeated until the amount of sediment in the pan is approximately equal to the volume of the sample bottles to be filled. Then, the required sediment volumes will be placed in the sample bottles. Sampling personnel will avoid decanting off the excess liquid during coning and quartering.

- 3.1.4 A description of properties of the sediment (color, texture, odor, organic content, grain size) should be recorded in the field logbook immediately after sample collection.
- 3.1.5 Sediment samples will be immediately stored at 4°C.
- 3.1.6 All sediment sample locations will be marked on a site map. A numbered stake will be placed above the visible high water mark on the bank closest to the sampling location. A description of the sampling site will be entered into the field logbook. This description will be adequate to allow the sampling station to be reoccupied at some future date.

4.0 Maintenance

- 4.1 Not applicable.

5.0 Precautions

- 5.1 Decontaminate the sampling equipment between sampling locations.

6.0 References

ASTM Method C702-80, Reducing Field Samples of Aggregate to Testing Size.

U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans."

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 7 LOW-FLOW GROUNDWATER SAMPLING

Purging Procedures

Groundwater sampling procedures will include water level measurements, calculation of well volumes, purging, and sampling activities. The following step-by-step procedures are in adherence with EPA Region V groundwater sampling protocols for low-flow pump purging and sampling which are based upon the method of Puls and Barcelona (EPA/540/S-9S/504). .

Step 1: Measure depth-to-water and depth-to-bottom of every well at the Site.

Step 2: Calculate one well volume of the screened or open interval.

Step 3: Lower the low-flow pump to the mid-point of the screened interval.

Step 4: Calibrate meters.

Step 5: Begin to purge well. EPA recommends a purge rate of less than 100 milliliters/minute. The purge rate should not exceed the recharge rate (i.e., less than 0.3 feet of draw down from static water level).

Step 6: Measure purging parameters at a minimum of one per well volume or every 3 to 5 minutes. Measurements will be collected via flow through cell for pH, temperature, specific conductivity, oxidation/reduction potential (ORP), dissolved oxygen (DO) as

described in Section 4.1.2. Turbidity will also be measured at the outflow of the flow through cell at every 3 to 5 minutes. All measurements will be recorded in the field logbook.

Step 7: After conductivity and temperature have stabilized to within 5% over three readings, pH readings differ less than 0.1 standard pH unit, ORP readings differ within 10 mV, and turbidity measurements differ within ∇ 10%, sampling can begin after the flow through cell is disconnected.

Step 8: Using the well purging pump at a flow rate of 100 ml/min and the sample will be collected out of the discharge line as described in Section 4.1.3. The date and time of the sample collection will be recorded in the field log notebook.

Modifications to these general procedures may be made in the field based on the specific conditions observed.

Field Analyses

Field measurements that will be performed during well purging will include pH, specific conductivity, temperature, oxidation/reduction potential (ORP), dissolved oxygen (DO) and turbidity measurements. Measurements will be collected by inserting the appropriate probes in a closed non-dedicated plastic container (flow-through cell) that is rinsed with deionized water prior to purging the well. Turbidity samples will be collected from the flow through cell outflow.

Calibration of the instruments will be completed at the beginning of each sampling day, checked in the middle of the day, and as otherwise necessary based on the functioning of the meters and equipment. Each meter will be field calibrated in accordance with the manufacturer=s specifications and appropriate calibration solutions. All calibrations will be recorded in the field log. Field calibration procedures at a minimum will include the following:

- pH meters will be calibrated according to manufacturer=s instructions prior to each day and will, at a minimum, consists of two standard buffer solutions (pH 4, 7 or 10) obtained from chemical supply houses. The pH values of the buffers will be compensated for temperature at which the pH sample is measured. Verification checks will be completed at least once per day using a standard solution. The verification check results must agree within ± 0.05 pH standard units or re-calibration will be performed.
- All temperature measurements will be measured using a field thermometer and recorded to ± 0.2 °C.
- Dissolved oxygen meters will be calibrated to ambient air conditions.
- Specific conductance meters will be calibrated prior to each use with a potassium chloride solution (1000 \leftrightarrow mhos) prepared by a qualified laboratory or chemical supplier.
- Turbidity meters will be calibrated daily prior to use with a minimum of two standards of known turbidity as prepared by the manufacturer of the instrument. These solutions should bracket the levels found in the groundwater.
- Oxidation - reduction potential probes will be checked daily against standard solutions (at least one) prepared by a qualified laboratory or chemical supplier.

All calibration procedures performed will be documented in the field logbook and will include the date and time of calibration, name of the person performing the calibration, reference standards used and instrument readings.

If equipment fails calibration or equipment malfunction is noted during calibration or use, the equipment will be tagged and removed from service.

Sample Collection

Groundwater samples will be collected using the low-flow pump or peristaltic pump and tubing at a rate of about 100 milliliters/minute with the flow through cell disconnected. Groundwater will be collected directly into laboratory prepared bottles. Any sample which may be analyzed for dissolved metals will be transferred directly from the un-preserved sampling bottles, through a new 0.45 micron pressure filter using a peristaltic pump with new tubing or a one time use vacuum filter, and then poured into a laboratory supplied preserved container. Any intermediate containers, pump tubing and filters will be disposed appropriately after each use.

All sample bottles will be identified by the use of sample tags/labels with the sample identification. Each sample label will be filled out by the sampler to avoid any possibility of sample misidentification and attached to the sample container. Indelible ink shall be used to complete the sample labels.

All samples will be labeled, preserved, handled, and have a full chain of custody in accordance with Sections 4.7 - 4.8 of the FSP.

Any water generated in the purging or sampling of the wells will be containerized in 55-gallon steel drums. Re-useable equipment (i.e., the electronic water level indicator probe, field parameter meters, the submersible pump) will be decontaminated between use at each well location and will be conducted in accordance with the decontamination procedures

outlined in Section 4.9 of the FSP. Prior to the commencement of all sampling activities the wells will be ordered so that suspected lesser contaminated wells will be sampled first.

STANDARD OPERATING PROCEDURE 8 GROUNDWATER MONITORING WELL INSPECTIONS

1.0 Introduction

Sites with groundwater monitoring wells require periodic inspections of the wells to determine their integrity and functionality. If available, boring logs and well construction diagrams would be useful to review prior to conducting an inspection. In addition to periodic inspections on sites with established programs, inspections are important to gain information on the usefulness of wells where we are new to the site and/or the wells have not been regularly sampled. A simple checklist on a groundwater monitoring well inspection form can be used to record observations.

2.0 Equipment

Materials useful for well inspection:

- Groundwater Monitoring Well Inspection Forms
- Site Map
- Camera and Film
- Well Keys
- New Locks
- Bolt Cutters
- Measuring Tape/wheel
- Water Level Probe
- Photoionization Detector (PID)
- Bailer with Rope
- Turkey Baster (or other suction tool)
- Boring Logs/Construction Diagrams

3.0 Procedures

1. Field Forms

A groundwater monitoring well inspection form will be used for each monitoring well to record relevant observations. The form should include the information on the outward appearance, inner appearance, and downhole features as described below (see sample form attached). Any additional observations should be recorded at the bottom of the form.

2. Outward Appearance

- a. Locate well and determine well identification.
- b. Determine if there are any problems accessing the well.

- c. Describe approximate location relative to fixed landmarks or provide a sketch with measures to fixed landmarks.
- d. Measure and record flushmount diameter or stickup height.
- e. Record the integrity of, material, and width or diameter of the protective casing.
- f. Identify if there is a weep hole in the protective casing.
- g. Document the integrity of the surface seal/apron if one exists. If so, determine the material of which it was constructed (cement, bentonite, etc.).
- h. Determine if surface drainage will pond up near the well and potentially flow into the well or if drainage is away from the wellhead. Identify if there is any evidence of erosion of soils in the immediate area around the well casing. Determine if frost heave has damaged the concrete pad.
- i. Record where any bollards are/should be present on a sketch and describe their condition.
- j. Determine the condition of any paint or markings on the well casing, cap, or bollards.
- k. Record if a well identification designation is present on the well and legible.
- l. Document if a lock is present and functional (aboveground completion), or if tie-down bolts are present and functional (flush-mounted completion).
- m. Take a photograph and describe on inspection form.

3. Inner Appearance

- a. Document if a lock is present and functional (flush-mounted completion).
- b. Unlock well, if applicable, or remove .
- c. Describe the integrity of, material, and width or diameter of the well casing.
- d. Verify if an inner cap exists and, if so, document the type of cap (i.e., threaded, slip, expansion plug).
- e. Record if a reference/measuring point exists and, if so, the type of point (i.e., groove, indelible ink mark).
- f. Determine if there is a dedicated bailer or tubing in the well.
- g. Identify if there is any evidence that the well is double cased.
- h. For flushmount wells (or stick-ups without weep holes or proper seals), indicate if water is present inside the casing and if surface water has the potential to enter the well. Purge the water from the casing with a suction tool, bailer, or sponge, as applicable. Inspect the rubber seal between the casing and the cap and confirm that all bolts are present and functioning.

4. **Downhole**
 - a. Stand upwind, open the wellhead and collect a headspace PID reading.
 - b. Describe any odors.
 - c. Describe if the well casing is offset or bent.
 - d. Measure and record the depth to water, depth to LNAPL (if applicable), and total well depth with a water level probe (Do not remove any dedicated bailer or tubing prior to measuring).
 - e. Measure total depth of well
 - f. Determine if there is any sediment at the bottom of the well and describe if it is hard or soft.
5. **Post Inspection**
 - a. Replace inner cap and well cover
 - b. Lock the well, if applicable.
 - c. If it is a flushmount well, remove debris from around the well cover and replace bolts if they have been stripped or are missing. Make sure rubber seal between the casing and the cap is present and free of debris or tears.
 - d. Document warranted maintenance items on Well Inspection Report and indicate completion date for actions.

4.0 References

Barcelona, M.J., J.P. Gibb and R.A. Miller, 1983. A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling. SWS Contract Report 327, Illinois State Water Survey, Champaign, IL.

Ricci, E.D., 1985. The Evaluation of an Existing Groundwater Monitoring Program. Proceedings of the 6th Nat. Conf. on Management of Uncontrolled Hazardous Waste Sites, Nov. 4-6, 1985, pps. 84-87. HMCRI, Silver Spring, MD.

USEPA, 1987. Data Quality Objectives. OSWER Directive 9335.0-7B, March 1987.

U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans."

STANDARD OPERATING PROCEDURE 9 WATER LEVEL AND WELL-DEPTH MEASUREMENTS

1.0 Scope and Application

The purpose of this Standard Operating Procedure (SOP) is to delineate protocols for measuring water level and well-depths in groundwater monitoring wells.

This SOP is based on the technical requirements described in the U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001), "Engineering and Design Requirements for the Preparation of Sampling and Analysis Plans." Use of this SOP will provide data for the following uses: site characterizations and providing support in the evaluation of remedial alternatives; providing a database to provide support for engineering design of remediation activities, and support during implementation of remediation activities.

2.0 Materials

- a. Water Level Indicator with cable measured at 0.01 foot increments
- b. Plastic sheeting
- c. Folding ruler or pocket steel tape
- d. Field Logbook
- e. Photoionization Detector (PID)
- f. Flame Ionization Detector (FID)

3.0 Procedure

3.1 Preliminary Steps

- 3.1.1 Locate the well and verify its position on the site map. Record whether positive identification was obtained, including the well number and any identifying marks or codes contained on the well casing or protective casing.
- 3.1.2 Remove the well cap and check for organic vapors using a PID and FID.
- 3.1.3 Locate and record the specific benchmark or survey point for the well, which may be a mark at the top of the casing or surveyors pin embedded in the protective structure. Determine from the records and record in the field logbook the elevation of

this point. Measure and record the vertical distance from the benchmark to the top of the well casing, to the nearest 0.01 feet. Measure and record the metal casing stick-up (the distance between the top of the casing and nominal ground (level)).

- 3.1.4 Record any observations and remarks regarding the completion characteristics and well condition, such as evidence of cracked casing or surface seals, security of the well (locked cap), and evidence of tampering.
- 3.1.5 Keep all equipment and supplies protected from contamination. Use clean plastic sheeting around each well to prevent contact of the water level indicator with the ground. Keep the water level indicator probe in its protective case when not in use.

3.2 Operation

- 3.2.1 Remove the water level indicator probe from the case, turn on the sounder, and test check the battery and sensitivity scale by pushing the red button. Adjust the sensitivity scale until you can hear the buzzer.
- 3.2.2 Slowly lower the probe and cable into the well, allowing the cable reel to unwind. Continue lowering until the meter buzzes. Very slowly, raise and lower the probe until the point is reached where the meter just begins to buzz. Marking the spot by grasping the cable with the thumb and forefingers at the top of the casing, withdraw the cable and record the depth.
- 3.2.3 To measure the well depth, lower the probe until slack is noted in the cable. Very slowly raise and lower the cable until the exact bottom of the well is "felt". Measure and record the depth.
- 3.2.4 Withdraw the cable and probe, and decontaminate according to SOP H.1.1.

4.0 Maintenance

- 4.1 Check the batteries of the water indicator each time the instrument is used.

5.0 Precautions

- 5.1 Refer to the Facility-Wide Health and Safety Plan for appropriate health and safety precautions.

6.0 References

U.S. Army Corps of Engineers manual, EM 200-1-3 (1 February 2001),
"Engineering and Design Requirements for the Preparation of Sampling and
Analysis Plans."

7.0 Attachments

None.

STANDARD OPERATING PROCEDURE 10 PROCEDURE FOR THE DOCUMENTATION OF SAMPLE LOCATIONS

Title: Procedure for the Documentation of Sample Locations

I. Introduction

This guideline is to provide reference information on the documentation of sample locations (without the use of the Global Positioning System (GPS)) at the Sauer Dump Site.

II. Definitions

Azimuth. The direction of a horizontal line as measured on an imaginary horizontal circle; the angular distance (measured clockwise) between a fixed point and a point of observation.

Bearing. The angular direction of any place or object at one fixed point in relation to another fixed point; the direction of a line on the earth's surface with reference to the cardinal points of the compass.

Control Point. A well-defined fixed point used as a reference from which particular measurements can be made.

III. Guidelines and Requirements

There are three conventional methods that will be used to locate sample points. Generally, the preferred method will be the gridded method. The three-line measurement method and angle and distance method can also be used. All methods in the following discussion will assume that the fixed points from which measuring will originate will be known points (controls) located on a map and/or plan, or oriented to an aerial photograph.

A. Gridded Method

1. All measurements made using the Gridded Method will be referenced from an established control point. The control point, which is where $x,y = 0,0$, will be located at the corner of the property.

Stand on the property facing toward the street. The $x, y = 0, 0$ coordinate will be located in the front (assume front is the portion of the property closest to the street) right-hand corner of the property boundary. Use the site map, which will show the property boundary, to determine this location. Mark this location on the site map downloaded from the field laptop.

2. From this control point, lay out tape measurers along the property boundary (to the extent possible) to represent the x and y axes. The x -axis will run parallel to the street and the y -axis will run perpendicular to the street.
3. Conceive of a straight line from the sample point, to the x -axis. The line must be perpendicular to this axis. Record the measurement (e.g., 25 feet 6 inches). Repeat this process for the y -axis. The sample point location should be recorded in the following format:

Example - $x = 25$ feet 6 inches, $y = 37$ feet 8 inches

4. Record this data in the field laptop.

B. Three-line Measurement Method

1. Locate three control points on the property. The control point is a known location on a map or plan, but may also include buildings or other permanent objects. For outdoor work, the control points will be located on the site map, which will be generated from the existing planimetric base mapping. For the indoor work, the field team will generate a site sketch which contains the locations of the control points.
2. From each control point, measure the distance from the control point to the sample point and determine the general direction (e.g., southwest).
3. Record this data in the field laptop.

C. Angle and Distance Method

1. Locate one control point; the control point (A) is a known location on a map or plan, but may also include buildings or other permanent objects. For outdoor work, the control points will be located on the site map, which will be generated from the existing planimetric base mapping. For the indoor work, the field team will generate a site sketch which contains the locations of the control points.
2. From the control point locate the sample point. Measure its azimuth or bearing using a compass.
3. Once the horizontal angle of the point has been turned, measure the distance from the control point to the sample point.
4. Record this data in the field laptop.

IV. Compass

In general, there are two types of compasses: a basic compass ("Boy Scout" compass) and a Brunton compass (sometimes referred to as a pocket transit). Only a basic compass will be used at this site. The compass is used to measure horizontal angles. To do this, the instrument has a magnetic needle and a horizontal circle graduated into 360 intervals or degrees. Each instrument will also have a sight from which a target or a point can be aligned with the instrument.

In general, basic compasses will have sights or a line scribed onto the glass cover of the compass circle. To read the compass, hold it level to the ground surface so that the needle may float freely. Orient the compass so that north (N) and the needle are aligned. Then rotate the compass so that the compass sights are pointed into the direction of the sampling point. The horizontal angle with respect to magnetic north can then be read from the needle. Depending on the type of compass, the geographic direction of east and west may be inverted. The reasoning behind inverting these directions is to make reading the horizontal angle a direct reading- for example, north 40° east. Compasses using the normal orientation of east and west cannot be read directly. If you rotate the compass clockwise, to the east, the needle drifts westward and you could easily read the angle as north 40° west.

Other hints for operating a compass include using the damping button and rotating the horizontal circle. Holding the damping button will stop the movement of the needle and make reading the angle/direction easier. On some compasses the

graduated horizontal circle may be rotated so a particular direction is read. This makes reading that angle easier, but should only be used if that particular direction is being used for long periods of time or over long distances.

V. References

EPA, 1987. A Compendium of Superfund Field Operations Methods. Section 14: Land Surveying, Aerial Photography, and Mapping, pp. 14-1 to 14-5. Office of Emergency and Remedial Response, Office of Waste Programs Enforcement. U.S. Environmental Protection Agency, Washington, D.C. EPA/540/P-87/001. December 1987.

STANDARD OPERATING PROCEDURE 11 PROCEDURE FOR MANAGEMENT AND DISPOSAL OF INVESTIGATION DERIVED WASTE

I. Introduction

This procedure describes the methods used to manage, store, and dispose of investigation derived waste produced during environmental sampling at the Sauer Dump Site. The procedures specifically address sediments, soils, water, solvents, and PPE waste generated from collection of sediment, soil and water samples.

This SOP does not address radioactive decontamination, PPE for radioactive waste, or disposal of radioactive contaminated waste material.

II. Definitions

DCM	Dichloromethane, organic solvent
HSC	Health and Safety Coordinator
IDW	Investigation derived waste
PPE	Personal Protective Equipment

III. Equipment and Supplies

The purchase, maintenance, and use of the supplies and equipment listed below are the responsibility of the designated site Health and Safety Coordinator (HSC).

The following equipment and supplies will be used to collect and dispose of investigation derived waste:

1. Waste Storage and Disposal Containers

- a. 30- or 55-gallon drums for solid and liquid wastes, including 30 gallon plastic drums for solids, and sealed top drums with screw-plug openings for liquids. As for liquid storage, steel (6D) drums will be used in the storage of solvent waste. For aqueous organic and acid waste, polylined (17E) drums will be used for storage.

2. Transferring Equipment

- a. Plastic safety funnels with brass or plastic screens and vents

- b. Hand pump/siphon with Teflon or tygon tubing
- c. Tools: screwdriver, drum plug wrench, and brass pliers
- d. Drum dolly

3. Personal Protective Equipment

- a. Disposable Tyvex coveralls and/or lab coats
- b. Disposable plastic gloves (nitrile, butyl rubber, or Viton)
- c. Respirator and cartridges [consult Environment, Safety, and Health (ES&H) Officer to ascertain necessity]
- d. Shoe covers (Rubber or Tyvek)

4. Spill Cleanup Equipment and Supplies

- a. Spill absorbent (Vermiculite or Speedidry™)
- b. Broom, foxtail and dustpan
- c. Shovel
- d. Paper towels
- e. 85-gallon overpack drum
- f. Manual drum pump (same as pump in '2. Transferring Equipment')

- 5. **Labels and Logs** A supply of labels and log sheets that are referred to in this SOP are to be kept on site in an easily accessible location, described in the workplan. Additional logs are obtained from the HSC.
- 6. **Digital camera** to document IDW management.

IV. Guidelines

The following procedures will be used to store, manage, and transport IDW:

Waste Disposal

IDW is held in the appropriate designated storage area until approval for disposal is granted. After the HSC receives documentation on the level of contamination in the waste, the HWC assists the Project Manager in deciding whether the waste is suitable for disposal in a landfill, or must be discarded in a hazardous waste stream.

Solid Waste

1. Solid waste is to be transferred into an air-tight, 30 gallon open top drum.
2. The lid is to be removed from the collection container and the contents placed into the storage drum.
3. Once the transfer has been completed, the lid and sealing ring are to be replaced on the storage drum.
4. The transfer will be recorded on the waste transfer log, and this log will be placed in a location described in the WP for reference.

Liquid Waste

1. All solvents used for decontamination must be captured and disposed of in appropriate, labeled, aqueous waste containers. Liquids collected into the chemical waste container must be discarded in an appropriate waste stream. Care must be taken not to mix substances that will react with each other. If there is any question concerning compatibility, the HSC or Project Manager should be contacted prior to taking action. A record of the type, relative amount, and hazard associated with each substance added must be kept on the hazardous waste log. This log must be attached to the satellite container. Waste may be temporarily stored, if properly labeled, prior to satellite container introduction. The waste contents in these temporary storage containers must be introduced into an approved satellite container by the end of every working day.
2. Staff performing decontamination procedures need to wear appropriate PPE, gloves (e.g. nitrile) and eye protection. Care must be taken in cleaning not to allow contact of cleaning solutions with clothing as much as possible. If circumstances dictate contact will occur (e.g. high pressure washing, splashing, high wind), waterproof outer clothing must be worn (e.g. foul weather gear or rain gear).
3. Decontamination procedures may vary depending on specific workplan specifications, and unique contaminants of concern at specific locations. The project workplan may designate collection of equipment rinse samples to document effectiveness of cleaning.
4. Liquid waste is to be transferred into an air-tight, 55-gallon, screw-cap drum. When a new drum is started, the larger cap is unscrewed with

the drum plug wrench. The safety vent is screwed in and the cap tightened by hand.

PPE

1. PPE are to be transferred into air-tight, 30 gallon open top drums.
2. The lid is to be removed from the collection container and the contents placed into the storage drum.
3. Once the transfer has been completed, the lid and sealing ring will be replaced on the storage drum.
4. A general description of the PPE, and locations it was worn, will be recorded on the waste transfer log. This log will be maintained in a location described in the WP for reference.

Transportation of IDW to the Disposal Area

Transportation of hazardous waste is carried out by assigned Hazardous Waste Handlers only. Personal Protective Equipment is worn during transport and disposal. Satellite containers are transported from to the truck using either dollies or carts.

Health and Safety Coordinator

The HSC is responsible for overseeing IDW and arranging for IDW to be disposed of off site in accordance with local, state, and federal Regulations. The responsibilities of the HSC include:

1. Packaging and labeling of containers
2. Arranging for waste removal
3. Maintaining manifest records and tracking the manifest until its signed and returned
4. Conducting weekly inspections of the waste area
5. Ensuring that the proper waste-handling materials and personal protective equipment are available and adequate (e.g., gloves, coveralls, goggles, respirators and cartridges, boots, funnels, pumps, etc.)
6. Maintaining emergency spill response equipment

IV. References

STANDARD OPERATING PROCEDURE 12 FIELD DOCUMENTATION

1.0 INTRODUCTION

Records of field activities generated during the course of projects must be capable of withstanding challenges to validity, accuracy, and legibility. Thus field data is required to be legible, identifiable, retrievable, and protected against damage, deterioration, and loss. Data must be recorded in standardized formats and in accordance with prescribed procedures. This standard operating procedure (SOP) describes the procedures and personnel responsibilities associated with recording field data at the Sauer Dump Site.

2.0 DEFINITIONS

Raw data are defined as any worksheets, records, memoranda, or notes that result from original observations and activities of a project and that are necessary for the reconstruction and evaluation of the project. Raw data may include, but are not limited to, information recorded in:

- Field survey logs
- Laboratory Record Books (LRB)
- Instrument maintenance logs and calibration records
- Sample chain-of-custody forms
- Standard or stock solution preparation records
- Laboratory data sheets (e.g., sample preparation or miscellaneous documentation forms)
- Project-specific data form
- Taxonomic Species ID forms

Raw data may also include photographs, maps, microfilm or microfiche copies, computer printouts, magnetic media such as dictated observations, recorded data from automated instruments, and correspondence related to planning, conduct, and interpretation of a project.

Field Data. Any and all information collected during activities at the site.

Electronic Field Data Form. A standardized electronic data form used for the collection of information and/or technical data during field activities.

Field Laptop Computer. A laptop computer that uses standardized electronic data forms to generate a chronological record of field activities.

3.0 PROCEDURES

3.1 General

A separate logbook should be dedicated for each sampling project and contain the name of the project leader, team members, and project name written inside the front cover. All aspects of sample collection and handling should be documented in the logbook. Data should be entered directly onto the appropriate form; entries should not be recorded on intermediate materials (e.g., scrap paper) and then transcribed to the logbook. If data must be collected and cannot be entered directly onto the appropriate form, the data should be recorded in a coherent and organized manner and attached permanently in the project logbook. Entries should be legible, accurate, and complete. The language should be factual and objective.

If standard forms are used to record data, the forms must contain enough information to ensure traceability. The minimum information required on each form is the project number, project phase or task, descriptive title identifying the type of data to be recorded (e.g., sample weights), date the work was performed, and the name or initials of the person(s) performing the work and recording the data. For field-collected data, information regarding the sample collection equipment should also be included, such as use and decontamination, field equipment and measurements, calculations and calibration data, sample location, sample number, time of collection, and any observations or unusual events. If the recorded data includes measurements, units must be included. Unused or non-applicable areas of the forms should be deleted or marked "NA". Collection of QC samples should also

be documented, as well as any deviations from procedural documents, such as the QAPP and SOPs.

All entries must be made in waterproof, non-erasable ink, preferably black. Felt-tipped pens should be avoided because many of the inks are soluble in water or organic solvents. The use of pencil to record data is not acceptable, except in rare circumstances (e.g., inclement weather conditions in the field). If pencil must be used, the data must be photocopied, stamped or marked as a verified copy, and signed and dated. The photocopies should be maintained with the original data in the project files.

All data must be recorded promptly and legibly. Entries must be signed or initialed by the person performing the work. If another individual recorded the data, that person must also sign or initial. Entries must be dated on the day of entry; times should be recorded for activities for which time intervals are critical.

Any videos, slides, or photographs taken in the field should be numbered to correspond to logbook entries. The name of the photographer, date, time, site location, and site description should be entered sequentially into the logbook as photos are taken. Special lenses, films, filters, or other image enhancement techniques must be noted in the logbook.

The documentation of field activities at uncontrolled hazardous waste sites is surrounded by a variety of legal guidelines that must be understood prior to the commencement of field activities. It is imperative that the personnel who will be conducting the field activities understand the overall constitutional, statutory, and evidentiary legal requirements as they apply to the site inspection documentation and to the rights of potentially responsible parties.

Documentation of an investigative team's field activities often provides the basis for technical site evaluations and other such related written reports. All electronic records and notes generated in the field will be considered controlled evidentiary documents and may be subject to scrutiny in litigation. Consequently, it is essential that the Site Field Manager or designee, either of whom may be called to testify, pay attention to detail, and document to the extent practicable every aspect of the inspection.

Personnel designated as being responsible for documenting field activities must be aware that all electronic notes taken may provide the basis for preparing responses for legal interrogatories.

Field documentation must provide sufficient information and data to enable reconstruction of field activities. A laptop computer using standardized electronic data forms will provide the basic means for documenting field activities.

Control and maintenance of field laptops is the responsibility of the Site Field Manager or designee. If the person responsible for documenting site inspection activities is other than the Site Field Manager, the transfer must be noted.

3.2 Documentation of Field Activities

Electronic field entries must provide an unbiased, concise, detailed picture of all field activities.

Step-by-step instructions and procedures for documenting field activities are provided below. These instructions and procedures are organized as follows:

1. The first set of instructions and procedures provide general guidance relating to the format and technique in which electronic field entries are to be made. It is important that field activities are documented in the most organized, chronological manner possible.
2. The second set of instructions and procedures provide guidance on information to be recorded when field activities are electronically documented. Generally the who, what, when, where, and how of all field activities must be recorded.

Instruction and procedures relating to the format and technique in which electronic field entries are made are as follows:

1. Each day field activities are conducted the date, time, site name, location, Malcolm Pirnie personnel and their responsibilities, non-Malcolm Pirnie personnel, and observed weather conditions must be entered into the field laptop. During the course of site activities any deviations from the work plan must also be documented.
2. All photos taken must be traceable to field entries and all photo locations must be referenced on a site map (for outdoor work) or site sketch (for indoor work). Information in the photo log must include the date, time, photographer, and description.
3. All entries must be made in language that is objective, factual, and free of personal feelings or other terminology that might prove inappropriate.
4. All entries must be accompanied by the appropriate military time (such as 1530 instead of 3:30). A time and status entry is recommended every 30 minutes or less.
5. If the individual designated for field documentation tasks transfers those tasks to another team member, he or she must clearly document this transfer of responsibility.
6. At the end of each workday all field data files will be uploaded to a database and a CD or a disk back-up of the files will be created. Additionally, all electronic field data forms will be printed out at the end of each workday. The person(s) who made the entries must sign and date each page that is printed out.

Instructions and procedures providing guidance on what information on field activities is to be recorded are provided below.

3.2 General Site Information

General site characteristics must be recorded. Information may include:

1. Type of access into facility (locked gates, etc.).
2. General and adjacent characteristics such as topography, demography, distance to population centers (including residential, commercial, and industrial), wells, and prime agricultural land.
3. Anything that is unexpected on site (e.g., appearance of drums that have not been previously recorded).
4. Information obtained from interviews with access or responsible party personnel (if applicable), or other interested party contacts on site.
5. Names of any community contacts on site.

3.3 Site Map

A site map or sketch must be provided. For the outdoor work, the site map will be generated from the existing planimetric base mapping and will be available in an electronic format. For the indoor work, the field team will generate a site sketch which will eventually be scanned into the field laptop GIS/Database. The map should provide the following information:

1. Site features that may provide evidence of contaminant presence and/or migration.
2. Landmarks and their distances.
3. Sample locations.
4. Health and safety hazards.
5. Photograph locations.

6. Map orientation (indicate north).

If possible, an approximate scale will also be included. Use as many sketches and maps as necessary.

3.4 Sample Activities

A chronological record of each sampling activity must be kept. During sampling, the following information will be entered into the laptop:

1. Explanation for sampling at the location identified in the sampling plan (e.g., discolored soil, stressed vegetation).
2. Field instrument equipment used and purpose of use (i.e., screening), calibration methods used, field results, and quality control (QC) information.
3. Exact sample location. The sample location(s) will be marked on a map and located using a Global Positioning System (GPS), if possible. If the GPS will not work on the property (e.g., too many overhead barriers), the location will be established via conventional methods (i.e., measuring tape).
4. Sample matrix.
5. Sample description, (e.g., color, texture, odor, soil type) and any other important distinguishing features.
6. Identification number, volume, sample interval, sampling method, and whether or not this is a quality control sample (e.g., duplicate). Any sample manipulations such as compositing, as well as preservation techniques will also be recorded.
7. Date and time of sample and data collection and any factors that may affect their quality.
8. All sample identification numbers.

As part of chain-of-custody procedures, recorded on-site sampling information

must include sample number, date, time, sampling personnel, sample type, designation of sample as a grab or composite, and any preservative used. Sample locations should be referenced by sample number on the site sketch or map. The offer and/or act of providing sample splits to a third party (e.g., the responsible party or the responsible party representative; state, county, or municipal, environmental and/or health agency, etc.) must be documented.

3.6 Sample Dispatch Information

When sampling is complete, the various documents associated with sampling such as the chain-of-custody, traffic reports, Federal Express receipts, etc., must be stapled to the electronic forms printed out at the end of each workday.

3.7 Data Corrections

Corrections to data should be made by drawing a single line through the original entry and replacing it with the correct value. Original data should not be obliterated or written over. All corrections and changes must be initialed, dated, and justified. Write-overs are considered data changes and must be treated in the same manner as other changes, i.e., the written-over value must be deleted with a single line and replaced with the correct value, and the correction initialed, dated, and justified. Justifications for changes should be clear and concise; vague explanations such as "Wrong number" should be avoided. Suggested error codes for the more common changes are provided in Attachment 1. If a code other than the ones listed in Attachment 1 is used, an explanation of the code must be included in the project files.

3.8 Data Transcriptions

Data that are transcribed from other sources must be traceable to their original source (*i.e.*, either the specific location of the original data must be identified or the data transfer process must be described in an SOP or the project plan). Data entered in spreadsheets are assumed to be transcribed unless clearly marked as direct-entry data. If data are transcribed by hand, vs. instrument transfer, the name of the person transcribing the data and the date of transcription must be recorded. If the transcription was verified, the name of the verifier and the date of verification should be documented.

3.9 Calculations

Calculations should be thoroughly documented so that the calculation can be duplicated by a person other than the originator. If the formula applied to data is not documented in an SOP then it must be documented with the data (as miscellaneous documentation, a footnote, etc.). All data sources, methods of calculation, and assumptions should be documented or identified. If data relevant to the calculation have been recorded elsewhere, the location of that data should be specified.

3.10 Computer-driven Data Collection and Analysis

In computer-driven data systems, the individual responsible for entering the data and the date of entry must be identified. All printouts must be initialed and dated by the person responsible. Changes in computer entries must be traceable to the original entry, and the reason for the change, the date of the change, and the name of the individual responsible for the change must be documented.

4.0 PERSONNEL RESPONSIBILITIES AND TRAINING

It is the responsibility of the technical managers to ensure that all staff performing the procedures described in this SOP are properly trained and that documentation of training exists prior to the performance of those procedures. Individuals whose responsibilities include data recording are responsible for reading and understanding this SOP and for performing the procedures in accordance with the stated requirements.

5.0 REFERENCES

EPA. 2002. RCRA Waste Sampling Draft Technical Guidance: Planning, Implementation, and Assessment. U.S. Environmental Protection Agency, Office of Solid Waste. EPA 530-D-02-002. August 2002.

U.S. EPA-Characterization of Hazardous Waste Sites - A Methods Manual, Volume I - Site Investigations, April 1985:

USACE Requirements for the Preparation of Sampling and Analysis Plans, September 1, 1994.

6.0 ATTACHMENTS

1. Error Code List

Attachment 1

ERROR CODE LIST

Error codes should be written near the correction and must be accompanied by the initials of the person making the change and the date of the change.

WL	Inadvertently recorded in the wrong location (e.g., row, column, page)
CC	Changed for greater clarity
WO	Write over
SE	Spelling error
IR	Inadvertently not recorded at the time of initial observation
CE	Calculation error
TE	Transcription error
RE	Rounding error
EI	Entry not initialed, dated, and/or justified at the time of entry
TI	Incorrect time
DA	Incorrect date
UN	Incorrect units
ID	Incorrect sample ID
MD	See miscellaneous documentation form (refer to page or Misc Doc #)
WP	Peak misidentification (gas chromatography only; analyst judged peak to be incorrectly identified by instrument software)
S/B	Should be; clarifies correct data

STANDARD OPERATING PROCEDURE 13 SAMPLE CUSTODY AND TRACKING

I. Introduction

Sample control is a vital aspect of any environmental monitoring program that generates data that may be used for regulatory purposes or as evidence in a court of law. Additionally, the complexity of many environmental sampling programs, which may involve the collection and analysis of samples of various media from different sites to be analyzed for several parameters, makes a sample control system essential. The purpose of this standard operating procedure (SOP) is to delineate sample custody procedures and responsibilities related to field operations. This SOP defines the procedures, organizational responsibilities, and documentation requirements associated with the field and laboratory sample control system.

II. Definitions

Chain-of-Custody Records – The administrative records associated with the physical possession and/or storage history of each individual sample from the purchase and preparation of each sample container and sampling apparatus to the final analytical result and sample disposal.

Sample control – The formal system designed to provide sufficient information to reconstruct the history of each sample, including collection, shipment, receipt and distribution within the laboratory, analysis, storage or disposal, and data reporting.

Sample custody – Samples are considered to be in a person's custody if

- The samples are in a person's actual possession;
- The samples are in a person's view after being in that person's possession;
- The samples were in a person's possession and then were locked or sealed up to prevent tampering; or,
- The samples are in a secure area

III. Responsibilities

The Sample Management Officer (SMO) receives samples that are collected by the Field team. The responsibilities of the SMO include:

1. Receiving samples, verifying that each sample listed on the custody form has been received. (Attachment 1)
2. Completing and signing the custody records accurately and legibly;
3. Maintaining records of sample receipt, release, and shipment (including a copy of the bill of lading) in the Custodian Logbook;
4. Packaging samples for shipment to off-site analytical laboratories in a manner that minimizes the risk of breaks and leaks and ensures that the samples are maintained at the appropriate temperature; see appropriate SOP for details.
5. Notifying each receiving laboratory that samples have been shipped and ensuring that each laboratory returns a faxed copy of the completed custody forms within 24 hours after receipt;
6. Distributing completed custody forms;
7. Arranging for the return of shipping coolers to the client or shipper, if appropriate; and,
8. Communicating sample custody problems to the appropriate project or task manager and implementing corrective action as directed.

IV. Procedures

1. **Sample Receipt:** Once samples are received by the laboratory they should be stored in the lab refrigerator as soon as possible. The original sample custody forms should be transmitted with the samples.

The lab sample receiving officer must review and document the receipt of the samples by completing a project-specific Sample Receipt Form for samples received each day. As part of sample receipt,

- The sample receiving officer should record the temperature of each cooler to document whether or not the samples were maintained at the appropriate temperature (frozen, cool, or room temperature) during shipment. The temperature of a cooler blank (if available), melt water, or the external temperature of the sample containers should be measured and documented. (Thermometers or probes are never inserted into a sample container);

- In general, shipping containers should only be opened under a vented hood unless the character of the samples is known to be innocuous;
- The sample receiving officer formally receives the samples after inventorying the samples vs. the custody forms, by signing and dating the Received By portion of the custody form. This signature documents that the sample custodian has custody of each sample listed on the form;
- The sample receiving officer must determine whether the sample condition upon receipt is acceptable. That is, that the sample temperatures are appropriate for the intended analysis; and that sample integrity is acceptable (no broken or cracked jars or lids). The QAPP or field sampling plan will define acceptable sample handling and holding times. If sample containers, preservation, or delivery do not meet the QAPP/SAP criteria then the sample custodian must notify the project manager who in turn must notify the client; and they must complete a Corrective Action Form (Attachment 3).
- Samples should be stored in the appropriate storage location until samples are released to the appropriate analytical laboratory.

2. Sample Acceptance/Rejection Criteria: It is the responsibility of the project manager to specify in the QAPP that project samples are being analyzed for compliance monitoring. In these cases samples could be rejected if:

- The integrity of the samples is compromised (leaks, cracks, grossly contaminated container exteriors or shipping cooler interiors, obvious odors, etc.);
- The identity of the container cannot be verified;
- The proper preservation of the container cannot be established;
- VOC vials contain bubbles of sizes greater than 1% of the vial volume;
- Sample custody forms are incomplete (the sample collector is not documented or the custody forms are not signed and dated by the person who relinquished the samples);
- The sample collector did not relinquish the samples; and,
- Samples are designated for VOA analysis but no VOA trip blank is provided.

If the SMO or laboratory sample receiving officer identifies any of the above conditions the project manager must be notified.

It is the responsibility of the sample receiving officer to ensure that any conditions that compromise sample integrity are recorded on the Sample Receipt Form. The sample receiving officer will notify the Project Manager of sample receipt, condition, and problems (e.g., breakage, leakage, missing samples, excessive temperatures).

3. **Documentation:** Documentation of sample custody includes the sample custody forms, any additional records of transmittal (e.g., letter), a copy of the air bill (if applicable), and the Sample Receipt form. The records are maintained by the sample receiving officer in the Custody Logbook.

Sample custody forms are initiated in the field and are shipped with the samples to the analytical laboratories. Each laboratory should send a faxed copy of the custody forms back to the SMO within 24 hours to document the receipt of samples and for early identification of sample loss or breakage. The original custody forms are returned to the project manager/task leader as part of the final data report. The originals are maintained in the project files have been logged in. A copy of the completed custody forms will be maintained in the Custody Logbook. Sample receipt and condition will also be tracked over the internet via the field application software.

4. **Sample Storage:** Upon completion of sample log-in procedures, samples are transferred to a secure location for storage until transfer to the analytical laboratory. This location may be a room, refrigerator, or freezer, depending on the storage requirements of the samples, but must be an area that can be locked from the outside. This storage location is documented on the Sample Receipt form. Only the lab sample receiving officer will have keys to these controlled-access areas.
5. **Initial Sample Processing and Sample IDs:** The project QAPP should define the protocol codes.

6. Sample Packaging and Shipping

- Preparation
 - Coolers should be washed inside and outside with soap and warm water to avoid any possible contamination of the samples. The coolers should have two sturdy handles, a working top, and be in good shape. Do not use any coolers that are damaged or are contaminated.
- Cooler Labeling
 - It is critical that cooler labels are secured to the cooler to ensure that samples are not lost.
 - The shipping label should be permanently attached to the cooler. In order to ensure that the label doesn't fall off, scrub the cooler lid and rinse with a solvent (e.g., methanol). Stick the label on the lid and tape over it with packing tape.
 - In addition to the shipping label, a full label with the recipient's name and address as well as the sender's name and address should be attached to the outside of the cooler.
 - The sample custody form should include the full addresses of the recipient and the shipping organizations, as well as a contact name at each organization.
 - Print "Environmental Samples" and "This End Up" clearly on top of the shipping container. Put upward pointing arrows on all four sides of the container.

- 7. Sample Shipping:** The SMO or designee packs the samples securely in a cooler with bubble wrap and adds blue ice or crushed ice to achieve the proper temperature and to ensure that the samples stay at a constant temperature for their entire trip. The cooler should have at least one inch of bubble wrap placed on the bottom of the cooler and the samples should be wrapped in bubble wrap if breakable or crushable containers are used. Placing the majority of the ice packs on the bottom of the cooler prevents the ice packs from crushing the sample containers. Additionally, the samples must be packed tightly and not be able to move freely in the cooler; they must be secure. An upper weight limit of 70 pounds per cooler is suggested. All paper work is signed, the original custody form is placed in a zip lock bag with a cover letter, and taped to the top of the cooler to avoid

moisture damage. The coolers should be sealed shut with tape or strapping material. Finally, custody seals should be placed on the outside of the coolers to assure samples are not tampered with during shipment.

When one sample shipment is contained in multiple coolers, the custody forms should be copied, placed in Zip-lock bags, and attached to the inside top of each cooler. Copies should be clearly labeled as such and they should indicate which samples are contained in each cooler. The individual coolers should be numbered 1 of 3, 2 of 3, etc. In addition, the commercial carrier label should be completed to indicate the cooler number and total number of coolers in the shipment (1 of 3, 2 of 3, etc.). It is recommended that copies of all custodies and tracking information be saved by the shipper.

Shipping over national holidays should be avoided whenever possible.

8. **Sample Archival and Disposal:** Unused portions of field samples remain in the custody of the sample custodian. The decision to archive "extra" sample should be made by the client and the Project Manager when the project is initiated. Sample disposition and the length of storage should be defined in the project plan. In the absence of other directives, unexpended samples that are maintained under proper storage conditions archived for six months after the delivery of the final data. Unless otherwise specified by the client, the samples will be discarded in the proper waste stream after this period. Samples not maintained at appropriate temperatures are likely unsuitable for analysis and are held only until chemical analysis is complete so that the samples may be discarded in the appropriate waste stream. The project manager will be notified prior to the disposal of samples.
9. **Safety:** Sample handling must always assume that samples are potentially "contaminated." Therefore, sample shipping containers are always opened in a vented fume hood, and personnel protective equipment is worn when unpacking samples (safety glasses, lab coat, and gloves).

Occasionally, samples are received broken. Because the potential hazard may be unknown all spills must be treated as if the material is hazardous. Clean-up materials should be maintained in the sample custody room. These consist of:

- absorbent (e.g., speedi-dry) paper towels
- dust pan and brush
- plastic bags
- glass disposal container
- solid waste stream container
- heavy-duty gloves

The hazardous waste coordinator should be contacted to determine the proper disposal procedures for spilled sample. In general, water samples are absorbed into chemical absorbent; sediment, soil, or tissues are placed in heavy-duty plastic bags. These are both disposed of in the laboratory's solid waste stream. Broken glass containers are placed in the glass disposal container.

10. **Training:** A person who is being trained as a SMO must first read this SOP. The person may then perform specific tasks under the supervision of a qualified instructor (SMO). Tasks performed by the trainee are reviewed and co-signed by the SMO until it has been established that the trainee is able to perform these tasks without supervision.

ATTACHMENTS

1. Severn Trent laboratory Standard Chain-of-Custody form
2. Sample Custody Corrective Action Form

Attachment 1
Chain-of-Custody Form

<div style="display: inline-block; background-color: black; color: white; padding: 2px 5px; font-weight: bold;">Chain of Custody Record</div> <div style="display: inline-block; text-align: center; margin-left: 10px;"> <div style="background-color: black; color: white; padding: 2px 5px; font-weight: bold;">SEVERN TRENT</div> <div style="font-size: 2em; font-weight: bold; margin-top: -10px;">STL</div> </div>		Severn Trent Laboratories, Inc.	
Client STL-4124 (0901)		Project Manager	Chain of Custody Number 229986
Address		Telephone Number (Area Code)/Fax Number	Date
City	State	Zip Code	Lab Number
Project Name and Location (State)		Site Contact	Page 2 of 2
Contract/Purchase Order/Quote No.		Carrier/Waybill Number	Special Instructions/ Conditions of Receipt
Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	
<div style="display: flex; justify-content: space-between;"> <div> Possible Hazard Identification <input type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown Turn Around Time Required <input type="checkbox"/> 24 Hours <input type="checkbox"/> 48 Hours <input type="checkbox"/> 7 Days <input type="checkbox"/> 14 Days <input type="checkbox"/> 21 Days <input type="checkbox"/> Other _____ 1. Relinquished By _____ Date _____ Time _____ </div> <div> Sample Disposal <input type="checkbox"/> Return To Client <input type="checkbox"/> Disposal By Lab <input type="checkbox"/> Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month) </div> </div>			
2. Relinquished By _____ Date _____ Time _____			
3. Relinquished By _____ Date _____ Time _____			
Comments			

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

Attachment 2
Sample Custody Corrective Action Form

Project Number _____ Client _____

Description of Problem (continue on back, if needed):

The sample custodian must contact the project manager on the day that problems are identified. If the project manager is not in the office the laboratory manager must be notified.

Documentation of project manager notification:

Sample Custodian:	_____	_____
	Signature	Date
Project Manager	_____	_____
	Signature	Date

Documentation of client notification (to be completed by project manager):

On _____ I contacted _____ at _____
Date Name of client contact Name of client organization

Results of communication with client (Describe any corrective action directed by the client):

RETURN THIS ORIGINAL TO THE SAMPLE CUSTODIAN. THE SAMPLE CUSTODIAN WILL PROVIDE COPIES TO THOSE ON THE ORIGINAL SAMPLE CUSTODY DISTRIBUTION LIST.

Date that this form was received by the custodian: _____