SAMPLING AND ANALYSIS PLAN

for

REMEDIAL INVESTIGATION ACTIVITIES

SHAFFER EQUIPMENT/ ARBUCKLE CREEK AREA SITE

Fayette County, Minden, West Virginia

EPA Contract Number EP-S3-07-04
EPA Work Assignment Number 083-RICO-A38L
Tetra Tech Project Number 112G08863

OCTOBER 2019

TETRA TECH

Project-Specific SAP Worksheet #1 and #2- Title and Approval Page

Document Title: Sampling and Analysis Plan (SAP) for Remedial Investigation (RI) Activities at Shaffer Equipment/Arbuckle Creek Area Site

Site Name/Project Name: Shaffer Equipment/Arbuckle Creek Area Site
Site Location: Minden, West Virginia
Operable Unit: Not applicable (NA)
Contractor Name: Tetra Tech
Contract Title: Remedial Investigation/Feasibility Study (RI/FS)
Contract Number: Remedial Action Contract (RAC) 3, EP-S3-07-04
Work Assignment Number: 083-RICO-A38L

Lead Organization: United States Environmental Protection Agency (USEPA)

Preparer's Name and Organizational Affiliation: Tetra Tech

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Preparation Date (Day/Month/Year): 29 October 2019

List organizational partners (stakeholders) and connection with lead organization:
USEPA, Region 3, lead organization
West Virginia Department of Environmental Protection (WVDEP), state regulatory agency

List data users:
USEPA, Region 3
WVDEP
Tetra Tech

Previous Plans and Reports Relevant to Project:

See Worksheet #13

Review Signature: [redacted]

Signature/Date
[redacted]/RAC QAM/Tetra Tech

[redacted]

Approval Signature:

Signature/Date
[redacted]/RAC PM/Tetra Tech

Other Approval Signatures:

Signature/Date
Stepan Nevshehirlian/USEPA Region 3 RPM

Signature/Date
TBD/USEPA Region 3 OASQA

EXECUTIVE SUMMARY

This Sampling and Analysis Plan (SAP) encompasses Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) requirements for a Remedial Investigation (RI) Work Plan at the Shaffer Equipment/Arbuckle Creek Area Site in Minden, West Virginia. This document constitutes the planning document, specific protocols for sample collection, sample handling and storage, chain-of-custody, laboratory and field analyses, data validation, and data reporting.

This SAP has been prepared by Tetra Tech on behalf of the United States Environmental Protection Agency (USEPA) Region 3 under the Remedial Action Contract (RAC) Contract Number EP-S3-07-04, Work Assignment (WA) No. 083-RICO-A38L. This SAP was generated for, and complies with, applicable USEPA and West Virginia Department of Environmental Protection (WVDEP) requirements, regulations, guidance, and technical standards. This SAP is presented in the format of 37 standard worksheets specified in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) guidance documents (USEPA, 2012).

The purpose of this WA is to develop information that will allow the USEPA to select a remedy that eliminates, reduces, or controls risks to human health and the environment.

The Shaffer Equipment Company (SEC) Property operated from approximately 1970 until 1983 at a facility located on the western end of the Town of Minden, West Virginia. SEC built electrical substations for the coal mining industry. The former SEC Property, approximately 5 acres, is located within the floodplain of Arbuckle Creek, which borders the property to the north. The site slopes slightly to the north towards Arbuckle Creek. The site is in a valley with a steep hillside south of the site. A roadway to the east separates the site from residential structures.

During 1984 inspections of the former SEC facility by the West Virginia Department of Natural Resources (WVDNR) and USEPA, mismanagement of electrical transformers was observed to have resulted in the release of polychlorinated biphenyl (PCB)-containing oils to the environment. Hundreds of transformers and capacitors were observed across the property. A majority of the transformers were found resting on their sides. Several of the transformers and capacitors had broken insulators with heavy oil spillage evident on the ground surface. The main contaminants of concern are PCBs.

Contamination from the SEC Property has migrated to Arbuckle Creek and has deposited in areas within the floodplain of Arbuckle Creek and downstream segments of the creek. Also, contaminated sediment within the creek were reportedly placed within residential yards, along Rocklick Road, and at the Berwind Green Hill Mine Dump Area (aka Needles Eye). Other areas of concern include the Britt Bath House Area, an area immediately north (across Arbuckle Creek) of the SEC Property, and the New River and Pocahontas Coal Company (NR&P) Supply House (aka the Powerhouse); all of which were used for storage of transformers. Rocklick Road is another area of concern because PCB-contaminated oils were reportedly used for dust control on the unpaved portions of the road and contaminated sediment from Arbuckle Creek were reportedly placed along the roadway.

The data to be collected during this RI, combined with data from previous investigations, will be used to determine the nature and extent of contamination and to characterize risks to human health and the environment. Additional data are needed to characterize the nature and extent of target analyte concentrations that exceeded risk-based benchmarks during previous investigations; to investigate potential target analytes that have not been previously analyzed to determine if there are additional contaminants at the site; to define the nature and extent of the contaminants; and to conduct a baseline Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA). The primary objective of this project is to complete the RI and provide sufficient data to support the completion of the Feasibility Study (FS) to address unacceptable risks.

Field activities conducted under this SAP shall meet the requirements of the accompanying Site-Specific Health and Safety Plan (HASP). The field procedures utilized will comply with WVDEP and/or USEPA Region 3 guidance.

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J EXPLANATION AND JUSTIFICATION OF PSLs

ACRONYMS AND ABBREVIATIONS

%	Percent
%D	Percent Difference or Percent Drift
%R	Percent Recovery
°C	Degree Celsius
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criterion
BERA	Baseline Ecological Risk Assessment
BFB	Bromofluorobenzene
bgs	Below Ground Surface
BTAG	Biological Technical Assistance Group
CAS	Chemical Abstracts Service
CCV	Continuing Calibration Verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CIH	Certified Industrial Hygienist
CLP	Contract Laboratory Program
COPC	Chemical of Potential Concern
CRQL	Contract Required Quantitation Limit
CSM	Conceptual Site Model
cm	Centimeter
CVAA	Cold Vapor Atomic Absorption
DFTPP	Decafluorotriphenylphosphine
DI	Deionized
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DOT	Department of Transportation
DPT	Direct Push Technology
DQI	Data Quality Indicator
DQO	Data Quality Objectives
Eco-SSL	Ecological Soil Screening Level
EDD	Electronic Data Deliverable
EICP	Extracted Ion Current Profile
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ERT	Environmental Response Team
ESAT	Environmental Services and Assistance Team
ESL	Ecological Screening Level
ESI	Expanded Site Inspection
ESV	Ecological Screening Value
EU	Exposure Unit
ft	Feet
FSP	Field Sampling Plan
FS	Feasibility Study
FOL	Field Operations Lead
FTMR	Field Task Modification Request
g	Gram
GC/ECD	Gas Chromatograph / Electron Capture Detector
GC/MS	Gas Chromatograph / Mass Spectrometer
GPS	Global Positioning System
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HCl	Hydrochloric Acid
HHRA	Human Health Risk Assessment

ACRONYMS AND ABBREVIATIONS

HI	Hazard Index
HNO3	Nitric Acid
HQ	Hazard Quotient
HRGC/HRMS	High Resolution Gas Chromatograph / High Resolution Mass Spectrometer
HRS	Hazard Ranking System
HSM	Health and Safety Manager
HSO	Health and Safety Officer
ICAL	Initial Calibration
ICP-AES	Inductively Coupled Plasma - Atomic Emission Spectrometry
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ICV	Initial Calibration Verification
IDW	Investigation-Derived Waste
ILCR	Incremental Lifetime Cancer Risk
IS	Internal Standard
L	Liter
LANL	Los Alamos National Laboratory
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LNAPL	Light Non-Aqueous Phase Liquid
MDL	Method Detection Limit
mg/kg	Milligram per Kilogram
mL	Milliliter
MPC	Measurement Performance Criterion
MS/MSD	Matrix Spike/Matrix Spike Duplicate
mV	Millivolt
NA	Not Applicable
NAD83	North American Datum of 1983
NaOH	Sodium Hydroxide
NAVD88	North American Vertical Datum of 1988
ng/kg	Nanogram per Kilogram
NOAA	National Oceanic and Atmospheric Administration
NR&P	New River and Pocahontas Coal Company
NTU	Nephelometric Turbidity Unit
OASQA	Office of Analytical Services and Quality Assurance
ORNL	Oak Ridge National Laboratory
ORP	Oxidation/Reduction Potential
Oz	Ounce
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCP	Pentachlorophenol
PDF	Portable Document Format
PFK	Perfluorokerosene
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
ppm	Parts per Million
PQL	Practical Quantitation Limit
PQLG	Practical Quantitation Limit Goal
PSHO	Project Safety and Health Officer
PSL	Project Screening Level
QA	Quality Assurance
QAM	Quality Assurance Manager

ACRONYMS AND ABBREVIATIONS

QAPP	Quality Assurance Project Plan
QC	Quality Control
RAC	Remedial Action Contract
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RLSC	Regional Laboratory Services Coordinator
RPD	Relative Percent Difference
RPM	Regional Project Manager
RR	Relative Response
RRF	Relative Response Factor
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RSL	Regional Screening Level
RT	Retention Time
S/N	Signal to Noise Ratio
SAP	Sampling and Analysis Plan
SEC	Shaffer Equipment Company
SI	Site Inspection
SIM	Select Ion Monitoring
SLERA	Screening Level Ecological Risk Assessment
SOP	Standard Operating Procedure
SSHO	Site Safety and Health Officer
SVOC	Semivolatile Organic Compound
TAL	Target Analyte List
TBD	To Be Determined
TCL	Target Compound List
TOC	Total Organic Carbon
TSCA	Toxic Substances Control Act
Tt	Tetra Tech
UCL	Upper Confidence Limit
UFP	Uniform Federal Policy
UFP-QAPP	Uniform Federal Policy for Quality Assurance Project Plans
µg/kg	Microgram per Kilogram
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit
VOC	Volatile Organic Compound
WA	Work Assignment
WDM	Window Defining Mixture
WQS	Water Quality Standard
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Department of Natural Resources

If any required SAP elements and required information are not applicable to the project, then circle the omitted SAP elements and required information on the attached table. Provide an explanation for their exclusion below.

The following table provides a "cross-walk" between the SAP elements outlined in the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP Manual), the necessary information, and the location of the information within the corresponding Worksheet.

SAP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to SAP Worksheet No.
Title and Approval Page	- Title and Approval Page - Table of Contents	1/2
Document Format and Table of Contents (Updated Document Control Format Document Control Numbering System Table of Contents SAP Identifying Information	- SAP Identifying Information	1/2
Distribution List and Project Personnel Sign-Off Sheet Distribution List Project Personnel Sign-Off Sheet	- Distribution List - Project Personnel Sign-Off Sheet	3 4
Project Organization Project Organizational Chart Communication Pathways Personnel Responsibilities and Qualifications Special Training Requirements and Certification	- Project Organizational Chart - Communication Pathways - Personnel Responsibilities and Qualifications - Special Personnel Training Requirements	5 6 7 8
Project Planning/Problem Definition Project Planning (Scoping) Problem Definition, Site History, and Background	- Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background	9 10
Project Quality Objectives and Measurement Performance Criteria Development of Project Quality Objectives Using the Systematic Planning Process Measurement Performance Criteria	- Site-Specific Project Quality Objectives - Measurement Performance Criteria	11 12
Secondary Data Evaluation	- Sources of Secondary Data and Information - Secondary Data Criteria and Limitations	13
Project Overview and Schedule Project Overview Project Schedule	- Summary of Project Tasks - Reference Limits and Evaluation - Project Schedule/Timeline	14 15 16

SAP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to SAP Worksheet No.
Sampling Tasks Sampling Process Design and Rationale Sampling Procedures and Requirements Sampling Collection Procedures Sample Containers, Volume, Preservation Equipment/Sample Containers Cleaning and Decontamination Procedures Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures Supply Inspection and Acceptance Procedures Field Documentation Procedures	- Sampling Design and Rationale - Sample Location Map - Sampling Locations and Methods/Standard Operating Procedures (SOP) Requirements - Analytical Methods/SOP Requirements - Field Quality Control (QC) Sample Summary - Sampling SOPs - Project Sampling SOP References - Field Equipment Calibration, Maintenance, Testing, and Inspection	17 18 19 20 21 22
Analytical Tasks Analytical SOPs Analytical Instrument Calibration Procedures Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures Analytical Supply Inspection and Acceptance Procedures	- Analytical SOPs - Analytical SOP References - Analytical Instrument Calibration - Analytical Instrument and Equipment Maintenance, Testing, and Inspection	23 24 25
Sample Collection Documentation, Handling, Tracking, and Custody Procedures Sample Collection Documentation Sample Handling and Tracking System Sample Custody	- Sample Collection Documentation, Handling, Tracking, and Custody SOPs - Sample Container Identification - Sample Handling Flow Diagram - Example Chain-of-Custody Form and Seal	27 26
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SAP Element(s) and Corresponding Section(s) of UFP-QAPP Manual	Required Information	Crosswalk to SAP Worksheet No.
Assessments and Response Actions Planned Assessments Assessment Findings and Corrective Action Responses	- Assessments and Response Actions - Planned Project Assessments - Audit Checklists - Assessment Findings and Corrective Action Responses	31 32
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Final Project Report	- Final Report(s)	33
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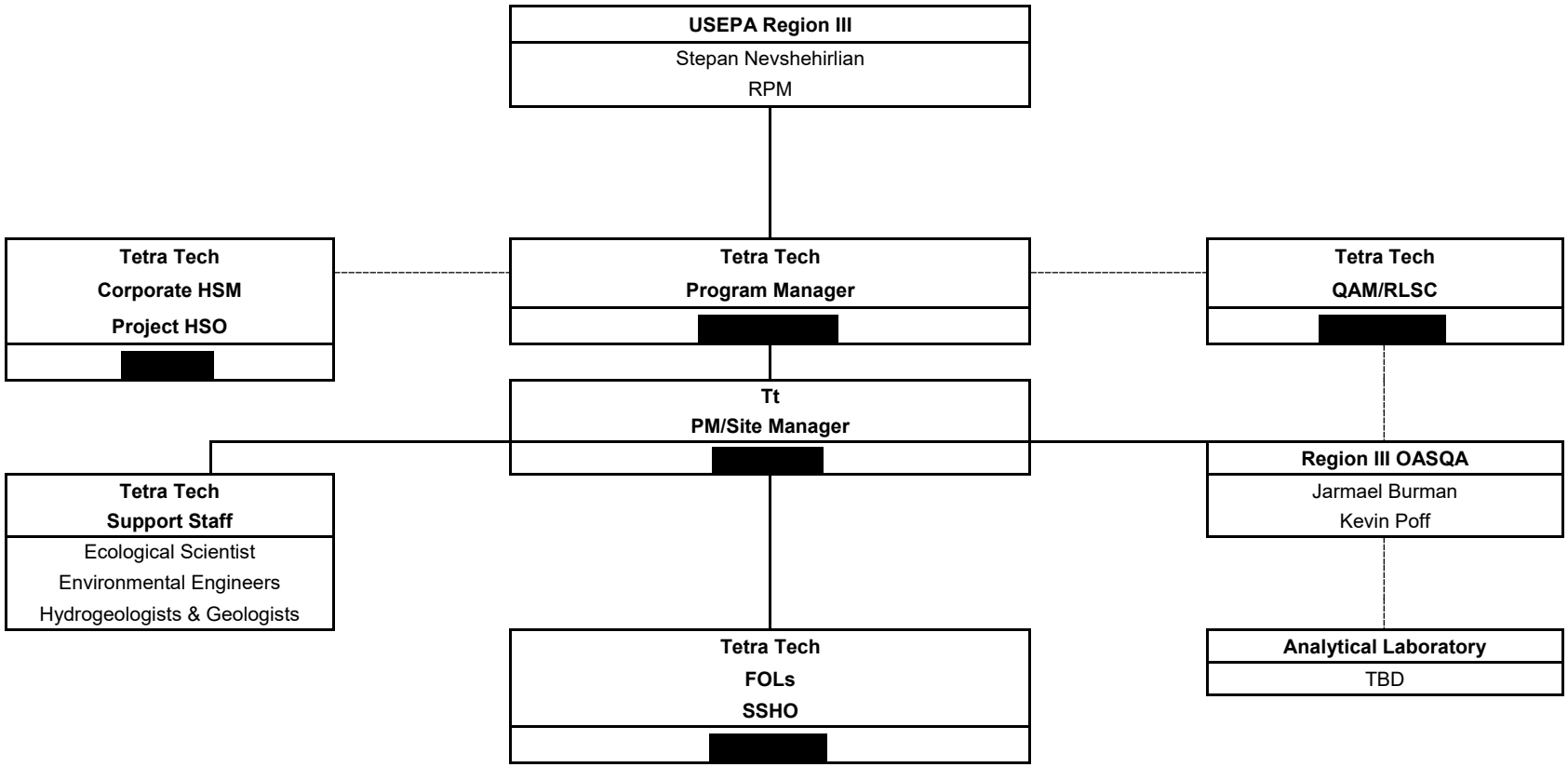
Streamlining Data Review Data Review Steps to Be Streamlined Criteria for Streamlining Data Review Amounts and Types of Data Appropriate for Streamlining	NA	NA

SAP Worksheet #3 and 5 – Project Organization and Distribution List

Line of Communication ----------
Line of Authority _____

PROJECT ORGANIZATION CHART



SAP Worksheet #3 and 5 – Project Organization and Distribution List

SAP Recipient	Title	Organization	Telephone Number	E-mail Address
Stepan Nevshehirlian	Remedial Project Manager	USEPA Region 3	(215) 814-3402	Nevshehirlian.Stepan@epa.gov
TBD	Office of Analytical Services and Quality Assurance (OASQA) Quality Assurance Team	USEPA Region 3	NA	R3ESC-QA@epa.gov
Jake McDougal	Program Manager – Superfund and Federal Facilities Restoration	WVDEP – Division of Land Restoration	(304) 389-7596	jason.s.mcdougal@wv.gov
[redacted]	Project Manager (PM)	Tetra Tech	[redacted]	[redacted]
[redacted]	RAC 3 Quality Assurance Manager (QAM) / Regional Laboratory Services Coordinator (RLSC)	Tetra Tech	[redacted]	[redacted]
[redacted]	Field Operations Lead (FOL)	Tetra Tech	[redacted]	[redacted]
[redacted]	Site Safety and Health Officer (SSHO)	Tetra Tech	[redacted]	[redacted]
[redacted]	Project Safety and Health Officer (PSHO)	Tetra Tech	[redacted]	[redacted]

SAP Worksheet #4, 7, and 8 – Personnel Qualifications and Sign-off Sheet

Name	Title	Experience/Training	Signature/Date
Organization: USEPA			
Stepan Nevshehirlian	Remedial PM	NA	Signature on Worksheet #1
Organization: WVDEP			
Jake McDougal	WVDEP PM	NA	
Organization: Tetra Tech			
[redacted]	PM	30 years of professional experience. B.A. Chemistry	Signature on Worksheet #1
[redacted]	QAM	20 years of professional experience. B.S. Biology	Signature on Worksheet #1
[redacted]	Program Health and Safety Manager	30 plus years of professional experience. B.S, Safety. CIH/CSP. 40-hr. Hazardous Waste Operations and Emergency Response (HAZWOPER) with current 8-hr. refresher	
[redacted]	PSHO	30 years professional experience. B.S. Biology. CSP. 40-hr. HAZWOPER with current 8-hr. refresher. First Aid/CPR trained.	
[redacted]	SSHO	10 years professional experience. G.S. Applied Geology. 40-hr. HAZWOPER with current 8-hr. refresher. First Aid/CPR trained.	
[redacted]	FOL	10 years professional experience. G.S. Applied Geology. 40-hr. HAZWOPER with current 8-hr. refresher. First Aid/CPR trained.	
TBD	Field Personnel	40-hr. Hazardous Waste Operations and Emergency Response (HAZWOPER) with current 8-hr. refresher	

Additional personnel qualifications are available on request.

Certification that project personnel have read the text will be obtained by one of the following methods as applicable:

1. In the case of regulatory agency personnel with oversight authority, approval letters or e-mails will constitute verification that applicable sections of the SAP have been reviewed. Copies of regulatory agency approval letters / e-mails will be retained in the project files as project records (see Worksheet #29).

2. E-mails will be sent to the listed USEPA, WVDEP, Tetra Tech, and subcontractor project personnel who will be requested to verify by e-mail that they have read the applicable SAP / sections and the date on which they were reviewed. Copies of the verification e-mail will be included in the project files (see Worksheet #29).

   A copy of the signed Worksheet #4, 7, and 8 will be retained in the project files and is identified as a project record in Worksheet #29.

Key personnel will be instructed to read the SAP portions indicated in this worksheet prior to attending an internal site-specific kick-off meeting for field activities. The Tetra Tech PM will track when the reviews have been completed, obtain signatures, and ensure that the completed sign-off sheet is included in the central project file.

SAP Worksheet #6 - Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Overall implementation of the project	USEPA PM	Stepan Nevshehirlian	(215) 814-3402	Open communication via telephone, email, or face to face meetings will occur among these primary points of contact for USEPA and contacts for other stakeholders, as required.
QA issues during implementation of the project	USEPA OASQA Tetra Tech QAM	TBD [redacted]	TBD [redacted]	Tetra Tech will notify USEPA district personnel verbally or via email of significant quality issues.
Deviation from SAP (significant enough to potentially prevent attainment of project objectives or increase risk/liability of USEPA)	Tetra Tech FOL Tetra Tech PM USEPA PM	[redacted] [redacted] Stepan Nevshehirlian	[redacted] [redacted] (215) 814-3402	The FOL will verbally notify Tetra Tech's PM who, in turn, will contact USEPA. The PM or designee will complete a Field Task Modification Request (FTMR) to document the deviations.
Minor change to SAP	Tetra Tech FOL Tetra Tech PM USEPA PM	[redacted] [redacted] Stepan Nevshehirlian	[redacted] [redacted] (215) 814-3402	Will notify Tetra Tech's FOL of approval of minor change (verbal, written or electronic).
Major change to SAP (significant enough to alter Data Quality Objectives [DQOs])	Tetra Tech FOL Tetra Tech PM USEPA PM	[redacted] [redacted] Stepan Nevshehirlian	[redacted] [redacted] (215) 814-3402	Will notify USEPA prior to implementation for review/ approval; will notify Tetra Tech's FOL of approval of major change (verbal, written or electronic); USEPA and Tetra Tech's PM must sign official corrective action documentation (FTMR) (written only).
Technical issues that create schedule delays or could prevent attainment of project objectives	Tetra Tech PM Tetra Tech FOL Tetra Tech QAM USEPA PM	[redacted] [redacted] [redacted] Stepan Nevshehirlian	[redacted] [redacted] [redacted] (215) 814-3402	The person identifying the issue will communicate verbally or via email with the Tetra Tech FOL, PM, or QAM to communicate the concern to them and develop an appropriate path forward. The Tetra Tech PM will consult the USEPA as necessary.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure
Sample quality issue (e.g., broken sample bottles, incorrect preservation)	Laboratory PM	TBD	TBD	The person identifying the issue will notify the Tetra Tech FOL, who will then contact Tetra Tech's PM and/or Tetra Tech's QAM to determine corrective action (verbal, written, or electronic).
Corrective action for sample quality issue	Tetra Tech QAM	[redacted]	[redacted]	Will respond to issues from laboratory through USEPA (Contract Laboratory Program [CLP]) or directly (Tier IV laboratory) with potential corrective action (verbal, written, or electronic). The PM will consult the USEPA if systemic performance is a concern.

SAP Worksheet #9 - Project Planning Session Summary

Site Name/Project Name: Shaffer Equipment/Arbuckle Creek Area Site

Site Location: Minden, Fayette County, West Virginia
Operable Unit: NA
Date of Session: April 17, 2019 Scoping Session; May 14, 2019 Site Visit; and May 21, 2019 Follow-up Conference Call
Scoping Session Purpose: To discuss the scope of work for the project.

Comments/Decisions: Below is a summary of the scoping session, site visit, and the follow-up conference calls, where the scope of the sampling necessary to complete the RI was discussed. Appendix A contains the minutes and summaries of these discussions.

During the April 17, 2019 scoping session, the site background, prior investigations/actions and upcoming data collection were discussed. The team agreed that the field work will be done in phases. Phase I will focus on SEC Property soil and groundwater sampling. Phase II will include residential soil sampling, sediment/surface water sampling, and sampling of the Berwind Green Hill Mine Dump Area, N R & P Supply House and Rocklick Road. Phase II could include porewater sampling, mine pool discharge, biological sampling, and any other data needed to complete the RI report.

On May 14, 2019 a site visit was completed by the Project Team. The project areas were toured along with confluence of Arbuckle Creek and the New River.

Tetra Tech submitted on May 17, 2019, a summary of proposed sampling activities for the site. A follow up conference call with USEPA occurred on May 21, 2019 to the discuss the proposed sampling. In general, USEPA agreed with the approach outlined, with the addition of some additional sampling in certain areas.

During subsequent phone calls with USEPA, it was agreed that PCB wipe samples would be collected from inside residential properties.

Based on comments on the SAP and discussions with the Team, a phased approach will be implemented for sampling. Soil sampling at the SEC Property, Britt Bath House Area, Possible Transformer Area, Berwind Green Hill Mine Dump Area, N R & P Supply House, and Rocklick Road will be conducted, along with residential sampling and surface water and sediment sampling in Arbuckle Creek and New River. Well installation and groundwater sampling will be completed after the results of the soil, surface water, and sediment sampling are evaluated. An additional phase of investigation may be needed to collect data for porewater, mine pool discharge, and any other media needed to complete the RI report.

Action Items: Tetra Tech agreed to prepare the Work Plan and Budget Estimate, followed by the site-specific planning documents after the Work Plan is approved.

Consensus Decisions:	Not applicable
Meeting Attendees (Scoping Session):	USEPA Region III – Stepan Nevshehirlian, Justin Bleiler, Melissa Linden, Andrea Bain, Kathy Davies, Bruce Pluta, Cathleen Kennedy, and Evelyn Sorto WVDEP – Bill Huggins, Ross Brittain, and Jake McDougal ATSDR – Christine Lloyd, Anthony Trubiano, and Jill Dyken Tetra Tech – [redacted], [redacted], and [redacted] Weston – [redacted]

SAP Worksheet #10 - Conceptual Site Model

10.1 SITE DESCRIPTION AND HISTORY

SEC conducted operations at a facility located on the western end of the Town of Minden, West Virginia from approximately 1970 until 1983. The company built electrical substations for the coal mining industry. The former SEC Property, approximately 5 acres, is located within the floodplain of Arbuckle Creek, which borders the property to the north. The site slopes slightly to the north towards Arbuckle Creek. The site is in a valley with a steep hillside south of the site. A roadway to the east separates the site from residential structures. Figures 1 and 2 show the site location.

Inspections of the former SEC facility in 1984 by the WVDNR and USEPA found that PCB-containing electrical transformers were being mismanaged. Hundreds of transformers and capacitors were observed across the property; a majority of them were found resting on their sides. Several of the transformers and capacitors had broken insulators with heavy oil spillage evident on the ground surface.

Historical activities at SEC, including the mismanagement of PCB-containing electrical transformers, resulted in the release of PCBs to the environment. Contaminated soil and sediment from the site have also been transported from the site via the periodic flooding of Arbuckle Creek and the dredging of sediment in Arbuckle Creek. In addition, PCB-contaminated soil is reported to have been used for dust suppression measures along Rocklick Road.

10.2 PHYSICAL CHARATERISTICS OF THE SITE

The SEC Property in Fayette County, West Virginia is situated in the Appalachian Plateaus Physiographic Province of West Virginia. Topographically, the Appalachian Plateaus Province is characterized by a series of uplifted, dissected plateaus. The major tributaries have eroded broad, deep, steep-sided valleys; local relief along the valleys may exceed 1,000 feet. The drainage pattern exhibited is dendritic (NUS, 1991a).

The area around Arbuckle Creek is mostly underlain by Dekalb and Gilpin, very stony soils (NUS, 1991a). The Dekalb Series consists of moderately deep, well-drained soils found on ridge tops, hillsides, and mountainsides and formed in acid material weathered from sandstone. The Gilpin Series consists of moderately deep, well-drained soils found on rolling shale ridges and mountainsides and formed in acid material weathered from sandstone, siltstone, and shale. Some areas of concern near the SEC Property that are also being investigated are mostly underlain by mine dump debris including the area at the NR&P Supply House and Berwind Green Hill Mine Dump Area (aka Needles Eye) (NUS, 1990d and 1990e).

The former SEC Property and most of the surrounding area along Arbuckle Creek are underlain by the Pennsylvanian New River Formation (Pottsville Group). Groundwater in the Pottsville Group occurs in and moves through primary interstitial openings and secondary openings developed in the sedimentary bedrock. The strata in the study area have been only slightly deformed by tectonic activity so that secondary openings, such as fractures and joints, are minor, laterally discontinuous, and narrow (NUS, 1991a). Joints and fractures in the area appear to serve as water conduits and not as water-storage reservoirs. Rocks in the study area are probably hydraulically interconnected via the joint and fracture openings. Groundwater recharge occurs primarily through the infiltration of local precipitation, and groundwater discharge is by wells, seeps, springs, and streams. Aquifers developed in the New River Formation are capable of yielding sufficient quantities of potable water for most uses. Groundwater flow direction beneath the site is not known; however, groundwater is expected to flow toward Arbuckle Creek.

Palustrine and riverine wetlands have been identified in the study area (NUS, 1991a). Palustrine wetlands identified include unconsolidated bottom, scrub/shrub, and forested. Riverine wetlands identified include unknown perennial unconsolidated shore and unknown perennial unconsolidated bottom. The nearest wetlands to the site, greater than five acres, have been delineated and are approximately 0.5 miles east of

the eastern boundary of the former SEC Property and include a palustrine unconsolidated bottom. The wetlands are hydraulically interconnected with the shallow aquifers and serve as additional discharge points. They do not lie within the drainage pathway of the site. However, although drainage does not flow directly from the site to the wetland, it can migrate there via flooding of Arbuckle Creek.

10.3 REGIONAL GEOLOGY

The site is situated in the Appalachian Plateau Physiographic Province of West Virginia. The Appalachian Plateau Province is a large, elongated structural basin that contains up to 15 kilometers of Paleozoic age sedimentary rocks. Non-marine to shallow marine sedimentary structures and fossils characterizes the sedimentary sequence and indicate that deposition in the basin was in shallow environments on a slowly subsiding crust and not into an originally deep basin. In general, the individual rock units are laterally discontinuous and cannot be traced over large areas of the basin. At the close of the Pennsylvanian Period during the Allegheny Orogeny, the rocks within the Appalachian Plateaus Province were moderately deformed as a result of continental collision. The northwestward-directed tectonic compressional forces produced by continental collision folded the rocks into northeast-southwest-trending synclines and anticlines. The rocks in the Appalachian Plateaus are gently folded and often nearly flat lying dipping less than 2 or 3 degrees). Structurally, the folding is much less intense than that found to the east in the adjacent Valley and Ridge Physiographic Province. Stress-relief fracturing has occurred in major valleys where significant amounts of the overlying strata have been removed. Tectonic fractures and stress-relief fractures account for a majority of the porosity and permeability found in the rocks. Topographically, the Appalachian Plateaus Province is characterized by a series of uplifted, dissected plateaus. The major tributaries have eroded broad, deep, steep-sided valleys; local relief along the valleys may exceed 1,000 feet. The drainage pattern throughout the Appalachian Plateau is dendritic (NUS, 1991a).

The Pennsylvanian age Kanawha Formation (Pottsville Group) stratigraphically overlies the New River Formation where it has not been eroded. The Kanawha Formation ranges in stratigraphic thickness from 0 to 1,370 feet in the Fayette County area and consists predominantly of sandstone, with some shale, siltstone, and coal. Several marine zones have been noted in the Kanawha Formation. The Kanawha Formation extends from the top of the Homewood Sandstone to the top of the Upper Nuttall Sandstone and includes Stockton (Mercer), Coal burg, Winifrede, Chilton, Williamson, Cedar Grove, Alma, Peerless, Campbell Creek, Eagle, Gilbert, and Douglas coals. In the study area, the Kanawha Formation caps the dissected plateaus between major stream valleys (NUS, 1991a).

In the area of Minden, West Virginia, the Pennsylvanian Age New River Formation (Pottsville Group) is typically the upper most formation. The New River Formation ranges in stratigraphic thickness from 0 to 730 feet in the Fayette County area and consists predominantly of sandstone, with some shale, siltstone, and coal. Minor amounts of conglomeratic sandstone may be present. The New River Formation extends from the top of the Flattop Mountain Sandstone to the top of the Upper Nuttall Sandstone and includes Pocahontas Coal Nos. 8 and 9, and Iaeger, Sewell, Welch, Raleigh, Beckley, and Fire Creek coals (NUS, 1991a).

Below the New River Formation lies the Pennsylvanian Age Pocahontas Formation (Pottsville Group) and is only exposed near the Site in the incised valley of the New River. The Pocahontas Formation has a maximum stratigraphic thickness of 400 feet and consists predominantly of sandstone some shale, siltstone, and coal. The Pocahontas Formation extends from the top of the Flattop Mountain Sandstone to the top of the Mississippian. Includes from Pocahontas coals Nos. 1 through 7.

10.4 SITE HYDROGEOLOGY

In 2001, four monitoring wells were installed around the cap at the SEC Property. During installation auger refusal was encountered between 9 and 10 feet bgs. Subsurface materials encountered included unconsolidated silty sand with cobbles. No environmental investigations have been completed in the

bedrock; however, based on the regional geology, the bedrock in the area of Minden, West Virginia is likely sandstone with varying thicknesses of shale with potential coal seams.

Groundwater in the Pottsville Group occurs in and moves through primary interstitial openings and secondary openings developed in the sedimentary bedrock. The strata in the vicinity of the Site have been only slightly deformed by tectonic activity so that secondary openings, such as fractures and joints, are minor, laterally discontinuous, and narrow. Joints and fractures in the area appear to serve as water conduits and not as water-storage reservoirs. Groundwater in the study area are hydraulically interconnected via the joint and fracture openings. Groundwater recharge occurs primarily through the infiltration of local precipitation, and groundwater discharge is by wells, seeps, springs, and streams. Localized seasonal fluctuations in water levels are common and are the result of an increase or decrease in the amount of water available for infiltration (NUS, 1991a).

10.5 WATER SUPPLY

Per the 2018 Expanded Site Inspection (ESI), the West Virginia American Water Company supplies potable water to persons within a 4-mile target distance limit via a surface water intake on the New River located upstream of its confluence with Arbuckle Creek (Weston Solutions, 2018a). The report indicated that groundwater within 4-mile target distance limit of the site was not used for drinking water. No surface water intakes are located within a 15-mile target distance limit (Weston Solutions, 2018a).

10.6 PREVIOUS INVESTIGATIONS

To identify the source and extent of PCBs present in soil and sediment, the following project areas have been investigated as areas of concern:

- Area of SEC activities, including the former SEC Property and adjacent Possible Transformer Storage Area to the east
- Britt Bath House Area
- Arbuckle Creek within the limits of the former SEC Property and approximately 1 mile downstream
- Residential properties located along Arbuckle Creek
- Rocklick Road
- NR&P Supply House
- Berwind Green Hill Mine Dump Area (Needles Eye)

The following paragraphs summarize each project area and previous investigations conducted within each area. Figure 2 shows each project area.

10.6.1 Shaffer Equipment Company Property

The area of interest at the former SEC Property include the western portion where transformers were found during the 1984 inspection and the area to the east where transformers were possibly stored. The subsequent investigations are described in the ESI (Weston Solutions, 2018a), and a detailed timeline is presented in the 2003 Removal Action Report (International Consultants, 2003). The previous investigations are only briefly noted in this section.

A Preliminary Site Assessment was conducted on October 3, 1984 by WVDNR and USEPA (NUS, 1990a). During the 1984 Preliminary Assessment, 150 transformers, 60 capacitors, and 75 drums were observed at the site (USEPA, 1984). Sampling conducted during the Preliminary Assessment at eight locations indicated PCB concentrations ranging from 3 parts per million (ppm) to more than 20,000 ppm (NUS, 1990a). Additional sampling was conducted in November 1984 through February 1985 to more fully characterize the site; samples were analyzed for PCBs. A review of the analytical data for sediment

samples collected from runoff ditches and Arbuckle Creek revealed that PCB contamination had migrated from the site to Arbuckle Creek and downstream locations.

Hazards posed by the site led to a request for an emergency removal action, and initial investigative site activities began in December 1984 and were completed in December 1987 (USEPA, 1987). The removal action included the removal and disposal of 4,735 tons of soil from an approximate 1-acre area, shown on Figure 6 Appendix B, that contained PCBs at concentrations greater than 50 ppm in soil (Figure 3 in Appendix B), as well as the removal of capacitors, transformers, and drummed liquids generated from draining and flushing transformers (USEPA, 1987). The depth of excavation ranged from 6 inches below ground surface (bgs) to 24 inches bgs (Figure 6 in Appendix B). Confirmatory samples of the excavated areas were taken to ensure effective PCB removal (USEPA, 1987). Both areas were excavated to PCB levels less than 50 ppm. Soil from the 1984 removal was transferred onto a clay-lined staging pad prior to disposal at a landfill in Emelle, Alabama. Other activities included rerouting water lines, fencing the site, and establishing temporary containment ponds to prevent contaminated runoff from migrating from the site. The excavation area and staging pad were located in the area west of the present-day capped area.

Following the initial removal action activities, a Trip Report (NUS, 1990a) was prepared that summarized additional sampling results for surface soil, subsurface soil, surface water, sediment, and public water. Groundwater samples were collected from the mouth of a nearby mine to address concerns raised by Concerned Citizens to Save Fayette County that PCBs were dumped directly into the drift mouth of the Minden Mine. Appendix B includes a figure from the Trip Report showing the location of samples collected at the site in 1990. Several of the samples were in areas with known transformer storage or oil stained soil. Several of these areas from the investigation showed elevated levels of contaminated such as 1, 2, 4-trichlorobenzene and Aroclor-1260. Based on an evaluation of present day verse historical mapping, the majority of these samples appear to be located under the present-day capped area (Figure 2.1B in Appendix B). Two of the samples (SD-7 and SD-8) that showed higher levels of 1, 2, 4-trichlorobenzene and Aroclor-1260 were taken from sediment found in drainage ditches.

The drainage ditch at SD-8 bisected the site and was located in an area that had been excavated to a depth of 24-inches bgs; PCB concentrations in the confirmatory samples collected from this area were less than 50 ppm. Sample SD-7 was collected from a drainage ditch at the northwestern corner of the former Shaffer Equipment building. Additionally, there is another ditch located between the SD-8 and SD-7 samples, that has been historically observed to have elevated concentrations of PCBs. This additional drainage ditch area and the drainage ditch associated with sample SD-7 both appear to be located under the present-day cap. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, and PCBs. The data provided in the 1990 Trip Report indicates that select VOCs, SVOCs, pesticides, PCBs, and metals were detected at concentrations above laboratory reporting limits. PCBs, the primary contaminants of concern, were detected in the majority of soil and sediment samples obtained from the site but were detected in residential soil at concentrations less than USEPA Toxic Substances Control Act (TSCA) cleanup guidelines for residential soil. In addition, PCBs were not detected in the public water supply sample nor the mine mouth sample. Appendix B includes the analytical summaries provided in the 1990 Trip Report.

A second removal action was conducted from November 1990 through January 1991 at eight areas (Figures 15 and 16 in Appendix B) on the site (USEPA Region 3 TAT, 1994). The areas were excavated to depths of 1 inch, 6 inches, or 3 feet bgs based on PCB concentrations determined via field screening methods (International Consultants, 2003). The excavated areas were backfilled with soil from a borrow area south of the SEC Property. PCB concentrations ranged from 0.1 to 1,000 ppm in the backfilled area. Area 1 is located where excavation took place west of the present-day capped area in 1984. Areas II, III, IV and V are located under the present-day capped area. Results from Areas VII and VIII came back clean (International Consultants, 2003); however, post excavation results from area VI were found to be 722 ppm for PCBs at 3 feet bgs.

In 1993, the USEPA Region 3 Technical Assistance Team (TAT) was tasked to perform a site review at the SEC Property (USEPA Region 3 TAT, 1994). Additional samples were collected from the SEC Property and off SEC Property areas. Several soil samples were collected from a pit area southeast of the SEC Property to address concerns raised by Concerned Citizens to Save Fayette County that SEC had dumped PCB-contaminated oil in the area. The pit area was identified by a former employee of SEC; however, he did not have personal knowledge of any dumping activities. It was claimed that PCB-contaminated oil was disposed of in a 14-foot deep pit area from 1973 and 1974. The pit area identified was approximately 250 feet long and 30 to 40 feet wide. Appendix B includes a figure showing the location of samples collected in 1993 from the SEC Property. Samples were screened in the field for PCBs, and select samples were analyzed in a laboratory for PCBs. No PCBs were detected in the samples collected from the pit area. PCB concentrations in the remaining samples (those not collected from the pit area) ranged from 0.36 to 59.9 ppm in samples collected for fixed-base laboratory analysis. Appendix B includes the analytical summaries provided in the 1993 site review.

In 2001, remediation activities began on construction of an impervious cap/barrier over the contaminated soil, placement of a sheet pile cutoff wall along portions of Arbuckle Creek to eliminate migration of contaminants from the site, surface diversion and drainage ditches, installation of four new wells for groundwater monitoring purposes, as well as stone slope protection along Arbuckle Creek (International Consultants, 2003). An impervious cap was installed over the PCB-contaminated soil, and layers of clean soil and topsoil were placed on the area, and the area was seeded for re-vegetation. Appendix B includes a figure showing the location of the capped area.

The ESI conducted by Weston Solutions involved the collection of some samples from the SEC Property to determine the extent of PCB contamination along Arbuckle Creek (Weston Solutions, 2018a). Investigations for the ESI were conducted in June 2017, December 2017, March 2018, and June 2018. Appendix B includes figures showing the locations of samples. Appendix B includes the analytical summaries provided in the ESI (Weston Solutions, 2018a). The samples collected within the SEC Property and Arbuckle Creek areas are summarized below.

In June 2017, five surface soil samples plus one duplicate (SS33 through SS37, SS40), three subsurface soil samples (SB05, SB07, and SB08), and seven groundwater samples (GW001 through GW007) were collected from the SEC Property and Arbuckle Creek and analyzed for PCBs (Weston Solutions, 2018a). The sampling occurred 10 days following a major flood event. Surface soil samples were collected from 0 to 6 inches bgs, and subsurface soil samples were also collected. Three of the groundwater samples (GW005 through GW007) were collected from mine outfalls located on the SEC Property, and four of the groundwater samples (GW001 through -GW004) were collected from monitoring wells. Several surface soil samples and groundwater samples from the outfalls were also analyzed for dioxins.

In December 2017, two surface soil samples (SEC-SS-SE-01 and SEC-SS-SE02) were collected from 0 to 6 inches bgs and analyzed for PCBs. Sample SEC-SS-SE-01 was collected just outside of the excavated area, and SEC-SS-02 was collected beneath a compounded section of the capped area.

In March 2018, eight soil samples (SS-202, SS-205 through SS-211) plus one duplicate were collected from 0 to 6 inches bgs and analyzed for PCBs.

In June 2018, samples included sediment samples from mine portal discharge channels, and one of these sediment samples collected outside of a mine portal (SD-98) was located within the area of former SEC Property activities.

The majority of the SEC Property PCB concentrations from samples collected during the ESI were less than laboratory detection limits. Two samples SEC-SS-SE-01 and SEC-SS-SE-02 had detections of total PCBs of 54 mg/kg and 0.530 mg/kg respectfully. Based on discussions with the USEPA, planning documents are being prepared for the excavation of the PCB-contaminated soil at location SEC-SS-SE-01.

10.6.2 Britt Bath House Area

The Britt Bath House Area of the site is located immediately north of the former SEC Property on the northern side of Arbuckle Creek. It is estimated that the property was obtained by the Berwind Land Company in the early 1920s; the company was known as NR&P from the 1940s to 1960s (NUS, 1991b). The property was sold to a private owner in 1980 (NUS, 1990b). The Britt Bath House Area consisted of a large brick building, which was the former bath house, and a small brick building south of the main building located on approximately 3 acres of land. The immediate area around the buildings is heavily wooded and overgrown. Surface water runoff flows south to Arbuckle Creek. A drainage ditch parallels the western side of the former bath house and flows south toward the creek.

The bath house was used by miners employed at the nearby former NR&P Minden Mine (NUS, 1990b). The mine and bath house were in operation from the 1920s to the late 1950s or early 1960s (NUS, 1990b). The bath house building was then used by SEC for storage of miscellaneous equipment including switch gear, cabinets, and floodlights, among other things, until the late 1970s (NUS, 1990b). However, the date the SEC started using the building for storage is not known. At one point in the late 1980s to early 1990s, the former bath house was used as a garage for repair of cars and trucks, and the small building was used as a repair shop for televisions (NUS, 1990b). The past owner also used the property to repair mining equipment and infrequently refurbished transformers.

A Preliminary Assessment was conducted by NUS in June 1990 because of the concern that an abandoned transformer may have leaked PCB-contaminated oil onto the surrounding soil (NUS, 1990b). The abandoned transformer was identified by the Concerned Citizens to Save Fayette County and was observed during the site visit conducted on June 19, 1990. The abandoned transformer was open at one end, and the case was empty, except for some small pieces of sheet metal. There was no evidence during the site visit of stained soil or stressed vegetation in the vicinity of the abandoned transformer; therefore, it was considered unlikely the transformer contained oil. The owner at the time reported he did not know how the transformer had gotten to the site and indicated it had been on the property less than a year since the owner did not notice the transformer before December 1989. The identification plate indicated the transformer was manufactured in 1927. Although PCBs were not used in transformer oil at that time the unit was manufactured, it cannot be certain that PCB oil had never been added to the transformer. It is also unknown if SEC had ever stored transformers or other potential sources of PCBs at the Britt Bath House Area.

A Site Inspection (SI) of the Britt Bath House Area was conducted by NUS in 1991 to determine if PCB contamination was present based on the presence of the abandoned transformer found on the Britt Bath House Area during the 1990 Preliminary Assessment. During the 1991 SI, samples were collected at ten surface soil locations from locations near the transformer, trash burn barrels, and a debris pile, and in drainage pathways near the transformer and burn barrel (NUS, 1991b). Appendix C includes a figure showing the location of soil samples collected from the Britt Bath House Area. Samples were analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. The data provided in the 1991 SI Report indicates that select VOCs, SVOCs, PCBs, and metals were detected above laboratory reporting limits. PCBs were only detected near a 55-gallon scrap drum located to the east of the former bath house (2,600 micrograms per kilogram [µg/kg] of Aroclor-1248) and within the drainage ditch leading from this drum to the creek (300 µg/kg of Aroclor-1248). The remaining samples, including the samples collected near the abandoned transformer, did not have detected concentrations of PCBs. Appendix C includes the analytical summaries provided in the SI.

During the ESI conducted by Weston Solution in June 2018, some samples were collected from the Britt Bath House Area to determine the extent of PCB contamination along Arbuckle Creek (Weston Solutions, 2018a). Two sediment samples (SEC-SD-81 and SEC-SD-82) were collected in a drainage channel near a mine outfall pipe approximately 200 feet north of Arbuckle Creek near the western portion of the area. Two soil samples (SEC-SS-248 and SEC-SS-249), one sediment sample (SEC-SD-95), and one groundwater sample plus a duplicate (SEC-GW-01 and SEC-GW-02) were collected from a potential mine

hole 20 feet deep located approximately 50 feet north of Arbuckle Creek. Appendix B includes figures showing the location of collected samples. The samples were analyzed for SVOCs, polycyclic aromatic hydrocarbons (PAHs), pesticides, PCBs, and metals. PCBs were not detected in these samples. The analytical results are also included in Appendix B.

10.6.3 Arbuckle Creek Area

Arbuckle Creek flows east for approximately one mile past the former SEC Property and approximately two additional miles through the New River Gorge National River park to its confluence with the New River. The main area of concern is the length of the creek within approximately one mile downstream of the former SEC Property, and the secondary area of concern is the two-mile stretch in the National River park. Areas adjacent to Arbuckle Creek are mainly residential (Weston Solutions, 2018b). A wetland delineation was conducted in 2018, and seven wetlands were identified adjacent to Arbuckle Creek (Weston Solutions, 2018b).
It is a relatively small, shallow low gradient perennial creek through most of its length ranging from a few feet wide in the upstream portion and then increasing to 20 to 30 feet wide further downstream of the New River Gorge National River Park boundary.

The creek is generally less than one to two feet deep throughout much of its reach; however, there are some deeper pools in the further downstream portion. Large sections of the channel are relatively straight but there are some bends in the channel throughout the creek where deposition can occur. Arbuckle Creek becomes a higher gradient stream downstream of New River Gorge National River Park boundary, where the banks become very steep upstream of where it enters the New River. There are few depositional areas between this point and where it subsequently discharges into the New River. Sediment from Arbuckle Creek will ultimately be transported to the New River, especially during heavy rain events. Arbuckle Creek is not a known fishery, but many small fish were observed in several portions of the creek during site visits.

In recent years, the creek has been known to flood approximately four to five times a year. Additionally, historic flood events occurred in the eastern portion of West Virginia in 1985, as well as specifically in Minden, in July 2001, June 2016, and June 2017. In the summer of 1984, prior to the discovery of PCB contamination on the SEC Property, in an effort to control the periodic flooding of Arbuckle Creek, the creek was dredged and the sediment were allegedly placed on residential properties in the form of berms for flood control and as backfill to restore yards to grade and in abandoned mine piles (NUS, 1991a). These berms were observed during the 1990 Preliminary Assessment (NUS, 1990c).

Samples from drainage ditches from the former SEC Property to Arbuckle Creek and from within the creek collected during initial investigations in 1984 and 1985 revealed migration of PCBs off site to Arbuckle Creek (NUS, 1990a). Additional sampling was conducted in November 1984 through February 1985 to more fully characterize the site, and the samples were screened for PCBs. A review of the data for runoff ditch and creek samples revealed that PCB contamination had migrated off site to Arbuckle Creek. PCBs were detected in most soil and sediment samples collected from the site in 1990. Appendix D includes a figure showing the sample locations and analytical summaries from the 1990 Trip Report.

During the 1991 SI, surface soil samples were collected along the bank of Arbuckle Creek (S-13, S-14, S-17). Some of these were also obtained from locations within residential yards. Surface water (SW-1 through SW-3) and sediment samples (SD-1 through SD-8) were also collected (NUS, 1991a). Appendix D includes a figure showing the location of soil samples collected from the Arbuckle Creek Area. Samples were analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. PCBs were widespread, occurring in most soil and sediment samples. No PCBs were detected in surface water. Appendix D includes the analytical summaries provided in the SI Report.

The ESI conducted by Weston Solutions included collection of surface water and sediment samples from Arbuckle Creek as part of the investigation of the extent of PCBs along Arbuckle Creek (Weston Solutions, 2018a). Investigations for the ESI, which included sediment and surface water collection, were conducted

in June 2017, December 2017, March 2018, May 2018, and June 2018. Appendix B includes figures showing the locations of collected samples. Appendix B included the analytical summaries provided in the ESI (Weston Solutions, 2018a).

In June 2017, 25 surface water and sediment samples including two duplicates were collected from locations along Arbuckle Creek up to one mile downstream of the former SEC Property. Two samples (SW/SD-24 and SW/SD-25) were collected upstream of the former SEC Property. Samples were analyzed for PCBs with select samples analyzed for dioxins.

In December 2017, 28 additional sediment samples including one duplicate were collected from locations biased toward locations that contained elevated PCB concentrations in the June 2017 sediment samples.

In March 2018, seven sediment samples including one duplicate were collected; however, these samples were all collected over one mile downstream of the former SEC Property within the New River Gorge National River park and analyzed for PCBs.

In May 2018, 11 sediment samples were collected over one mile downstream of the former SEC Property within the New River Gorge National River park, and four sediment samples (SD-67 to SD-70) were collected from a wetland area immediately downstream of the former SEC Property.

In June 2018, sediment samples included two samples upstream of the former SEC Property (SD-71 and SD-72) and six samples (including one duplicate) adjacent to the former SEC Property (SD-73 to SD-78), as well as some collected from mine portals and on residential properties (see section 10.6.4).

The samples collected from the ESI confirmed the results of the SI Report i.e., that PCBs are widespread throughout the sediment in Arbuckle Creek. PCB results ranged from concentrations less than laboratory reporting limits to 50 mg/kg in SD-6. Figures 9 and 10 depict the sediment PCB sample results with sample locations being color-coded to show ranges of PCB concentrations. There were no PCBs detected in the sediment background locations.

PCBs were also not detected in the sediment samples collected from outside of Arbuckle Creek or wetlands near the creek.

No PCBs were detected in any of the surface water samples collecting during the ESI.

Only one groundwater sample had a PCB concentration greater than laboratory reporting limits. The sample collected from GW-001 had a PCB concentration of 3.7 µg/L.

10.6.4 Residential Properties located along Arbuckle Creek

Residential properties are located within the floodplain of Arbuckle Creek downstream of the former SEC Property. Sediment from the creek were allegedly placed on residential properties in 1984 in the form of berms for flood control, as backfill to restore yards to grade, and in abandoned mine piles (NUS, 1991a). Residents are located west of the property and downstream from the property to the east. The closest resident to the SEC Property is approximately 0.25 mile to the northwest. Residents are connected to a public water supply and do not have private wells (EPA Region 3 TAT, 1994).

Since the 1984 Preliminary Assessment (USEPA, 1984), additional sampling was conducted to define the extent of contamination. Collection of soil samples from residential properties downstream of the SEC Property have revealed PCB contamination. In January 1985, five soil samples were collected from residential yards 0.25 mile and 1 mile downstream of the former SEC Property within the floodplain of Arbuckle Creek (NUS, 1990a). The concentrations of PCBs were 11 and 15 ppm in four residential yards. Five additional residential yard samples collected in February 1985 had PCB concentrations ranging from 1 to 7 ppm at 0.3 to 1 mile downstream from the SEC Property (NUS, 1990a).

Following the initial SEC removal action activities discussed in Section 10.6.1 (SEC activities), a Trip Report was prepared by NUS (NUS, 1990a) that included sampling of surface soil, subsurface soil, surface water, sediment, and public water. A few of these samples were located on residential property along the creek bank (S-101 and S-102) and from between houses (S-107). Appendix B includes a figure showing the location of samples collected from SEC Property for the 1990 Trip Report. PCBs were detected in the majority of soil and sediment samples obtained from the site but were detected in residential soil at concentrations less than USEPA TSCA cleanup guidelines for residential soil. Appendix B includes the analytical summaries provided in the 1990 Trip Report.

The 1991 SI for the Arbuckle Creek Area included surface soil samples (S-3 to S-15) from residential yards (NUS, 1991a). Surface soil samples had PCB concentrations ranging from not detected to 5,100 µg/kg. Appendix B includes the analytical summaries provided in the 1991 SI.

In 1993, the USEPA Region 3 Technical Assistance Team was tasked to perform a site review at SEC Property (USEPA Region 3 TAT, 1994). Samples were collected from on and off property. During project planning, 32 occupied residences were identified within the flood plain along the south and north banks of Arbuckle Creek downstream of the former SEC Property. Several low-lying areas with the potential of being contaminated by sediment from the site were also identified. Based on the number of residences present, six soil samples were collected from residences (S-168, S-169, S-170, S-172, S-174, and S-175) and three samples from low lying areas (S-171, S-173, and S-176). Appendix B includes a figure showing the location of samples collected from SEC Property for the 1993 site review. Appendix B includes the analytical summaries provided in the 1993 site review.

During the ESI conducted by Weston Solutions, some samples were collected at residential properties and other areas throughout the Town of Minden as part of the investigation of the extent of PCBs along Arbuckle Creek (Weston Solutions, 2018a). Investigations for the ESI were conducted in June 2017, December 2017, March 2018, and June 2018 as summarized in Section 10.6.1. Appendix B includes figures showing the locations of collected samples. Appendix B included the analytical summaries provided in the ESI (Weston Solutions, 2018a). Some of the samples were collected from locations within the area of activities as described in Section 10.6.1; however, the remaining samples were collected from areas including residential properties and the wetland area. Some samples were background samples (SS-11, SS-12, SS-R5-01, SS-150 through SS-156) and were collected from residential properties upstream of the former SEC Property. Some of the residential areas sampled in March 2018 are located a distance away from Arbuckle Creek throughout the Town of Minden. Samples SS-112, SS-113, and SS-115, located south of Arbuckle Creek, and SS-124, located north of Arbuckle Creek, are located approximately 350 to 500 feet from the creek. In addition, the March 2018 surface soil sampling throughout the Town of Minden included samples at residential properties close to 1 mile downstream including SS-101 to SS-109. June 2018 sampling included surface soil from yards and sediment samples from drainage ditches on residential properties, including properties located approximately 900 feet north of the creek.

PCB were not detected in the majority of the background and residential soil samples collected during the ESI. However, PCB concentrations in the following residential samples ranged from 0.22 mg/kg in the SEC-SS-T8-04 to 1.4 mg/kg in SS-217: SS-14, SS-15, SS-26, SS-27, SS-42, SS-43, SS-105, SS-217, SS-223, SEC-SS-T8-04, SEC-SS-R2-01, and SEC-SS-R3-01.

10.6.5 Rocklick Road

Rocklick Road was identified by the Concerned Citizens to Save Fayette County as an area that received stream sediment from Arbuckle Creek in 1984 as part of a road fill and surfacing project. The sediment was dredged from Arbuckle Creek by an unknown contractor. There is anecdotal evidence that PCB-containing oil may have also been sprayed on the unpaved portion of the road for dust control.

The portion of Rocklick Road that received dredged sediment from Arbuckle Creek is approximately 1,000 square feet in size and is located on an unpaved portion of the road. Several residential dwellings are located near the area, which is immediately adjacent to Rocklick Creek. Appendix E contains a figure showing the location of the area.

An SI (NUS, 1991c) was conducted at Rocklick Road in 1991 to determine the extent of PCB contamination. During the SI, samples were collected at four soil locations plus one duplicate (S-1 to S-4), two surface water sample locations plus one duplicate (SW-2 to SW-4), and three sediment sample locations (SD-1 to SD-3). Appendix E contains a figure showing the location of samples collected at Rocklick Road. The samples were analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. PCBs were not detected in any of the samples. Appendix E includes the analytical summaries provided in the 1991 SI.

In 2002, the USEPA Remedial Site Assessment team decided that no further Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) pre-remedial assessment action be conducted at Rocklick Road based on the results of the 1991 SI Report (i.e., the absence of PCB contamination).

10.6.6 NR&P Supply House

The NR&P Supply House is located in the southern portion of Minden. The N R & P Supply House is an abandoned substation that contained six abandoned transformers in the basement of a building. No remnants of the building are currently above grade (NUS, 1990d). During the 1920s, the N R & P Supply House was used to store equipment and supplies for the coal industry. The above ground portion of the building was reportedly demolished in 1966 (NUS, 1990d). Also, there are two small building foundations on the northwest portion that were reportedly used at one time as a jail. Currently, the area is overgrown with brush and trees. Several residences are located near the N R & P Supply House. Appendix F contains a figure showing the location of the N R & P Supply House.

In 1989, the General Electric Company performed sampling at the site at the request of the property owner, the Berwind Land Company (NUS, 1990d). According to Berwind representatives, six transformers that had been stored in the basement of the supply house had been opened and their windings removed for scrap. Dielectric oil, which may have contained PCBs, may have been dumped in the building basement when the windings were removed. General Electric Company collected four surface soil samples outside the supply house basement and four surface water samples from the standing water inside the basement near the transformer remains and analyzed them for PCBs. No PCBs were detected in any of the samples.

Additional samples from the N R & P Supply House were collected as part of the 1991 SI (NUS, 1991d). Seven surface soil samples (S-1 through S-7) were collected from areas immediately surrounding the former supply house, and five sediment samples (SD-1 through SD-5) were collected from drainage ditches and low-lying areas leading from the area. Appendix F contains a figure showing the location of the samples. The samples were analyzed for VOCs, SVOCs, metals, cyanide, pesticides, and PCBs. PCBs were not detected in any samples collected. Appendix F also includes the analytical summaries provided in the 1991 SI.

In 2002, the USEPA Remedial Site Assessment team decided that no further CERCLA pre-remedial assessment action would be conducted at the N R & P Supply House based on the results of the 1991 SI Report (i.e., the absence of PCBs). An Executive Summary Report for the N R & P Supply House summarized the history and work completed for the area (Triad Engineering, 2006). As part of the Executive Summary Report, Triad conducted a Hazard Ranking System (HRS) of the area. The score calculated was 8.23. The report concluded that based on previous site investigations and the low HRS score, there does not appear to be a significant risk associated with the area.

During the ESI conducted by Weston Solutions, two sediment samples (SD-101 and SD-102) were collected from locations immediately downgradient of the N R & P Supply House (Weston Solutions,

2018a). The samples were analyzed for PCBs, pesticides, SVOCs, and metals. PCBs were not detected in the sediment samples. Appendix B includes figures showing the locations of collected samples. Appendix B also includes the analytical summaries provided in the ESI (Weston Solutions, 2018a).

10.6.7 Berwind Green Hill Mine Dump Area

The Berwind Green Hill Mine Dump Area was historically an open coal mine dump operated by NR&P. Mine dump debris is a mixture of coal, slate, sandstone, and shale material. The area is located on the southern slope of a hillside. The area was abandoned at an unknown date. The abandoned dump was covered with soil, filled, and revegetated in approximately 1986 or 1987 (NUS, 1990e). The hillside was terraced at this time, and rock-lined runoff central ditches were established. The rock-lined drainage ditches lead into Arbuckle Creek roughly 800 feet south of the area. The area is completely bordered to the west, north, and east by woodland, and the southern foot of the slope is bordered by residential homes, approximately 500 feet downslope of the area. A water storage tank is located on the eastern edge of the hill.

Concerned Citizens to Save Fayette County provided the anecdotal evidence that in 1984, several truckloads of sediment from Arbuckle Creek may have been placed at the mine dump area as part of a flood control effort (NUS, 1990e). The 1990 Preliminary Assessment was conducted because of the concern that possible action may have resulted in the presence of PCBs at the mine dump area because portions of Arbuckle Creek downstream of the former SEC Property contain sediment contaminated with PCBs. However, as noted in the 1990 Preliminary Assessment, details were not available on whether dredged sediment was placed at the abandoned mine dump (NUS, 1990e). Any sediment dumped may have been covered with soil during the reclamation activities in 1986 or 1987. During the 1990 Preliminary Assessment, two garbage dump piles consisting of building and auto debris were identified at the area. One debris pile (50 feet by 50 feet) was located at the top of the hill on the area's northeastern corner, and debris included furniture and automotive parts such as tires and gas tanks. The second debris pile (50 feet by 100 feet) was located at the foot of the hill below the wooded area and contained burned household trash and automotive parts.

An SI of the mine dump area was conducted by NUS in 1991 to determine if PCB contamination was present based on anecdotal evidence that sediment dredge material from Arbuckle Creek was placed at the area as noted in the 1990 Preliminary Assessment. During the 1991 SI, eight surface soil samples were collected from drainage ditches, the debris piles, and near a water tank, and two sediment samples were collected from drainage ditches at the foot of the hill (NUS, 1991e). Appendix G includes a figure showing the location of soil samples collected from the area. Samples were analyzed for VOCs, SVOCs, metals, pesticides, and PCBs. The data provided in the 1991 SI Report indicates that select VOCs, SVOCs, and metals were detected in the samples. PCBs were not detected in any of the samples. Appendix G includes the analytical summaries provided in the SI Report.

During the ESI conducted by Weston Solutions, some samples were collected from the mine dump area in June 2018 (Weston Solutions, 2018a). Soil samples were collected from nine locations. Generally, a surface soil sample from 0 to 6 inches and a deeper interval (12 to 18 inches, except SEC-SS-232 collected from 18 to 28 inches) were collected from most locations. Appendix B includes figures showing the location of collected samples. The samples were analyzed for SVOCs, PAHs, pesticides, PCBs, and metals. PCBs were not detected in any of the samples. The analytical results are included in Appendix B.

10.6.8 Activities Outside Areas of Concern

Some surface soil and sediment samples collected during the ESI in June 2018 were collected from mine portals. Samples from mine portals located a distance away from Arbuckle Creek are noted here. These samples include two sediment samples (SD-79 and SD-80) located approximately 1200 feet north of

Arbuckle Creek at the former SEC Property, five sediment samples (SD-83 through SD-85, SD-88, and SD-99) located approximately one mile downstream and approximately 200 to 550 feet from the creek, and two sediment samples (SD-103 and SD-104) located near the N R & P Supply House approximately 1,300 feet south of the creek. Surface soil samples (SS-244 and SS-245) were collected near a mine discharge pipe near the N R & P Supply House and approximately 500 feet south of the creek. The samples were analyzed for SVOCs, PCBs, pesticides, and metals; no PCBs were detected in these samples.

10.7 CONCEPTUAL SITE MODEL

This conceptual site model (CSM) details the potential contaminant sources, migration pathways, and potential receptors for the historical SEC Property activities. The CSM will be updated in the RI Report based on the results of the RI activities.

10.7.1 Sources and Potential Contaminants

The main contaminants of concern associated with SEC activities are PCBs associated with dielectric oil used in the transformers. This CSM focusses on the PCB contamination; however, VOCs and PAHs may also be associated with other site activities. A full suite of analytical parameters is being analyzed to characterize possible site activities that may have resulted in contaminated environmental media. If these contaminants are shown to be present based on the expanded analytical suite, then additional information concerning the fate and transport of these analytes will be included in the updated CSM in the RI Report.

As discussed above, the main area of concern is contaminated soil on former SEC Property that has resulted from improper storage of PCB-containing transformers and other historical activities on the property. During site visits in the 1990s, transformers were observed with oil-stained soil. Contamination occurred from surface spills of PCB-containing oil from the transformers. Much of the PCB-contaminated soil was covered by an impervious cap installed in 2001. Other areas of concern where transformers may have been stored include the Britt Bath House Area, Possible Transformer Area, and the N R & P Supply House.

Contamination from the SEC Property, Britt Bath House Area, Possible Transformer Area, and the N R & P Supply House may have migrated to Arbuckle Creek or may have been deposited in areas within the floodplain and downstream segments of the creek. Excavated sediment within Arbuckle Creek may have also been placed within residential yards, along Rocklick Road, and at the Berwind Green Hill Mine Dump Area. Rocklick Road is also an area of concern because PCB-contaminated oil may have been sprayed on the unpaved portion of the roadway for dust suppression.

The areas of concern and the sources of contamination are summarized in the table below.

Area of Concern	Source of Potential Contamination
Former SEC Property	Improper storage of PCB-containing transformers
Britt Bath House Area	Abandoned transformer
Arbuckle Creek Area	Migration of contamination from SEC Property
Residential Properties	Migration of contamination from SEC Property Placement of potentially contaminated sediment within yards
Rocklick Road	Use of potentially contaminated sediment in roadwork Potential use of PCB-contaminated oil for dust control

Area of Concern	Source of Potential Contamination
Berwind Green Hill Mine Dump Area	Placement of potentially -contaminated sediment within dump

10.7.2 Contamination Migration Pathways

The most likely source of contamination from the Shaffer Equipment Property would be from transformers, capacitors, and drums that were improperly stored and/or disposed causing a release to the ground surface.

The main contaminants are from the dielectric fluids in transformers and capacitors that contained PCBs. Other contaminants, including VOCs and PAHs which have been detected at the site during historical investigations, could also be associated with the PCB releases or other activities at the site. PCBs are chemically and biologically stable, hydrophobic, have high electrical resistivity, have low volatility, and are resistant to heat degradation. PCBs are soluble in organic or hydrocarbon solvents, oils, fats, and slightly soluble in water. PCBs tend to attach to the surface of organic matter and clay and then migrate with these media. Surface releases of PCB oil will migrate downward through the subsurface soil and laterally forming a conic shape of contamination. Contaminants in surface soil could be transported from the source areas to Arbuckle Creek and the surrounding area by storm water run-off, erosion, or flooding. Once deposited in the sediment in Arbuckle Creek, the contaminants could move downstream through water or sediment transport, and ultimately enter the New River. Potentially contaminant-laden water and sediment could also be deposited onto properties neighboring Arbuckle Creek during flood events. Contaminants in surface soil or subsurface soil can also migrate to groundwater as a result of facilitated transport in association with solvents, colloids, or emulsion. Once the contaminants reach the water table there is a potential for lateral migration of contaminants in groundwater and potential discharge to surface water. Because PCB oil is denser than water ,there is a propensity for vertical migration of contaminants to deeper portions of the groundwater through soil or bedrock fractures.

Most PCBs are slightly soluble in water. This solubility decreases with increased chorine content. This characteristic reduces the transport potential of PCBs from soil to water (groundwater or surface water) and causes them to typically bind to soil. However, small amounts of PCBs are released from sediment and/or soil to water over time. As PCBs degrade over time, the chlorine content is lowered increasing the solubility of the contaminants.

Facilitated transport and the speciation of the PCBs (i.e., lower chlorinated homologs) are a contributing factor in the accumulation of PCBs in water. Facilitated transport is an important characteristic for determining the migration of PCBs Facilitated transport are conditions (physical and chemical) that allow typically immobile PCBs to become mobile. When PCBs are mixed with solvents, attach to colloids, or are entrained in an emulsion they are more likely to migrate. When PCBs are mixed with solvents (as was standard practice to increase viscosity) its effective solubility increases. With this increased solubility, PCBs can become more mobile in soil and water.

Emulsions of PCBs (DNAPL) can migrate rapidly downward in the right physical and geochemistry conditions. DNAPLs will migrate downward until a confining layer or barrier is encountered. This downward migration allows PCBs to interact with groundwater and a variety of geochemical conditions that could aid in the dissolution of PCBs into groundwater. Additionally, these DNAPLs could migrate through soil and bedrock fractures horizontally and vertically as preferential pathways.

Biodegradation is the only process known to transform PCBs under environmental conditions, and only the lighter compounds are measurably biodegraded (U.S. EPA, December 1979). Only PCBs with relatively few chlorine atoms are readily susceptible to aerobic biodegradation. Anaerobic biodegradation of PCBs is more likely for sediment for the more highly chlorinated congeners. Aerobic biodegradation in soil,

surface water, and sediment is limited to the less chlorinated congeners. Although some microorganisms (e.g., *Phanaerochaete chrysosporium*) may biodegrade PCBs, such fungi may not exist in local soil.

10.7.3 Land Use, Potential Receptors, and Exposure Pathways

Most of the areas of concern included in this SAP consist of open areas accessible to the public that are not used for any specific purpose. For example, although the SEC Property is privately owned, access to the property is not restricted and the public uses the area for driving recreational all-terrain vehicles. Recreational users may also use areas along Arbuckle Creek, which flows through the New River Gorge National River park. No industrial or commercial activities are currently conducted in the areas of concern. As previously identified, there are residential properties located at and near some of the areas of concern, especially along Arbuckle Creek and Rocklick Road.

In general, potential human receptors under current land use include trespassers, recreational users, and residents. Future land use is expected to remain the same as current land use. However, potential future users could also include residentsindustrial/commercial workers, utility workers, and construction workers if the properties were to be developed. Current and future terrestrial ecological receptors include flora and fauna (plants, soil invertebrates, birds, amphibians, and mammals) present at and around the site. In addition, current and future aquatic ecological receptors include fish, sediment invertebrates, and piscivorous birds and mammals.

The human health exposure pathways include:

- Dermal contact with surface water/sediment and incidental ingestion of surface water by current/future recreational users and trespassers.
- Ingestion, dermal contact, and inhalation (dust) of surface soil by future workers (commercial, utility, and construction) and future residents as well as current/future residents, current/future recreational users, and current/future trespassers.
- Ingestion, dermal contact, and inhalation (dust) of subsurface soil by future residents and future workers (commercial, utility, and construction).
- Ingestion and dermal contact with groundwater by future residents and future construction workers.

The ecological exposure pathways include:

- Ingestion and direct contact of surface soil by ecological receptors,
- Ingestion and direct contact of surface water by ecological receptors.
- Ingestion and direct contact of sediment by ecological receptors.
- Ingestion of prey items that have accumulated constituents from soil, surface water, and sediment by ecological receptors.

SAP Worksheet #11 – Project/Data Quality Objectives

PROBLEM STATEMENT

Because of historical industrial activities, environmental media at the site has been impacted, and human or ecological receptors may be at risk from exposure to contaminants in soil, sediment, groundwater, pore water, and surface water. Previous investigations have identified chemicals of potential concern (COPCs) in soil, groundwater, and sediment; however, a full characterization of contaminants has not been completed. An RI must be conducted to characterize the extent of contamination and define the human or ecological risks from exposure to contaminated site media. Once the investigation is complete, the Project Team (defined as USEPA, WVDEP, and Tetra Tech) will evaluate remedial alternatives based on the COPCs identified in the HHRA and SLERA.

PROJECT OBJECTIVES

The primary objective for this project is to collect sufficient data to determine if site contaminants pose a risk to human and ecological receptors. This will be achieved by collecting various media samples which will provide data for decision-making. The SAP includes the discussion of the data to be collected in during the RI field work. Other data such as pore water, mine pool discharge, and biological sampling, along with any other data that maybe needed to complete RI report, is not discussed in this SAP. A technical memorandum will be submitted to the team summarizing results of the RI field work and a recommendation for additional work needed to complete the RI will be provided. The team will obtain consensus on the path forward prior to conducting the additional work.

Field work will be conducted at the SEC Property capped area, SEC Property non-capped area, Possible Transformer Storage Area east of the capped area, Britt Bath House Area, background locations, residential properties, Arbuckle Creek, wetland areas near Arbuckle Creek, the Berwind Green Hill Mine Dump Area (Needles Eye), Rocklick Road, the N R & P Supply House, and New River. Data are needed to:

- Horizontally and vertically characterize soil contamination.
- Investigate areas of concern.
- Confirm or eliminate COPCs by analyzing for a full suite of analytes.
- Determine if metals are naturally occurring in the environment by collecting additional background soil samples.
- Confirm and bound soil contamination at and near areas of concern.
- Identify groundwater flow direction.
- Better characterize groundwater contamination.
- Characterize sediment and surface water in Arbuckle Creek and wetland areas.
- Evaluate the potential human health and ecological risks associated with exposure to contaminants.

INFORMATION INPUTS

To meet the RI project objectives, the physical and chemical data to be collected are described below.

Field Soil Screening

Field surface and subsurface soil data will be determined using a Photoionization Detector (PID). These data will be used to identify potential source locations and select the subsurface soil interval from the soil borings with the highest concentrations of volatile contaminants (determined by the PID). Observations via

PID readings will not solely be used in sample selection. Visual screening of soil cores will also be used to determine whether signs of contamination exist.

Physical Data

The collection of physical groundwater and surface water parameters, including dissolved oxygen (DO), specific conductance, pH, temperature, turbidity, and oxidation-reduction potential (ORP) data, will assist with site characterization and, when combined with chemical soil, sediment, surface water, and groundwater data, will assist with understanding the nature and extent of site contamination. The groundwater measurements will be used to determine whether groundwater samples are representative of the groundwater from the aquifer being investigated. Soil field parameters, including soil classification (as per the Unified Soil Classification System [USCS]) will be noted on the boring log for each ½-foot interval starting from land surface to 2 feet bgs and then for each following 2-foot interval until termination of the soil boring. Grain size and total organic carbon (TOC) for soil and sediment samples will be analyzed to estimate relative bioavailability.

Chemical Data

Surface and subsurface soil, sediment, surface water, and groundwater chemical data are needed to evaluate the environmental media as potential sources of contamination and to determine the nature and extent of contamination. Since there has not been a comprehensive investigation of potential contaminants, all of the soil and groundwater samples collected will be analyzed for the full list of Target Compound List (TCL)/Target Analyte List (TAL) analytes, including TCL VOCs, TCL SVOCs (including low level PAHs and pentachlorophenol [PCP] analyzed by Selected Ion Monitoring [SIM]) and low level 1,4-dioxane (analyzed by SVOCs-SIM), TCL pesticides, PCB congeners, PCB Aroclors, dioxin/furans, and TAL inorganics (23 metals and cyanide) to assist in the determination of the full list of COPCs for the site. .

The list of all chemical analytical groups and individual target analytes within each group is presented in Worksheet #15. The sampling methods are presented in Worksheet #18, and the analytical methods are presented in Worksheet #19.

Chemical Data – Mobile Lab

Based on its availability, the mobile lab will be used to help determine the subsurface samples to be sent for fixed-base analysis. Also, all residential soil samples will be analyzed by the mobile lab to potentially give residents quick turnaround sampling data.

The USEPA Environmental Response Team (ERT) Mobile Laboratory will be utilized for “real-time” PCB analysis. Appropriate usage of mobile analytical laboratory support provides quick turnaround for time-critical data needed for field decisions concerning characterization. High-quality analyses can be achieved with detection limits well below contaminant action levels. Rigorous QA/QC procedures ensure the reliability of the analytical data. For additional details on the use of the mobile lab, see Worksheet #14/16 along with Appendix H which contains the ERT Mobile Laboratory’s site-specific QAPP for this project.

Dissolved and Total Metals Data

Groundwater concentrations of dissolved metals are needed to provide additional data at locations where the sample matrix has a turbidity of greater than 10 nephelometric turbidity units (NTUs). Total metals data are generally used for risk screening comparisons to Project Screening Levels (PSLs). Turbidity at the site may be an issue, thus limiting the ability of total metals data to represent actual groundwater conditions. In anticipation of potential turbidity issues during this investigation, dissolved metals concentrations must be measured, in addition to total metals concentrations. The dissolved metals concentrations may be used by the Project Team in a “lines of evidence” approach to estimate the degree of partitioning of metals between aqueous and particulate phases for a variety of reasons, such as:

- Estimating bioavailabilities of metals;
- Qualifying the degree of risk as estimated based on total metal concentrations; and
- Other uses within the context of an updated CSM that provide a more complete or accurate picture of risks than would be possible using total metals concentrations alone.

For the baseline ecological risk assessment, dissolved metals data are needed for surface water because that is the portion that is bioavailable to aquatic organisms. Total metals data are typically used in the human health risk assessment, unless it is surmised that turbid sample conditions are contributing to elevated metals concentrations in surface water samples (i.e., that the total metals concentrations are not representative of the concentrations present in the dissolved sample matrix).

Groundwater Level Measurements

Water level measurements (via electronic oil/water interface probe) in monitoring wells are needed to provide information regarding the potentiometric surface (i.e., elevation) of the water table at sampling locations and to determine the direction(s) of groundwater flow. The monitoring wells will allow for the collection of sufficiently accurate groundwater level measurements to meet this objective for perched water, if perched water is encountered. During water level measurements, the potential presence of light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) will also be evaluated.

Sample Location Data

Sample location horizontal coordinates and vertical depths must be measured. Horizontal coordinates may be measured with equal effectiveness using a global positioning system (GPS) or by a state licensed land surveyor. Depth intervals are best measured using a tape measure or other device with similar accuracy and precision (e.g., a water level meter). The horizontal coordinates must be documented using the data identified in Worksheet #14, “Global Position System Locating and Mapping” section to accurately map the sampling locations. Additionally, each boring location will be marked with a surveyor’s lath and boring ID.

Project Screening Levels (PSLs)

This RI requires chemical data that can be used to determine the nature and extent of contamination and to evaluate potential risk to site receptors. To determine COPCs, laboratory results must first be compared to media-specific HHRA and ecological risk assessment (ERA) PSLs as part of the risk screening process. To obtain data quality that is sensitive enough to compare to the PSLs, the lowest of the reference screening values was selected and presented in Worksheet #15. The selected human health and ecological risk benchmarks for screening are as follows.

Human Health PSLs

The USEPA RSLs were used preferentially as soil, sediment, groundwater, and surface water PSLs with consideration of the WVDEP Cleanup Standards. Soil values were used as sediment values for human health. Surface water values were based on water quality standards.

Soil/Sediment

- R-RSL – Residential Soil RSL at a carcinogenic risk equal to 1E-06 and non-carcinogenic risk at a Hazard Quotient (HQ) = 0.1 (USEPA, 2019a)
- WVDEP – Residential Soil Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017)

Surface Water

- AWQC – Human Health Ambient Water Quality Criteria (AWQC) (USEPA, 2015b)
- WVDEP WQS – Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016)

Groundwater

- R-RSL – Residential Tap water RSL at a carcinogenic risk equal to 1E-06 and non-carcinogenic risk at an HQ = 0.1 (USEPA, 2019a)
- WVDEP – Groundwater Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017)

Ecological PSLs

Ecological Soil Screening Levels (Eco-SSLs) were used preferentially as soil PSLs; however, Eco-SSLs are currently available for only a few analytes. PSLs were selected from the sources identified below in order of preference. (Note: Chemical concentrations in groundwater wells closest to the river will be compared to ecological PSLs).

Surface soil

- Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005)
- LANL – LANL Ecological Screening Values (LANL, 2017)
- Oak Ridge National Laboratory (ORNL) soil benchmarks (Efroymson, 1997a,b)
- Region 4 Soil Screening Levels (USEPA, 2018b)
- R5 – Region V Ecological Screening Level (ESL) (USEPA, 2003)

Sediment

- R3 Biological Technical Assistance Group (BTAG) SD - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006c)
- LANL – LANL Ecological Screening Values (ESV) (LANL, 2017)
- ORNL Sediment benchmarks (Jones et al., 1997)
- Region 4 Freshwater sediment screening levels (USEPA, 2018b)
- R5 – Region V ESL (USEPA, 2003)

Surface Water

- R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b)
- West Virginia Water Quality Standards (WVDEP, 2016)
- USEPA WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a)
- LANL – LANL Ecological Screening Values (LANL, 2017)
- ORNL surface water benchmarks (Suter and Tsao, 1996)
- Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b)
- R5 – Region V ESL (USEPA, 2003)

To conduct comparisons of site data to the applicable screening values, the selected laboratory must be able to achieve method detection limits (MDLs) and Contract Required Quantitation Limits (CRQLs) that are low enough to measure constituent concentrations below the screening values to ensure laboratory sensitivity is sufficient. In cases where conventional test methods are not able to achieve detection limits that are lower than the PSLs (such as for arsenic), rules for evaluating the data are required that help the

Project Team determine with reasonable satisfaction whether the constituent poses a potentially unacceptable risk.

Analytical data reported by the laboratory use the following reporting conventions: All concentrations less than the MDL will be considered non-detects and will be reported with a "U" qualifier; between the MDL and CRQL will be reported with a “J” qualifier; and at or above the CRQL will be reported with no qualifier.

If a target analyte has a PSL between the MDL and CRQL, the “J” flagged data will be accepted to achieve project goals. The inability to quantifiably compare individual analytes to PSLs with confidence must be addressed in the risk evaluation uncertainty analysis in each risk assessment.

Average concentrations, as represented by the 95-percent upper confidence limit (UCL) of the mean, will be determined, specific to the human receptor which it represents. The 95-percent UCL will be determined using USEPA’s ProUCL software, Version 5.1 (released May 2016) and will be used to represent the exposure point concentration (EPC) for soil. If there are not enough samples to statistically calculate a UCL, the maximum detected concentrations will be used to represent EPCs.

Per the USEPA Risk Assessment Guidance for Superfund, Part A (USEPA, 1989), an evaluation of non-detects greater than the PSL will be presented in the uncertainty section of the risk assessment in the RI Report.

Risk Assessments

Historical and newly collected RI data will be reviewed to determine if it is of sufficient quality to assess the nature and extent of contamination from COPCs and to calculate the current risk to human and ecological receptors. Previously collected data may be used if it was validated (or can be validated) and determined to represent current site conditions. Risk assessments will be conducted in accordance with USEPA protocols and guidance documents for HHRAs and ERAs.

STUDY AREA BOUNDARIES

The Shaffer Equipment/Arbuckle Creek Area Site begins at the former SEC Property and stretches eastward along Arbuckle Creek to locations where the creek enters the national recreational area. The site includes residential properties near the creek. There are also potential outlying areas, such as Rocklick Road, Berwind Green Hill Mine Dump Area (Needles Eye) and portions of New River that are part of the study areas. The final horizontal boundary will be determined by the results of the proposed fieldwork for this RI.

The vertical boundary for soil extends to bedrock, which is anticipated to be at a depth of approximately 10 feet bgs. During this RI, data that are representative of three populations of interest will be collected from two different soil intervals, which include soil at or near the surface and subsurface soil with the highest PID readings or signs of impact. If no impact is seen, then the sample interval just above the water table or refusal will be submitted for analysis. These populations represent soil that may be contaminated due to activities or disposal on the surface or near the surface, soil that may be impacted by subsurface disposal, and soil that may be impacted by vertical migration of COPCs.

The groundwater populations of interest include the shallow or surficial aquifer and deeper water bearing zone. The upper vertical boundary for groundwater, the depth to the shallow aquifer, is approximately 10feet bgs. Representative samples from each of the populations of interest will be collected and used for decision making.

The target groundwater population for groundwater monitoring includes all groundwater samples from existing and new monitoring wells. Groundwater samples collected from site monitoring wells as part of the RI represent the shallow and deeper population zone that has been affected by site contaminants.

The target surface water and sediment populations for monitoring include all samples of surface water and sediment that are collected upstream, near, and downstream of the suspected source areas. The decision unit corresponds to the ecological media (surface water and sediment) at the source area and downstream of the affected area. Spatial boundary for the ecological media is the width and depth of the source area and downstream locations.

The collocated sediment interval of interest is 0 to 6 inches bgs, which defines the vertical boundary for this media. The population of interest for sediment includes any sediment in Arbuckle Creek just west of the site to sediment located near the confluence of Arbuckle Creek and the New River. Surface water data collected from Arbuckle Creek is representative surface water that may be contaminated due to migration of contaminated site media. Additionally, sediment samples will be taken from seven locations along the New River. Two of the sediment samples will be taken upstream and five will be taken downstream from the confluence with Arbuckle Creek in the New River to evaluate the migration of site contaminants during the investigation (Figure 13). A representative sample from large depositional areas will be collected by taking a composite of the sediment in large dispositional areas. The composite will be collected from three different locations within the large depositional area.

No temporal boundaries have been identified for soil, groundwater, surface water, sediment sampling, or groundwater monitoring sampling events. Presumed upgradient groundwater samples will be collected first, and the downstream surface water and sediment locations will be collected prior to the upstream locations.

ANALYTIC APPROACH

Contamination Delineation Decision Statement

If the Project Team determines, based on a combination of the data collected from the RI sampling events and data collected during the ESI investigation, that the presence of COPCs have been adequately characterized at the site in three dimensions in soil, groundwater, sediment, and surface water, then human health and ecological risk assessments will proceed to completion; otherwise, the Project Team will need to decide whether additional data collection is warranted to characterize the nature and extent of soil, groundwater, sediment, and/or surface water COPCs, along with other potential media (such as porewater). At a minimum, this evaluation must consider the following factors relative to the existing CSM in each environmental medium:

- Frequency of detection for each constituent and the spatial distribution of the detections;
- Extent of PSL exceedance for each constituent in each medium and the spatial distribution of the exceedances;
- Comparison to background concentrations;
- Magnitude of concentrations and concentration gradients within, and on the perimeter of, the investigated areas; and
- Identification of COPCs and their estimated contributions to unacceptable levels of risk.

The tendency to collect more data will increase as spatial concentration patterns indicate that a potentially unacceptable risk exists outside the investigated areas, that the levels or distribution of contaminants are not known to a satisfactory degree of confidence, or that the data indicate that the CSM is in significant error.

The extent of contamination will be determined through comparison of concentrations on the outer edge of the sampling pattern to PSLs, and by reviewing concentration patterns to assess whether areas of contamination can be enclosed with a concentration isopleth separating the contamination area on the inside of a closed polygon from uncontaminated area(s) outside the polygon. This judgment will be based on experience and will be reviewed by the Project Team. In cases where an analytical result is J-qualified,

the Project Team will accept that data for delineation purposes. These sample results will be used in combination with the results of other contaminants with PSLs above CRQLs to carry out the delineation decision making. If data are not sufficient to characterize the site contamination, an additional round of sampling may be required to complete delineation.

Mobile Laboratory Decision Statement

As discussed above, if it is available at the time of the investigation, the USEPA ERT mobile laboratory will be utilized for "real-time" PCB analysis. The data will be used to assist in the selection of the deeper sample interval to be sent to the fixed-base laboratory. Also, all residential soil samples will be analyzed by the mobile lab to potentially give residents quick turnaround sampling data.

Risk Assessment Decision Statements

If the risk screening evaluation concludes that target analyte concentrations in soil, groundwater, surface water, or sediment are greater than the PSLs within the study area boundaries, then conduct an HHRA or an ERA, as appropriate, to determine whether an unacceptable human health or ecological risk is present.

Human Health Risk Assessment

Step 1:

If cumulative risks across all applicable exposure pathways and environmental media are unacceptable [i.e., HQs or Hazard Indices (HIs) are greater than 1, accounting for either the cumulative HI or HIs for specific target organs, and/or Incremental Lifetime Cancer Risks (ILCRs) are greater than 1×10^{-4}], then proceed to a feasibility study (FS) to evaluate remedial alternatives for the identified risk drivers (contaminants of concern [COCs]); otherwise proceed to Step 2.

Step 2:

If HQs or HIs are less than 1, accounting for either the cumulative HI or HIs for specific target organs, and ILCRs are less than 1×10^{-4}, then recommend no further investigation and no further remedial action and determine whether public notification to meet WVDEP regulation is required for the site.

Screening Level Ecological Risk Assessment

The goal of the SLERA is to identify and characterize the current and potential threats to the environment from a hazardous substance release. The SLERA will be conducted in accordance with guidance presented in the following documents:

- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997).
- OSWER Directive 9285.7-28 P Issuance of Final Guidance: Ecological Risk Assessment and Risk Management Principles for Superfund Sites (USEPA, 1999a)
- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- The Region 3 Biological technical Assistance Group (BTAG) Frequently Asked Questions (https://www.epa.gov/risk/btag-frequently-asked-questions).

The first two steps of the eight step ERA process comprise the SLERA, where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3 is the first step of a baseline ecological risk assessment (BERA) and consists of refining the generic assumptions to reflect site-specific conditions to further focus the ERA process on the chemicals of greatest concern at the site.

Ecological receptor exposure units (EUs) will be defined in the SLERA based on the combined data from the historical investigations and the RI. If, after completing a SLERA through Step 2 no unacceptable ecological risks are identified, there is no need for remediation on the basis of ecological risk. Otherwise, the Project Team will decide if it is necessary to continue the ERA process past Step 2 to include Step 3. If, after completing an ERA through Step 3, risks are determined to be acceptable, then no further investigation or action is needed to protect ecological receptors. Otherwise, the Project Team will decide if it is necessary to continue the ERA process past Step 3. Continuing past Step 3 of the ERA process would require a decision by the Project Team to develop an addendum to the RI SAP or a separate SAP prior to initiation and, therefore, are not included in this SLERA methodology.

PERFORMANCE CRITERIA

Samples for chemical analyses will be collected primarily from biased locations in areas most likely to be contaminated based on the current CSM. This biased selection of sample locations does not support the use of quantitative statistics to estimate decision performance as specified in the DQO guidance (USEPA, 2006a). Instead, the Project Team will use the results of this investigation to determine whether the quality of data collected is sufficient to support the attainment of project objectives and to decide whether further investigation is required. Performance criteria for laboratory-generated data are normal laboratory QA limits and pre-established detection limits for target analytes, as listed in Worksheet #15. The data quality will be reviewed to ensure that performance criteria have been met and that the data are sufficient for decision-making purposes. The RI Report will document the detection limits achieved by the laboratory for all sample analyses, and any associated uncertainties will be discussed in the risk assessment section.

The data set generated by the laboratory will be reviewed to ensure that the intended samples were collected, and that usable data was reported for all samples submitted. If all data are collected as planned and no data points are missing or rejected for quality reasons, then the investigation completeness will be considered satisfactory. If any data gaps are identified, including missing or rejected data, the Project Team will assess whether a claim of having obtained project objectives is reasonable based on the quantity and types of data gaps. Project Team members will be involved in rendering the conclusion by consensus regarding adequacy of the data.

To limit uncertainty in the field and laboratory data, performance criteria for field collection and laboratory analysis will be measured. Performance criteria are described in Worksheets #12, 15, and 28. Once the samples have been collected and analyzed, the distribution of the data will be determined and the appropriate UCL will be calculated for each media.

PLANS FOR OBTAINING DATA

The data collection plan and the sample design rationale are included in Worksheet #17.

SAP Worksheet #12 - Measurement Performance Criteria Table – VOCs/SVOCs/PAHs in Solid and Aqueous Matrices

Matrix	Solid / Aqueous
Analytical Group	TCL VOCs TCL SVOCs

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.1 SA-1.2 SA-1.3	Contract Laboratory Program (CLP) SOM02.4	Precision (field); Representativeness	≤ 50 RPD for solid and ≤ 30 RPD for aqueous matrices	Field Duplicate	S&A
		Bias/Contamination	No analytes detected > CRQL	Trip blanks (VOCs only), Field Blanks, Equipment Rinsate Blanks	S&A
		Bias/Contamination	No analytes detected > CRQL unless a common laboratory contaminant, then must be < 2X CRQL (VOC) or <5X CRQL (SVOC)	Method blank	A
		Accuracy/Sensitivity	-50 to 100 percent of area, ±10 second retention time (RT) shift from initial calibration (ICAL) or daily continuing calibration verification (CCV) for VOCs and ±30 second RT shift for SVOCs	Internal Standards	A
		Accuracy	Compound specific percent recoveries (%Rs) (See CLP SOM02.4 Table 10 [VOC] and Table 11 [SVOC])	System Monitoring Compounds (surrogates)	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 11 [VOC] and Table 12 [SVOC])	MS	A
		Precision (laboratory)	Compound specific (See CLP SOM02.4 Table 11 [VOC] and Table 12 [SVOC])	MSD	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 4 [VOC] and Table 5 [SVOC])	Calibration Verification Standards	A
		Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – TCL Pesticides in Solid and Aqueous Matrices

Matrix	Solid / Aqueous
Analytical Group	TCL Pesticides

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.1 SA-1.2 SA-1.3 SOP-1	CLP SOM02.4	Precision (field); Representativeness	≤ 50 RPD for solid and ≤ 30 RPD for aqueous matrices	Field Duplicate	S&A
		Bias/Contamination	No analytes detected > CRQL	Field Blanks, Equipment Rinsate Blanks	S&A
		Bias/Contamination	No analytes detected > CRQL	Method blank	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 12 [Pest])	Laboratory Control Sample (LCS)	A
		Accuracy	30 – 150%R (up to one surrogate may fail)	System Monitoring Compounds (surrogates)	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 11 [Pest])	Matrix Spike (MS)	A
		Precision (laboratory)	Compound specific (See CLP SOM02.4 Table 11 [Pest])	Matrix Spike Duplicate (MSD)	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 2)	Calibration Verification Standards	A
		Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – Dioxins/Furans and PCB Congeners in Solid and Aqueous Matrices

Matrix	Solid / Aqueous / Wipe Samples
Analytical Group	Dioxin/Furans PCB Congeners

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.1 SA-1.2 SA-1.3	CLP HRSM01.2	Precision (field); Representativeness	≤ 50 RPD for solid and ≤ 30 RPD for aqueous matrices	Field Duplicate	S&A
		Bias/Contamination	No analytes detected > CRQL	Field Blanks, Equipment Rinsate Blanks	S&A
		Bias/Contamination	No analytes detected ≥ ½ CRQL; OCDD/OCDF must be < 3X CRQL	Method blank	A
		Accuracy	Compound specific (See CLP HRSM01.2 Table 5 [dioxin/furan] Table 5 [PCB congeners])	LCS	A
		Precision (laboratory)	RPD < 30%	Laboratory Control Sample Duplicate (LCSD)	A
		Accuracy	Compound specific (See CLP HRSM01.2 Table 5 [dioxin/furan] Table 1 [PCB congeners])	Labeled Compounds	A
		Accuracy	Compound specific (See CLP HRSM01.2 Table 2 [dioxin/furan] Table 7 [PCB congeners]) Relative Response (RR) ±25 Percent Difference (%D) RR Factor (RRF) ±35%D Signal to Noise (S/N) Ratio ≥10	Calibration Verification Standards	A
		Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – Aroclors in Solid and Aqueous Matrices

Matrix	Solid / Aqueous
Analytical Group	Aroclors

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.1 SA-1.3	CLP SOM02.4	Precision (field); Representativeness	≤ 50 RPD for solid and ≤ 30 RPD for aqueous matrices	Field Duplicate	S&A
		Bias/Contamination	No analytes detected > CRQL	Field Blanks, Equipment Rinsate Blanks	S&A
		Bias/Contamination	No analytes detected > CRQL	Method blank	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 8 [PCBs])	Laboratory Control Sample (LCS)	A
		Accuracy	30 – 150%R (up to one surrogate may fail)	System Monitoring Compounds (surrogates)	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 7 [PCs])	Matrix Spike (MS)	A
		Precision (laboratory)	Compound specific (See CLP SOM02.4 Table 7 [PCBs])	Matrix Spike Duplicate (MSD)	A
		Accuracy	Compound specific (See CLP SOM02.4 Table 2)	Calibration Verification Standards	A
		Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – TAL Inorganics in Solid and Aqueous Matrices

Matrix	Solid / Aqueous
Analytical Group	Target Analyte List (TAL) Inorganics

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.1 SA-1.2 SA-1.3	CLP SOW ISM02.4 ICP-MS (Metals) CVAA (Mercury) Spectrometer (Cyanide)	Precision (field); Representativeness	≤ 50 RPD for solid and ≤ 30 RPD for aqueous matrices if concentrations are >5X CRQL; otherwise control limit is the CRQL.	Field Duplicate	S&A
		Accuracy/Bias	No analytes detected > CRQL or > 1/10 sample concentration.	Field blanks, Equipment Rinsate Blanks	S&A
		Accuracy/Bias	No analytes detected > CRQL or > 1/10 sample concentration.	Preparation Blanks, Calibration Blanks	A
		Accuracy	±20 %R or within ±2X CRQL, whichever is greater	Interference Check Sample	A
		Accuracy	70 – 130%R	LCS	A
		Accuracy/Sensitivity	60 – 125%R	Internal Standards	A
		Accuracy	75 – 125%R	MS and Post-Digestion Spike, and Post-Distillation Samples	A
		Precision (laboratory)	RPD ≤ 20 if concentration >5X CRQL; otherwise the control limit is the CRQL.	Laboratory Duplicate	A
		Accuracy	If analyte concentration ≥50X the MDL, then 5X dilution concentration shall be within 10%D from the original sample after correction.	Serial Dilution	A
		Accuracy	90 – 110%R (ICP-MS Metals) 85 – 115%R (Mercury and Cyanide)	Calibration Verification Standard	A
		Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – TOC in Solid Matrix

Matrix	Solid
Analytical Group	TOC

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.3	SW-846 9060A	Precision (field); Representativeness	≤ 100 Relative Percent Difference (RPD) for solid and ≤ 50 RPD for aqueous matrices	Field Duplicate	S&A
		Accuracy/Bias	< 500 mg/kg	Method blank	A
		Accuracy	±20%	LCS/ICV	A
		Accuracy	±25%	MS	A
		Precision (laboratory)	RPD ≤ 30	MSD / Duplicate	A
		Accuracy	+/- 20 percent of true value	Calibration Verification Standard	A
		Completeness	90 percent	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #12 - Measurement Performance Criteria Table – Grain Size in Solid Matrix

Matrix	Solid
Analytical Group	Grain Size

Sampling Procedure[1/]	Analytical Method/Standard Operating Procedure (SOP)[2/]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SA-1.3	ASTM D6913	Completeness	90%	Data evaluation by project decision makers	S&A
SA-1.3	ASTM D422	Completeness	90%	Data evaluation by project decision makers	S&A

[1/]Reference number from SAP Worksheet #18.
[2/]Reference number from SAP Worksheet #23.

SAP Worksheet #13 - Secondary Data Criteria and Limitations Table

Secondary Data	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	Data Source (Originating Organization, Report Title, and Date)	How Data Will Be Used	Limitations on Data Use
ESI samples	Weston Solutions, soil, sediment, and surface water samples, 2017-2018	Weston Solutions, 2018a. Final Expanded Site Inspection Report, Shaffer Equipment/Arbuckle Creek Area Site, Minden, Fayette County, West Virginia.	Quantitatively in RI report	None
Wetland delineation	Weston Solutions, maps of delineated wetlands, 2018	Weston Solutions, 2018b. Wetland Delineation Report, Shaffer Equipment-Minden, Fayette County, West Virginia.	Identify locations of wetland areas	None
Installation of Cap	International Consultants, as-built drawings of location of cap and other construction activities including to eliminate migration of contaminants	International Consultants, 2003. Final Removal Action Report, Installation of Impervious Cap/Barrier, Shaffer Equipment Company, Fayette County, West Virginia.	Identify locations of construction activities	None
Site Review with sample collection	EPA Region 3 TAT, soil and sediment from on and off property locations including a pit area, 1993	EPA Region 3 TAT, 1994. Site Review Trip Report, Shaffer Electric Company Site, Minden, Fayette County, WV.	Qualitatively in RI report	Sample figures do not allow for identification of exact sample locations. Data is approximately 30 years ago and may not reflect current conditions.
SI of Arbuckle Creek Area	NUS, soil, sediment, surface water, 1990	NUS, 1991a. Site Inspection of Arbuckle Creek Area.		

Secondary Data	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	Data Source (Originating Organization, Report Title, and Date)	How Data Will Be Used	Limitations on Data Use
SI of Bath House/Britt Property	NUS, soil, 1990	NUS, 1991b. Site Inspection of Bath House/Britt Property.	Qualitatively in RI report	Sample figures do not allow for identification of exact sample locations. Data is approximately 30 years ago and may not reflect current conditions.
SI of Rocklick Road	NUS, soil, sediment, surface water, 1990	NUS, 1991c. Site Inspection of Rocklick Road.		
SI of Berwind Green Hill/Reclaimed Mine Dump	NUS, soil, sediment, 1990	NUS, 1991e. Site Inspection of Berwind Green Hill/Reclaimed Mine Dump.		
Trip report with sample collection	NUS, soil, surface water, sediment, and public water, 1990	NUS, 1990a. Field Trip Report of Shaffer Equipment Company.		

SAP Worksheet #14 and 16 - Project Tasks and Schedule

The field tasks are summarized below. A brief description of these tasks is also provided.

- Mobilization/Demobilization (including Site-Specific Health and Safety Training and Utility Clearance)
- Sample Collection Tasks
- Monitoring Equipment Calibration
- Soil Sampling Procedures
- Mobile Laboratory Analysis (if available)
- Monitoring Well Installation and Sampling
- Surface Water and Sediment Sampling
- Wipe Sampling
- Investigation-Derived Waste (IDW) Management
- GPS Locating and Mapping
- Surveying
- Field Decontamination Procedures
- Sample Custody and Shipment Tasks
- Quality Control Tasks
- Additional Project-related Tasks

MOBILIZATION AND DEMOBILIZATION

This subtask involves preparing for the field activities and demobilizing from the site upon their completion. Following approval of the project plans, Tetra Tech will identify the necessary field support equipment, supplies, and facilities, and begin mobilization activities. Tetra Tech anticipates mobilizing a small office trailer, portable toilet, and temporary security fencing to support field activities. Site mobilization will consist of preparation for field activities and includes, but is not limited to, the following activities:

- Perform all required training and orientation.
- Obtain all equipment required to perform field activities.
- Make improvements to the site access road and road that leads to the Berwind Green Hill Mine Dump Area.
- Identify and prepare locations for all field activities.
- Coordinate sample types, analyses, and sampling schedule with USEPA (Tetra Tech assumes that all sample analyses will be performed by USEPA or by an USEPA-contracted commercial laboratory). Tetra Tech will only procure a commercial laboratory(s) to perform the analyses if specifically authorized by USEPA.

As part of demobilization, equipment and supplies will be collected, inventoried, and returned as appropriate. All field investigation paperwork will be filed and docketed in the project record.
Tetra Tech will prepare a list of all equipment and supplies necessary for the field team to perform the field activities. This list includes but is not limited to:

- All documents, forms, logbooks, logsheets, labels, custody seals, airbills, and other paperwork required by the SAP and HASP.
- Vehicles for personnel, equipment, and sample transport.
- Personnel and equipment decontamination supplies and equipment required by the SAP and HASP.
- Media sampling field analytical equipment and calibration standards for all required parameters of the SAP.
- All required sample containers.
- Equipment and supplies for sample custody, preservation, and packaging.

- Other miscellaneous office and field supplies.

During the required training and orientation, all field team members will review the SAP and will be given site-specific health and safety training based on the HASP. A field team orientation meeting will be held to familiarize personnel with the scope of the field activities. The orientation will include a walking tour of the site and a drive around the main roads of the area to familiarize personnel with the physical layout of the site.

The field team will obtain the required equipment and supplies from the Tetra Tech warehouse or offices and transport it to and stage it at the base of operations. Any equipment not available at the Tetra Tech warehouse or offices will be purchased or rented by Tetra Tech. Equipment will be calibrated as required by the SAP and HASP on an as-needed basis. Equipment will be re-stocked, replaced, or repaired as needed.

Site demobilization will consist of removing from the site all facilities, supplies, and equipment no longer needed at the end of fieldwork. The base of operations and fieldwork locations will be restored as closely as possible to their original conditions by the field team or the responsible subcontractor.

Site-Specific Health and Safety Training

Orientation and site-specific health and safety training will be performed individually for each of the various subcontractor crews as they mobilize at the site. It will also be necessary to provide orientation and health and safety training for any additional or replacement field team members assigned after the initial mobilization.

Utility Clearance

Prior to the commencement of any intrusive activities, a notification will be made to the West Virginia One-Call system to mark out any utilities in the work area. See Tetra Tech SOP HS-1.0 (Appendix I) for further information on utility clearance.

SAMPLE COLLECTION TASKS

All sampling events will include completing trip reports and chain of custodies using SCRIBE and proper packaging to comply with Department of Transportation (DOT) regulations and the CLP Guidance for Field Samplers (USEPA, 2014) and assure safe arrival at the designated laboratory. SCRIBE assists in the process of managing environmental data by capturing sampling, observational, and monitoring field data. This software tool can import electronic data deliverables (EDD) from analytical laboratories, location data from a GPS, or data generated using real-time analytical methods.

Sample labeling will be performed in accordance with Tetra Tech SOP SA-6.3, and the sample numbering scheme will be in accordance with Tetra Tech SOP CT-04. Methods for recording field data will be in accordance with Tetra Tech SOP SA-6.3, and selection of sample containers, sample preservation, packaging, and shipping will be in accordance with Tetra Tech SOP SA-6.1. Tetra Tech SOPs are in Appendix I.

The sampling and analysis program is outlined in Worksheet #18. Sampling requirements for each type of analysis (e.g., container type, preservation method, holding time) are listed in Worksheet #19. Field and laboratory QC samples will also be collected, as outlined in Worksheet #20.

MONITORING EQUIPMENT CALIBRATION

The calibration of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of equipment to document the accuracy, sensitivity, or precision of the measurements and

to determine if correction should be applied to the readings. Each instrument requiring calibration will have its own equipment calibration log documenting the calibration of the equipment including the frequency and type of standard or calibration procedure. Monitoring equipment calibration procedures are described in Worksheet #22.

SOIL SAMPLING PROCEDURES

Surface and Subsurface Soil Sampling

The soil borings will be advanced using a direct push technology (DPT) drilling rig. A track-mounted rig will be used because of the potential for soft ground and the desire to minimize the amount of any required access improvements. To drill the borings, a probe assembly fitted with 5-foot-long acetate sleeves will be hydraulically advanced ("pushed") into the subsurface to obtain soil cores that are 5 feet in length. The probe and sleeve will be withdrawn. The sampling assembly will be fitted with a new acetate sleeve and reinserted into the borehole. If a location is inaccessible with a track-mounted drill-rig, then a hand-auger will be used to install the boring to the maximum depth practicable.

Upon retrieval, each acetate liner will be cut open, the lithology will be described by the geologist, and the core will be vertically screened for VOCs with a PID by disturbing the surface of the core every 6 inches with a disposable trowel and will be visually examined for qualitative signs of contamination, such as soil staining (black/oily soil), odor, and a determination of fill versus native soil.

All of the samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at fixed-base laboratories designated by USEPA to confirm COPCs since a full suite of analyses has not been conducted. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors. Surface soil samples will be collected from 0 to 6 inches bgs and 6 to 24 inches for near surface samples, and one subsurface interval to be selected in the field based on PID readings, visual observations (signs of impact), or results from the mobile lab. If mobile lab data is not available or no signs of impact are observed, then a variety of sample depths will be chosen to ensure full characterization of the subsurface.

DPT borings produce very few drill cuttings. Those that are produced and not used for sampling will be containerized in a 55-gallon drum and the boring will be sealed with granular bentonite chips.

For all soil samples collected, the VOC samples will be collected with an EnCore™ sampling instrument. Each EnCore™ sampling "kit" contains a self-sealing package for shipment and delivery to the laboratory. Samples to be analyzed for TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors, ,TAL metals, TOC and grain size will be obtained from each boring and will be homogenized in a stainless steel bowl prior to filling the sampling jars.

The soil boring locations will not be surveyed but will be located with a GPS tool having sub-meter accuracy.

Worksheets #17 specifies the soil sample locations and analytes for this investigation. Worksheets #18 and 23 specify the analytical methods to be used.

Background Surface and Subsurface Soil Sampling

Surface and subsurface soil samples will be collected with a hand auger from the background locations. These samples will be used to determine background concentrations of soil contaminants near the site and to distinguish between locations potentially impacted by site operations and those attributable to background conditions. Surface soil samples will be collected from 0 to 6 inches bgs and 6 to 24 inches for near surface samples, and one subsurface interval to be selected in the field based on PID readings,

visual observations (signs of impact), or results fromthe mobile lab. If mobile lab data is not available or no signs of impact are observed, then a variety of sample depths will be chosen to ensure full characterization of the subsurface. Background samples will be analyzed for TCL SVOCs, TCL pesticides, PCB congeners, Aroclors, dioxins/furans, and TAL metals at fixed-base laboratories designated by USEPA. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

As a first step in the background evaluation, the analytical data will be evaluated to determine if there are any outliers present in the data using a combination of graphical plots and statistical tests. Data points identified as true outliers will be removed from the dataset. Next, the background surface, near-surface and subsurface soil analytical results will be compared using a combination of graphical plots and statistical tests to determine if the analytical results are comparable. If the surface, near surface, and subsurface soil analytical results are comparable, the surface, near surface, and subsurface soil analytical results will be combined into one dataset. If the analytical results for surface, near surface, and subsurface soil are not comparable, then the datasets will not be combined. The resulting dataset(s) will be combined with the existing background dataset and 95% upper tolerance limits (UTL) will be calculated.

Residential Soil Sampling

Residential soil sampling and analysis will be performed adjacent to Arbuckle Creek to characterize residual soil contamination that may be attributable to historical flooding.

Composite soil samples at the residential properties will be based on a 50’ by 50’ grid area that will be generated for each property. Modifications to the grid size will be made for relatively small properties so that a minimum of four grid cells are identified for each property. At the residential properties, two surface samples from 0 to 6 inches bgs, one near surface sample from 6 to 24 inches bgs, and one 24 to 48 inches sample will be collected from each grid for compositing. Samples from all grid cells from the same depth interval will be composited. A discrete VOC sample will be taken from each property at a depth of 6 inches bgs. A discrete/grab sample from 0 to 3 inches bgs will be collected using a hand trowel if there is a sensitive receptor exposure zone, such as a play area for a child resident on the property. The residential samples will be collected using either a hand auger or DPT drilling rig depending on access.

The residential samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

All residential soil samples will be analyzed by the mobile lab.

Soil sampling procedures are discussed in Tetra Tech SOP SA-1.3, soil logging procedures are documented in Tetra Tech SOP GH-1.5, and the use of the PID is discussed in manufacturer’s instructions. These SOPs are included in Appendix I.

Worksheet #17 specifies the number of sampling locations and analytes for this investigation, but the exact locations will be determined in the field. Worksheets #18 and 23 specify the analytical methods to be used.

Mobile Laboratory Soil Sampling

Subsurface soil samples collected from the SEC Property, Possible Transformer Storage Area, Britt Bath House Area, will be analyzed by the USEPA Mobile Laboratory. Subsurface soil samples will be analyzed by the EPA Mobile Laboratory to aid in the selection of the deeper sample interval. In the event that the

mobile laboratory is not available, subsurface samples deeper than 24 inches will be selected in the field based on PID reading and visual observations (signs of impact). If the mobile lab is not available and no signs of impact are noted in the field, then a range of deeper samples will be submitted to the lab for analysis to ensure full coverage of the deeper intervals.

All residential soil samples will be analyzed by the mobile lab, to potentially give residents quick turnaround sampling data.

MONITORING WELL INSTALLATION AND SAMPLING

Borehole Drilling and Monitoring Well Installation

The current monitoring well network consists of four shallow overburden monitoring wells installed on the SEC Property in the vicinity of the cap. The existing monitoring well network will be expanded to monitor the shallow and deep-water bearing zones across the SEC Property (Figure 4). One shallow and deep monitoring well also will be installed in a background area located west of the SEC Property (Figure 3).

Shallow Borehole Drilling and Monitoring Well Installation

Based on the depths of the existing shallow monitoring wells, it is anticipated that the shallow monitoring wells will be installed to a depth of 10 feet bgs. The shallow monitoring well borings will be advanced utilizing a 4 ¼-inch inside diameter (ID) hollow-stem auger drilling method which will create a borehole diameter of 8 inches. This will facilitate the installation of a 2-inch schedule 40 polyvinyl chloride (PVC) riser with five feet of machine slotted screen. The slot size of the screen is anticipated to be 0.010 inches. Following installation of the riser and screen, an inert quartz sand filter (anticipated to be #2 Morrie sand) will be installed in the annular space between borehole and well screen to two feet above the screened interval. Bentonite chips will be placed on top of the sand filter pack to approximately 6 inches from the ground surface and hydrated to create a seal. The monitoring wells will be completed with a 4-inch steel stickup protective casing installed with a concrete pad. The protective casing will be 5 feet in length and will extent 2.5 feet into the ground. The wells will be installed in accordance with WVDEP regulations (47CSR59 and 47CSR60).

Deep Borehole Drilling and Monitoring Well Installation

The deep monitoring wells will be installed using air rotary methodologies and will be installed in accordance with WVDEP regulations (47CSR59 and 47CSR60). To isolate the surficial overburden water bearing zone, a 6-inch steel outer casing will be installed. The outer casing will be installed using 8 ¼ ID hollow-stem augers and an 8-inch diameter air hammer and will extend up to five feet into the bedrock. The outer casing is anticipated to be installed to 15 feet bgs and will be grouted in place using a bentonite-Portland cement slurry mixed to a ratio of 5% bentonite. This slurry will be pumped into the outer annulus of the borehole through a tremie pipe filling the annular space from the bottom. The grout will be allowed to set over a period of 24-hours prior to drilling through the outer casing.

Following outer casing, the bedrock drilling will continue to an anticipated depth of 50 feet bgs. The field geologist will log the subsurface materials throughout the drilling process monitoring for changes in lithology and moisture content that may indicate water bearing zones. Upon completion of each deep boring, geophysical logging will be performed as described in the below section. The results of the geophysical evaluations for each deep boring and the observed subsurface conditions will be discussed with the Project Team and consensus will be reached as to the construction of each deep monitoring well. The coordination of the geophysical logging and subsequent installation of the monitoring well will be coordinated to limit the time that the deep boring will remain open.

The deep monitoring wells will be constructed of 2-inch schedule 40 PVC riser with at least 5 feet of machine slotted screen. Longer screened intervals may be installed depending on the water bearing zoned

encountered. The screened interval will target water bearing zones observed during drilling or from the geophysical logging. The slot size of the well screen is anticipated to be 0.010 inches. Following installation of the riser and screen, an inert quartz sand filter (anticipated to be #2 Morrie sand) will be installed in the annular space between borehole and well screen to at least two feet above the screened interval. A 2-foot layer of bentonite pellets or chips will be placed on top of the sand filter pack to create a seal. If the bentonite seal is above the water table, water will be added to allow proper hydration of the annular seal.

The monitoring wells will be completed with a 4-inch steel stickup protective casing installed with a concrete pad. The protective casing will be 5 feet in length and will extent 2.5 feet into the ground. The remaining portions of the annual space will be filled with a bentonite-Portland cement slurry mixed to a ratio of 5% bentonite. This slurry will be pumped into the outer annulus of the borehole through a tremie pipe filling the annular space from the bottom. The grout will be allowed to set over a period of 12-hours prior completing the surface completions. Any settling in the annular grout will be topped off before the surface completions are installed. The monitoring wells will be completed with a 4-inch steel stickup protective casing installed with a concrete pad. The protective casing will be 5 feet in length and will extent 2.5 feet into the ground.

Monitoring Well Development

The new shallow and deep monitoring wells will be developed by over-pumping the monitoring wells with a submersible pump with frequent surging of the saturated screened interval using a surge block. The surging will dislodge fine-grain materials from the filter pack and borehole wall to improve well efficiency. Care will be taken to not cause damage to the well components. In the event that a shallow monitoring well does not have adequate water column for development (e.g., less than 2 feet), over pumping with recharge may be implemented.

All recovered groundwater and sediment will be containerized in 55-gallon drums for subsequent IDW management. The development at each monitoring wells will be completed until the discharge water is clear and free of sediment to the satisfaction of the Tetra Tech Geologist or for a maximum of 2 hours per well. Turbidity of the discharge water will be monitored every 5 minutes with a nephelometer. Development will be conducted in accordance with SOP GH-2.8 (Appendix I).

Downhole Geophysics

In each deep monitoring well location (expected to be drilled to a maximum depth of 50 feet below ground surface) a borehole geophysical investigation will be performed prior to monitoring well installation. The borehole geophysical investigation will consist of a suite of measurements collected from six 4-inch open bedrock boreholes. These measurements will include one run of fluid temperature and fluid resistivity, followed by a run of an acoustic and optical televiewer, a third final run with a 3-arm caliper, and a final run with a heat pulse flow meter. These geophysical techniques will be employed to provide a more detailed understanding of the site subsurface and hydrogeologic conditions (e.g., fractures, dip, groundwater in-flow zones, lithology) and to aid in monitoring well screen placement. Prior to the geophysical logging, a datum will be established at each borehole. It will be measured accurately to establish ground surface for each borehole, so that accurate depths below ground surface can be displayed on each log. The geophysical methods that will be employed at the site are described in greater detail below.

Borehole Fluid Temperature and Resistivity

The combined borehole temperature and fluid resistivity probe provides a measurement of the temperature of the borehole fluid and its resistance to conducting electric current versus depth. The probe is normally run first to obtain the natural, undisturbed thermal gradient in the borehole and will generally show sharp or gradual changes in the gradient caused by fluid flow in fractures. From the temperature measurements, differential temperature (rate of change of the temperature with depth) can be calculated and used to correlate water flowing into and out of the formation.

Borehole fluid temperature and fluid resistivity data will be logged in each borehole starting at the top of the tooling positioned with the top of surface casing. Borehole fluid temperature and fluid resistivity data will be logged from the ground surface down the borehole at a rate not exceeding 20 feet per minute.

This tool, along with the fluid resistivity or fluid conductivity, is designed to log the hole on the trip down the borehole rather than up the borehole. Optimal results are measured once borehole fluids have stabilized. Disturbing the water will cause large changes in the temperature gradient.

Fluid resistivity identifies differences in the concentration of total dissolved solids in borehole fluid; these differences typically indicate sources of water that have come from different transmissive zones. From these measurements, specific conductance can be calculated.

Acoustic and Optical Televiewer

The optical and acoustic televiewers are useful borehole imaging probes that provide oriented, 360°, continuous digital picture and sonar-like images of the borehole, respectively. The best applications for both probes include fracture detection and evaluation and measurement of the attitude of bedding and fractures.

Acoustic and Optical televiewer data will be collected from a well-centralized probe and centralization within the borehole will be graphically plotted and monitored for this purpose. Televiewer data will be collected at a rate less than 10 feet per minute. The acoustic and optical televiewer will generate an image of the borehole wall by transmitting ultrasonic pulses from a fixed transducer with rotating mirror and recording the amplitude and travel time of the signals reflected at the interface between borehole fluid and the formation (borehole wall).

This geophysical logging method is an effective tool for mapping the location and character/orientation of fractures intersecting the borehole, lithology, solution channels, and very useful when used to generate a high-resolution acoustic-caliper log. The log provides a visual fish-eye view and side-looking view of borehole in which fractures, flowing water, and other pertinent information can be observed. This technique provides information on the strike and dip of planar features.

Caliper Log

Caliper logging involves the measurement of the borehole diameter versus depth. Data is collected by means of a mechanical probe consisting of 3 arms, normally separated at 120° which are attached to a potentiometer. Changes in resistance recorded in the potentiometer are recorded as voltage changes and are proportional to the borehole diameter. Caliper is useful for determining changes in borehole diameter, lithologic analysis, and presence of fractures or washout zones and to obtain well construction details such as depth of casing.

The 3-arm caliper tool will be lowered to the bottom of the borehole and then will be opened. Caliper data will be logged from the bottom following the same section to the top. Caliper data will be collected at a rate of 12-15 feet per minute. At the start of each field day, the caliper arms will be calibrated using two different sized calibration rings. Data will be plotted together on report logs so that all data can be used to interpret bedrock fractures, thin beds, and borehole aperture changes (e.g. borehole collapse, fracture aperture). The caliper log will generate a continuous profile of borehole diameter. It is an effective tool in providing information for locating slumping or cavities and fractures in the open borehole walls.

Heat Pulse Flow Meter

The heat pulse flow meter (HPFM) is an instrument that measures the vertical direction and flow rate of the fluids that are present within a borehole. This instrument is lowered to a desired depth (typically above and below a known fracture), and a heat grid is released from the instrument into the water. The travel time of

the heat grid to the sensor above or below the heat source is calculated and converted to a flow rate in gallons per minute. The heat pulse flow meter can be used to measure the rate of vertical flow, identify the direction of vertical flow, establish relative hydraulic gradients, and identify transmissive fractures or geologic units open to boreholes that are the source(s) of water or that could act as conduits for cross-flow in an open hole.

Geophysical Investigation Reporting

A report of linear logs will be plotted for fluid temperature, fluid resistivity, 3-arm caliper tool, and amplitude, tadpole, borehole deviation, structure (projection), travel time and 360° pseudo cores will be displayed for acoustic and optical televiewer data in relation to depth. Orientations (strikes and dips) of fractures will be interpreted and calculated by the geophysicist using well log processing software, and polar plots and rose diagrams will be provided displaying fracture trends.

The results of the geophysical investigation in consultation with USEPA will be used for the determination of proper screen placement for each monitoring well location in which the geophysical investigation was completed. Results will also be used for determining, if necessary, the depth(s) at which effective packer testing is possible.

Packer Testing

Based on the results of the borehole geophysics, the need to perform packer testing for vertical chemical profiling will be discussed with the Team.

Water Level Measurements

A synoptic round of water level measurements from monitoring wells (existing) and total well depth soundings from all new monitoring wells will be collected prior to sampling to provide information regarding groundwater flow patterns and gradients following Tetra Tech SOP GH-1.2 (Appendix C). All water level measurements will be taken within a 4-hour period using an electronic water level meter. Water level elevations will be recorded to within 0.01-foot accuracy from a marked reference point on the well riser pipe. Water levels will be recorded on a Tetra Tech water level form. The water level meter will be decontaminated prior to use and between each monitoring well. The water level data will be used to construct water level contour maps in accordance with Tetra Tech SOP GH-2.5 (Appendix I).

Groundwater Sampling

Two rounds of monitoring well sampling are proposed. The groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors, dioxins/furans, and TAL metals. All groundwater samples will also be analyzed in the field for temperature, pH, DO, turbidity, and ORP.

All new monitoring wells will be purged prior to sampling. All screened monitoring wells with a screen length of 10 feet or less will be purged and sampled using the low-flow sampling techniques in accordance with the USEPA Region 3 "*Recommended Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells*", Bulletin No. QAD023, June 16, 1999 (Appendix C). The monitoring wells will be purged and sampled using a peristaltic pump. The pumping rate will be set at between 0.1 to 0.4 liters/minute. The purge water discharge will be monitored for pH, specific conductivity, temperature, turbidity, ORP, and DO. When the levels of these parameters stabilize, the purging is complete, and sampling can begin. Parameter stabilization is defined as three successive readings (taken at least 5 minutes apart) within 0.1 unit for pH, 3% for conductivity, 10% for temperature, turbidity and DO, and 10 millivolts (mV) for ORP. If possible, the stabilized turbidity reading should be less than 10 NTUs. The pumping rate will be controlled, and the well's water level will be constantly monitored to assure that the static water level is not drawn down into or below the screen. The vertical location of the pump, the required minimum purge volume, and the

calculations for parameter stabilization will be recorded on the groundwater sample log sheet. Monitoring well sampling procedures are discussed in SOP SA-1.1 (Appendix I).

Worksheet #17 specifies the groundwater sample locations and analytes for this investigation. Worksheets #18 and 23 specify the analytical methods to be used.

SURFACE WATER AND SEDIMENT SAMPLING

Surface water and sediment sampling will be performed within Arbuckle Creek and the wetland areas to supplement previously collected surface water and sediment data. Sediment samples will be collected in depositional areas with fine-grained materials being targeted. Three background surface water and sediment locations (SW/SD-300 through SW/SD-302) are proposed northwest of the Shaffer Equipment Company Property. Surface water and sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals (total and dissolved in surface water). Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the sediment samples in Arbuckle Creek will be analyzed for TOC and grain size. All of the samples from the New River will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

All surface water and collocated sediment samples will be collected following Tetra Tech SOP SA-1.2 (Appendix C). The collocated sediment samples (from 0 to 6 inches bgs) will be collected using a sediment coring device to prevent loss of fine materials on the surface. In the New River, sediment samples will also be collected from 6 to 12 inches. In addition, each wetland sampling location will be evaluated to determine whether the media is more indictive of soil than sediment. If the soil is determined to be hydric, a second sample at the 6 to 24 inches bgs will be collection to assess the risk to soil organisms and their predators.

Each surface water grab sample will be collected using a container that allows a sample to be collected in a manner that avoids incorporation of sediment in the sample. If the sediment becomes disturbed during sampling and visible signs of suspended solids are collected, the area will be allowed to settle, and a new sample will be collected. Alternatively, and especially in areas of fine sediment or very shallow water, surface water samples may be collected using a peristaltic pump fitted with Teflon tubing which is extended to the sampling point. This technique of extending the field sampler's reach reduces the potential for disturbing and suspending soft, light sediment material.

All the surface water will be collected starting with the furthest downstream sample. Because the goal of monitoring is to evaluate changes in water quality over time, it is important to be as consistent in sampling methods as possible. The sampling will be scheduled such as no precipitation should occur at least 12 hours prior to the sampling event to reduce the likelihood of suspended solids in the surface water that could impact the results.

Worksheet #17 specifies the surface water and sediment sample locations and analytes for this investigation. Worksheets #18 and 23 specify the analytical methods to be used.

WIPE SAMPLING

PCB wipe sampling will be performed in occupied residential structures adjacent to Arbuckle Creek to determine the presence of PCBs inside of the residences.

A wipe sample can be collected to determine if the surface is contaminated with PCBs. A standard wipe test, as specified in 40 CFR 761.123, uses a 10 centimeter (cm) by 10 cm (or equivalent that equals 100 cm^2) template to outline the sample area and a gauze pad or glass wool that has been saturated with hexane to collect the sample. The hexane-saturated wipe is used to thoroughly swab the area inside the

100 cm^2 template. Care must be taken to assure proper use of the sampling template, as the sample results will be based on the 100 cm^2 sample area (i.e., µg per 100 cm^2).

It is anticipated that two wipe samples will be collected from each residence in a high exposure area such as the kitchen or living room. Wipe samples will be analyzed via CLP HRSM01.2

PCB wipe sampling procedures are discussed in SOP 1. This SOP is included in Appendix I.

Worksheet #17 specifies the number of wipe samples and analytes for this investigation, but the exact locations will be determined in the field. Worksheets #18 ad 23 specify the analytical methods to be used.

INVESTIGATION-DERIVED WASTE MANAGEMENT

It is anticipated that IDW materials will be generated during the field investigation. These wastes must be disposed in such a manner that does not contribute to further environmental contamination or pose a threat to public health or safety. Tetra Tech SOP SA-7.1 (Appendix I) provides information on the handling of IDW. IDW will be stored at the SEC Property area within the vacant area of the warehouse or within temporary fencing at an SEC Property area location to be identified at the onset of the fieldwork. Disposal of the IDW following receipt of the analytical data should be coordinated with USEPA.

IDW that will be generated from the field activities includes personal protective equipment (PPE), soil and aqueous waste consisting mostly of groundwater generated during well development and monitoring well sampling activities, but also includes decontamination fluids. All soil and aqueous waste will be containerized in 55-gallon drums at the SEC Property area.

All solid and aqueous waste characterization analyses will be performed by the IDW subcontractor. Upon receipt of the analyses, waste profiles will be generated, and the IDW subcontractor will properly dispose of all wastes at appropriate disposal facilities.

PPE-related waste will be double-bagged and disposed as municipal solid waste. Temporary waste collection services are not proposed.

GLOBAL POSITION SYSTEM LOCATING AND MAPPING

A hand-held GPS unit capable of sub-meter accuracy (i.e., Trimble GeoXM or Trimble GeoHX) will be rented and used to locate all sampling points in accordance with the manufacturer's guidance. The rental equipment provider is responsible for the proper calibration and maintenance of the GPS. To ensure sub-meter accuracy, the GPS unit typically requires a minimum of six satellites to capture a position. If sub-meter accuracy is not attainable at any location for any reason, such as trees, valleys, or any other interference, then this will be documented in the field notes.

The GPS coordinate system will be set up so that horizontal coordinates are collected and documented in the field using the North American Datum of 1983 (NAD83) West Virginia State Plane Coordinate System, South Zone, in United States Survey Feet for easting and northing. Vertical coordinates will be documented by land surveying (see below) using the North American Vertical Datum of 1988 (NAVD88) to map the ground surface and groundwater elevations to the accuracy required to properly determine groundwater flow direction.

SURVEYING

After completing the well installation, all existing and newly-installed wells will be surveyed for vertical elevation and horizontal location. Surveying activities will be performed by a West Virginia-licensed land surveyor. Tetra Tech will provide site access and direct the surveyor to all survey locations. In addition, site benchmark(s) will be established to aid in the performance of subsequent survey work.

The surveyor will provide horizontal coordinates of all points X, Y, to the nearest 0.1 foot, and vertical coordinates of all points Z, to the nearest 0.01 foot. All measurements will be reported and recorded in U.S. Survey Feet. Tetra Tech will use the survey data, along with groundwater measurements discussed above to determine the direction of groundwater flow. A potentiometric surface map will be included in the RI Report.

FIELD DECONTAMINATION PROCEDURE

Sample containers will be provided certified-clean (I-Chem 300, or equivalent) from the analytical laboratory. Decontamination of sampling equipment (e.g., non-disposable hand trowels, hand augers) will be conducted prior to and between sampling at each location. At each location, an abbreviated decontamination procedure consisting of a soapy water (laboratory-grade detergent) rinse followed by tap water rinse and a deionized (DI) water rinse will be performed.

Disposable sampling equipment used for sampling activities shall be discarded as IDW. Field analytical equipment such as pH, conductivity, and temperature instrument probes will be rinsed with DI water and Alconox. Personnel decontamination procedures are discussed in the HASP.

All downhole drilling equipment, including drill rods and augers, will be decontaminated prior to beginning work and between all boreholes using a high-pressure wash. The water to be used for cleaning will be from a potable source.

SAMPLE CUSTODY AND SHIPMENT TASKS

Sample custody and shipment tasks are defined in Tetra Tech SOP SA-6.1 (Appendix I) and are discussed in Worksheet #27.

QUALITY CONTROL TASKS

QC samples will be collected at frequencies listed in Worksheet #12.

ADDITIONAL PROJECT-RELATED TASKS

Additional project-related tasks include:

- Analytical Tasks
- Data Generation Procedures
- Data Management
- Assessment and Oversight
- Data Review
- Project Reports

Analytical Tasks

Chemical analyses for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors, dioxins/furans, TAL metals, TOC, and grain size will be performed by a USEPA-subcontracted CLP laboratory (TBD). The laboratory shall be a current CLP laboratory for the methods that they perform and target analytes that they analyze under this SAP. Analyses will be performed in accordance with the analytical methods identified in Worksheet #30. The laboratories will meet the CRQLs specified in Worksheet #15. The laboratories will perform the chemical analyses following laboratory-specific SOPs (Worksheets #19 and 23) developed based on the methods listed in Worksheets #19 and 30. Copies of the Laboratory SOPs can be provided upon request after the subcontractor laboratory(s) is selected.

All soil and sediment results will be reported by the laboratory on a dry-weight basis. Results of percent moisture will be reported in each analytical data package and associated EDDs. This information will be captured in the project database. Percent moisture information will also be captured in the RI Report.

The samples will be submitted for analyses under the USEPA CLP or DAS procurement system for special analytical services. Analytical services procured under the DAS program will require complete CLP data packages where applicable and complete QC documentation in accordance with the method where applicable. The analytical method provides details of sample preparation, extraction, analyses, and detection limits. CRQLs should be below the PSLs, although in some instances, the PSL may be below the lowest possible detection limits for that method.

The analytical data packages will be in the CLP format, with validity being fully verifiable. The data packages will contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method specific QC information (results, %Rs, RPDs, relative standard deviations [RSDs], and %Ds, etc.).

Soil, sediment, surface water, and groundwater samples will be collected and shipped to a CLP laboratory for analysis. Data from the laboratory will be reported to the Region 3 OASQA in Fort Meade, Maryland. All data will be validated using Organic Level 2 and Inorganic Level 2 validation by the Region 3 Environmental Services and Assistance Team (ESAT). A final data validation report in Portable Document Format (PDF) and an EDD will be reported to the USEPA RPM, the Tetra Tech PM, and the Tetra Tech RLSC by email. The Tetra Tech RLSC will upload and maintain the data in a password-protected Access database.

If available, samples analyzed by the USEPA Mobile Laboratory will be submitted directly to the laboratory by field personnel. The analytical data packages from the Mobile Laboratory will be fully verifiable. The data packages will contain raw data, summary forms for all sample and laboratory method blank data, and summary forms containing all method specific QC information (results, %Rs, RPDs, relative standard deviations [RSDs], and %Ds, etc. The lab data will be provided in hard format to Tetra Tech. Tetra Tech will incorporate the mobile laboratory data into the project database.

Data Generation Procedures

Project documentation and records include the following:

- Field sample collection and field measurement records, as described in Worksheets #27 and 29.
- Data assessment documents and records, as listed in Worksheet #29.

Data recording formats are described in Worksheet #27.

Data Management Tasks

Data management tasks, including the data handling, tracking, storage, archiving, retrieval, and security processes, are addressed in Worksheet #29.

Data Assessment and Oversight Tasks

Refer to Worksheet #32 for assessment findings and corrective actions and to Worksheet #33 for QA management reports.

Data Review Tasks

Data verification is described in Worksheet #34. Data validation is described in Worksheets #35 and 36. Usability assessment is described in Worksheet #37.

Project Reports

Draft and final versions of the RI report, including the HHRA and ERA, will be prepared and submitted to the USEPA and WVDEP for review. The RI report will include the following sections:

- Executive Summary - A brief description of the work conducted and the findings.
- Introduction and Background - A description of the history of operations and activities at the site and a summary of any previous investigations and removal actions.
- Description of Field Investigations - A summary of the work performed in accordance with the approved SAP, any approved SAP addenda, and any field modifications as documented by the Tetra Tech FOL. This section will include maps showing the sampling locations and tables summarizing the data collected.
- Data Quality - A summary of quantitative analytical performance indicators such as completeness, precision, bias, and sensitivity, and qualitative indicators such as representativeness and comparability. This section will also include a reconciliation of project data with the DQOs and identification of deviations from this SAP.
- A data usability assessment will be used to identify significant deviations in analytical performance that could affect the ability to meet project objectives. The elements of this review are presented in Worksheet #37.
- Nature and Extent of Contamination - A discussion of the contamination detected in each medium sampled in relation to the CSM of the site. This section will note the removals previously conducted (if applicable), contamination addressed, and any additional contaminants found during this field effort. Detected contaminant concentrations will be tabulated for each medium and depicted on maps.
- Contaminant Fate and Transport - A description of the contaminants detected and their behavior in soil, bedrock, groundwater, surface water, and sediment, particularly with emphasis on the future migration of these contaminants to any possible exposure areas.
- Human Health and Ecological Risk Assessments - The HHRA will be completed after all of the available data are collected. The SLERA will be conducted after the surface water, sediment, and pore water data are collected because the results will be used to determine the data needs for the BERA. The BERA will be prepared after the additional data (i.e., toxicity/bioaccumulation studies) are conducted.
- Summary and Conclusions - A summary of the findings, conclusions as to whether delineation of contamination is adequate, and recommendations for further investigations, if needed.

A draft RI Report will be submitted via an electronic copy, and the final version of the RI Report will be submitted in hardcopy and electronic format to the USEPA and WVDEP.

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
RI SAP/HASP Development	Tetra Tech	August 2019	October 2019	SAP/HASP	October 2019
Approval of SAP	USEPA / WVDEP	October/November 2019	October/November 2019	NA	NA
Phase 1 Fieldwork – Soil, Surface Water, Sediment, and Wipe Sampling	Tetra Tech	November 2019	December 2019	NA	NA
Phase 1 Analytical Data – Soil, Surface Water, Sediment, and Wipe Sampling	Laboratory TBD	December 2019	January 2020	Laboratory Report	January 2020
Phase 1 Data Validation – Soil, Surface Water, Sediment, and Wipe Sampling	USEPA ESAT	January 2020	February 2020	Data Validation Report	February 2020
Recommendations for Phase 2 Fieldwork(1) – Groundwater	Tetra Tech	January 2020	January 2020	Technical Memorandum	January 2020
Approval of Phase 2 Fieldwork – Groundwater	USEPA / WVDEP	February 2020	February 2020	NA	NA
Phase 2 RI Fieldwork – Groundwater	Tetra Tech	February2020	February 2020	NA	NA
Phase 2 Analytical Data – Groundwater	Laboratory TBD	February 2020	March 2020	Laboratory Report	March 2020
Phase 2 Data Validation – Groundwater	USEPA ESAT	March 2020	April 2020	Data Validation Report	April 2020
Recommendations for Phase 3 Fieldwork(1,2)	Tetra Tech	May 2020	May 2020	Technical Memorandum	May 2020
Approval of Phase 3 Fieldwork	USEPA / WVDEP	June 2020	June 2020	NA	NA
Phase 3 RI Fieldwork	Tetra Tech	July 2020	August 2020	NA	NA
Phase 3 Analytical Data	Laboratory TBD	August 2020	September 2020	Laboratory Report	September 2020
Phase 3 Data Validation	USEPA ESAT	September 2020	October 2020	Data Validation Report	October 2020
Draft RI Report	Tetra Tech	November 2020	December 2020	Draft RI Report	December 2020
Final RI Report	Tetra Tech	January 2021	February 2021	Final RI Report	February 2021

[1] Based on analytical data from the previous phase of fieldwork.
Includes additional sampling (e.g., biological sampling) needed to complete the RI report.

SAP Worksheet #15 – Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Matrix: Soil
Analytical Group: TCL PCB Aroclors (mobile laboratory)

Analyte	CAS Number	Project Goal (mg/kg)	Achievable Laboratory Limits[1]	
			Reporting Limit (mg/kg)	MDL (mg/kg)
Aroclor 1016	12674-11-2	1	0.250	TBD
Aroclor 1221	11104-28-2	1	0.500	TBD
Aroclor 1232	11141-16-5	1	0.250	TBD
Aroclor 1242	53469-21-9	1	0.250	TBD
Aroclor 1248	12672-29-6	1	0.250	TBD
Aroclor 1254	11097-69-1	1	0.250	TBD
Aroclor 1260	11096-82-5	1	0.250	TBD
Aroclor 1268	11100-14-4	1	0.250	TBD

[1] Results are reported on a wet weight basis. Mobile laboratory results will be used for delineation purposes only and will used for qualitative purposes in the risk assessments.

Matrix: Soil
Analytical Group: Aroclors following CLP SOM02.4

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Aroclor-1016	12674-11-2	0.41 N	0.041	R-RSL	Region 4[(2)]	0.014	0.033	TBD
Aroclor-1221	11104-28-2	0.2 C	0.041	R-RSL	Region 4[(2)]	0.014	0.033	TBD
Aroclor-1232	11141-16-5	0.17 C	0.041	R-RSL	Region 4[(2)]	0.014	0.033	TBD
Aroclor-1242	53469-21-9	0.23 C	0.041	R-RSL	LANL	0.014	0.033	TBD
Aroclor-1248	**12672-29-6**	0.23 C	**0.0073**	R-RSL	**LANL**	**0.0024**	0.033	TBD
Aroclor-1254	11097-69-1	0.12 N	0.041	R-RSL	LANL	0.014	0.033	TBD
Aroclor-1260	11096-82-5	0.24 C	0.33	R-RSL	LANL	0.08	0.033	TBD
Aroclor-1262	37324-23-5	NC	0.041	None	Region 4[(2)]	0.014	0.033	TBD
Aroclor-1268	11100-14-4	NC	0.041	None	Region 4[(2)]	0.014	0.033	TBD

[1] The HHRA PSL references for soil screening (the lower was selected): R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10). The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); R4 - Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003).

[2] Value for total PCBs.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Sediment
Analytical Group: Aroclors following CLP SOM02.4

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Aroclor-1016	12674-11-2	4.1 N	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1221	11104-28-2	2 C	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1232	11141-16-5	1.7 C	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1242	53469-21-9	2.3 C	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1248	12672-29-6	2.3 C	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1254	11097-69-1	1.2 N	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1260	11096-82-5	2.4 C	0.0598	R-RSL	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1262	37324-23-5	NC	0.0598	None	R3 BTAG SED[(2)]	0.02	0.033	TBD
Aroclor-1268	11100-14-4	NC	0.0598	None	R3 BTAG SED[(2)]	0.02	0.033	TBD

[1] The HHRA PSL references for sediment screening (the lower was selected): R-RSL - Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment. The ERA PSL references for sediment screening are the following, in order of preference: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006b); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks; Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003).

[2] Value for total PCBs.

Matrix: Surface Water
Analytical Group: Aroclors following CLP SOM02.4

Analyte	CAS Number	PSL (µg/L)		PSL Reference[1]		PQLG (µg/L)	Achievable Laboratory Limits	
		HHRA	ERA	HHRA	ERA		CRQL (µg/L)	MDL (µg/L)
Aroclor-1016	**12674-11-2**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1221	**11104-28-2**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1232	**11141-16-5**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1242	**53469-21-9**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1248	**12672-29-6**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1254	**11097-69-1**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1260	**11096-82-5**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1262	**37324-23-5**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD
Aroclor-1268	**11100-14-4**	**0.000044**	**0.000074**	**WVDEP(2)**	**R3 BTAG SW(2)**	**0.000015**	**1.0**	TBD

[1] The HHRA PSL references for surface water screening are the lower of the following: T-RSL - USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016). The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018b) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003).

[2] Value for total PCBs.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: Aroclors following CLP SOM02.4

Analyte	CAS Number	PSL (µg/L)		PSL Reference[1]		PQLG (µg/L)	Achievable Laboratory Limits	
		HHRA	ERA	HHRA	ERA		CRQL (µg/L)	MDL (µg/L)
Aroclor-1016	**12674-11-2**	**0.14 N**	NA	**T-RSL**	NA	**0.047**	**1.0**	TBD
Aroclor-1221	**11104-28-2**	**0.0047 C**	NA	**T-RSL**	NA	**0.0016**	**1.0**	TBD
Aroclor-1232	**11141-16-5**	**0.0047 C**	NA	**T-RSL**	NA	**0.0016**	**1.0**	TBD
Aroclor-1242	**53469-21-9**	**0.0078 C**	NA	**T-RSL**	NA	**0.0026**	**1.0**	TBD
Aroclor-1248	**12672-29-6**	**0.0078 C**	NA	**T-RSL**	NA	**0.0026**	**1.0**	TBD
Aroclor-1254	**11097-69-1**	**0.0078 C**	NA	**T-RSL**	NA	**0.0026**	**1.0**	TBD
Aroclor-1260	**11096-82-5**	**0.0078 C**	NA	**T-RSL**	NA	**0.0026**	**1.0**	TBD
Aroclor-1262	37324-23-5	NC	NA	None	NA	None	1.0	TBD
Aroclor-1268	11100-14-4	NC	NA	None	NA	None	1.0	TBD

NA – Not applicable.

[1] The HHRA PSL references for groundwater (the lower was selected): T-RSL - USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10).

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Soil
Analytical Group: TCL VOCs following CLP SOM02.4 Low

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
1,1,1-Trichloroethane	71-55-6	640	0.04	WVDEP	R4	0.013	0.005	TBD
1,1,2,2-Tetrachloroethane	79-34-5	0.60 C	0.127	R-RSL	R4	0.042	0.005	TBD
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	670 N	NC	R-RSL	None	220	0.005	TBD
1,1,2-Trichloroethane	79-00-5	0.15 N	0.32	R-RSL	R4	0.05	0.005	TBD
1,1-Dichloroethane	75-34-3	3.6 C	0.14	R-RSL	R4	0.047	0.005	TBD
1,1-Dichloroethene	75-35-4	23 N	0.04	R-RSL	R4	0.013	0.005	TBD
1,2,3-Trichlorobenzene	87-61-6	6.3 N	20	R-RSL	ORNL	2.1	0.005	TBD
1,2,4-Trichlorobenzene	120-82-1	5.8 N	0.27	R-RSL	LANL	0.09	0.005	TBD
1,2-Dibromo-3-chloropropane	96-12-8	0.0053 C	NC	R-RSL	None	0.0018	0.005	TBD
1,2-Dibromoethane	106-93-4	0.036 C	1.23	R-RSL	R5	0.012	0.005	TBD
1,2-Dichlorobenzene	95-50-1	180 N	0.09	R-RSL	R4	0.03	0.005	TBD
1,2-Dichloroethane	107-06-2	0.46 C	0.4	R-RSL	R4	0.13	0.005	TBD
1,2-Dichloropropane	78-87-5	1.1 C	0.28	WVDEP	R4	0.093	0.005	TBD
1,3-Dichlorobenzene	541-73-1	NC	0.08	None	R4	0.027	0.005	TBD
1,4-Dichlorobenzene	106-46-7	2.6 C	0.88	R-RSL	R4	0.29	0.005	TBD
2-Butanone	78-93-3	2,700 N	1	R-RSL	R4	0.33	0.010	TBD
2-Hexanone	591-78-6	20 N	0.36	R-RSL	LANL	0.12	0.010	TBD
4-Methyl-2-pentanone	108-10-1	3,300 N	9.7	R-RSL	LANL	3.2	0.010	TBD
Acetone	67-64-1	6,100 N	0.04	R-RSL/ WVDEP	R4	0.013	0.010	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Benzene	71-43-2	1.2 C	0.12	R-RSL/ WVDEP	R4	0.04	0.005	TBD
Bromochloromethane	74-97-5	15 N	NC	R-RSL	None	5	0.005	TBD
Bromodichloromethane	75-27-4	0.29 C	0.54	R-RSL	R5	0.097	0.005	TBD
Bromoform	75-25-2	19 C	0.07	R-RSL	R4	0.023	0.005	TBD
Bromomethane	**74-83-9**	0.68 N	**0.002**	R-RSL	**R4**	**0.00067**	**0.005**	**TBD**
Carbon disulfide	75-15-0	77 N	0.005	R-RSL	R4	0.0017	0.005	TBD
Carbon tetrachloride	56-23-5	0.65 C	0.05	R-RSL	R4	0.017	0.005	TBD
Chlorobenzene	108-90-7	28 N	2.4	R-RSL	LANL	0.8	0.005	TBD
Chloroethane	75-00-3	1,400 N	NC	R-RSL	None	470	0.005	TBD
Chloroform	67-66-3	0.32 C	0.05	R-RSL	R4	0.017	0.005	TBD
Chloromethane	74-87-3	11 N	10.4	R-RSL	R5	3.5	0.005	TBD
cis-1,2-Dichloroethene	156-59-2	1.7 N	0.04	WVDEP	R4	0.013	0.005	TBD
cis-1,3-Dichloropropene	10061-01-5	1.8 C[3]	NC	R-RSL	None	0.6	0.005	TBD
Cyclohexane	110-82-7	120	NC	WVDEP	None	40	0.005	TBD
Dibromochloromethane	124-48-1	8.3 C	2.05	R-RSL/ WVDEP	R5	0.68	0.005	TBD
Dichlorodifluoromethane	75-71-8	8.7 N	39.5	R-RSL	R5	2.9	0.005	TBD
Ethylbenzene	100-41-4	5.8 C	0.27	R-RSL	R4	0.09	0.005	TBD
Isopropylbenzene	98-82-8	190 N	0.04	R-RSL	R4	0.013	0.005	TBD
m,p-Xylenes	179601-23-1	55 N[4]	0.1	R-RSL	R4	0.033	0.005	TBD
Methyl acetate	79-20-9	2,300 N	NC	WVDEP	None	770	0.005	TBD
Methyl cyclohexane	108-87-2	NC	NC	None	None	None	0.005	TBD
Methylene chloride	75-09-2	35 N	2.6	R-RSL	LANL	0.87	0.005	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Methyl-tert-butyl ether	1634-04-4	47 C	NC	R-RSL	None	16	0.005	TBD
o-Xylene	95-47-6	65 N	NC	R-RSL	None	22	0.005	TBD
Styrene	100-42-5	600 N	1.2	R-RSL	LANL	0.4	0.005	TBD
Tetrachloroethene	127-18-4	8.1 N	0.06	R-RSL	R4	0.02	0.005	TBD
Toluene	108-88-3	490 N	0.15	R-RSL	R4	0.05	0.005	TBD
trans-1,2-Dichloroethene	156-60-5	13 N	0.04	WVDEP	R4	0.013	0.005	TBD
trans-1,3-Dichloropropene	10061-02-6	1.8 C[3]	NC	R-RSL	None	0.6	0.005	TBD
Trichloroethene	79-01-6	0.41 N	0.06	R-RSL	R4	0.02	0.005	TBD
Trichlorofluoromethane	75-69-4	79 N	52	WVDEP	LANL	17	0.005	TBD
Vinyl chloride	75-01-4	0.057 C	0.03	WVDEP	R4	0.01	0.005	TBD
Xylenes (total)	1330-20-7	58 N	0.1	R-RSL	R4	0.033	0.005	TBD

CAS – Chemical Abstracts Service
PQLG – Project Quantitation Limit Goal
NC – No Criterion

[1] The HHRA PSL references for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is for 1,3-dichloropropene.
[4] Value is for m-xylene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Soil
Analytical Group: TCL SVOCs following CLP SOM02.4 Low (including low level PAHs and PCP by SIM) and 1,4-Dioxane by SVOCs-SIM

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
1,1-Biphenyl	92-52-4	4.7 N	0.2	R-RSL	R4	0.067	0.17	TBD
1,2,4,5-Tetrachlorobenzene	95-94-3	1.7 N	0.18	WVDEP	R4	0.06	0.17	TBD
1,4-Dioxane[3]	123-91-1	5.3 C	2.05	R-RSL	R5	0.68	0.0005	TBD
2,2'-Oxybis(1-chloropropane)	108-60-1	5.1 C	19.9	WVDEP	R5	1.7	0.33	TBD
2,3,4,6-Tetrachlorophenol	**58-90-2**	190 N	**0.04**	R-RSL/ WVDEP	**R4**	**0.013**	**0.17**	**TBD**
2,4,5-Trichlorophenol	95-95-4	630 N	4	R-RSL/ WVDEP	ORNL	1.3	0.33	TBD
2,4,6-Trichlorophenol	88-06-2	6.3 N	10	R-RSL	ORNL	2.1	0.33	TBD
2,4-Dichlorophenol	**120-83-2**	19 N	**0.05**	R-RSL/ WVDEP	**R4**	**0.017**	**0.33**	**TBD**
2,4-Dimethylphenol	**105-67-9**	130 N	**0.01**	R-RSL/ WVDEP	**R5**	**0.0033**	**0.33**	**TBD**
2,4-Dinitrophenol	**51-28-5**	13 N	**0.061**	R-RSL/ WVDEP	**R4**	**0.02**	**0.33**	**TBD**
2,4-Dinitrotoluene	121-14-2	1.7 C	6	R-RSL/ WVDEP	LANL	0.57	0.33	TBD
2,6-Dinitrotoluene	606-20-2	0.36 C	4	R-RSL/ WVDEP	LANL	0.12	0.33	TBD
2-Chloronaphthalene	**91-58-7**	480 N	**0.0122**	R-RSL	**R5**	**0.0041**	**0.33**	**TBD**
2-Chlorophenol	**95-57-8**	34 N	**0.06**	WVDEP	**R4**	**0.02**	**0.17**	**TBD**
2-Methylphenol	**95-48-7**	320 N	**0.1**	R-RSL/ WVDEP	**R4**	**0.033**	**0.33**	**TBD**
2-Nitroaniline	**88-74-4**	63 N	**0.02**	R-RSL/ WVDEP	**R4**	**0.0067**	**0.33**	**TBD**

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
2-Nitrophenol	88-75-5	NC	1.6	None	R5	0.53	0.33	TBD
3,3'-Dichlorobenzidine	**91-94-1**	1.2 C	**0.03**	R-RSL/ WVDEP	**R4**	**0.01**	**0.33**	**TBD**
3-Methylphenol	**108-39-4**	320 N	**0.09**	R-RSL/ WVDEP	**R4**	**0.03**	**0.33**	**TBD**
3-Nitroaniline	99-09-2	NC	3.16	None	R5	1.1	0.33	TBD
4,6-Dinitro-2-methylphenol	**534-52-1**	0.51 N	**0.144**	R-RSL	**R5**	**0.048**	**0.33**	**TBD**
4-Bromophenyl phenyl ether	101-55-3	NC	NC	None	None	None	0.33	TBD
4-Chloro-3-methylphenol	59-50-7	630 N	7.95	R-RSL	R5	2.7	0.33	TBD
4-Chloroanaline	106-47-8	2.7 C	1	R-RSL/ WVDEP	LANL	0.33	0.33	TBD
4-Chlorophenyl phenyl ether	7005-72-3	NC	NC	None	None	None	0.33	TBD
4-Methylphenol	**106-44-5**	630 N	**0.08**	R-RSL/ WVDEP	**R4**	**0.027**	**0.33**	**TBD**
4-Nitroaniline	100-01-6	25 N	21.9	R-RSL	R5	7.3	0.33	TBD
4-Nitrophenol	100-02-7	NC	5.12	None	R4	1.7	0.33	TBD
Acetophenone	98-86-2	780 N	300	R-RSL	R5	100	0.33	TBD
Atrazine	**1912-24-9**	2.4 C	**0.00005**	R-RSL/ WVDEP	**R4**	**0.000017**	**0.33**	**TBD**
Benzaldehyde	100-52-7	170 C	NC	R-RSL	None	57	0.33	TBD
Bis(2-chloroethoxy)methane	111-91-1	19 N	0.302	R-RSL	R5	0.1	0.17	TBD
Bis(2-chloroethyl)ether	**111-44-4**	**0.23 C**	23.7	**R-RSL**	R5	**0.077**	**0.33**	**TBD**
Bis(2-ethylhexyl)phthalate	**117-81-7**	39 C	**0.02**	R-RSL/ WVDEP	**LANL**	**0.0067**	**0.33**	**TBD**
Butyl benzyl phthalate	85-68-7	290 C	0.59	R-RSL/ WVDEP	R4	0.2	0.33	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Caprolactam	105-60-2	3,100 N	NC	R-RSL/ WVDEP	None	1,000	0.33	TBD
Carbazole	**86-74-8**	NC	**0.07**	None	**R4**	**0.023**	**0.33**	**TBD**
Dibenzofuran	**132-64-9**	7.3 N	**0.15**	R-RSL	**R4**	**0.05**	**0.33**	**TBD**
Diethyl phthalate	**84-66-2**	5,100 N	**0.25**	R-RSL/ WVDEP	**R4**	**0.083**	**0.33**	**TBD**
Dimethyl phthalate	131-11-3	NC	10	None	LANL	3.3	0.33	TBD
Di-n-butyl phthalate	**84-74-2**	630 N	**0.011**	R-RSL/ WVDEP	**LANL**	**0.0037**	**0.33**	**TBD**
Di-n-octyl phthalate	117-84-0	63 N	0.91	R-RSL	LANL	0.3	0.33	TBD
Hexachlorobenzene	**118-74-1**	**0.21 C**	**0.079**	**R-RSL**	**LANL**	**0.026**	**0.33**	**TBD**
Hexachlorobutadiene	**87-68-3**	1.2 C	**0.009**	R-RSL	**R4**	**0.003**	**0.33**	**TBD**
Hexachlorocyclopentadiene	**77-47-4**	**0.18 N**	**0.001**	**R-RSL**	**R4**	**0.00033**	**0.33**	**TBD**
Hexachloroethane	**67-72-1**	1.8 C	**0.024**	R-RSL	**R4**	**0.008**	**0.33**	**TBD**
Isophorone	78-59-1	570 C	139	R-RSL/ WVDEP	R5	46	0.33	TBD
Nitrobenzene	98-95-3	5.1 C	2.2	R-RSL	LANL	0.73	0.33	TBD
N-Nitrosodi-n-propylamine	**621-64-7**	**0.078 C**	0.544	**R-RSL/ WVDEP**	R5	**0.026**	**0.33**	**TBD**
N-Nitrosodiphenylamine	86-30-6	110 C	0.545	R-RSL/ WVDEP	R4	0.18	0.33	TBD
Phenol	108-95-2	1,900 N	0.79	R-RSL/ WVDEP	LANL	0.26	0.33	TBD
PAHs and PCP[4]								
2-Methylnaphthalene	91-57-6	24 N	29	R-RSL	Eco SSL	8.0	0.0033	TBD
Acenaphthene	83-32-9	360 N	0.25	R-RSL	LANL	0.083	0.0033	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Acenaphthylene	208-96-8	420 N	29	WVDEP	Eco SSL	9.7	0.0033	TBD
Anthracene	120-12-7	1800 N	6.8	R-RSL	LANL	2.3	0.0033	TBD
Benzo(a)anthracene	56-55-3	0.21 C	0.73	WVDEP	LANL	0.07	0.0033	TBD
Benzo(a)pyrene	50-32-8	0.016 C	1.1	WVDEP	Eco SSL	0.0053	0.0033	TBD
Benzo(b)fluoranthene	205-99-2	0.16 C	1.1	WVDEP	Eco SSL	0.053	0.0033	TBD
Benzo(g,h,i)perylene	191-24-2	180 N[5]	1.1	R-RSL/ WVDEP	Eco SSL	0.37	0.0033	TBD
Benzo(k)fluoranthene	207-08-9	1.6 C	1.1	WVDEP	Eco SSL	0.37	0.0033	TBD
Chrysene	218-01-9	16 C	1.1	WVDEP	Eco SSL	0.37	0.0033	TBD
Dibenzo(a,h)anthracene	53-70-3	0.016 C	1.1	WVDEP	Eco SSL	0.0053	0.0033	TBD
Fluoranthene	206-44-0	240 N	29	R-RSL/ WVDEP	Eco SSL	9.7	0.0033	TBD
Fluorene	86-73-7	240 N	29	R-RSL	Eco SSL	9.7	0.0033	TBD
Indeno(1,2,3-c,d)pyrene	193-39-5	0.16 C	1.1	WVDEP	Eco SSL	0.053	0.0033	TBD
Naphthalene	91-20-3	3.8 C	1	R-RSL	LANL	0.33	0.0033	TBD
Phenanthrene	85-01-8	180 N[5]	29	R-RSL	Eco SSL	9.7	0.0033	TBD
Pyrene	129-00-0	180 N	1.1	R-RSL	Eco SSL	0.37	0.0033	TBD
Pentachlorophenol	87-86-5	1.0 C	2.1	R-RSL/ WVDEP	Eco SSL	0.33	0.0067	TBD

[1] The HHRA PSL references for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] For 1,4-Dioxane, samples must be analyzed by SVOCs-SIM to achieve the CRQL.

[4] The low-level PAHs and PCP will be analyzed by SIM to obtain lower detection limits.

[5] The R-RSL value is for pyrene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Soil
Analytical Group: TCL Pesticides following CLP SOM02.4

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
4,4'-DDD	72-54-8	0.19 N	0.021	R-RSL	Eco SSL	0.007	0.0033	TBD
4,4'-DDE	72-55-9	2 C	0.021	R-RSL/ WVDEP	Eco SSL	0.007	0.0033	TBD
4,4'-DDT	50-29-3	1.9 C	0.021	R-RSL/ WVDEP	Eco SSL	0.007	0.0033	TBD
Aldrin	309-00-2	0.039 C	0.0033	R-RSL/ WVDEP	R5	0.0011	0.0017	TBD
Alpha-BHC	**319-84-6**	0.086 C	**0.0003**	R-RSL/ WVDEP	**R4**	**0.0001**	**0.0017**	**TBD**
beta-BHC	**319-85-7**	0.3 C	**0.0003**	R-RSL/ WVDEP	**R4**	**0.0001**	**0.0017**	**TBD**
cis-Chlordane	5103-71-9	1.7 C[3]	0.0029	R-RSL	R4	0.00097	0.0017	TBD
delta-BHC	319-86-8	0.086 C[4]	9.94	R-RSL/ WVDEP	R5	0.029	0.0017	TBD
Dieldrin	**60-57-1**	0.034 C	**0.0029**	R-RSL	**R4**	**0.00097**	**0.0033**	**TBD**
Endosulfan I	**959-98-8**	45 N[5]	**0.0009**	WVDEP	**R4**	**0.0003**	**0.0017**	**TBD**
Endosulfan II	**33213-65-9**	45 N[5]	**0.0009**	WVDEP	**R4**	**0.0003**	**0.0033**	**TBD**
Endosulfan sulfate	**1031-07-8**	38 N	**0.0007**	R-RSL	**R4**	**0.00023**	**0.0033**	**TBD**
Endrin	**72-20-8**	1.9 N	**0.0014**	R-RSL/ WVDEP	**LANL**	**0.00047**	**0.0033**	**TBD**
Endrin aldehyde	7421-93-4	1.9 N[6]	0.0105	R-RSL/ WVDEP	R5	0.0035	0.0033	TBD
Endrin ketone	53494-70-5	1.9 N[6]	NC	R-RSL/ WVDEP	None	0.63	0.0033	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
gamma-BHC (Lindane)	58-89-9	0.57 C	0.0031	R-RSL/ WVDEP	R4	0.001	0.0017	TBD
Heptachlor	**76-44-8**	0.13 C	**0.0016**	R-RSL	**R4**	**0.00053**	**0.0017**	**TBD**
Heptachlor epoxide	**1024-57-3**	0.07 C	**0.00015**	R-RSL	**R4**	**0.00005**	**0.0017**	**TBD**
Methoxychlor	**72-43-5**	32 N	**0.0021**	R-RSL/ WVDEP	**R4**	**0.0007**	**0.017**	**TBD**
Toxaphene	**8001-35-2**	0.49 C	**0.00015**	R-RSL/ WVDEP	**R4**	**0.00005**	**0.17**	**TBD**
trans-Chlordane	5103-74-2	1.7 C[3]	2.2	R-RSL	LANL	0.57	0.0017	TBD

[1] The HHRA PSL references for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is for chlordane.

[4] Value is for alpha-BHC.

[5] Value is for endosulfan.

[6] Value is for endrin.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Soil
Analytical Group: PCBs Congeners following CLP HRSM01.2

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-8	34883-43-7	NC	NC	None	None	None	2E-06	TBD
PCB-18	37680-65-2	NC	NC	None	None	None	2E-06	TBD
PCB-28	7012-37-5	NC	NC	None	None	None	2E-06	TBD
PCB-44	41464-39-5	NC	NC	None	None	None	2E-06	TBD
PCB-52	35693-99-3	NC	NC	None	None	None	2E-06	TBD
PCB-66	32598-10-0	NC	NC	None	None	None	2E-06	TBD
PCB-77[(3)]	32598-13-3	0.038 C	0.00032	R-RSL	LANL	0.0001	2E-06	TBD
PCB-81[(3)]	70362-50-4	0.012 C	0.00016	R-RSL	LANL	0.00005	2E-06	TBD
PCB-101	37680-73-2	NC	NC	None	None	None	2E-06	TBD
PCB-105[(3)]	32598-14-4	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-114[(3)]	74472-37-0	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-118[(3)]	31508-00-6	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-123[(3)]	65510-44-3	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-126[(3)]	57465-28-8	0.000036 C	0.0000029	R-RSL	LANL	9.7E-7	2E-06	TBD
PCB-128	38380-07-3	NC	NC	None	None	None	2E-06	TBD
PCB-138	35065-28-2	NC	NC	None	None	None	2E-06	TBD
PCB-153	35065-27-1	NC	NC	None	None	None	2E-06	TBD
PCB-156[(3)]	38380-08-4	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-157[(3)]	69782-90-7	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-167[(3)]	52663-72-6	0.12 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-169[(3)]	32774-16-6	0.00012 C	0.0000097	R-RSL	LANL	3.2E-6	2E-06	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-170	35065-30-6	NC	NC	None	None	None	2E-06	TBD
PCB-180	35065-29-3	NC	NC	None	None	None	2E-06	TBD
PCB-187	52663-68-0	NC	NC	None	None	None	2E-06	TBD
PCB-189(3)	39635-31-9	0.13 C	0.0097	R-RSL	LANL	0.003	2E-06	TBD
PCB-195	52663-78-2	NC	NC	None	None	None	2E-06	TBD
PCB-206	40186-72-9	NC	NC	None	None	None	2E-06	TBD
Total PCBs(4)	NA	NC	0.041	None	Region 4	0.014	NA	NA

[1] The HHRA PSL reference for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Screening levels for dioxin-like congeners are calculated based on toxicity equivalence factor to 2,3,7,8-TCDD based on the "Framework for the Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furan, and Biphenyls in Ecological Risk Assessment" (USEPA, 2008).

[4] Results for the sum of 18 NOAA congeners multiplied by two will compared to the screening level for total PCBs.

Matrix: Soil
Analytical Group: Dioxins/Furans following CLP HRMS01.2

Analyte	CAS Number	PSL (ng/kg)		PSL Reference[1]		PQLG (ng/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ng/kg)	MDL (ng/kg)
2,3,7,8-TCDD	**1746-01-6**	4.8 C	**0.29**	R-RSL	**LANL**	**0.1**	**1**	**TBD**
1,2,3,7,8-PeCDD	**40321-76-4**	4.8 C[3]	**0.29**	R-RSL	**LANL**	**0.1**	**5**	**TBD**
1,2,3,4,7,8-HxCDD	**39227-28-6**	48 C[3]	**2.9**	R-RSL	**LANL**	**1**	**5**	**TBD**
1,2,3,6,7,8-HxCDD	**57653-85-7**	48 C[3]	**2.9**	R-RSL	**LANL**	**1**	**5**	**TBD**
1,2,3,7,8,9-HxCDD	**19408-74-3**	48 C[3]	**2.9**	R-RSL	**LANL**	**1**	**5**	**TBD**
1,2,3,4,6,7,8-HpCDD	35822-46-9	480 C[3]	29	R-RSL	LANL	10	5	TBD
OCDD	3268-87-9	16000 C[3]	967	R-RSL	LANL	320	10	TBD
2,3,7,8-TCDF	51207-31-9	48 C[3]	2.9	R-RSL	LANL	1	1	TBD
1,2,3,7,8-PeCDF	57117-41-6	160 C[3]	9. 7	R-RSL	LANL	3.2	5	TBD
2,3,4,7,8-PeCDF	**57117-31-4**	16 C[3]	**0.97**	R-RSL	**LANL**	**0.32**	**5**	**TBD**
1,2,3,4,7,8-HxCDF	70648-26-9	48 C[3]	2.9	R-RSL	LANL	1	5	TBD
1,2,3,6,7,8-HxCDF	57117-44-9	48 C[3]	2.9	R-RSL	LANL	1	5	TBD
1,2,3,7,8,9-HxCDF	72918-21-9	48 C[3]	2.9	R-RSL	LANL	1	5	TBD
2,3,4,6,7,8-HxCDF	60851-34-5	48 C[3]	2.9	R-RSL	LANL	1	5	TBD
1,2,3,4,6,7,8-HpCDF	67562-39-4	480 C[3]	29	R-RSL	LANL	10	5	TBD
1,2,3,4,7,8,9-HpCDF	55673-89-7	480 C[3]	29	R-RSL	LANL	10	5	TBD
OCDF	39001-02-0	16000 C[3]	967	R-RSL	LANL	320	10	TBD

[1] The HHRA PSL reference for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.

Matrix: Soil
Analytical Group: TAL Inorganics (Metals and Cyanide) following CLP ISM02.4 ICP-MS (and Mercury by CVAA)

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Aluminum	7429-90-5	7,700 N	NA	R-RSL/ WVDEP	None	2,600	20 AES[3]	TBD
Antimony	**7440-36-0**	3.1 N	**0.27**	R-RSL/ WVDEP	**Eco SSL**	**0.09**	**1**	**TBD**
Arsenic	**7440-38-2**	**0.43 C**	6.8	**WVDEP**	LANL	**0.14**	**0.5**	**TBD**
Barium	7440-39-3	1500 N	110	R-RSL/ WVDEP	LANL	37	5	TBD
Beryllium	7440-41-7	16 N	2.5	R-RSL/ WVDEP	LANL	0.83	0.5	TBD
Cadmium	**7440-43-9**	3.7 N	**0.36**	WVDEP	**Eco SSL**	**0.12**	**0.5**	**TBD**
Calcium	7440-70-2	NC	NC	None	None	None	500 AES[3]	TBD
Chromium	**7440-47-3**	**0.3 C[4]**	**0.34**	**R-RSL**	**LANL**	**0.1**	**1**	**TBD**
Cobalt	7440-48-4	2.3 N	13	R-RSL/ WVDEP	Eco SSL	0.77	0.5	TBD
Copper	7440-50-8	310 N	28	R-RSL/ WVDEP	Eco SSL	9.3	1	TBD
Iron	7439-89-6	5500 N	200	R-RSL/ WVDEP	ORNL	67	10 AES[3]	TBD
Lead	7439-92-1	200	11	USEPA[5]	Eco SSL	3.7	0.5	TBD
Magnesium	7439-95-4	NC	NC	None	None	None	500 AES[3]	TBD
Manganese	7439-96-5	180 N	220	R-RSL	Eco SSL	60	0.5	TBD
Mercury	**7439-97-6**	1.1 N	**0.013**	R-RSL	**LANL**	**0.0043**	**0.1**	**TBD**
Nickel	7440-02-0	150 N	38	R-RSL/ WVDEP	Eco SSL	13	0.5	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Potassium	7440-09-7	NC	NC	None	None	None	500 AES[3]	TBD
Selenium	**7782-49-2**	39 N	**0.52**	R-RSL/ WVDEP	**Eco SSL**	**0.17**	**2.5**	**TBD**
Silver	7440-22-4	39 N	4.2	R-RSL/ WVDEP	Eco SSL	1.4	0.5	TBD
Sodium	7440-23-5	NC	NC	None	None	None	500 AES[3]	TBD
Thallium	**7440-28-0**	**0.078 N**	**0.05**	**R-RSL/ WVDEP**	**LANL**	**0.017**	**0.5**	**TBD**
Vanadium	**7440-62-2**	**0.55 N**	7.8	**WVDEP**	Eco SSL	**0.18**	**2.5**	**TBD**
Zinc	7440-66-6	2300 N	46	R-RSL/ WVDEP	Eco SSL	15	1	TBD
Cyanide	**57-12-5**	2.3 N	**0.098**	R-RSL/ WVDEP	**LANL**	**0.033**	**0.5**	**TBD**

CVAA – Cold Vapor Atomic Absorption
ICP-MS – Inductively Coupled Plasma-Mass Spectrometry
ICP-AES (or "AES") – Inductively Coupled Plasma-Atomic Emission Spectroscopy

[1] The HHRA PSL references for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10); The ERA PSL references for surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] AES – The CLP Laboratory may elect to analyze these metals by ICP-AES instead of ICP-MS at their discretion; however, all the same QC criteria must be met.
[4] Value is for hexavalent chromium.
[5] Value referenced in December 2016 OLEM Memo (USEPA, 2016).

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Sediment
Analytical Group: TCL VOCs following CLP SOM02.4 Low

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
1,1,1-Trichloroethane	71-55-6	6,400	0.0302	WVDEP	R3 BTAG SED	0.010	0.005	TBD
1,1,2,2-Tetrachloroethane	79-34-5	6 C	1.36	R-RSL	R3 BTAG SED	0.45	0.005	TBD
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	6,700 N	NC	R-RSL	None	2,200	0.005	TBD
1,1,2-Trichloroethane	79-00-5	1.5 N	1.24	R-RSL	R3 BTAG SED	0.41	0.005	TBD
1,1-Dichloroethane	75-34-3	36 C	0.02	R-RSL	LANL	0.0067	0.005	TBD
1,1-Dichloroethene	75-35-4	230 N	0.031	R-RSL	R3 BTAG SED	0.010	0.005	TBD
1,2,3-Trichlorobenzene	87-61-6	63 N	0.858	R-RSL	R3 BTAG SED	0.29	0.005	TBD
1,2,4-Trichlorobenzene	120-82-1	58 N	2.1	R-RSL	R3 BTAG SED	0.70	0.005	TBD
1,2-Dibromo-3-chloropropane	96-12-8	0.053 C	NC	R-RSL	None	0.018	0.005	TBD
1,2-Dibromoethane	106-93-4	0.36 C	NC	R-RSL	None	0.12	0.005	TBD
1,2-Dichlorobenzene	95-50-1	1,800 N	0.0165	R-RSL	R3 BTAG SED	0.0055	0.005	TBD
1,2-Dichloroethane	107-06-2	4.6 C	0.25	R-RSL	ORNL	0.083	0.005	TBD
1,2-Dichloropropane	78-87-5	11 C	0.333	WVDEP	R5	0.11	0.005	TBD
1,3-Dichlorobenzene	541-73-1	NC	4.43	None	R3 BTAG SED	1.5	0.005	TBD
1,4-Dichlorobenzene	106-46-7	26 C	0.599	R-RSL	R3 BTAG SED	0.20	0.005	TBD
2-Butanone	78-93-3	27,000 N	0.27	R-RSL	ORNL	0.09	0.010	TBD
2-Hexanone	591-78-6	200 N	0.022	R-RSL	ORNL	0.0073	0.010	TBD
4-Methyl-2-pentanone	108-10-1	33,000 N	0.033	R-RSL	ORNL	0.011	0.010	TBD
Acetone	67-64-1	61,000 N	0.065	R-RSL/ WVDEP	LANL	0.022	0.010	TBD
Benzene	71-43-2	12 C	0.01	R-RSL/ WVDEP	LANL	0.0033	0.005	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Bromochloromethane	74-97-5	150 N	NC	R-RSL	None	50	0.005	TBD
Bromodichloromethane	75-27-4	2.9 C	0.21	R-RSL	R4	0.07	0.005	TBD
Bromoform	75-25-2	190 C	0.654	R-RSL	R3 BTAG SED	0.22	0.005	TBD
Bromomethane	74-83-9	6.8 N	0.0065	R-RSL	R4	0.0022	0.005	TBD
Carbon disulfide	**75-15-0**	770 N	**0.000851**	R-RSL	**R3 BTAG SED**	**0.00028**	**0.005**	**TBD**
Carbon tetrachloride	56-23-5	6.5 C	0.0642	R-RSL	R3 BTAG SED	0.021	0.005	TBD
Chlorobenzene	108-90-7	280 N	0.00842	R-RSL	R3 BTAG SED	0.0028	0.005	TBD
Chloroethane	75-00-3	14,000 N	NC	R-RSL	None	4700	0.005	TBD
Chloroform	67-66-3	3.2 C	0.022	R-RSL	ORNL	0.0073	0.005	TBD
Chloromethane	74-87-3	110 N	NC	R-RSL	None	37	0.005	TBD
cis-1,2-Dichloroethene	156-59-2	17 N	0.432	WVDEP	R4	0.14	0.005	TBD
cis-1,3-Dichloropropene	**10061-01-5**	18 C[3]	**0.0015**	R-RSL	**R4**	**0.0005**	**0.005**	**TBD**
Cyclohexane	110-82-7	1,200	NC	WVDEP	None	400	0.005	TBD
Dibromochloromethane	124-48-1	83 C	0.198	R-RSL/ WVDEP	R4	0.066	0.005	TBD
Dichlorodifluoromethane	75-71-8	87 N	NC	R-RSL	None	29	0.005	TBD
Ethylbenzene	100-41-4	58 C	1.1	R-RSL	R3 BTAG SED	0.37	0.005	TBD
Isopropylbenzene	98-82-8	1,900 N	0.086	R-RSL	R3 BTAG SED	0.029	0.005	TBD
m,p-Xylenes	179601-23-1	550 N[4]	0.13	R-RSL	R4	0.043	0.005	TBD
Methyl acetate	79-20-9	23,000 N	NC	WVDEP	None	7700	0.005	TBD
Methyl cyclohexane	108-87-2	NC	NC	None	None	---	0.005	TBD
Methylene chloride	75-09-2	350 N	0.018	R-RSL	LANL	0.006	0.005	TBD
Methyl-tert-butyl ether	1634-04-4	470 C	0.304	R-RSL	R4	0.1	0.005	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
o-Xylene	95-47-6	650 N	NC	R-RSL	None	220	0.005	TBD
Styrene	100-42-5	6000 N	0.559	R-RSL	R3 BTAG SED	0.19	0.005	TBD
Tetrachloroethene	127-18-4	81 N	0.468	R-RSL	R3 BTAG SED	0.16	0.005	TBD
Toluene	108-88-3	4900 N	0.01	R-RSL	LANL	0.0033	0.005	TBD
trans-1,2-Dichloroethene	156-60-5	130 N	1.05	WVDEP	R3 BTAG SED	0.35	0.005	TBD
trans-1,3-Dichloropropene	**10061-02-6**	18 C[3]	**0.0015**	R-RSL	**R4**	**0.0005**	**0.005**	**TBD**
Trichloroethene	79-01-6	4.1 N	0.0969	R-RSL	R3 BTAG SED	0.032	0.005	TBD
Trichlorofluoromethane	75-69-4	790 N	NC	WVDEP	None	260	0.005	TBD
Vinyl chloride	75-01-4	0.57 C	0.482	WVDEP	R4	0.16	0.005	TBD
Xylenes (total)	1330-20-7	580 N	0.13	R-RSL	LANL	0.043	0.005	TBD

[1] The HHRA PSL references for sediment screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The ERA PSL references for sediment screening are the following, in order of preference: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006b); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks; Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is for 1,3-dichloropropene.

[4] Value is for m-xylene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Sediment
Analytical Group: TCL SVOCs following CLP SOM02.4 Low (including low level PAHs and PCP by SIM) and 1,4-Dioxane by SVOCs-SIM

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
1,1-Biphenyl	92-52-4	47 N	1.22	R-RSL	R3 BTAG SED	0.41	0.17	TBD
1,2,4,5-Tetrachlorobenzene	95-94-3	17 N	1.09	WVDEP	R3 BTAG SED	0.36	0.17	TBD
1,4-Dioxane[3]	123-91-1	53 C	0.119	R-RSL	R5	0.04	0.067	TBD
2,2'-Oxybis(1-chloropropane)	108-60-1	51 C	NC	WVDEP	NC	17	0.33	TBD
2,3,4,6-Tetrachlorophenol	58-90-2	1,900 N	0.284	R-RSL/ WVDEP	R3 BTAG SED	0.095	0.17	TBD
2,4,5-Trichlorophenol	**95-95-4**	6,300 N	**0.034**	R-RSL/ WVDEP	**R4**	**0.011**	**0.33**	**TBD**
2,4,6-Trichlorophenol	**88-06-2**	63 N	**0.213**	R-RSL	**R3 BTAG SED**	**0.071**	**0.33**	**TBD**
2,4-Dichlorophenol	**120-83-2**	190 N	**0.117**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.039**	**0.33**	**TBD**
2,4-Dimethylphenol	**105-67-9**	1,300 N	**0.029**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.0097**	**0.33**	**TBD**
2,4-Dinitrophenol	**51-28-5**	130 N	**0.223**	R-RSL/ WVDEP	**R4**	**0.074**	**0.33**	**TBD**
2,4-Dinitrotoluene	**121-14-2**	17 C	**0.0416**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.014**	**0.33**	**TBD**
2,6-Dinitrotoluene	**606-20-2**	3.6 C	**0.296**	R-RSL/ WVDEP	**R4**	**0.099**	**0.33**	**TBD**
2-Chloronaphthalene	91-58-7	4,800 N	0.417	R-RSL	R5	0.14	0.33	TBD
2-Chlorophenol	**95-57-8**	340 N	**0.0312**	WVDEP	**R3 BTAG SED**	**0.010**	**0.17**	**TBD**
2-Methylphenol	**95-48-7**	3,200 N	**0.012**	R-RSL/ WVDEP	**ORNL**	**0.004**	**0.33**	**TBD**
2-Nitroaniline	88-74-4	630 N	NC	R-RSL/ WVDEP	None	210	0.33	TBD
2-Nitrophenol	**88-75-5**	NC	**0.168**	None	**R4**	**0.056**	**0.33**	**TBD**
3,3'-Dichlorobenzidine	**91-94-1**	12 C	**0.127**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.042**	**0.33**	**TBD**
3-Methylphenol	**108-39-4**	3,200 N	**0.112**	R-RSL/ WVDEP	**R4**	**0.037**	**0.33**	**TBD**

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
3-Nitroaniline	99-09-2	NC	NC	None	NC	None	0.33	TBD
4,6-Dinitro-2-methylphenol	534-52-1	5.1 N	1.477	R-RSL	R4	0.49	0.33	TBD
4-Bromophenyl phenyl ether	101-55-3	NC	1.23	None	R3 BTAG SED	0.41	0.33	TBD
4-Chloro-3-methylphenol	**59-50-7**	6,300 N	**0.005**	R-RSL	**R4**	**0.0017**	**0.33**	**TBD**
4-Chloroanaline	**106-47-8**	27 C	**0.0009**	R-RSL/ WVDEP	**R4**	**0.0003**	**0.33**	**TBD**
4-Chlorophenyl phenyl ether	7005-72-3	NC	NC	None	NC	None	0.33	TBD
4-Methylphenol	106-44-5	6,300 N	0.67	R-RSL/ WVDEP	R3 BTAG SED	0.22	0.33	TBD
4-Nitroaniline	100-01-6	250 N	NC	R-RSL	None	83	0.33	TBD
4-Nitrophenol	**100-02-7**	NC	**0.153**	None	**R4**	**0.051**	**0.33**	**TBD**
Acetophenone	98-86-2	7,800 N	NC	R-RSL	None	2600	0.33	TBD
Atrazine	**1912-24-9**	24 C	**0.00662**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.0022**	**0.33**	**TBD**
Benzaldehyde	**100-52-7**	1,700 C	**0.059**	R-RSL	**R4**	**0.02**	**0.33**	**TBD**
Bis(2-chloroethoxy)methane	111-91-1	190 N	NC	R-RSL	NC	63	0.17	TBD
Bis(2-chloroethyl)ether	**111-44-4**	2.3 C	3.52	R-RSL	R5	**0.77**	**0.33**	**TBD**
Bis(2-ethylhexyl)phthalate	**117-81-7**	390 C	**0.18**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.06**	**0.33**	**TBD**
Butyl benzyl phthalate	85-68-7	2,900 C	10.9	R-RSL/ WVDEP	R3 BTAG SED	3.6	0.33	TBD
Caprolactam	105-60-2	31,000 N	NC	R-RSL/ WVDEP	NC	10,000	0.33	TBD
Carbazole	86-74-8	NC	NC	None	None	None	0.33	TBD
Dibenzofuran	132-64-9	73 N	0.415	R-RSL	R3 BTAG SED	0.14	0.33	TBD
Diethyl phthalate	84-66-2	51,000 N	0.603	R-RSL/ WVDEP	R3 BTAG SED	0.2	0.33	TBD
Dimethyl phthalate	131-11-3	NC	NC	None	None	None	0.33	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Di-n-butyl phthalate	84-74-2	6,300 N	6.47	R-RSL/ WVDEP	R3 BTAG SED	2.2	0.33	TBD
Di-n-octyl phthalate	117-84-0	630 N	40.6	R-RSL	R5	14	0.33	TBD
Hexachlorobenzene	**118-74-1**	2.1 C	**0.02**	R-RSL	**R3 BTAG SED**	**0.0067**	**0.33**	**TBD**
Hexachlorobutadiene	**87-68-3**	12 C	**0.0265**	R-RSL	**R5**	**0.0088**	**0.33**	**TBD**
Hexachlorocyclopentadiene	**77-47-4**	1.8 N	**0.0065**	R-RSL	**R4**	**0.0022**	**0.33**	**TBD**
Hexachloroethane	67-72-1	18 C	1.027	R-RSL	R3 BTAG SED	0.34	0.33	TBD
Isophorone	78-59-1	5,700 C	0.432	R-RSL/ WVDEP	R5	0.14	0.33	TBD
Nitrobenzene	**98-95-3**	51 C	**0.145**	R-RSL	**R5**	**0.048**	**0.33**	**TBD**
N-Nitrosodi-n-propylamine	621-64-7	0.78 C	NC	R-RSL/ WVDEP	NC	0.26	0.33	TBD
N-Nitrosodiphenylamine	86-30-6	1,100 C	2.68	R-RSL/ WVDEP	R3 BTAG SED	0.89	0.33	TBD
Phenol	108-95-2	19,000 N	0.42	R-RSL/ WVDEP	R3 BTAG SED	0.14	0.33	TBD
PAHs and PCP[4]								
2-Methylnaphthalene	91-57-6	240 N	0.0202	R-RSL	R3 BTAG SED	0.0067	0.0033	TBD
Acenaphthene	83-32-9	3,600 N	0.0067	R-RSL	R3 BTAG SED	0.0022	0.0033	TBD
Acenaphthylene	208-96-8	4200	0.0059	WVDEP	R3 BTAG SED	0.002	0.0033	TBD
Anthracene	120-12-7	18,000 N	0.0572	R-RSL	R3 BTAG SED	0.019	0.0033	TBD
Benzo(a)anthracene	56-55-3	2.1 C	0.108	WVDEP	R3 BTAG SED	0.036	0.0033	TBD
Benzo(a)pyrene	50-32-8	0.16 C	0.15	WVDEP	R3 BTAG SED	0.05	0.0033	TBD
Benzo(b)fluoranthene	205-99-2	1.6 C	0.19	WVDEP	LANL	0.063	0.0033	TBD
Benzo(g,h,i)perylene	191-24-2	1800 N[5]	0.17	R-RSL/ WVDEP	R3 BTAG SED	0.057	0.0033	TBD
Benzo(k)fluoranthene	207-08-9	16 C	0.24	WVDEP	R3 BTAG SED	0.08	0.0033	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Chrysene	218-01-9	160 C	0.166	WVDEP	R3 BTAG SED	0.055	0.0033	TBD
Dibenzo(a,h)anthracene	53-70-3	0.16 C	0.033	WVDEP	R3 BTAG SED	0.011	0.0033	TBD
Fluoranthene	206-44-0	2,400 N	0.423	R-RSL/ WVDEP	R3 BTAG SED	0.14	0.0033	TBD
Fluorene	86-73-7	2,400 N	0.0774	R-RSL	R3 BTAG SED	0.026	0.0033	TBD
Indeno(1,2,3-c,d)pyrene	193-39-5	1.6 C	0.017	WVDEP	R3 BTAG SED	0.0057	0.0033	TBD
Naphthalene	91-20-3	38 C	0.176	R-RSL	R3 BTAG SED	0.059	0.0033	TBD
Phenanthrene	85-01-8	1,800 N[5]	0.204	R-RSL	R3 BTAG SED	0.068	0.0033	TBD
Pyrene	129-00-0	1,800 N	0.195	R-RSL	R3 BTAG SED	0.065	0.0033	TBD
Pentachlorophenol	87-86-5	10 C	0.504	R-RSL/ WVDEP	R3 BTAG SED	0.17	0.0067	TBD

[1] The HHRA PSL references for sediment screening are: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The ERA PSL references for sediment screening are the following, in order of preference R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006b); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks; Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] For 1,4-Dioxane, samples must be analyzed by SVOCs-SIM to achieve the CRQL as required by the PSL since this analyte is a known COPC at the site.

[4] The low-level PAHs and PCP will be analyzed by SIM to obtain lower detection limits.

[5] Value is for pyrene.

NA – Not applicable

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Sediment
Analytical Group: TCL Pesticides following CLP SOM02.4

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
4,4'-DDD	72-54-8	1.9 N	0.00488	R-RSL	R3 BTAG SED	0.0016	0.0033	TBD
4,4'-DDE	**72-55-9**	20 C	**0.00316**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.0011**	**0.0033**	**TBD**
4,4'-DDT	50-29-3	19 C	0.0041	R-RSL/ WVDEP	LANL	0.0014	0.0033	TBD
Aldrin	309-00-2	0.39 C	0.002	R-RSL/ WVDEP	R3 BTAG SED	0.00067	0.0017	TBD
Alpha-BHC	319-84-6	0.86 C	0.006	R-RSL/ WVDEP	R3 BTAG SED	0.002	0.0017	TBD
beta-BHC	319-85-7	3 C	0.005	R-RSL/ WVDEP	R3 BTAG SED	0.0017	0.0017	TBD
cis-Chlordane	5103-71-9	17 C[3]	0.0032	R-RSL	LANL	0.0011	0.0017	TBD
delta-BHC	319-86-8	0.86 C[4]	6.4	R-RSL/ WVDEP	R3 BTAG SED	0.29	0.0017	TBD
Dieldrin	**60-57-1**	0.34 C	**0.0019**	R-RSL	**R3 BTAG SED**	**0.00063**	**0.0033**	**TBD**
Endosulfan I	959-98-8	450 N[5]	0.0029	WVDEP	R3 BTAG SED	0.00097	0.0017	TBD
Endosulfan II	33213-65-9	450 N[5]	0.014	WVDEP	R3 BTAG SED	0.0047	0.0033	TBD
Endosulfan sulfate	1031-07-8	380 N	0.0054	R-RSL	R3 BTAG SED	0.0018	0.0033	TBD
Endrin	**72-20-8**	19 N	**0.00222**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.00074**	**0.0033**	**TBD**
Endrin aldehyde	7421-93-4	19 N[6]	0.48	R-RSL/ WVDEP	R5	0.16	0.0033	TBD
Endrin ketone	53494-70-5	19 N[6]	NC	R-RSL/ WVDEP	NC	6.3	0.0033	TBD
gamma-BHC (Lindane)	58-89-9	5.7 C	0.00237	R-RSL/ WVDEP	R3 BTAG SED	0.00079	0.0017	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Heptachlor	76-44-8	1.3 C	0.068	R-RSL	R3 BTAG SED	0.023	0.0017	TBD
Heptachlor epoxide	1024-57-3	0.7 C	0.00247	R-RSL	R3 BTAG SED	0.00082	0.0017	TBD
Methoxychlor	72-43-5	320 N	0.0187	R-RSL/ WVDEP	R3 BTAG SED	0.0062	0.017	TBD
Toxaphene	**8001-35-2**	4.9 C	**0.0001**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.000033**	**0.17**	**TBD**
trans-Chlordane	5103-74-2	17 C[3]	0.0032	R-RSL	LANL	0.0011	0.0017	TBD

[1] The HHRA PSL references for sediment screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017) (noncarcinogens were divided by 10), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The ERA PSL references for sediment screening are: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006b); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks; Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is for chlordane.

[4] Value is for alpha-BHC.

[5] Value is for endosulfan.

[6] Value is for endrin.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Sediment
Analytical Group: PCB Congeners following CLP HRSM01.2

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-8	34883-43-7	NC	NC	None	None	None	2E-06	TBD
PCB-18	37680-65-2	NC	NC	None	None	None	2E-06	TBD
PCB-28	7012-37-5	NC	NC	None	None	None	2E-06	TBD
PCB-44	41464-39-5	NC	NC	None	None	None	2E-06	TBD
PCB-52	35693-99-3	NC	NC	None	None	None	2E-06	TBD
PCB-66	32598-10-0	NC	NC	None	None	None	2E-06	TBD
PCB-77[(3)]	32598-13-3	0.38 C	0.0085	R-RSL	R3 BTAG SED	0.0028	2E-06	TBD
PCB-81[(3)]	70362-50-4	0.12 C	0.0017	R-RSL	R3 BTAG SED	0.00057	2E-06	TBD
PCB-101	37680-73-2	NC	NC	None	None	None	2E-06	TBD
PCB-105[(3)]	32598-14-4	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-114[(3)]	74472-37-0	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-118[(3)]	31508-00-6	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-123[(3)]	65510-44-3	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-126[(3)]	57465-28-8	0.00036 C	0.00017	R-RSL	R3 BTAG SED	0.000057	2E-06	TBD
PCB-128	38380-07-3	NC	NC	None	None	None	2E-06	TBD
PCB-138	35065-28-2	NC	NC	None	None	None	2E-06	TBD
PCB-153	35065-27-1	NC	NC	None	None	None	2E-06	TBD
PCB-156[(3)]	38380-08-4	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-157[(3)]	69782-90-7	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-167[(3)]	52663-72-6	1.2 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-169[(3)]	32774-16-6	0.0012 C	0.017	R-RSL	R3 BTAG SED	0.0004	2E-06	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-170	35065-30-6	NC	NC	None	None	None	2E-06	TBD
PCB-180	35065-29-3	NC	NC	None	None	None	2E-06	TBD
PCB-187	52663-68-0	NC	NC	None	None	None	2E-06	TBD
PCB-189(3)	39635-31-9	1.3 C	0.17	R-RSL	R3 BTAG SED	0.057	2E-06	TBD
PCB-195	52663-78-2	NC	NC	None	None	None	2E-06	TBD
PCB-206	40186-72-9	NC	NC	None	None	None	2E-06	TBD
Total PCBs(4)	NA	NC	0.0598	None	R3 BTAG SED	0.02	NA	NA

[1] The HHRA PSL references for sediment screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The ERA PSL references for sediment screening are the following, in order of preference: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006c); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks (Jones, et al., 1997); Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Screening levels for dioxin-like congeners are calculated based on toxicity equivalence factor to 2,3,7,8-TCDD based on the "Framework for the Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furan, and Biphenyls in Ecological Risk Assessment" (USEPA, 2008).

[4] Results for the sum of 18 NOAA congeners multiplied by two will compared to the screening level for total PCBs.

Matrix: Sediment
Analytical Group: Dioxins/Furans following CLP HRMS01.2

Analyte	CAS Number	PSL (ng/kg)		PSL Reference[1]		PQLG (ng/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ng/kg)	MDL (ng/kg)
2,3,7,8-TCDD	**1746-01-6**	48 C	**0.85**	R-RSL	**R3 BTAG SED**	**0.28**	**1**	**TBD**
1,2,3,7,8-PeCDD	**40321-76-4**	48 C[3]	**0.85**	R-RSL	**R3 BTAG SED**	**0.28**	**5**	**TBD**
1,2,3,4,7,8-HxCDD	**39227-28-6**	480 C[3]	**1.7**	R-RSL	**R3 BTAG SED**	**0.57**	**5**	**TBD**
1,2,3,6,7,8-HxCDD	57653-85-7	480 C[3]	85	R-RSL	R3 BTAG SED	28	5	TBD
1,2,3,7,8,9-HxCDD	19408-74-3	480 C[3]	85	R-RSL	R3 BTAG SED	28	5	TBD
1,2,3,4,6,7,8-HpCDD	35822-46-9	4,800 C[3]	850	R-RSL	R3 BTAG SED	280	5	TBD
OCDD	3268-87-9	160,000 C[3]	8,500	R-RSL	R3 BTAG SED	2,800	10	TBD
2,3,7,8-TCDF	51207-31-9	480 C[3]	17	R-RSL	R3 BTAG SED	5.7	1	TBD
1,2,3,7,8-PeCDF	57117-41-6	1,600 C[3]	17	R-RSL	R3 BTAG SED	5.7	5	TBD
2,3,4,7,8-PeCDF	**57117-31-4**	160 C[3]	**1.7**	R-RSL	**R3 BTAG SED**	**0.57**	**5**	**TBD**
1,2,3,4,7,8-HxCDF	70648-26-9	480 C[3]	8.5	R-RSL	R3 BTAG SED	2.8	5	TBD
1,2,3,6,7,8-HxCDF	57117-44-9	480 C[3]	8.5	R-RSL	R3 BTAG SED	2.8	5	TBD
1,2,3,7,8,9-HxCDF	72918-21-9	480 C[3]	8.5	R-RSL	R3 BTAG SED	2.8	5	TBD
2,3,4,6,7,8-HxCDF	60851-34-5	480 C[3]	8.5	R-RSL	R3 BTAG SED	2.8	5	TBD
1,2,3,4,6,7,8-HpCDF	67562-39-4	4,800 C[3]	85	R-RSL	R3 BTAG SED	28	5	TBD
1,2,3,4,7,8,9-HpCDF	55673-89-7	4,800 C[3]	85	R-RSL	R3 BTAG SED	28	5	TBD
OCDF	39001-02-0	160,000 C[3]	8,500	R-RSL	R3 BTAG SED	2,800	10	TBD

[1] The HHRA PSL reference for soil screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to sediment; The ERA PSL references for surface soil screening are the following, in order of preference: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006c); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks (Jones, et al., 1997); Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.

Matrix: Sediment
Analytical Group: TAL Inorganics (TAL Metals and Cyanide) following CLP ISM02.4 ICP-MS (and Mercury by CVAA)

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Aluminum	7429-90-5	77,000 N	25,000	R-RSL/ WVDEP	LANL	8,300	20 AES[3]	TBD
Antimony	7440-36-0	31 N	2	R-RSL/ WVDEP	R3 BTAG SED	0.67	1	TBD
Arsenic	7440-38-2	4.3 C	9.8	WVDEP	R3 BTAG SED	1.4	0.5	TBD
Barium	7440-39-3	15,000 N	150	R-RSL/ WVDEP	LANL	50	5	TBD
Beryllium	7440-41-7	160 N	NC	R-RSL/ WVDEP	NC	53	0.5	TBD
Cadmium	7440-43-9	37 N	0.99	WVDEP	R3 BTAG SED	0.33	0.5	TBD
Calcium	7440-70-2	NC	NC	None	NC	None	500 AES[3]	TBD
Chromium	7440-47-3	3 C[4]	43.4	R-RSL	R3 BTAG SED	1	1	TBD
Cobalt	7440-48-4	23 N	50	R-RSL/ WVDEP	R3 BTAG SED	7.7	0.5	TBD
Copper	7440-50-8	3,100 N	31.6	R-RSL/ WVDEP	R3 BTAG SED	11	1	TBD
Iron	7439-89-6	55,000 N	20,000	R-RSL/ WVDEP	R3 BTAG SED	6,700	10 AES[3]	TBD
Lead	7439-92-1	200	35.8	USEPA[5]	R3 BTAG SED	12	0.5	TBD
Magnesium	7439-95-4	NC	NC	None	NC	None	500 AES[3]	TBD
Manganese	7439-96-5	1,800 N	460	R-RSL	R3 BTAG SED	150	0.5	TBD
Mercury	7439-97-6	11 N	0.18	R-RSL	R3 BTAG SED	0.06	0.1	TBD
Nickel	7440-02-0	1,500 N	22.7	R-RSL/ WVDEP	R3 BTAG SED	7.6	0.5	TBD

Analyte	CAS Number	PSL (mg/kg)		PSL Reference[1]		PQLG (mg/kg)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
Potassium	7440-09-7	NC	NC	None	NC	None	500 AES[3]	TBD
Selenium	**7782-49-2**	390 N	**2**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.67**	**2.5**	**TBD**
Silver	7440-22-4	390 N	1	R-RSL/ WVDEP	R3 BTAG SED	0.33	0.5	TBD
Sodium	7440-23-5	NC	NC	None	NC	None	500 AES[3]	TBD
Thallium	7440-28-0	0.78 N	NC	R-RSL/ WVDEP	NC	0.26	0.5	TBD
Vanadium	7440-62-2	5.5 N	NC	WVDEP	NC	1.8	2.5	TBD
Zinc	7440-66-6	23,000 N	121	R-RSL/ WVDEP	R3 BTAG SED	40	1	TBD
Cyanide	**57-12-5**	23 N	**0.1**	R-RSL/ WVDEP	**R3 BTAG SED**	**0.033**	**0.5**	**TBD**

[1] The HHRA PSL references for sediment screening: R-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Soil (USEPA, 2019a); The WVDEP Voluntary Cleanup Standards De Minimis Table 60-3B (WVDEP, 2017); The ERA PSL references for sediment screening are the following, in order of preference: R3 BTAG SED - USEPA Region 3 Ecological Freshwater Sediment Screening Benchmarks (USEPA, 2006c); LANL – LANL Ecological Screening Values (LANL, 2017); ORNL Sediment Benchmarks (Jones, et al., 1997); Region 4 Freshwater sediment screening levels (USEPA, 2018b); R5 – Region V Ecological Screening Levels (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] AES – The CLP Laboratory may elect to analyze these metals by ICP-AES instead of ICP-MS at their discretion; however, all of the same QC criteria must be met.

[4] Value is for hexavalent chromium.

[5] Value referenced in December 2016 OLEM Memo (USEPA, 2016).

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: TCL VOCs following CLP SOM02.4 Trace

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
1,1,1-Trichloroethane	71-55-6	8000 N	11	T-RSL	R3 BTAG SW	3.7	0.50	TBD
1,1,2,2-Tetrachloroethane	**79-34-5**	**0.17**	610	**WVDEP**	R3 BTAG SW	**0.057**	**0.50**	**TBD**
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	10000 N	NC	T-RSL	NC	3300	0.50	TBD
1,1,2-Trichloroethane	**79-00-5**	**0.41 N**	1200	**T-RSL**	R3 BTAG SW	**0.14**	**0.50**	**TBD**
1,1-Dichloroethane	75-34-3	28 C	47	T-RSL	R3 BTAG SW	9.3	0.50	TBD
1,1-Dichloroethene	**75-35-4**	**0.03**	25	**WVDEP**	R3 BTAG SW	**0.01**	**0.50**	**TBD**
1,2,3-Trichlorobenzene	87-61-6	7 N	8	T-RSL	R3 BTAG SW	2.3	0.50	TBD
1,2,4-Trichlorobenzene	120-82-1	4 N	24	T-RSL	R3 BTAG SW	1.3	0.50	TBD
1,2-Dibromo-3-chloropropane	**96-12-8**	**0.0033 C**	NC	**T-RSL**	NC	**0.0011**	**0.50**	**TBD**
1,2-Dibromoethane	**106-93-4**	**0.075 C**	NC	**T-RSL**	NC	**0.025**	**0.50**	**TBD**
1,2-Dichlorobenzene	95-50-1	300 N	0.7	T-RSL	R3 BTAG SW	0.23	0.50	TBD
1,2-Dichloroethane	**107-06-2**	**0.035**	100	**WVDEP**	R3 BTAG SW	**0.012**	**0.50**	**TBD**
1,2-Dichloropropane	78-87-5	8.2 N	520	T-RSL	R4	2.7	0.50	TBD
1,3-Dichlorobenzene	541-73-1	400	150	WVDEP	R3 BTAG SW	50	0.50	TBD
1,4-Dichlorobenzene	106-46-7	4.8 C	26	T-RSL	R3 BTAG SW	1.6	0.50	TBD
2-Butanone	78-93-3	5600 N	14,000	T-RSL	R3 BTAG SW	1900	5.0	TBD
2-Hexanone	591-78-6	38 N	99	T-RSL	R3 BTAG SW	13	5.0	TBD
4-Methyl-2-pentanone	108-10-1	6300 N	170	T-RSL	R3 BTAG SW	57	5.0	TBD
Acetone	67-64-1	14000 N	1,500	T-RSL	R3 BTAG SW	500	5.0	TBD
Benzene	71-43-2	0.66	370	WVDEP	R3 BTAG SW	0.22	0.50	TBD

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Bromochloromethane	74-97-5	83 N	NC	T-RSL	NC	28	0.50	TBD
Bromodichloromethane	75-27-4	0.55	340	WVDEP	R4	0.18	0.50	TBD
Bromoform	75-25-2	4.3	320	WVDEP	R3 BTAG SW	1.4	0.50	TBD
Bromomethane	74-83-9	7.5 N	16	T-RSL	R4	2.5	0.50	TBD
Carbon disulfide	75-15-0	810 N	0.92	T-RSL	R3 BTAG SW	0.31	0.50	TBD
Carbon tetrachloride	**56-23-5**	**0.25**	13.3	**WVDEP**	R3 BTAG SW	**0.083**	**0.50**	**TBD**
Chlorobenzene	108-90-7	78 N	1.3	T-RSL	R3 BTAG SW	0.43	0.50	TBD
Chloroethane	75-00-3	21000 N	NC	T-RSL	NC	7000	0.50	TBD
Chloroform	67-66-3	2.2 C	1.8	T-RSL	R3 BTAG SW	0.6	0.50	TBD
Chloromethane	74-87-3	190 N	NC	T-RSL	NC	63	0.50	TBD
cis-1,2-Dichloroethene	**156-59-2**	**0.035[3]**	590	**WVDEP**	ORNL	**0.012**	**0.50**	**TBD**
cis-1,3-Dichloropropene	**10061-01-5**	4.7 C[4]	**0.055**	T-RSL	**R3 BTAG SW**	**0.018**	**0.50**	**TBD**
Cyclohexane	110-82-7	13000 N	158	T-RSL	R4	53	0.50	TBD
Dibromochloromethane	124-48-1	8.7 C	320	T-RSL	R4	2.9	0.50	TBD
Dichlorodifluoromethane	75-71-8	200 N	NC	T-RSL	NC	67	0.50	TBD
Ethylbenzene	100-41-4	15 C	90	T-RSL	R3 BTAG SW	5.0	0.50	TBD
Isopropylbenzene	98-82-8	450 N	2.6	T-RSL	R3 BTAG SW	0.87	0.50	TBD
m,p-Xylenes	179601-23-1	190 N	13	T-RSL	R3 BTAG SW	4.3	0.50	TBD
Methyl acetate	79-20-9	20000 N	NC	T-RSL	NC	6700	0.50	TBD
Methyl cyclohexane	108-87-2	NC	52	None	R4	17	0.50	TBD
Methylene chloride	75-09-2	4.6	98.1	WVDEP	R3 BTAG SW	1.5	0.50	TBD
Methyl-tert-butyl ether	1634-04-4	140 C	11,070	T-RSL	R3 BTAG SW	47	0.50	TBD
o-Xylene	95-47-6	190 N	NC	T-RSL	NC	63	0.50	TBD

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Styrene	100-42-5	1200 N	72	T-RSL	R3 BTAG SW	24	0.50	TBD
Tetrachloroethene	127-18-4	0.8	111	WVDEP	R3 BTAG SW	0.27	0.50	TBD
Toluene	108-88-3	1100 N	2	T-RSL	R3 BTAG SW	0.67	0.50	TBD
trans-1,2-Dichloroethene	**156-60-5**	**0.035[3]**	970	**WVDEP**	R3 BTAG SW	**0.012**	**0.50**	**TBD**
trans-1,3-Dichloropropene	**10061-02-6**	4.7 C[4]	**0.055**	T-RSL	**R3 BTAG SW**	**0.018**	**0.50**	**TBD**
Trichloroethene	79-01-6	2.7	21	WVDEP	R3 BTAG SW	0.9	0.50	TBD
Trichlorofluoromethane	75-69-4	5200 N	NC	T-RSL	NC	1700	0.50	TBD
Vinyl chloride	**75-01-4**	**0.19 C**	930	**T-RSL**	R3 BTAG SW	**0.063**	**0.50**	**TBD**
Xylenes (total)	1330-20-7	190 N	13	T-RSL	R3 BTAG SW	4.3	0.50	TBD

[1] The HHRA PSL references for surface water screening are the minimum of the following: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018b) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is for 1,2-dichloroethene.

[4] Value is for 1,3-dichloropropene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: TCL SVOCs following CLP SOM02.4 Low (including low level PAHs and PCP by SIM) and 1,4-Dioxane by SVOCs-SIM

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
1,1-Biphenyl	**92-52-4**	**0.83 N**	14	**T-RSL**	R3 BTAG SW	**0.28**	**5.0**	**TBD**
1,2,4,5-Tetrachlorobenzene	**95-94-3**	**1.7 N**	**3**	**T-RSL**	**R3 BTAG SW**	**0.57**	**5.0**	**TBD**
1,4-Dioxane[3]	123-91-1	4.6 C	22,000	T-RSL	R5	1.5	0.5	TBD
2,2'-Oxybis(1-chloropropane)	108-60-1	710 N	NC	T-RSL	None	240	10	TBD
2,3,4,6-Tetrachlorophenol	**58-90-2**	240 N	**1.2**	T-RSL	**R3 BTAG SW**	**0.4**	**5.0**	**TBD**
2,4,5-Trichlorophenol	**95-95-4**	1200 N	**1.9**	T-RSL	**R4**	**0.63**	**5.0**	**TBD**
2,4,6-Trichlorophenol	**88-06-2**	**2.1**	**4.9**	**WVDEP**	**R3 BTAG SW**	**0.7**	**5.0**	**TBD**
2,4-Dichlorophenol	120-83-2	46 N	11	T-RSL	R3 BTAG SW	3.7	5.0	TBD
2,4-Dimethylphenol	105-67-9	360 N	15	T-RSL	R4	5	5.0	TBD
2,4-Dinitrophenol	51-28-5	39 N	71	T-RSL	R4	13	10	TBD
2,4-Dinitrotoluene	**121-14-2**	**2.4 C**	44	**T-RSL**	R3 BTAG SW	**0.8**	**5.0**	**TBD**
2,6-Dinitrotoluene	**606-20-2**	**0.49 C**	81	**T-RSL**	R3 BTAG SW	**0.16**	**5.0**	**TBD**
2-Chloronaphthalene	**91-58-7**	750 N	**0.396**	T-RSL	**R5**	**0.13**	**5.0**	**TBD**
2-Chlorophenol	95-57-8	91 N	24	T-RSL	R3 BTAG SW	8	5.0	TBD
2-Methylphenol	95-48-7	930 N	13	T-RSL	R3 BTAG SW	4.3	10	TBD
2-Nitroaniline	88-74-4	190 N	NC	T-RSL	None	63	5.0	TBD
2-Nitrophenol	88-75-5	NC	1920	None	R3 BTAG SW	640	5.0	TBD
3,3'-Dichlorobenzidine	**91-94-1**	**1.3 C**	**4.5**	**T-RSL**	**R3 BTAG SW**	**0.43**	**10**	**TBD**
3-Methylphenol	108-39-4	930 N	NC	T-RSL	None	310	5.0	TBD
3-Nitroaniline	99-09-2	NC	NC	None	None	None	10	TBD
4,6-Dinitro-2-methylphenol	**534-52-1**	**1.5 N**	23	**T-RSL**	R5	**0.5**	**10**	**TBD**

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
4-Bromophenyl phenyl ether	**101-55-3**	NC	**1.5**	None	**R3 BTAG SW**	**0.5**	**5.0**	**TBD**
4-Chloro-3-methylphenol	**59-50-7**	1400 N	**1**	T-RSL	**R4**	**0.33**	**5.0**	**TBD**
4-Chloroanaline	**106-47-8**	**3.7 C**	232	**T-RSL**	R3 BTAG SW	**1.2**	**10**	**TBD**
4-Chlorophenyl phenyl ether	7005-72-3	NC	NC	None	None	None	10	TBD
4-Methylphenol	106-44-5	1900 N	543	T-RSL	R3 BTAG SW	180	10	TBD
4-Nitroaniline	100-01-6	38 C	NC	T-RSL	None	13	10	TBD
4-Nitrophenol	100-02-7	NC	60	None	R3 BTAG SW	20	10	TBD
Acetophenone	98-86-2	1900 N	NC	T-RSL	None	630	10	TBD
Atrazine	**1912-24-9**	**3 C**	**1.8**	**T-RSL**	**R3 BTAG SW**	**0.60**	**5.0**	**TBD**
Benzaldehyde	100-52-7	190 C	143	T-RSL	R4	48	10	TBD
Bis(2-chloroethoxy)methane	111-91-1	59 N	NC	T-RSL	None	20	5.0	TBD
Bis(2-chloroethyl)ether	**111-44-4**	**0.14 C**	1900	**T-RSL**	R5	**0.047**	**5.0**	**TBD**
Bis(2-ethylhexyl)phthalate	117-81-7	56 C	16	T-RSL	R3 BTAG SW	5.3	10	TBD
Butyl benzyl phthalate	85-68-7	160 C	19	T-RSL	R3 BTAG SW	6.3	10	TBD
Caprolactam	105-60-2	9900 N	NC	T-RSL	None	3300	5.0	TBD
Carbazole	86-74-8	NC	NC	None	None	None	5.0	TBD
Dibenzofuran	**132-64-9**	**7.9 N**	**3.7**	**T-RSL**	**R3 BTAG SW**	**1.2**	**10**	**TBD**
Diethyl phthalate	84-66-2	15000 N	210	T-RSL	R3 BTAG SW	70	5.0	TBD
Dimethyl phthalate	**131-11-3**	NC	**3**	None	**LANL**	**1**	**10**	**TBD**
Di-n-butyl phthalate	84-74-2	900 N	19	T-RSL	R3 BTAG SW	6.3	5.0	TBD
Di-n-octyl phthalate	117-84-0	200 N	22	T-RSL	R3 BTAG SW	7.3	5.0	TBD
Hexachlorobenzene	**118-74-1**	**0.00072**	**0.0003**	**WVDEP**	**R3 BTAG SW**	**0.0001**	**10**	**TBD**
Hexachlorobutadiene	**87-68-3**	**1.4 C**	**1.3**	**T-RSL**	**R3 BTAG SW**	**0.043**	**5.0**	**TBD**

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Hexachlorocyclopentadiene	**77-47-4**	**0.41 N**	**0.45**	**T-RSL**	**R4**	**0.14**	**10**	**TBD**
Hexachloroethane	**67-72-1**	**3.3 C**	12	**T-RSL**	R3 BTAG SW	**1.1**	**10**	**TBD**
Isophorone	78-59-1	780 C	920	T-RSL	R4	260	5.0	TBD
Nitrobenzene	**98-95-3**	**1.4 C**	550	**T-RSL**	LANL	**0.47**	**5.0**	**TBD**
N-Nitrosodi-n-propylamine	**621-64-7**	**0.11 C**	NC	**T-RSL**	None	**0.037**	**5.0**	**TBD**
N-Nitrosodiphenylamine	**86-30-6**	120 C	210	T-RSL	R3 BTAG SW	40	5.0	TBD
Phenol	**108-95-2**	5800 N	**4**	T-RSL	**R3 BTAG SW**	**1.3**	**10**	**TBD**
PAHs and PCP[4]								
2-Methylnaphthalene	91-57-6	36 N	4.7	T-RSL	R3 BTAG SW	1.6	0.10	TBD
Acenaphthene	83-32-9	530 N	5.8	T-RSL	R3 BTAG SW	1.9	0.10	TBD
Acenaphthylene	208-96-8	530 N[5]	5.8	T-RSL	R3 BTAG SW	1.9	0.10	TBD
Anthracene	**120-12-7**	1800 N	**0.012**	T-RSL	**R3 BTAG SW**	**0.004**	**0.10**	**TBD**
Benzo(a)anthracene	**56-55-3**	**0.0038**	**0.018**	**WVDEP**	**R3 BTAG SW**	**0.0013**	**0.10**	**TBD**
Benzo(a)pyrene	**50-32-8**	**0.0038**	**0.015**	**WVDEP**	**R3 BTAG SW**	**0.0013**	**0.10**	**TBD**
Benzo(b)fluoranthene	**205-99-2**	**0.0038**	9	**WVDEP**	LANL	**0.0013**	**0.10**	**TBD**
Benzo(g,h,i)perylene	191-24-2	120 N[6]	7.6	T-RSL	LANL	2.5	0.10	TBD
Benzo(k)fluoranthene	**207-08-9**	**0.0038**	**0.0041**	**WVDEP**	**LANL**	**0.0013**	**0.10**	**TBD**
Chrysene	**218-01-9**	**0.0038**	**0.0018**	**WVDEP**	**LANL**	**0.0006**	**0.10**	**TBD**
Dibenzo(a,h)anthracene	**53-70-3**	**0.0038**	**0.0034**	**WVDEP**	**LANL**	**0.0011**	**0.10**	**TBD**
Fluoranthene	**206-44-0**	300	**0.04**	WVDEP	**R3 BTAG SW**	**0.013**	**0.10**	**TBD**
Fluorene	86-73-7	290 N	3	T-RSL	R3 BTAG SW	1	0.10	TBD
Indeno(1,2,3-c,d)pyrene	**193-39-5**	**0.0038**	4.3	**WVDEP**	LANL	**0.0013**	**0.10**	**TBD**
Naphthalene	91-20-3	1.7 C	1.1	T-RSL	R3 BTAG SW	0.37	0.10	TBD

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Phenanthrene	85-01-8	120 N[6]	0.4	T-RSL	R3 BTAG SW	0.13	0.10	TBD
Pyrene	**129-00-0**	120 N	**0.025**	T-RSL	**R3 BTAG SW**	**0.0083**	**0.10**	**TBD**
Pentachlorophenol	87-86-5	0.28	0.5	WVDEP	R3 BTAG SW	0.093	0.20	TBD

[1] The HHRA PSL references for surface water screening are the minimum of the following: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific analytical method. The identified CRQLs are for CLP Methods.

[3] For 1,4-dioxane, samples must be analyzed by SVOCs-SIM to achieve the CRQL as required by the PSL since this analyte is a known COPC at the site.

[4] The low-level PAHs and PCP will be analyzed by SIM to obtain lower detection limits.

[5] Value is for acenaphthene.

[6] Value is for pyrene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: TCL Pesticides following CLP SOM02.4

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
4,4'-DDD	**72-54-8**	**0.063 N**	**0.011**	**T-RSL**	**R3 BTAG SW**	**0.0037**	**0.10**	**TBD**
4,4'-DDE	72-55-9	0.46 C	100	T-RSL	LANL	0.15	0.10	TBD
4,4'-DDT	**50-29-3**	**0.000024**	**0.0005**	**WVDEP**	**R3 BTAG SW**	**0.000008**	**0.10**	**TBD**
Aldrin	**309-00-2**	**0.000071**	3	**WVDEP**	R3 BTAG SW	**0.000024**	**0.050**	**TBD**
Alpha-BHC	**319-84-6**	**0.0039**	NC	**WVDEP**	None	**0.0013**	**0.050**	**TBD**
beta-BHC	**319-85-7**	**0.014**	2.2	**WVDEP**	LANL	**0.0047**	**0.050**	**TBD**
cis-Chlordane	**5103-71-9**	**0.00046 C[3]**	**0.0022**	**WVDEP**	**R3 BTAG SW**	**0.00015**	**0.050**	**TBD**
delta-BHC	**319-86-8**	**0.0039 C[4]**	141	**WVDEP**	R3 BTAG SW	**0.0013**	**0.050**	**TBD**
Dieldrin	**60-57-1**	**0.000071**	**0.0019**	**WVDEP**	**WVDEP WQS**	**0.000024**	**0.10**	**TBD**
Endosulfan I	959-98-8	100 N[5]	0.051	T-RSL	R3 BTAG SW	0.017	0.050	TBD
Endosulfan II	**33213-65-9**	100 N[5]	**0.051**	T-RSL	**R3 BTAG SW**	**0.017**	**0.10**	**TBD**
Endosulfan sulfate	**1031-07-8**	110 N	**0.06**	T-RSL	**R4**	**0.02**	**0.10**	**TBD**
Endrin	**72-20-8**	**0.0023**	**0.0023**	**WVDEP**	**WVDEP WQS**	**0.00077**	**0.10**	**TBD**
Endrin aldehyde	**7421-93-4**	**0.0023 N[6]**	0.15	**WVDEP**	R5	**0.00077**	**0.10**	**TBD**
Endrin ketone	**53494-70-5**	**0.0023 N[6]**	NC	**WVDEP**	None	**0.00077**	**0.10**	**TBD**
gamma-BHC (Lindane)	**58-89-9**	**0.019**	**0.00008**	**WVDEP**	**WVDEP WQS**	**0.000027**	**0.050**	**TBD**
Heptachlor	**76-44-8**	**0.00021**	**0.0019**	**WVDEP**	**R3 BTAG SW**	**0.00007**	**0.050**	**TBD**
Heptachlor epoxide	**1024-57-3**	**0.014 C**	**0.0019**	**T-RSL**	**R3 BTAG SW**	**0.00063**	**0.050**	**TBD**
Methoxychlor	**72-43-5**	**0.03**	**0.00003**	**WVDEP**	**WVDEP WQS**	**0.00001**	**0.50**	**TBD**
Toxaphene	**8001-35-2**	**0.00073**	**0.0002**	**WVDEP**	**R3 BTAG SW/WVDEP WQS**	**0.000067**	**5.0**	**TBD**
trans-Chlordane	**5103-74-2**	**0.00046 C[3]**	**0.0022**	**WVDEP**	**R3 BTAG SW**	**0.00015**	**0.050**	**TBD**

[1] The HHRA PSL references for surface water screening are the minimum of the following: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific analytical method. The identified CRQLs are for CLP Methods.

[3] Value is for chlordane.

[4] Value is for alpha-BHC.

[5] Value is for endosulfan.

[6] Value is for endrin.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: PCB Congeners following CLP HRSM01.2

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
PCB-8	34883-43-7	NC	NC	None	None	None	2E-05	TBD
PCB-18	37680-65-2	NC	NC	None	None	None	2E-05	TBD
PCB-28	7012-37-5	NC	NC	None	None	None	2E-05	TBD
PCB-44	41464-39-5	NC	NC	None	None	None	2E-05	TBD
PCB-52	35693-99-3	NC	NC	None	None	None	2E-05	TBD
PCB-66	32598-10-0	NC	NC	None	None	None	2E-05	TBD
PCB-77	32598-13-3	0.06 C	0.000031	T-RSL	USEPA	0.00001	2E-05	TBD
PCB-81	**70362-50-4**	0.004 C	**0.0000062**	T-RSL	**USEPA**	**0.000002**	**2E-05**	**TBD**
PCB-101	37680-73-2	NC	NC	None	None	None	2E-05	TBD
PCB-105	32598-14-4	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-114	74472-37-0	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-118	31508-00-6	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-123	65510-44-3	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-126	**57465-28-8**	**0.000012 C**	**0.00000062**	**T-RSL**	**USEPA**	**0.0000002**	**2E-05**	**TBD**
PCB-128	38380-07-3	NC	NC	None	None	None	2E-05	TBD
PCB-138	35065-28-2	NC	NC	None	None	None	2E-05	TBD
PCB-153	35065-27-1	NC	NC	None	None	None	2E-05	TBD
PCB-156	38380-08-4	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-157	69782-90-7	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-167	52663-72-6	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-169	32774-16-6	0.00004 C	0.000062	T-RSL	USEPA	0.000013	2E-05	TBD
PCB-170	35065-30-6	NC	NC	None	None	None	2E-05	TBD

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
PCB-180	35065-29-3	NC	NC	None	None	None	2E-05	TBD
PCB-187	52663-68-0	NC	NC	None	None	None	2E-05	TBD
PCB-189	39635-31-9	0.04 C	0.00062	T-RSL	USEPA	0.0002	2E-05	TBD
PCB-195	52663-78-2	NC	NC	None	None	None	2E-05	TBD
PCB-206	40186-72-9	NC	NC	None	None	None	2E-05	TBD
Total PCBs(4)	NA	NC	0.000074	None	R3 BTAG SW	0.00003	NA	NA

1 The HHRA PSL references for surface water screening are the minimum of the following: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

2 Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

3 Screening levels for dioxin-like congeners are calculated based on toxicity equivalence factor to 2,3,7,8-TCDD based on the USEPA "Framework for the Application of the Toxicity Equivalence Methodology for Polychlorinated Dioxins, Furan, and Biphenyls in Ecological Risk Assessment" (USEPA, 2008).

4 Results for the sum of 18 NOAA congeners multiplied by two will compared to the screening level for total PCBs.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: Dioxins/Furans following CLP HRMS01.2

Analyte	CAS Number	PSL (pg/L)		PSL Reference[1]		PQLG (pg/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (pg/L)	MDL (pg/L)
2,3,7,8-TCDD	1746-01-6	0.013	0.0031	WVDEP	R3 BTAG SW	0.001	10	TBD
1,2,3,7,8-PeCDD	40321-76-4	0.013[3]	0.0031	WVDEP	R3 BTAG SW	0.001	50	TBD
1,2,3,4,7,8-HxCDD	39227-28-6	0.13[3]	0.0062	WVDEP	R3 BTAG SW	0.0021	50	TBD
1,2,3,6,7,8-HxCDD	57653-85-7	0.13[3]	0.31	WVDEP	R3 BTAG SW	0.044	50	TBD
1,2,3,7,8,9-HxCDD	19408-74-3	0.13[3]	0.31	WVDEP	R3 BTAG SW	0.044	50	TBD
1,2,3,4,6,7,8-HpCDD	35822-46-9	1.3[3]	3.1	WVDEP	R3 BTAG SW	0.44	50	TBD
OCDD	3268-87-9	43[3]	31	WVDEP	R3 BTAG SW	10	100	TBD
2,3,7,8-TCDF	51207-31-9	0.13[3]	0.062	WVDEP	R3 BTAG SW	0.021	10	TBD
1,2,3,7,8-PeCDF	57117-41-6	0.43[3]	0.062	WVDEP	R3 BTAG SW	0.021	50	TBD
2,3,4,7,8-PeCDF	57117-31-4	0.043[3]	0.0062	WVDEP	R3 BTAG SW	0.0021	50	TBD
1,2,3,4,7,8-HxCDF	70648-26-9	0.13[3]	0.031	WVDEP	R3 BTAG SW	0.01	50	TBD
1,2,3,6,7,8-HxCDF	57117-44-9	0.13[3]	0.031	WVDEP	R3 BTAG SW	0.01	50	TBD
1,2,3,7,8,9-HxCDF	72918-21-9	0.13[3]	0.031	WVDEP	R3 BTAG SW	0.01	50	TBD
2,3,4,6,7,8-HxCDF	60851-34-5	0.13[3]	0.031	WVDEP	R3 BTAG SW	0.01	50	TBD
1,2,3,4,6,7,8-HpCDF	67562-39-4	1.3[3]	0.31	WVDEP	R3 BTAG SW	0.1	50	TBD
1,2,3,4,7,8,9-HpCDF	55673-89-7	1.3[3]	0.31	WVDEP	R3 BTAG SW	0.1	50	TBD
OCDF	39001-02-0	43[3]	31	WVDEP	R3 BTAG SW	10	100	TBD

[1] The HHRA PSL reference for pore water/surface water screening: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface soil screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

[3] Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Surface Water
Analytical Group: TAL Inorganics (Metals and Cyanide) following CLP ISM02.4 ICP-MS (and Mercury by CVAA)

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Aluminum	7429-90-5	20000 N	87	T-RSL	R3 BTAG SW	29	20	TBD
Antimony	7440-36-0	7.8 N	30	T-RSL	R3 BTAG SW	2.6	2	TBD
Arsenic	**7440-38-2**	**0.52 C**	5	**T-RSL**	R3 BTAG SW	**0.17**	**1**	**TBD**
Barium	**7440-39-3**	1000	**4**	WVDEP	**R3 BTAG SW**	**1.3**	**10**	**TBD**
Beryllium	**7440-41-7**	4	**0.66**	WVDEP	**R3 BTAG SW**	**0.22**	**1**	**TBD**
Cadmium	**7440-43-9**	1	**0.25**	WVDEP[(3)]	**R3 BTAG SW**	**0.083**	**1**	**TBD**
Calcium	7440-70-2	NC	116,000	None	R3 BTAG SW	39,000	500	TBD
Chromium	**7440-47-3**	**0.35 C[4]**	11	**T-RSL**	WVDEP WQS	**0.12**	**2**	**TBD**
Cobalt	7440-48-4	6 N	23	T-RSL	R3 BTAG SW	2.0	1	TBD
Copper	7440-50-8	800 N	5.2	T-RSL	WVDEP WQS[(4)]	1.7	2	TBD
Iron	7439-89-6	1500	300	WVDEP	R3 BTAG SW	100	200	TBD
Lead	7439-92-1	15	1.3	T-RSL	WVDEP WQS[(3)]	0.43	1	TBD
Magnesium	7439-95-4	NC	82,000	None	R3 BTAG SW	27,000	500	TBD
Manganese	7439-96-5	430 N	120	T-RSL	R3 BTAG SW	40	1	TBD
Mercury	**7439-97-6**	**0.14**	**0.026**	**WVDEP**	**R3 BTAG SW**	**0.0087**	**0.2**	**TBD**
Nickel	7440-02-0	390 N	29	T-RSL	WVDEP WQS[(3)]	9.7	1	TBD
Potassium	7440-09-7	NC	53,000	None	R3 BTAG SW	18,000	500	TBD
Selenium	**7782-49-2**	50	**1**	WVDEP	**R3 BTAG SW**	**0.33**	**5**	**TBD**
Silver	7440-22-4	1	3.2	WVDEP[(3)]	R3 BTAG SW	0.33	1	TBD
Sodium	7440-23-5	NC	680,000	None	R3 BTAG SW	230,000	500	TBD

Analyte	CAS Number	PSL (ug/L)		PSL Reference[1]		PQLG (ug/L)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (ug/L)	MDL (ug/L)
Thallium	**7440-28-0**	**0.2 N**	**0.8**	**T-RSL**	**R3 BTAG SW**	**0.067**	**1**	**TBD**
Vanadium	7440-62-2	86 N	20	T-RSL	R3 BTAG SW	6.7	5	TBD
Zinc	7440-66-6	6000 N	67	T-RSL	WVDEP WQS(3)	22	2	TBD
Cyanide	**57-12-5**	**1.5 N**	**5**	**T-RSL**	**R3 BTAG SW**	**0.5**	**10**	**TBD**

[1] The HHRA PSL references for surface water screening are the minimum of the following: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a), multiplied by a factor of 10 to account for anticipated reduced exposure to surface water; The WVDEP Water Quality Standards (WQS) for Human Health (Acute) (WVDEP, 2016); The ERA PSL references for surface water screening are the following, in order of preference: minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018a) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003). Refer to Appendix B for further explanation and justification of PSLs.

[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific analytical method. The identified CRQLs are for CLP Methods.

[3] WVDEP criteria based on hardness, assumed 50 mg/L for SAP.

[4] Value is for hexavalent chromium.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: TCL VOCs following CLP Method SOM02.4 Trace

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
1,1,1-Trichloroethane	71-55-6	200	WVDEP	67	0.50	TBD
1,1,2,2-Tetrachloroethane	**79-34-5**	**0.076 C**	**T-RSL/WVDEP**	**0.025**	**0.50**	**TBD**
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1000 N	T-RSL	330	0.50	TBD
1,1,2-Trichloroethane	**79-00-5**	**0.041 N**	**T-RSL**	**0.014**	**0.50**	**TBD**
1,1-Dichloroethane	75-34-3	2.8 C	T-RSL/WVDEP	0.93	0.50	TBD
1,1-Dichloroethene	75-35-4	7	WVDEP	2.3	0.50	TBD
1,2,3-Trichlorobenzene	87-61-6	0.7 N	T-RSL	0.23	0.50	TBD
1,2,4-Trichlorobenzene	**120-82-1**	**0.4 N**	**T-RSL**	**0.13**	**0.50**	**TBD**
1,2-Dibromo-3-chloropropane	**96-12-8**	**0.00033 C**	**T-RSL**	**0.00011**	**0.50**	**TBD**
1,2-Dibromoethane	**106-93-4**	**0.0075 C**	**T-RSL**	**0.0025**	**0.50**	**TBD**
1,2-Dichlorobenzene	95-50-1	30 N	T-RSL	10	0.50	TBD
1,2-Dichloroethane	**107-06-2**	**0.17 C**	**T-RSL**	**0.057**	**0.50**	**TBD**
1,2-Dichloropropane	78-87-5	0.82 N	T-RSL	0.27	0.50	TBD
1,3-Dichlorobenzene	541-73-1	NC	None	NC	0.50	TBD
1,4-Dichlorobenzene	**106-46-7**	**0.48 C**	**T-RSL**	**0.16**	**0.50**	**TBD**
2-Butanone	78-93-3	560 N	T-RSL/WVDEP	190	5.0	TBD
2-Hexanone	**591-78-6**	**3.8 N**	**T-RSL**	**1.3**	**5.0**	**TBD**
4-Methyl-2-pentanone	108-10-1	120 N	WVDEP	40	5.0	TBD
Acetone	67-64-1	1400 N	T-RSL/WVDEP	470	5.0	TBD
Benzene	**71-43-2**	**0.46 C**	**T-RSL**	**0.15**	**0.50**	**TBD**
Bromochloromethane	74-97-5	8.3 N	T-RSL	2.8	0.50	TBD
Bromodichloromethane	**75-27-4**	**0.13 C**	**T-RSL/WVDEP**	**0.043**	**0.50**	**TBD**

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
Bromoform	75-25-2	3.3 C	T-RSL/WVDEP	1.1	0.50	TBD
Bromomethane	74-83-9	0.75 N	T-RSL/WVDEP	0.25	0.50	TBD
Carbon disulfide	75-15-0	81 N	T-RSL/WVDEP	27	0.50	TBD
Carbon tetrachloride	**56-23-5**	**0.46 C**	**T-RSL**	**0.15**	**0.50**	**TBD**
Chlorobenzene	108-90-7	7.8 N	T-RSL	2.6	0.50	TBD
Chloroethane	75-00-3	2100 N	T-RSL/WVDEP	700	0.50	TBD
Chloroform	**67-66-3**	**0.22 C**	**T-RSL/WVDEP**	**0.073**	**0.50**	**TBD**
Chloromethane	74-87-3	19 N	T-RSL/WVDEP	6.3	0.50	TBD
cis-1,2-Dichloroethene	156-59-2	3.6 N	T-RSL	1.2	0.50	TBD
cis-1,3-Dichloropropene	**10061-01-5**	**0.47 C[3]**	**T-RSL/WVDEP**	**0.16**	**0.50**	**TBD**
Cyclohexane	110-82-7	1300 N	T-RSL/WVDEP	430	0.50	TBD
Dibromochloromethane	124-48-1	0.87 C	T-RSL/WVDEP	0.29	0.50	TBD
Dichlorodifluoromethane	75-71-8	20 N	T-RSL/WVDEP	6.7	0.50	TBD
Ethylbenzene	100-41-4	1.5 C	T-RSL	0.5	0.50	TBD
Isopropylbenzene	98-82-8	45 N	T-RSL/WVDEP	15	0.50	TBD
m,p-Xylenes	179601-23-1	19 N	T-RSL	6.3	0.50	TBD
Methyl acetate	79-20-9	530 N	WVDEP	180	0.50	TBD
Methyl cyclohexane	108-87-2	NC	None	NC	0.50	TBD
Methylene chloride	75-09-2	5	WVDEP	1.7	0.50	TBD
Methyl-tert-butyl ether	1634-04-4	14 C	T-RSL/WVDEP	4.7	0.50	TBD
o-Xylene	95-47-6	19 N	T-RSL	6.3	0.50	TBD
Styrene	100-42-5	100	WVDEP	33	0.50	TBD
Tetrachloroethene	127-18-4	4.1 N	T-RSL	1.4	0.50	TBD
Toluene	108-88-3	110 N	T-RSL	37	0.50	TBD

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
trans-1,2-Dichloroethene	156-60-5	36 N	T-RSL	12	0.50	TBD
trans-1,3-Dichloropropene	**10061-02-6**	**0.47 C[3]**	**T-RSL/WVDEP**	**0.16**	**0.50**	**TBD**
Trichloroethene	**79-01-6**	**0.28 N**	**T-RSL**	**0.093**	**0.50**	**TBD**
Trichlorofluoromethane	75-69-4	110 N	WVDEP	37	0.50	TBD
Vinyl chloride	**75-01-4**	**0.019 C**	**T-RSL**	**0.0063**	**0.50**	**TBD**
Xylenes (total)	1330-20-7	19 N	T-RSL	6.3	0.50	TBD

[1] The HHRA PSL references for groundwater: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is for 1,3-dichloropropene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: TCL SVOCs following CLP Method SOM02.4 Low (and Low Level PAHs and PCP by SIM) and 1,4-Dioxane by SVOCs-SIM

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
1,1-Biphenyl	**92-52-4**	**0.083 N**	**T-RSL/WVDEP**	**0.028**	**5.0**	**TBD**
1,2,4,5-Tetrachlorobenzene	**95-94-3**	**0.098 N**	**WVDEP**	**0.033**	**5.0**	**TBD**
1,4-Dioxane[3]	**123-91-1**	**0.46 C**	**T-RSL/WVDEP**	**0.15**	**TBD**	**TBD**
2,2'-Oxybis(1-chloropropane)	**108-60-1**	**0.36 C**	**WVDEP**	**0.12**	**10**	**TBD**
2,3,4,6-Tetrachlorophenol	58-90-2	24 N	T-RSL/WVDEP	8.0	5.0	TBD
2,4,5-Trichlorophenol	95-95-4	120 N	T-RSL/WVDEP	40	5.0	TBD
2,4,6-Trichlorophenol	**88-06-2**	**1.2 N**	**T-RSL**	**0.4**	**5.0**	**TBD**
2,4-Dichlorophenol	**120-83-2**	**4.6 N**	**T-RSL/WVDEP**	**1.5**	**5.0**	**TBD**
2,4-Dimethylphenol	105-67-9	36 N	T-RSL/WVDEP	12	5.0	TBD
2,4-Dinitrophenol	**51-28-5**	**3.9 N**	**T-RSL/WVDEP**	**1.3**	**10**	**TBD**
2,4-Dinitrotoluene	**121-14-2**	**0.24 C**	**T-RSL/WVDEP**	**0.080**	**5.0**	**TBD**
2,6-Dinitrotoluene	**606-20-2**	**0.049 C**	**T-RSL/WVDEP**	**0.016**	**5.0**	**TBD**
2-Chloronaphthalene	91-58-7	33 N	WVDEP	11	5.0	TBD
2-Chlorophenol	**95-57-8**	**2.7 N**	**WVDEP**	**0.9**	**5.0**	**TBD**
2-Methylphenol	95-48-7	93 N	T-RSL/WVDEP	31	10	**TBD**
2-Nitroaniline	88-74-4	19 N	T-RSL/WVDEP	6.3	5.0	TBD
2-Nitrophenol	88-75-5	NC	None	NC	5.0	TBD
3,3'-Dichlorobenzidine	**91-94-1**	**0.13 C**	**T-RSL/WVDEP**	**0.043**	**10**	**TBD**
3-Methylphenol	108-39-4	93 N	T-RSL/WVDEP	31	5.0	TBD
3-Nitroaniline	99-09-2	NC	None	NC	10	TBD
4,6-Dinitro-2-methylphenol	**534-52-1**	**0.15 N**	**T-RSL**	**0.050**	**10**	**TBD**
4-Bromophenyl phenyl ether	101-55-3	NC	None	NC	5.0	TBD
4-Chloro-3-methylphenol	59-50-7	140 N	T-RSL	47	5.0	TBD

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
4-Chloroanaline	**106-47-8**	**0.37 C**	**T-RSL/WVDEP**	**0.12**	**10**	**TBD**
4-Nitroaniline	**100-01-6**	**3.8 C**	**T-RSL**	**1.3**	**10**	**TBD**
4-Nitrophenol	100-02-7	NC	None	NC	10	TBD
Acetophenone	98-86-2	190 N	T-RSL/WVDEP	63	10	TBD
Atrazine	**1912-24-9**	**0.3 C**	**T-RSL**	**0.10**	**10**	**TBD**
Benzaldehyde	100-52-7	19 C	T-RSL	6.3	10	TBD
Bis(2-chloroethoxy)methane	111-91-1	5.9 N	T-RSL	2.0	5.0	TBD
Bis(2-chloroethyl)ether	**111-44-4**	**0.014 C**	**T-RSL/WVDEP**	**0.0047**	**10**	**TBD**
Bis(2-ethylhexyl)phthalate	117-81-7	5.6 C	T-RSL	1.9	5.0	TBD
Butyl benzyl phthalate	85-68-7	16 C	T-RSL/WVDEP	5.3	5.0	TBD
Caprolactam	105-60-2	990 N	T-RSL/WVDEP	330	10	TDB
Carbazole	86-74-8	NC	None	NC	10	TBD
Dibenzofuran	**132-64-9**	**0.79 N**	**T-RSL/WVDEP**	**0.26**	**5.0**	**TBD**
Diethyl phthalate	84-66-2	1500 N	T-RSL/WVDEP	500	5.0	TBD
Dimethyl phthalate	131-11-3	NC	None	NC	10	TBD
Di-n-butyl phthalate	84-74-2	90 N	T-RSL/WVDEP	30	5.0	TBD
Di-n-octyl phthalate	117-84-0	20 N	T-RSL	6.7	10	TBD
Hexachlorobenzene	**118-74-1**	**0.0098 C**	**T-RSL**	**0.0033**	**5.0**	**TBD**
Hexachlorobutadiene	**87-68-3**	**0.14 C**	**T-RSL/WVDEP**	**0.047**	**5.0**	**TBD**
Hexachlorocyclopentadiene	**77-47-4**	**0.041 N**	**T-RSL**	**0.014**	**10**	**TBD**
Hexachloroethane	**67-72-1**	**0.33 C**	**T-RSL/WVDEP**	**0.11**	**5.0**	**TBD**
Isophorone	78-59-1	78 C	T-RSL/WVDEP	26	5.0	TBD
Nitrobenzene	**98-95-3**	**0.14 C**	**T-RSL/WVDEP**	**0.047**	**5.0**	**TBD**
N-Nitrosodi-n-propylamine	**621-64-7**	**0.011 C**	**T-RSL/WVDEP**	**0.0037**	**5.0**	**TBD**
N-Nitrosodiphenylamine	86-30-6	12 C	T-RSL/WVDEP	4.0	5.0	TBD

Analyte	CAS Number	PSL (ug/L)	PSL Reference[1]	PQLG (ug/L)	Achievable Laboratory Limits[2]	
					CRQL (ug/L)	MDL (ug/L)
Phenol	108-95-2	580 N	T-RSL/WVDEP	190	10	**TBD**
PAHs and PCP[4]						
2-Methylnaphthalene	91-57-6	3.6 N	T-RSL/WVDEP	1.2	0.10	TBD
Acenaphthene	83-32-9	24 N	WVDEP	8	0.10	TBD
Acenaphthylene	208-96-8	32 N	WVDEP	11	0.10	TBD
Anthracene	120-12-7	180 N	T-RSL/WVDEP	60	0.10	TBD
Benzo(a)anthracene	**56-55-3**	**0.012 C**	**WVDEP**	**0.004**	**0.10**	**TBD**
Benzo(a)pyrene	**50-32-8**	**0.025 C**	**T-RSL**	**0.0083**	**0.10**	**TBD**
Benzo(b)fluoranthene	**205-99-2**	**0.034 C**	**WVDEP**	**0.011**	**0.10**	**TBD**
Benzo(g,h,i)perylene	191-24-2	12 N[5]	T-RSL	4	0.10	TBD
Benzo(k)fluoranthene	207-08-9	0.34 C	WVDEP	0.11	0.10	TBD
Chrysene	218-01-9	3.4 C	WVDEP	1.1	0.10	TBD
Dibenzo(a,h)anthracene	**53-70-3**	**0.0034 C**	**WVDEP**	**0.0011**	**0.10**	**TBD**
Fluoranthene	206-44-0	80 N	T-RSL/WVDEP	27	0.10	TBD
Fluorene	86-73-7	15 N	WVDEP	5	0.10	TBD
Indeno(1,2,3-c,d)pyrene	**193-39-5**	**0.034 C**	**WVDEP**	**0.011**	**0.10**	**TBD**
Naphthalene	91-20-3	0.17 C	T-RSL/WVDEP	0.057	0.10	TBD
Phenanthrene	85-01-8	12 N[5]	T-RSL	4	0.10	TBD
Pyrene	129-00-0	7.9 N	WVDEP	2.6	0.10	TBD
Pentachlorophenol	**87-86-5**	**0.041 C**	**T-RSL**	**0.014**	**0.20**	**TBD**

[1] The HHRA PSL references for groundwater: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019)a. Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] For 1,4-Dioxane, samples must be analyzed by SVOCs-SIM to achieve the CRQL as required by the PSL since this analyte is a known COPC at the site.
[4] The low-level PAHs and PCP will be analyzed by SIM to obtain lower detection limits.
[5] Value is for pyrene.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: TCL Pesticides following CLP Method SOM02.4

Analyte	CAS Number	PSL (µg/L)	PSL Reference[1]	PQLG (µg/L)	Achievable Laboratory Limits[2]	
		HHRA	HHRA		CRQL (µg/L)	MDL (µg/L)
4,4'-DDD	**72-54-8**	**0.0063 N**	**T-RSL**	**0.0007**	**0.10**	**TBD**
4,4'-DDE	**72-55-9**	**0.046 C**	**T-RSL/ WVDEP**	**0.005**	**0.10**	**TBD**
4,4'-DDT	50-29-3	0.23 C	T-RSL/ WVDEP	0.026	0.10	TBD
Aldrin	**309-00-2**	**0.00092 C**	**T-RSL/ WVDEP**	**0.0001**	**0.050**	**TBD**
alpha-BHC	**319-84-6**	**0.0072 C**	**T-RSL/ WVDEP**	**0.0008**	**0.050**	**TBD**
beta-BHC	**319-85-7**	**0.025 C**	**T-RSL/ WVDEP**	**0.0028**	**0.050**	**TBD**
cis-Chlordane	**5103-71-9**	**0.02 C[3]**	**T-RSL**	**0.0022**	**0.050**	**TBD**
delta-BHC	**319-86-8**	**0.0072 C[4]**	**T-RSL/ WVDEP**	**0.0008**	**0.050**	**TBD**
Dieldrin	**60-57-1**	**0.00072 C**	**WVDEP**	**0.0002**	**0.10**	**TBD**
Endosulfan I	959-98-8	3.1 N[5]	WVDEP	1.1	0.050	TBD
Endosulfan II	33213-65-9	3.1 N[5]	WVDEP	1.1	0.10	TBD
Endosulfan sulfate	1031-07-8	3.1 N[5]	WVDEP	1.2	0.10	TBD
Endrin	72-20-8	0.23 N	T-RSL	0.026	0.10	TBD
Endrin aldehyde	7421-93-4	0.23 N[6]	T-RSL	0.026	0.10	TBD
Endrin ketone	53494-70-5	0.23 N[6]	T-RSL	0.026	0.10	TBD
gamma-BHC (Lindane)	**58-89-9**	**0.042 C**	**T-RSL**	**0.0047**	**0.050**	**TBD**
Heptachlor	**76-44-8**	**0.0014 C**	**T-RSL**	**0.00016**	**0.050**	**TBD**
Heptachlor epoxide	**1024-57-3**	**0.0014 C**	**T-RSL**	**0.00016**	**0.050**	**TBD**
Methoxychlor	72-43-5	3.7 N	T-RSL	0.4	0.50	TBD
Toxaphene	**8001-35-2**	**0.071 C**	**T-RSL**	**0.008**	**5.0**	**TBD**
trans-Chlordane	**5103-74-2**	**0.02 C[3]**	**T-RSL**	**0.0022**	**0.050**	**TBD**

[1] The HHRA PSL references for groundwater: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is for chlordane.
[4] Value is for alpha-BHC.
[5] Value is for endosulfan.
[6] Value is for endrin.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: PCB Congeners following CLP Method HRMS01.2

Analyte	CAS Number	PSL (µg/L)	PSL Reference[1]	PQLG (µg/L)	Achievable Laboratory Limits[2]	
		HHRA	HHRA		CRQL (µg/L)	MDL (µg/L)
PCB-8	34883-43-7	NC	None	None	2E-05	TBD
PCB-18	37680-65-2	NC	None	None	2E-05	TBD
PCB-28	7012-37-5	NC	None	None	2E-05	TBD
PCB-44	41464-39-5	NC	None	None	2E-05	TBD
PCB-52	35693-99-3	NC	None	None	2E-05	TBD
PCB-66	32598-10-0	NC	None	None	2E-05	TBD
PCB-77	32598-13-3	0.006 C	T-RSL	0.002	2E-05	TBD
PCB-81	70362-50-4	0.0004 C	T-RSL	0.00013	2E-05	TBD
PCB-101	37680-73-2	NC	None	None	2E-05	TBD
PCB-105	32598-14-4	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-114	74472-37-0	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-118	31508-00-6	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-123	65510-44-3	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-126	**57465-28-8**	**0.0000012 C**	**T-RSL**	**0.0000004**	**2E-05**	**TBD**
PCB-128	38380-07-3	NC	None	None	2E-05	TBD
PCB-138	35065-28-2	NC	None	None	2E-05	TBD
PCB-153	35065-27-1	NC	None	None	2E-05	TBD
PCB-156	38380-08-4	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-157	69782-90-7	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-167	52663-72-6	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-169	**32774-16-6**	**0.000004 C**	**T-RSL**	**0.0000013**	**2E-05**	**TBD**
PCB-170	35065-30-6	NC	None	None	2E-05	TBD

Analyte	CAS Number	PSL (µg/L)	PSL Reference[1]	PQLG (µg/L)	Achievable Laboratory Limits[2]	
		HHRA	HHRA		CRQL (µg/L)	MDL (µg/L)
PCB-180	35065-29-3	NC	None	None	2E-05	TBD
PCB-187	52663-68-0	NC	None	None	2E-05	TBD
PCB-189	39635-31-9	0.004 C	T-RSL	0.0013	2E-05	TBD
PCB-195	52663-78-2	NC	None	None	2E-05	TBD
PCB-206	40186-72-9	NC	None	None	NA	NA

[1] The HHRA PSL references for groundwater: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: Dioxins/Furans following CLP HRMS01.2

Analyte	CAS Number	PSL (pg/L)	PSL Reference[1]	PQLG (pg/L)	Achievable Laboratory Limits[2]	
					CRQL (pg/L)	MDL (pg/L)
2,3,7,8-TCDD	**1746-01-6**	**0.12 C**	**T-RSL**	**0.04**	**10**	**TBD**
1,2,3,7,8-PeCDD	**40321-76-4**	**0.12 C[3]**	**T-RSL**	**0.04**	**50**	**TBD**
1,2,3,4,7,8-HxCDD	**39227-28-6**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,6,7,8-HxCDD	**57653-85-7**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,7,8,9-HxCDD	**19408-74-3**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,4,6,7,8-HpCDD	**35822-46-9**	**12 C[3]**	**T-RSL**	**4**	**50**	**TBD**
OCDD	3268-87-9	400 C[3]	T-RSL	133	100	TBD
2,3,7,8-TCDF	**51207-31-9**	**1.2 C[3]**	**T-RSL**	**0.4**	**10**	**TBD**
1,2,3,7,8-PeCDF	**57117-41-6**	**4 C[3]**	**T-RSL**	**1.3**	**50**	**TBD**
2,3,4,7,8-PeCDF	**57117-31-4**	**0.4 C[3]**	**T-RSL**	**0.13**	**50**	**TBD**
1,2,3,4,7,8-HxCDF	**70648-26-9**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,6,7,8-HxCDF	**57117-44-9**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,7,8,9-HxCDF	**72918-21-9**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
2,3,4,6,7,8-HxCDF	**60851-34-5**	**1.2 C[3]**	**T-RSL**	**0.4**	**50**	**TBD**
1,2,3,4,6,7,8-HpCDF	**67562-39-4**	**12 C[3]**	**T-RSL**	**4**	**50**	**TBD**
1,2,3,4,7,8,9-HpCDF	**55673-89-7**	**12 C[3]**	**T-RSL**	**4**	**50**	**TBD**
OCDF	39001-02-0	400 C[3]	T-RSL	133	100	TBD

[1] The HHRA PSL reference for groundwater: T-RSL – Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.

Bolded values indicate that the PSL is less than the CRQL. However, the CRQL is sufficient for the intended data use, and the Project Team has agreed to accept this data for decision making if the results are discussed in the uncertainties section of the Risk Assessment in the RI Report.

Matrix: Groundwater
Analytical Group: TAL Metals (Total and Dissolved) following CLP ISM02.4 ICP-MS (and Mercury by CVAA)

Analyte	CAS Number	PSL (µg/L)	PSL Reference[1]	PQLG (µg/L)	Achievable Laboratory Limits[2]	
		HHRA	HHRA		CRQL (µg/L)	MDL (µg/L)
Aluminum	7429-90-5	2000 N	T-RSL/ WVDEP	670	20	TBD
Antimony	**7440-36-0**	**0.78 N**	**T-RSL/ WVDEP**	**0.26**	**2**	**TBD**
Arsenic	**7440-38-2**	**0.052 C**	**T-RSL**	**0.017**	**1**	**TBD**
Barium	7440-39-3	380 N	T-RSL	130	10	TBD
Beryllium	7440-41-7	2.5 N	T-RSL	0.83	1	TBD
Cadmium	**7440-43-9**	**0.92 N**	**T-RSL**	**0.31**	**1**	**TBD**
Calcium	7440-70-2	NC	None	---	500	TBD
Chromium	**7440-47-3**	**0.035 C[3]**	**T-RSL/ WVDEP**	**0.012**	**2**	**TBD**
Cobalt	**7440-48-4**	**0.6 N**	**T-RSL/ WVDEP**	**0.20**	**1**	**TBD**
Copper	7440-50-8	80 N	T-RSL/ WVDEP	27	2	TBD
Iron	7439-89-6	1400 N	T-RSL/ WVDEP	470	200	TBD
Lead	7439-92-1	15	T-RSL/ WVDEP	5	1	TBD
Magnesium	7439-95-4	NC	None	---	500	TBD
Manganese	7439-96-5	43 N	T-RSL	14	1	TBD
Mercury	**7439-97-6**	**0.063 N**	**T-RSL**	**0.021**	**0.2**	**TBD**
Nickel	7440-02-0	39 N	T-RSL/ WVDEP	13	1	TBD
Potassium	7440-09-7	NC	None	---	500	TBD
Selenium	7782-49-2	10 N	T-RSL	3.3	5	TBD
Silver	7440-22-4	9.4 N	T-RSL/ WVDEP	3.1	1	TBD
Sodium	7440-23-5	NC	None	---	500	TBD
Thallium	**7440-28-0**	**0.02 N**	**T-RSL**	**0.0067**	**1**	**TBD**
Vanadium	**7440-62-2**	**0.12 N**	**WVDEP**	**0.04**	**5**	**TBD**

Analyte	CAS Number	PSL (µg/L)	PSL Reference[1]	PQLG (µg/L)	Achievable Laboratory Limits[2]	
		HHRA	HHRA		CRQL (µg/L)	MDL (µg/L)
Zinc	7440-66-6	600 N	T-RSL/ WVDEP	200	2	TBD
Cyanide	**57-12-5**	**0.15 N**	**T-RSL**	**0.05**	**10**	**TBD**

[1] The HHRA PSL references for groundwater: T-RSL – USEPA Residential Screening Level Summary Table for TR = 1E-06 and THQ = 0.1 for Tap water (USEPA, 2019a). Refer to Appendix B for further explanation and justification of PSLs.
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.
[3] Value is for hexavalent chromium.

Matrix: Wipe
Analytical Group: PCBs Congeners following CLP HRSM01.2

Analyte	CAS Number	PSL (µg/100 cm²)		PSL Reference[1]		PQLG (µg/100 cm²)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-8	34883-43-7	NA	None	NA	None	NA	2E-06	TBD
PCB-18	37680-65-2	NA	None	NA	None	NA	2E-06	TBD
PCB-28	7012-37-5	NA	None	NA	None	NA	2E-06	TBD
PCB-44	41464-39-5	NA	None	NA	None	NA	2E-06	TBD
PCB-52	35693-99-3	NA	None	NA	None	NA	2E-06	TBD
PCB-66	32598-10-0	NA	None	NA	None	NA	2E-06	TBD
PCB-77	32598-13-3	NA	None	NA	None	NA	2E-06	TBD
PCB-81	70362-50-4	NA	None	NA	None	NA	2E-06	TBD
PCB-101	37680-73-2	NA	None	NA	None	NA	2E-06	TBD
PCB-105	32598-14-4	NA	None	NA	None	NA	2E-06	TBD
PCB-114	74472-37-0	NA	None	NA	None	NA	2E-06	TBD
PCB-118	31508-00-6	NA	None	NA	None	NA	2E-06	TBD
PCB-123	65510-44-3	NA	None	NA	None	NA	2E-06	TBD
PCB-126	57465-28-8	NA	None	NA	None	NA	2E-06	TBD
PCB-128	38380-07-3	NA	None	NA	None	NA	2E-06	TBD
PCB-138	35065-28-2	NA	None	NA	None	NA	2E-06	TBD
PCB-153	35065-27-1	NA	None	NA	None	NA	2E-06	TBD
PCB-156	38380-08-4	NA	None	NA	None	NA	2E-06	TBD
PCB-157	69782-90-7	NA	None	NA	None	NA	2E-06	TBD
PCB-167	52663-72-6	NA	None	NA	None	NA	2E-06	TBD
PCB-169	32774-16-6	NA	None	NA	None	NA	2E-06	TBD
PCB-170	35065-30-6	NA	None	NA	None	NA	2E-06	TBD

Analyte	CAS Number	PSL (µg/100 cm^2)		PSL Reference[1]		PQLG (µg/100 cm^2)	Achievable Laboratory Limits[2]	
		HHRA	ERA	HHRA	ERA		CRQL (mg/kg)	MDL (mg/kg)
PCB-180	35065-29-3	NA	None	NA	None	NA	2E-06	TBD
PCB-187	52663-68-0	NA	None	NA	None	NA	2E-06	TBD
PCB-189	39635-31-9	NA	None	NA	None	NA	2E-06	TBD
PCB-195	52663-78-2	NA	None	NA	None	NA	2E-06	TBD
PCB-206	40186-72-9	NA	None	NA	None	NA	2E-06	TBD
Total PCBs	NA	10	None	USEPA	None	3.3	NA	NA

[1] The HHRA PSL references for wipe samples are: USEPA – Criterion for all indoor, residential surfaces other than vault areas, 40 CFR §761.125(c)(4).
[2] Laboratory-specific MDLs are limits that an individual laboratory can achieve when performing a specific method. The identified CRQLs are for CLP Methods.

SAP Worksheet #17 - Sampling Design and Rationale

SAMPLING DESIGN

Samples will be collected at the site to determine whether chemical concentrations in site media (soil, groundwater, surface water, and sediment) exceed the most conservative (lowest) applicable risk-based human health or ecological screening values. The Project Team will characterize the nature and extent of contamination and evaluate human health and ecological risks at the site. Additionally, PCB wipe sampling will be performed in occupied residential structures adjacent to Arbuckle Creek to determine the presence of PCBs.

Data from the RI sampling events will be used to determine whether unacceptable contamination exists in the following locations: surface or subsurface soil; surface water and sediment in Arbuckle Creek/New River and wetlands; or groundwater beneath the site.

The selected sampling design is based on collecting representative samples from the environmental media of interest in areas most likely to be contaminated from site operations. This strategy ensures that an environmental problem will not be overlooked.

Proposed sampling and analysis for soil, groundwater, surface water, sediment, and wipe are described below for each area. Additional details (e.g., the exact methods and SOPs to be used and the PSLs that must be met) are provided in Worksheets #15, 19, and 21. USEPA and Tetra Tech will be the primary users of the data.

Proposed sampling locations are shown on Figures 3 through 11. An area-specific summary of the proposed sampling is provided below.

Background Soil Sampling

Surface, near surface, and subsurface soil samples will be collected with a DPT rig from ten background locations (SB300 through SB309). These samples will be used to determine background concentrations of soil contaminants near the site and to distinguish between locations potentially impacted by site operations and those attributable to background conditions. Surface soil samples will be collected from 0 to 6 inches bgs and 6 to 24 inches for near surface samples, and one subsurface interval to be selected in the field based on PID readings, visual observations (signs of impact) or results from the mobile lab. If the mobile lab data is not available or no signs of impact are seen, then a variety of sample depths will be chosen to ensure full characterization of the subsurface. A discrete VOC sample will be taken at 6 inches bgs for the surface soil samples. Background samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors. Figure 3 shows the locations of background samples to be collected.

PROPOSED ANALYSES SUMMARY

Sample ID	Analytes	Rationale
SB300-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB300-0624		
SB300-XXXX		
SB301-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB301-0624		
SB301-XXXX		
SB302-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB302-0624		
SB302-XXXX		
SB303-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB303-0624		
SB303-XXXX		
SB304-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB304-0624		
SB304-XXXX		
SB305-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB305-0624		
SB305-XXXX		
SB306-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB306-0624		
SB306-XXXX		
SB307-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors, dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB307-0624		
SB307-XXXX		
SB308-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB308-0624		
SB308-XXXX		
SB309-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.
SB309-0624		

Sample ID	Analytes	Rationale
SB309-XXXX	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations in soil.

[1] 20% of samples will be analyzed for PCB Aroclors.
[2] 25% of samples will be analyzed for TOC.

Example Sample Nomenclature
SB324-0006
SB = Soil Boring
0006 – Sample collected from 0 to 6 inches bgs

Shaffer Equipment Company Property Soil Sampling

The SEC Property surface, near surface, and subsurface soil sampling and analysis will be conducted to further characterize potential SEC Property source areas. Tetra Tech will advance 13 borings (SB310 through SB321 and SB369) near the capped area and 8 borings (SB322 through SB328 and SB366) outside the capped area. Soil borings will be installed using a DPT drilling rig. Soil samples will be collected from three depth intervals, 0 to 6 inches bgs, 6 to 24 inches bgs, and one subsurface interval to be identified in the field based on PID readings, visual observations (signs of impact), or results from the mobile lab. If the mobile lab data is not available or no signs of impact are observed, then a variety of sample depths will be chosen to ensure full characterization of the subsurface. A discrete VOC sample will be taken at 6 inches bgs for the surface soil samples. Sampling locations are based on a 75' by 75' grid area. Figure 4 shows the locations of SEC Property soil samples to be collected.

SEC Property soil samples will be analyzed for PCB Aroclors via the EPA Mobile Laboratory (if available) and for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

PROPOSED ANALYSES SUMMARY

Sample ID	Analytes	Rationale
SB310-0006	Mobile Laboratory: Aroclors[3] Fixed-based Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB310-0624		
SB310-XXXX		
SB311-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB311-0624		
SB311-XXXX		

Sample ID	Analytes	Rationale
SB312-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB312-0624		
SB312-XXXX		
SB313-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB313-0624		
SB313-XXXX		
SB314-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB314-0624		
SB314-XXXX		
SB315-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB315-0624		
SB315-XXXX		
SB316-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB316-0624		
SB316-XXXX		
SB317-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB317-0624		
SB317-XXXX		

Sample ID	Analytes	Rationale
SB318-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB318-0624		
SB318-XXXX		
SB319-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB319-0624		
SB319-XXXX		
SB320-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB320-0624		
SB320-XXXX		
SB321-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants SEC Property near the capped area.
SB321-0624		
SB321-XXXX		
SB322-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB322-0624		
SB322-XXXX		
SB323-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB323-0624		
SB323-XXXX		

Sample ID	Analytes	Rationale
SB324-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB324-0624		
SB324-XXXX		
SB325-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB325-0624		
SB325-XXXX		
SB326-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB326-0624		
SB326-XXXX		
SB327-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB327-0624		
SB327-XXXX		
SB328-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB328-0624		
SB328-XXXX		
SB366-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB366-0624		
SB366-XXXX		

Sample ID	Analytes	Rationale
SB369-0006	Mobile Laboratory: Aroclors[3] Fixed-base laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants outside the SEC Property capped area.
SB369-0624		
SB369-XXXX		

[1] 20% of samples will be analyzed for PCB Aroclors.
[2] 25% of samples will be analyzed for TOC.
[3] Analyses will be conducted depending on availability of Mobile Laboratory.

Possible Transformer Storage Area and Britt Bath House Area Soil/Sediment and Surface Water Sampling

Surface, near surface, and subsurface soil sampling will be conducted at the Britt Bath House Area and Possible Transformer Storage Area to characterize soil conditions near areas potential impacted by SEC Property activities. Tetra Tech will advance 8 borings (SB337 through SB344) at the Britt Bath House Area and 10 borings (SB329 through SB336, SB367, and SB368) at the Possible Transformer Storage Area. Soil borings will be installed using a DPT drilling rig. Soil samples will be collected from three depth intervals, 0 to 6 inches bgs, 6 to 24 inches, and one subsurface interval to be selected in the field base on PID readings, visual observations (signs of impact), or results from the mobile lab. If the mobile lab data is not available or no signs of impact are observed, then a variety of sample depths will be chosen to ensure full characterization of the subsurface. Two surface water and sediment samples (SW/SD340 and SW/SD341) will be collected in the Britt Bath House Area.

Sampling locations are based on a 150' by 150' grid area that has been generated for each location. Figure 5 shows the locations of near-site soil samples to be collected at the Possible Transformer Storage Area. Figure 6 shows the locations of near-site soil and sediment/surface water samples to be collected at the Britt Bath House Area.

Britt Bath House Area and Possible Transformer Storage Area soil and surface water/sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. If available, soil samples will also be analyzed for Aroclors via the EPA Mobile Laboratory. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

PROPOSED ANALYSES SUMMARY

Sample ID	Analytes	Rationale
SB337-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB337-0624		
SB337-XXXX		
SB338-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB338-0624		
SB338-XXXX		
SB339-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB339-0624		
SB339-XXXX		
SB340-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB340-0624		
SB340-XXXX		
SB341-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB341-0624		
SB341-XXXX		
SB342-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB342-0624		
SB342-XXXX		

Sample ID	Analytes	Rationale
SB343-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB343-0624		
SB343-XXXX		
SB344-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Britt Bath House Area.
SB344-0624		
SB344-XXXX		
SB329-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB329-0624		
SB329-XXXX		
SB330-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB330-0624		
SB330-XXXX		
SB331-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB331-0624		
SB331-XXXX		
SB332-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB332-0624		
SB332-XXXX		

Sample ID	Analytes	Rationale
SB333-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the pit area at the Possible Transformer Storage Area.
SB333-0624		
SB333-XXXX		
SB334-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the pit area at the Possible Transformer Storage Area.
SB334-0624		
SB334-XXXX		
SB335-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB335-0624		
SB335-XXXX		
SB336-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB336-0624		
SB336-XXXX		
SB367-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB367-0624		
SB367-XXXX		
SB368-0006	Mobile Laboratory: Aroclors[3] Fixed-base Laboratory: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Possible Transformer Storage Area.
SB368-0624		
SB368-XXXX		

Sample ID	Analytes	Rationale
SW/SD340	Mobile Laboratory: Aroclors[3] TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants from near former sample SD-95.
SW/SD341	Mobile Laboratory: Aroclors[3] TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants from activities at the Britt Bath House Area.

[1] 20% of samples will be analyzed for PCB Aroclors.
[2] 25% of samples will be analyzed for TOC.

Berwind Green Hill Mine Dump and Rocklick Road Soil/Sediment and Surface Water Sampling

Soil sampling and analysis will be conducted at the Berwind Green Hill Mine Dump Area (Needles Eye) and Rocklick Road to characterize contaminant concentration in areas where either dredged sediment was disposed of or PCB oil may have been used for dust suppression. Surface, near surface, and subsurface soil sampling will be also conducted at the Berwind Green Hill Mine Dump Area and Rocklick Road. Tetra Tech will advance ten borings (SB353 through SB362) at Rocklick Road and eight borings (SB345 through SB352) at the Berwind Green Hill Area. Soil borings will be installed using a DPT drilling rig. Soil samples will be collected from three depth intervals, 0 to 6 inches bgs and 6 to 24 inches for near surface samples, and one subsurface interval to be identified in the field based on PID readings or visual observations (signs of impact). Six surface water and sediment samples (SW/SD342 through SW/SD347) will be collected at Rocklick Road.

Sampling locations are based on a 150’ by 150’ grid area that has been generated for the Berwind Green Hill Mine Dump Area. These locations are illustrated on Figures 7 (Berwind Green Hill Mine Dump Area (Needles Eye)) and 8 (Rocklick Road).

Soil and surface water/sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

PROPOSED ANALYSES SUMMARY

Sample ID	Analytes	Rationale
SB353-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential placement of dredged sediment area.
SB353-0624		
SB353-XXXX		

Sample ID	Analytes	Rationale
SB354-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential placement of dredged sediment area.
SB354-0624		
SB354-XXXX		
SB355-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential placement of dredged sediment area.
SB355-0624		
SB355-XXXX		
SB356-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential placement of dredged sediment area.
SB356-0624		
SB356-XXXX		
SB357-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB357-0624		
SB357-XXXX		
SB358-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB358-0624		
SB358-XXXX		
SB359-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB359-0624		
SB359-XXXX		
SB360-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB360-0624		
SB360-XXXX		
SB361-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB361-0624		
SB361-XXXX		
SB362-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from either placement of sediment from dredging or potential spraying of oil on the unpaved roadway of Rocklick Road.
SB362-0624		
SB362-XXXX		
SB345-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB345-0624		
SB345-XXXX		

Sample ID	Analytes	Rationale
SB346-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB346-0624		
SB346-XXXX		
SB347-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB347-0624		
SB347-XXXX		
SB348-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB348-0624		
SB348-XXXX		
SB349-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB349-0624		
SB349-XXXX		
SB350-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB350-0624		
SB350-XXXX		
SB351-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB351-0624		
SB351-XXXX		
SB352-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil contaminants from activities conducted at the Berwind Green Hill Mine Dump Area
SB352-0624		
SB352-XXXX		
SW/SD342	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.
SW/SD343	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.
SW/SD344	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.

Sample ID	Analytes	Rationale
SW/SD345	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.
SW/SD346	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.
SW/SD347	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water related to placement of dredged sediment or from oil being sprayed on the roadway of Rocklick Road.

1 20% of samples will be analyzed for PCB Aroclors.
2 25% of samples will be analyzed for TOC.

N R & P Supply House Sampling

Due to potential access issues, soil sampling and analysis will be conducted on the road near the N R & P Supply House to characterize contaminant concentration in areas where PCB transformers may have leaked in the basement of the property. Three soil borings (SB363, SB364, and SB365) will be installed using a DPT drilling rig. These discrete soil samples will be collected from three depth intervals, 0 to 6 inches bgs, 6 to 24 inches bgs, and one subsurface interval to be selected based on PID readings, visual observations (signs of impact), or results from the mobile lab analysis. Subsurface samples should be collected at depths comparable to the depth of the N R & P Supply House basement. A discrete VOC sample will be taken at 6 inches for the surface soil samples. The three sampling locations are illustrated on Figure 9.

Soil samples for the N R & P Supply House will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size.

Sample ID	Analytes	Rationale
SB363-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential dumped PCB soil.
SB363-0624		
SB363-XXXX		
SB364-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential dumped PCB soil.
SB364-0624		
SB364-XXXX		
SB365-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of soil from potential dumped PCB soil.
SB365-0624		
SB365-XXXX		

1 20% of samples will be analyzed for PCB Aroclors.
2 25% of samples will be analyzed for TOC.

Residential Soil and Wipe Sampling

Residential soil/wipe sampling and analysis will be conducted at residences adjacent to Arbuckle Creek that may have experienced historical flooding. Soil samples at the residential properties will be based on a 50' by 50' grid area that will be generated for each property. Modifications to the grid size will be made for relatively small properties so that a minimum of four grid cells are identified for each property. At the residential properties, two surface samples from 0 to 6 inches bgs, one near surface sample from 6 to 24 inches bgs, and one 24 to 48 inches sample will be collected from each grid for compositing. Samples from all grid cells from the same depth interval will be composited. A discrete VOC sample will be taken from each property at a depth of 6 inches bgs. A discrete/grab sample from 0 to 3 inches bgs will be collected using a hand trowel if there is a sensitive receptor exposure zone, such as a play area for a child resident on the property. The sample identification numbers for the residential samples will include an "R" (for residential sample), a number (for site location number), an "S" (for soil sample), and the sample interval depth. The field team will document in the field notes and on the soil boring log form which residential address belongs to which sample. For instance, the sample identification for the 6 to 24 inches bgs interval taken at the first residential sampling site would be R1-S-0624. A note would be made that R1-S-0624 was taken at 100 Main Street.

The sample identification for a wipe sample would be residential sampling site and "WP" (for wipe sample). Two wipe samples are anticipated from each residential property. The sample identification for a wipe sample would be R1-WP-01. A note would be made that R1-WP-01 was taken at 100 Main Street. Until additional field reconnaissance is conducted, a public meeting is held, and discussions with residents occur, the exact properties to be sampled are not known, Therefore, a map of the sample locations is not provided in this SAP. It is anticipated that up to 25 residential properties will be sampled.

If available, residential soil samples will be analyzed for total PCBs (Aroclors) by the EPA Mobile Laboratory.

Additionally, residential soil samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and 25 percent of the surface soil and near surface soil samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors. Residential wipe samples will be analyzed for PCB congeners at a fixed-base laboratory.

Arbuckle Creek/Wetland Areas Sediment and Surface Water Sampling

Forty collocated surface water and sediment samples (SW/SD300 through SW/SD339) will be collected from Arbuckle Creek and the nearby wetlands to evaluate the migration of site contaminants via overland runoff. Numerous historic samples were collected in the last major pool in Arbuckle creek for PCBs. Two additional samples (SW/SD-329 and SW/SD-330) will be collected in this area for full suite analysis. Up to three of the collocated sample locations (SW/SD300 through SW/SD302) will be reserved to evaluate upstream conditions. The remaining locations will be collected along Arbuckle Creek and the Wetland Area. Each wetland sampling location will be evaluated to determine whether the media is more indictive of soil than sediment. If the soil is determined to be hydric, a second sample at the 6 to 24 inches bgs will be collected to assess the risk to soil organisms and their predators. Samples were proposed in larger wetlands to provide representative data of the entire wetlands. Surface water samples will be collected via direct fill methods or via a peristaltic pump if the surface water is relatively shallow or fine sediment is observed at the location. Collocated sediment samples from 0 to 6 inches bgs will be collected using a sediment coring device. Sediment and surface water locations are illustrated on Figures 10, 11, and 12.

Surface water/sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will

be analyzed for PCB Aroclors and 25 percent of the sediment samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

PROPOSED ANALYSES SUMMARY

Sample ID	Analytes	Rationale
SW300 SD300	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations of sediment / surface water contaminants in Arbuckle Creek and nearby wetlands.
SW301 SD301	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations of sediment / surface water contaminants in Arbuckle Creek and nearby wetlands.
SW302 SD302	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations of sediment / surface water contaminants in Arbuckle Creek and nearby wetlands.
SW303 SD303	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle near the site.
SW304 SD304	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle near the site.
SW305 SD305	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek.
SW306 SD306	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW307 SD307	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW308 SD308	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.

Sample ID	Analytes	Rationale
SW309 SD309	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW310 SD310	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW311 SD311	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW312 SD312	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW313 SD313	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW314 SD314	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW315 SD315	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW316 SD316	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW317 SD317	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in wetlands.
SW318 SD318	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek.
SW319 SD319	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near SD-03.
SW320 SD320	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To help characterize concentrations of sediment / surface water contaminants in Arbuckle Creek downstream of SD-03.
SW321 SD321	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To help characterize concentrations of sediment / surface water contaminants in Arbuckle Creek downstream of SD-03.

Sample ID	Analytes	Rationale
SW322 SD322	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near SD-06.
SW323 SD323	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To help characterize concentrations of sediment / surface water contaminants in Arbuckle Creek downstream of SD-06.
SW324 SD324	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To help characterize concentrations of sediment / surface water contaminants in Arbuckle Creek downstream of SEC-SD-T5-01.
SW325 SD325	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near bridge.
SW326 SD326	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near bridge.
SW327 SD327	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek.
SW328 SD328	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near SD-12.
SW329 SD329	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near SD-17.
SW330 SD330	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants in Arbuckle Creek near SD-59.
SW331 SD331	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To confirm and bound concentrations of sediment / surface water near SD-86 and SD-100. SD-86 and SD-100 had high PAH concentrations from ESI sampling.
SW332 SD332	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To confirm and bound concentrations of sediment / surface water near SD-86 and SD-100. SD-86 and SD-100 had high PAH concentrations from ESI sampling.
SW333 SD333	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To confirm and bound concentrations of sediment / surface water near SD-92. SD-92 had high metal concentrations from ESI sampling.
SW334 SD334	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To confirm and bound concentrations of sediment / surface water near SD-92. SD-92 had high metal concentrations from ESI sampling.

Sample ID	Analytes	Rationale
SW335 SD335	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants near the end of Rocklick Creek near the confluence with Arbuckle Creek.
SW336 SD336	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants near the end of Rocklick Creek near the confluence with Arbuckle Creek.
SW337 SD337	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants near the end of Arbuckle Creek near the confluence with the New River.
SW338 SD338	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants near the end of Arbuckle Creek near the confluence with the New River.
SW339 SD339	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment / surface water contaminants near the end of Arbuckle Creek near the confluence with the New River.

[1] 20% of samples will be analyzed for PCB Aroclors.
[2] 25% of sediment samples will be analyzed for TOC and grain size.

New River Sediment Sampling

Seven sediment samples, two upstream (SD348 through SD349) and five (SD-350 through SD-354) downstream from the confluence with Arbuckle Creek in the New River, will be collected during the RI to evaluate the migration of site contaminants. Two samples from each location (0 to 6 inches and 6 to 12 inches bgs) will be collected using a sediment coring device. A discrete VOC sample will be taken at 6 inches bgs for the surface soil samples. A representative sample from large depositional areas will be collected by taking a composite of the sediment in large dispositional areas. The composite will be collected from three different locations within the large depositional area. Sediment sampling locations are illustrated on Figure 13.

Sediment samples will be analyzed for TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors, dioxins/furans, and TAL metals at a fixed-base laboratory. Twenty percent of the samples will be analyzed for PCB Aroclors and all of the samples will be analyzed for TOC and grain size. The 80% of samples not initially analyzed for PCB Aroclors will be submitted to the laboratory and held until the Project Team decides whether they need to be analyzed for Aroclors.

Sample ID	Analytes	Rationale
SD348-0006 SD348-0612	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations of sediment contaminants in New River
SD349-0006 SD349-0612	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine background concentrations of sediment contaminants in New River

Sample ID	Analytes	Rationale
SD350-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment contaminants in New River
SD350-0612		
SD351-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment contaminants in New River
SD351-0612		
SD352-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment contaminants in New River
SD352-0612		
SD353-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment contaminants in New River
SD353-0612		
SD354-0006	TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, TAL metals, TOC and grain size[2]	To determine concentrations of sediment contaminants in New River
SD354-0612		

[1] 20% of samples will be analyzed for PCB Aroclors.
[2] 100% of samples will be analyzed for TOC.

Groundwater Monitoring

Eleven groundwater wells (MW100D, MW101D, MW102S, MW103D, MW104S, MW105S/D, MW106 S/D, and MW107S/D) will be installed and sampled. Figures 3 and 4 illustrate the well locations. MW107S/D will be installed in an area presumed to be upgradient of the SEC Property. The remaining wells will be installed at the SEC Property.

Two rounds of groundwater samples will be collected. Groundwater samples will be analyzed for TCL VOCs, TCL SVOCs, TAL metals, TCL pesticides, PCB congeners, PCB Aroclors, dioxins/furans, and TAL metals. Each groundwater sample will also be analyzed in the field for temperature, pH, DO, turbidity, and ORP.

PROPOSED ANALYSES SUMMARY

Well ID	Analytes	Rationale
MW100D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deeper groundwater contaminants near the SEC capped area.

Well ID	Analytes	Rationale
MW101D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deeper groundwater contaminants near the SEC Property capped area.
MW102S	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of shallow groundwater contaminants near the SEC Property capped area.
MW103D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deeper groundwater contaminants near the SEC Property capped area.
MW104S	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of shallow groundwater contaminants near the SEC Property capped area.
MW105S	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of shallow groundwater contaminants outside the SEC Property capped area.
MW105D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deep groundwater contaminants outside the SEC Property capped area.
MW106S	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of shallow groundwater contaminants outside the SEC Property capped area.

Well ID	Analytes	Rationale
MW106D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deep groundwater contaminants outside the SEC Property capped area.
MW107S	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of shallow groundwater contaminants upgradient of the SEC Property area.
MW107D	Fixed Lab: TCL VOCs, TCL SVOCs, TCL pesticides, PCB congeners, PCB Aroclors[1], dioxins/furans, and TAL metals Field: Temperature, pH, DO, turbidity, and ORP	To determine concentrations of deep groundwater contaminants upgradient of the SEC Property area.

[1] 20% of samples will be analyzed for PCB Aroclors.

Field Quality Control Samples

Field QC samples will be collected as part of the investigation, including field duplicates, trip blanks, equipment rinsate blanks, and field blanks. Worksheet #20 presents the field QC sample summary. Also, additional sample volume will be collected as necessary, if required by USEPA Region 3, for the laboratory QC analysis of matrix spike and MS/MSD analyses.

SAP Worksheet #18 - Sampling Locations and Methods

Matrix	Depth (units)	Analytical Group(s)	No. of Samples	Concentration Level[2]	Sampling SOP Reference	Rationale for Sample
Background Soil	Surface (0-6 inches [in]), Subsurface (6-24 in), and an additional TBD depth based on field observations	TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxins/Furans, TAL Metals, TOC and grain size[2]	32	Low	CT-04, GH-1.3, SA-1.3, SA-2.5, and SA-6.1	To establish background concentrations at locations not impacted by site activities.
Soil: SEC Possible Transformer Storage Area Britt Bath House Area	Surface (0-6 in) and Near surface (6-24 in and an additional TBD depth based on field observations)	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxin/Furans, TAL Metals, TOC and grain size[2]	111	Low	CT-04, GH-1.3, SA-1.3, SA-2.5, and SA-6.1	To determine the nature and extent of impacted soil.
Soil: Berwind Green Hill Mine Dump Area N R & P Supply House Rocklick Road	Surface (0-6 in) and Near surface (6-24 in and an additional TBD depth based on field observations)	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxin/Furans, TAL Metals, TOC and grain size[2]	67	Low	CT-04, GH-1.3, SA-1.3, SA-2.5, and SA-6.1	To determine the nature and extent of impacted soil offsite.
Residential Soil	Surface (two 0-6 in per grid) Near Surface (one 6-24 in per grid) Subsurface (one 24-48 in sample per grid) 0-3 in sample to be taken in high traffic/sensitive areas.	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxin/Furans, TAL Metals, TOC and grain size[2]	105	Low	CT-04, GH-1.3, SA-1.3, SA-2.5, and SA-6.1	To determine the nature and extent of impacted soil in residential properties.

Matrix	Depth (units)	Analytical Group(s)	No. of Samples	Concentration Level[2]	Sampling SOP Reference	Rationale for Sample
Groundwater [4]	NA	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxins/Furans, and TAL Metals (total and dissolved)	24	Low	CT-04, GH-1.2, GH-2.8, SA-1.1, and SA-6.1	To determine the nature and extent of impacted groundwater.
Sediment	0-6 inches from surface 6-12 inches from surface[3]	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxins/Furans, TAL Metals, TOC and grain size[2]	57	Low	CT-04, SA-1.2, and SA-6.1	To determine the nature and extent of sediment impact in the Arbuckle Creek.
Surface Water	NA	TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, PCB Aroclors[1], Dioxins/Furans, and TAL Metals (total and dissolved)	42	Low	CT-04, SA-1.2, and SA-6.1	To determine the nature and extent of surface water impact in Arbuckle Creek.
Wipe Samples	NA	PCB Congeners	53	Low	SOP-1	To determine the nature and extent of PCB inside of residents.

1 20% of samples will be analyzed for PCB Aroclors.
2 25% of solid samples will be analyzed for TOC and grain size.
3 New River Sediment samples will be taken from 0-6 and 6-12 inches bgs. Arbuckle Creek Sediment samples will be taken only from 0-6 inches.
4 Includes two rounds of groundwater sampling.

Field duplicates are included in the number of samples in this worksheet. Worksheet #12 identifies the other field QC samples to be collected during the field investigation.

SAP Worksheet #19 and 30 – Sample Containers, Preservation, and Hold Times

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume Used for Analysis	Containers (number, size, and type)[1]	Preservation Requirements	Maximum Holding Time (preparation/ analysis)[2]
Soil / Sediment	Metals (Includes Hg and CN)	ISM02.4	150 gram (g)	1 – 8 ounce (oz) wide mouth jar	Cool to ≤6 degrees Celsius (°C), but not frozen	28 days for Mercury; 6 months for all other metals
	SVOC	SOM02.4	150 g	1 – 8 oz Amber wide mouth jar	Cool to ≤6°C, but not frozen	14 days to preservation; 40 days to analysis
	Pesticides	SOM02.4	150 g	1 – 8 oz Amber wide mouth jar	Cool to ≤6°C, but not frozen	14 days to preservation; 40 days to analysis
	PCB Congeners	HRSM01.2	150 g	1 – 8 oz Amber wide mouth jar	Cool to ≤6°C, but not frozen	14 days to preservation; 365 days to analysis
	PCB Aroclors	SOM02.4	150g	1 – 8 oz Amber wide mouth jar	Cool to ≤6°C, but not frozen	14 days to preservation; 40 days to analysis
	Dioxin/Furans	HRSM01.2	150 g	1 – 8 oz Amber wide mouth jar	Cool to ≤6°C, but not frozen	1 year to analysis
	VOC	SOM02.4	15 g	3 – 5-gram Encore samplers	Cool to ≤6°C, but not frozen	48 hours to preparation; 14 days to analysis
	TOC	SW-846 9060A	2g	1 – 8 oz wide mouth jar	Cool to ≤6°C, but not frozen	28 days to analysis
	Grain Size	ASTM D6913	500g	1 – One-gallon Zipper-top plastic bag	Not applicable	Not applicable
	Grain Size	ASTM D422	500g	1 – One-gallon Zipper-top plastic bag	Not applicable	Not applicable
Groundwater / Surface Water	Metals (includes Hg)	ISM02.4	1 liter (L)	1 – 1L Plastic Bottle	HNO3 to pH<2; Cool to ≤6°C, but not frozen	28 days for Mercury; 6 months for all other metals
	Cyanide	ISM02.4	250 milliliter (mL)	250mL Plastic Bottle	NaOH to pH>10; Cool to ≤6°C, but not frozen	28 days to analysis
	SVOC (includes PAHs, PCP, and 1,4-Dioxane by SIM)	SOM02.4	2 L	2 – 1L Amber glass bottle	Cool to ≤6°C, but not frozen	7 days to preparation; 40 days to analysis
	Pesticides	SOM02.4	2 L	2 – 1L Amber glass bottle	Cool to ≤6°C, but not frozen	7 days to preparation; 40 days to analysis

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume Used for Analysis	Containers (number, size, and type)[1]	Preservation Requirements	Maximum Holding Time (preparation/ analysis)[2]
	PCB Congeners	HRSM01.2	2 L	2 – 1L Amber glass bottle	Cool to ≤6°C, but not frozen	7 days to preparation; 365 days to analysis
	PCB Aroclors	SOM02.4	2L	2 – 1L Amber glass bottle	Cool to ≤6°C, but not frozen	7 days to preparation; 40 days to analysis
	Dioxin/Furans	HRSM01.2	2 L	2 – 1L Amber glass bottle	Cool to ≤6°C, but not frozen	1 year to analysis
	VOC	SOM02.4	25 mL	3 – 40 mL amber glass vial	HCL to pH<2; Cool to ≤6°C, but not frozen	14 days to analysis
PCB Wipe Sample	PCB Congeners	HRSM01.2	10 cm by 10 cm area	gauze pad or glass wool that has been saturated with hexane	hexane	14 days to preparation; 365 days to analysis

[1] Sample size is a minimum; the containers listed will be filled to compensate for any required re-analysis or re-extractions. For samples requiring MS/MSD, containers listed should be doubled for solid samples and tripled for aqueous samples. Container size may change if field conditions change and/or laboratory procedures change.

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

SAP Worksheet #20 – Field QC Sample Summary

Matrix	Analytical Group	Environmental Samples	Field Duplicate Pairs[1]	MS/MSD[2]	Rinsate Blanks[3]	Trip Blanks[4]	Field Blank[5]
Soil: SEC, Possible Transformer Storage Area, and Britt Bath House Area	Metals	106	6	4/4	5	NA	3
	VOCs	106	6	NA	5	6	3
	SVOCs	106	6	NA	5	NA	3
	Pesticides	106	6	4/4	5	NA	3
	PCB Congeners	106	6	NA	5	NA	3
	PCB Aroclors[7]	22	2	NA	5	NA	3
	Dioxin/Furans	106	6	NA	5	NA	3
	TOC[8]	27	2	NA	5	NA	3
	Grain Size	106	6	NA	5	NA	3
Background Soil	SVOCs	30	2	NA	2	NA	*1*
	Pesticides	30	2	1/1	2	NA	1
	PCB Congeners	30	2	NA	2	NA	1
	PCB Aroclors[7]	6	1	NA	2	NA	1
	Dioxins/Furans	30	2	NA	2	NA	1
	Metals	30	2	1/1	2	NA	1
	TOC[8]	8	1	NA	2	NA	1
	Grain Size	30	2	NA	2	NA	1
Groundwater[6]	VOCs	22	2	NA	4	3	2
	SVOCs	22	2	NA	4	NA	2
	Pesticides	22	2	2/2	4	NA	2
	PCB Congeners	22	2	NA	4	NA	2

Matrix	Analytical Group	Environmental Samples	Field Duplicate Pairs[1]	MS/MSD[2]	Rinsate Blanks[3]	Trip Blanks[4]	Field Blank[5]
	PCB Aroclors[7]	5	1	NA	4	NA	2
	Dioxins/Furans	22	2	NA	4	NA	2
	Metals	22	2	2/2	4	NA	2
Residential Soil	VOCs	100	5	NA	10	10	4
	SVOCs	100	5	NA	10	NA	4
	Pesticides	100	5	5/5	10	NA	4
	PCB Congeners	100	5	NA	10	NA	4
	PCB Aroclors[7]	20	1	NA	10	NA	4
	Dioxins/Furans	100	5	NA	10	NA	4
	Metals	100	5	5/5	10	NA	4
	TOC[8]	25	2	NA	10	NA	4
	Grain Size	100	5	NA	10	NA	4
PCB Wipe Samples	PCB Congeners	50	3	NA	---	NA	---
Soil: Berwind Green Hill Mine Dump Area, N R & P Supply House, and Rocklick Road	VOCs	63	4	NA	5	5	2
	SVOCs	63	4	NA	5	NA	2
	Pesticides	63	4	3/3	5	NA	2
	PCB Congeners	63	4	NA	5	NA	2
	PCB Aroclors[7]	13	1	NA	5	NA	2
	Dioxins/Furans	63	4	NA	5	NA	2
	Metals	63	4	3/3	5	NA	2
	TOC[8]	16	1	NA	5	NA	2
	Grain Size	63	4	NA	5	NA	2

Matrix	Analytical Group	Environmental Samples	Field Duplicate Pairs[1]	MS/MSD[2]	Rinsate Blanks[3]	Trip Blanks[4]	Field Blank[5]
Surface Water	VOCs	40	2	NA	5	5	2
	SVOCs	40	2	NA	5	NA	2
	Pesticides	40	2	3/3	5	NA	2
	PCB Congeners	40	2	NA	5	NA	2
	PCB Aroclors[7]	8	1	NA	5	NA	2
	Dioxins/Furans	40	2	NA	5	NA	2
	Metals	40	2	3/3	5	NA	2
Sediment	VOCs	54	3	NA	2	3	2
	SVOCs	54	3	NA	2	NA	2
	Pesticides	54	3	3/3	2	NA	2
	PCB Congeners	54	3	NA	2	NA	2
	PCB Aroclors[7]	11	1	NA	2	NA	2
	Dioxins/Furans	54	3	NA	2	NA	2
	Metals	54	3	3/3	2	NA	2
	TOC[9]	24	2	NA	2	NA	2
	Grain Size	54	3	NA	2	NA	2

1 One for each 20 samples of similar matrix (i.e., soil, groundwater, etc.).
2 One of each for each 20 samples of similar matrix (i.e., soil, groundwater, etc.).
3 One per day of equipment decontamination activities.
4 One per cooler per day of sampling for VOCs.
5 One per source water used to decontaminate equipment.
6 Includes two rounds of groundwater samples.
7 20% of samples will be analyzed for PCB Aroclors.
8 25% of samples will be analyzed for TOC.
9 100% of New River Sediment Samples will be analyzed for TOC.

SAP Worksheet #21 – Field SOPs

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
CT-04	Sample Nomenclature (November 2016, Revision 5)	Tetra Tech	None	N	SOP in Appendix I
GH-1.1	Site Reconnaissance (September 2016, Revision 3)	Tetra Tech	Not applicable	N	SOP in Appendix I
GH-1.2	Evaluation of Existing Monitoring Wells and Water Level Measurement (February 2016, Revision 4)	Tetra Tech	Field logbook, electric water-level indicator or hydrocarbon interface probe, field forms, decontamination equipment and supplies, PID	N	SOP in Appendix I
GH-1.3	Soil and Rock Drilling Methods (May 2017, Revision 3)	Tetra Tech	Drilling or Direct Push Technology rig, accessories, and general field supplies	N	SOP in Appendix I
GH-1.5	Borehole and Sample Logging (January 2012, Revision 2)	Tetra Tech	General field supplies	N	SOP in Appendix I
GH-2.8	Groundwater Monitoring Well Installation (January 2012, Revision 4)	Tetra Tech	Health and safety equipment, well drilling and installation equipment, hydrogeologic equipment, drive point installation tools	N	SOP in Appendix I
HS-1.0	Utility Locating and Excavation Clearance (July 2016, Revision 4)	Tetra Tech	Remote subsurface sensing, magnetometer, ground-penetrating radar, etc.	N	SOP in Appendix I
SA-1.1	Groundwater Sample Acquisition and Water Quality Testing (July 2016, Revision 9)	Tetra Tech	Sample bottleware, sampling pump, instrumentation, decontamination supplies	N	SOP in Appendix I
SA-1.2	Surface Water and Sediment Sampling (September 2016, Revision 8)	Tetra Tech	General sampling supplies	N	SOP in Appendix I

Reference Number	Title, Revision Date, and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
SA-1.3	Soil Sampling (September 2016, Revision 11)	Tetra Tech	General sampling supplies	N	SOP in Appendix I
SA-2.5	Direct Push Technology (May 2017, Revision 5)	Tetra Tech	DPT Rig, accessories, and supplies	N	SOP in Appendix I
SA-6.1	Non-Radiological Sample Handling (July 2016, Revision 5)	Tetra Tech	Sample bottle ware, packaging material, shipping materials	N	SOP in Appendix I
SA-6.3	Field Documentation (September 2017, Revision 6)	Tetra Tech	Field logbook, field sample forms, boring logs	N	SOP in Appendix I
SA-7.1	Decontamination of Field Equipment (July 2016, Revision 8)	Tetra Tech	Decontamination equipment, scrub brushes, phosphate-free detergent, deionized water	N	SOP in Appendix I
SOP 1	Wipe Sampling Procedure for PCBs (May 2016)	Eurofins	Collected of PCB Wipe Samples	N	SOP in Appendix I

SAP Worksheet #22 - Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria		Corrective Action	Responsible Person	SOP Reference[1/]
Water Quality Meter	Calibrate with standard solutions	NA	NA	Prior to day's activities; end of day's activities; anytime anomaly suspected	pH Meter	+/- 0.1 units	Clean probe, replace battery, replace membrane, replace probe	FOL or designee	GH-2.8, SA-1.1, Manufacturer's Guidance Manual
					Dissolved Oxygen	± 3%			
					Specific Conductivity	± 1% of full scale*			
					ORP	± 10 mV			
					Temperature	± 0.1 °C			
					Turbidity	± 2 NTU			
Water Quality Meter	NA	NA	Visual inspection	Prior to day's activities	No defects noted		Replace probe	FOL or designee	GH-2.8, SA-1.1, Manufacturer's Guidance Manual
Water Quality Meter	NA	Check/replace battery	NA	Prior to day's activities; anytime anomaly suspected	NA		Replace battery; replace probe	FOL or designee	GH-2.8, SA-1.1, Manufacturer's Guidance Manual
PID	Calibrate with standard gases	NA	NA	Prior to day's activities; end of day's activities; anytime anomaly suspected	+/- 5 parts per million (ppm)		Clean probe, replace battery, replace probe	FOL or designee	Manufacturer's User Manual
PID	NA	NA	Visual inspection	Prior to day's activities	No defects noted		Replace probe	FOL or designee	Manufacturer's User Manual

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1/]
PID	NA	Check/replace battery	NA	Prior to day's activities; anytime anomaly suspected	NA	Replace battery; replace probe	FOL or designee	Manufacturer's User Manual
Oil/Water Level Indicator	NA	NA	Visual inspection	Prior to day's activities	No defects noted	Replace	FOL or designee	GH-1.2, Manufacturer's Guidance Manual
Oil/Water Level Indicator	NA	NA	Auditory inspection	Prior to day's activities; end of day's activities; anytime anomaly suspected	Audio tone for contact with water (markings in increments of ± 0.01 feet)	Replace	FOL or designee	GH-1.2, Manufacturer's Guidance Manual
Oil/Water Level Indicator	NA	Check/replace battery	NA	Prior to day's activities; anytime anomaly suspected	NA	Replace battery	FOL or designee	GH-1.2, Manufacturer's Guidance Manual

SAP Worksheet #23 - Analytical SOP References Table

Reference Analytical Method	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SOP 1709	Field Analysis of Polychlorinated Biphenyls (PCBs) by GC/ECD in Soil/Sediment Samples in the ERT Mobile Laboratory (11/2011)	Screening	PCB Aroclors	Gas Chromatograph/ Electron Capture Detector (GC/ECD)	USEPA ERT	N
ISM02.4	USEPA CLP SOW for Inorganic Superfund Methods Multi-Media, Multi-Concentration (10/2016)	Definitive	Total TAL Metals	Inductively Couple Plasma Mass Spectrometer (ICP-MS)	TBD	N
		Definitive	Mercury	Cold Vapor Atomic Absorption Spectrometer (CVAA)	TBD	N
		Definitive	Cyanide	Spectrophotometer	TBD	N
SOM02.4	USEPA CLP SOW for Organic Superfund Methods Multi-Media, Multi-Concentration (10/2016)	Definitive	TCL VOCs	Gas Chromatograph/Mass Spectrometer (GC/MS)	TBD	N
		Definitive	TCL SVOCs (includes SIM PAHs, PCP, and 1,4-Dioxane)	GC/MS	TBD	N
		Definitive	TCL Pesticides	GC/ECD	TBD	N
		Definitive	PCB Aroclors	GC/ECD	TBD	N
HRSM01.2	USEPA CLP SOW for High Resolution Superfund Methods Multi-Media Multi-Concentration (10/2014)	Definitive	Dioxin/Furans PCB Congeners	High Resolution MS/ High Resolution GC (HRMS/HRGC)	TBD	N
SW-846 5035A	Closed-System Purge-and-Trap Extraction for Volatile Organics in Soil and Waste Samples	Definitive	VOC	NA	TBD	N
CLP HRSM01.2	USEPA CLP HRSM01.2 for PCB wipe samples	Definitive	PCB Congener	NA	TBD	N

Reference Analytical Method	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
SW-846 9060A	Total Organic Carbon	Definitive	TOC	TOC Analyzer	TBD	N
ASTM D6913	Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis	Definitive	Grain Size	Sieve	TBD	N
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils	Definitive	Grain Size	Hydrometer	TBD	N

SAP Worksheet #24 - Analytical Instrument Calibration Table

The following analytical instrument calibration information is for CLP SOW method analyses at fixed-based laboratories only. The USEPA ERT mobile laboratory PCB analysis instrument calibration information can be found in Appendix H.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
GC/MS VOCs	Instrument Performance Check (Bromofluoro-benzene [BFB] Tuning)	Beginning of each 12-hour period during which samples are to be analyzed.	Meets ion abundance criteria in Table 2 of the method.	Re-tune the GC/MS system. May need to clean ion source and/or quadrupole rods. BFB criteria must be met before any other samples are analyzed.	Analyst/Supervisor	SOM02.3 – Trace/Low VOCs
GC/MS VOCs	Initial Calibration (ICAL) (5 points)	Instrument receipt, instrument change (new trap, column, etc.), when CCV does not meet criteria.	1. RRF must be ≥ criteria in Table 4 of the method. 2. RSD must be ≤ criteria in Table 4 of method. 3. Up to 2 target compounds may fail RRF but must meet RRF of 0.01 or up to 2 targets may fail RSD but meet max. RSD requirement of 40%.	1. Inspect the system. May be necessary to clean ion source, change column, or service purge-and-trap device in addition to other CA. 2. Recalibrate.	Analyst/Supervisor	SOM02.3 – Trace/Low VOCs
GC/MS VOCs	Continuing Calibration Verification (CCV)	Prior to analysis of samples and after BFB tuning. At the end of each 12-hour shift.	1. Must be at or near the mid-point concentration. 2. RRF must be ≥ criteria in Table 4 of the method. 3. %D must be within range of Table 4 criteria. 4. Up to 2 RRFs may fail but must meet RRF of 0.01 or up to 2 targets may fail RSD but meet max. RSD requirement of 40%.	Re-calibrate. If closing CCV fails, samples must be reanalyzed. May be necessary to clean ion source, change column, or service purge-and-trap device in addition to other CA.	Analyst/ Supervisor	SOM02.3 – Trace/Low VOCs
GC/MS SVOCs	Instrument Performance Check (Decafluorotri-phenylphosphine [DFTPP] Tuning)	Beginning of each 12-hour period during which samples are to be analyzed.	Meets ion abundance criteria in Table 2 of the method.	Re-tune the GC/MS system. May need to clean ion source and/or quadrupole rods. DFTPP criteria must be met before any other samples are analyzed.	Analyst/Supervisor	SOM02.3 – SVOCs

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
GC/MS SVOCs	ICAL (5 points)	Instrument receipt, instrument change (new trap, column, etc.), when CCV does not meet criteria.	1. RRF must be ≥ criteria in Table 4 of method. 2. RSD must be ≤ criteria in Table 4 of method. 3. Up to 2 target compounds may fail RRF but must meet RRF of 0.01 or up to 2 targets may fail RSD but meet max. RSD requirement of 40%.	1. Inspect the system. May be necessary to clean ion source, change column, or service purge-and-trap device in addition to other CA. 2. Recalibrate.	Analyst/Supervisor	SOM02.3 - SVOCs
GC/MS SVOCs	CCV	Prior to analysis of samples and after DFTPP tuning. At the end of each 12-hour shift.	1. Must be at or near the mid-point concentration. 2. RRF must be ≥ criteria in Table 4 of the method. 3. %D must be within range of Table 4 criteria. 4. Up to 2 RRFs may fail but must meet RRF of 0.01 or up to 2 targets may fail RSD but meet max. RSD requirement of 40%.	Re-calibrate. If closing CCV fails, samples must be reanalyzed. May be necessary to clean ion source, change column, or service purge-and-trap device in addition to other CA.	Analyst/ Supervisor	SOM02.3 – SVOCs
GC/MS SIM Low Level 1,4-Dioxane, PAHs and PCP	Instrument Performance Check (DFTPP Tuning)	Beginning of each 12-hour period during which samples are to be analyzed.	Meets ion abundance criteria in Table 2 of the method.	Re-tune the GC/MS system. May need to clean ion source and/or quadrupole rods. DFTPP criteria must be met before any other samples are analyzed.	Analyst/Supervisor	SOM02.3 – 1,4-Dioxane, PAHs, and PCP
GC/MS SIM Low Level 1,4-Dioxane, PAHs, and PCP	ICAL (5 points)	Instrument receipt, instrument change (new trap, column, etc.), when CCV does not meet criteria.	The %RSDs for RF of 1,4-Dioxane must be ≤ 15%.	Repeat calibration if criterion is not met.	Analyst/Supervisor	SOM02.3 - 1,4-Dioxane, PAHs, and PCP
GC/MS SIM Low Level 1,4-Dioxane, PAHs, and PCP	CCV	Prior to analysis of samples and after DFTPP tuning. At the end of each 12-hour shift.	%D must be ≤ 20%.	Investigate cause and repeat injection once. If failure repeats, repeat ICAL and reanalyze all samples analyzed since the last successful CCV.	Analyst/ Supervisor	SOM02.3 - 1,4-Dioxane, PAHs, and PCP

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
GC/ECD Pesticides	Breakdown Check	Perform daily prior to sample analysis.	The degradation must be ≤ 20% for both DDT and Endrin to verify the inertness of the injection port.	Correct the problem then repeat breakdown check. No samples shall be run until degradation is ≤20% for both DDT and Endrin and ≤30% for both combined.	Analyst/Supervisor	SOM02.3 – Pesticides
GC/ECD Pesticides	ICAL – A 5-point calibration of individual pesticides, with a mid-point calibration of toxaphene is prepared for all target analytes	Upon instrument receipt, major instrument change, or when the CCV does not meet criteria, prior to sample analysis.	The RSD for RFs for each target analyte must be ≤ 20-30% (see Table 2 of the method). If a single-point calibration for toxaphene is used and toxaphene is identified in the analysis of a sample, a minimum of a 5-point ICAL of the identified compound with reanalysis of sample must be performed.	Correct problem and repeat ICAL. No samples may be run until ICAL has passed.	Analyst/Supervisor	SOM02.3 - Pesticides
GC/ECD Pesticides	CCV	Prior to analysis of samples and at the end of each 12-hour shift.	The %D of all target analytes must be ≤25% for the opening CCV and ≤25% for the closing CCV.	Correct problem and rerun CCV. If that fails, repeat ICAL and reanalyze all samples analyzed since the last successful CCV.	Analyst/ Supervisor	SOM02.3 – Pesticides
HRGC/HRMS Dioxin/Furans, PCB Congeners	System Check (Perfluorokerosene [PFK] Tune)	Beginning of each 12-hour period during which samples are to be analyzed.	Static resolving power must be ≥10,000, and the deviation between the exact m/z and the theoretical m/z for each exact m/z monitored must be < 5 ppm.	The instrument must be adjusted until the technical acceptance criteria are met. Refer to manufacturer's instructions for trouble-shooting systems that will not meet tune criteria.	Analyst/ Supervisor	HRSM01.2 – Dioxin/Furans, PCB Congeners

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
HRGC/HRMS Dioxin/Furans, PCB Congeners	Window Defining Mixture (WDM) and Isomer Specificity Check Standard	Beginning of each 12-hour period during which samples are to be analyzed.	Beginning and ending CDDs/CDFs (dioxin/furans) and beginning and ending congeners (PCB congeners) are eluting as given in Table 7of Method. Height of the valley between the least resolved adjacent isomer and the 2,3,7,8-substituted isomer is ≤25% (dioxin/furan). Height of the valley between the least resolved adjacent isomer is less than 40% of the height of the shorter peak and if PCB-156 and PCB-157 elute within 2 seconds of each other (PCB congeners).	The analytical conditions must be adjusted, and the test repeated or the HRGC column must be replaced.	Analyst/ Supervisor	HRSM01.2 – Dioxin/Furans, PCB Congeners
GC/ECD Aroclors	ICAL - A 5-point calibration of Aroclor 1660 (1016/1260 mixture) is prepared	Upon instrument receipt, major instrument change, when CCV does not meet criteria.	%RSD must be ≤20% for Aroclor 1016/1260 – if another Aroclor is detected in a sample, a 5-point ICAL must be performed and meet the above criteria for that Aroclor.	Correct problem then repeat ICAL. No samples may be run until ICAL has passed.	Analyst/Supervisor	SOM02.4– Aroclors
GC/ECD Aroclors	CCV	Prior to analysis of samples and at the end of each 12-hour shift.	The %D of all target analytes must be ≤25% for the opening CCV and ≤50% for the closing CCV.	Correct problem and rerun CCV. If that fails, repeat ICAL and reanalyze all samples analyzed since the last successful CCV.	Analyst/ Supervisor	SOM02.4 – Aroclors

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
HRGC/HRMS Dioxin/Furans	ICAL – 5 points	Instrument receipt, instrument change (new trap, column, etc.), when CCV does not meet criteria.	The isomer specificity shall be resolved with a valley of ≤25%. The m/z ratios must be within the limits specified in Table 9 of Method. The S/N ratios for the HRGC/HRMS signal in every selected ion current profile must be ≥10. RTs of the isomers must fall within the appropriate RT windows established by analysis of the WDM. %RSD for the RR must be ≤20% and the %RSD for the RRF must be ≤35%.	Inspect the system for problems. It may be necessary to change columns, adjust the system, and recalibrate until all the technical acceptance criteria are met. All initial calibration technical acceptance criteria must be met before any samples, LCS/LCSD, and required blanks are analyzed.	Analyst/ Supervisor	HRSM01.2 – Dioxin/Furans
HRGC/HRMS PCB Congeners	ICAL – 5 points	Instrument receipt, instrument change (new trap, column, etc.), when CCV does not meet criteria.	The isomer specificity shall be resolved with a valley of ≤40%. The m/z ratios must be within the limits specified in Table 9 of Method. The S/N ratios for the HRGC/HRMS signal in every selected ion current profile must be ≥10. RTs of the isomers must fall within the appropriate RT windows established by analysis of the CS1 and CS209. %RSD for the RR must be ≤20% and the %RSD for the RRF must be ≤35%.	Inspect the system for problems. It may be necessary to change columns, adjust the system, and recalibrate until all the technical acceptance criteria are met. All initial calibration technical acceptance criteria must be met before any samples, LCS/LCSD, and required blanks are analyzed.	Analyst/ Supervisor	HRSM01.2 – PCB Congeners

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
HRGC/HRMS Dioxin/Furans	CCV	Beginning and end of each 12-hour shift.	All CDDs/CDFs in the calibration standard must be within their respective ion abundance ratios. The relative retention times (RRTs) of the native and labeled CDDs/CDFs shall be within the limits defined in Table 2 of the Method. The %D between the continuing calibration verification RR and the mean RR from the initial calibration must be within ±25%. The %D between the continuing calibration verification RRF and the mean RRF from the initial calibration must be within ±35%. The peaks representing both native and labeled compounds in the CS3 standard must have a S/N ratio greater than or equal to 10.	Inspect the system for problems. It may be necessary to change columns, adjust the system, and recalibrate. It may be necessary to segregate samples with particularly serious matrix issues for further cleanup or dilution and reanalysis to obtain compliant beginning and ending calibration checks.	Analyst/ Supervisor	HRSM01.2 – Dioxin/Furans

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
HRGC/HRMS PCB Congeners	CCV	Beginning and end of each 12-hour shift.	All 209 congener target analytes in the calibration standard (both native and labeled) must be within their respective ion abundance ratios. The RRTs of the native and labeled 209 congener target analytes shall be within the limits defined in Table 7 of the Method. The %D between the continuing calibration verification RR/RRF and the mean RR/RRF from the initial calibration must be within ±25% for the WHO toxic congeners/LOC as defined in Table 5. The peaks representing both native and labeled compounds in the CS3 or CS209 standard must have a S/N ratio greater than or equal to 10. The HRMS tune data must be checked and meet the resolution requirement at greater than or equal to 10,000. The absolute RTs of the Labeled Toxic/LOC/Window-Defining Congeners Standard Spiking Solution in the verification test must be within ±15 seconds of the respective RTs in the calibration. If an alternate column is employed, which requires different criteria for peak identification, the laboratory must report the alternate RTs and RRT windows which are used for peak acceptance in the SDG Narrative.	Inspect the system for problems. It may be necessary to change columns, adjust the system, and recalibrate. If recalibration is required, recalibration for the 209 congeners must also be performed. It may be necessary to segregate samples with particularly serious matrix issues for further cleanup or dilution and reanalysis to obtain compliant beginning and ending calibration checks.	Analyst/ Supervisor	HRSM01.2 – PCB Congeners

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
ICP/MS Metals	Tuning Solution	Before calibration.	RSD of absolute signals must be < 5% for each isotope in the tuning solution.	None.	Analyst/Supervisor	ISM02.3 Metals
ICP/MS Metals	Instrument Calibration	Each time the instrument is turned on and set up, or after a calibration failure.	At least 6 standards including a blank with a minimum of three replicate integrations. Correlation coefficient must be ≥0.995.	Re-calibrate.	Analyst/Supervisor	ISM02.3 Metals
ICP/MS Metals	Initial Calibration Verification (ICV)	Immediately after calibration.	Must be within 90 – 110 %R, and the %RSD of the ICV integrations must be < 5.0%.	Terminate analysis, correct problem, recalibrate, and verify.	Analyst/Supervisor	ISM02.3 Metals
ICP/MS Metals	Initial Calibration Blank (ICB)	Following each instrument calibration, immediately after ICV.	The absolute value of each result must be ≤ the CRQL for aqueous samples.	Terminate analysis, correct problem, recalibrate, verify calibration, and reanalyze preceding analytical samples from last compliant blank.	Analyst/Supervisor	ISM02.3 Metals
ICP/MS Metals	CCV	At the beginning and end of the sequence, and every 2 hours.	Must be within 90 – 110 %R, and the %RSD of the CCV integrations must be < 5.0%.	Terminate analysis, correct problem, recalibrate, and verify. Reanalyze associated samples.	Analyst/Supervisor	ISM02.3 Metals
ICP/MS Metals	Continuing Calibration Blank (CCB)	Every two hours of a run and at the beginning of each run. Performed immediately after the CCV.	The absolute value of each result must be ≤ the CRQL for aqueous samples.	Terminate analysis, correct problem, recalibrate, verify calibration, and reanalyze preceding analytical samples from last compliant blank.	Analyst/Supervisor	ISM02.3 Metals
CVAA Mercury	Calibration Curve – a minimum of a 6-point calibration	Daily, each time the instrument is set up, or after a calibration failure.	Each standard must be within 30%D of true value. Correlation coefficient must be ≥0.995.	Re-calibrate.	Analyst/Supervisor	ISM02.3 Mercury
CVAA Mercury	ICV	Immediately after calibration.	Must be within 85 – 115 %R.	Terminate analysis, correct problem, recalibrate, and verify.	Analyst/Supervisor	ISM02.3 Mercury
CVAA Mercury	CCV	At the beginning and end of the sequence, and every 1 hour.	Must be within 85 – 115 %R.	Terminate analysis, correct problem, recalibrate, and verify. Reanalyze associated samples.	Analyst/Supervisor	ISM02.3 Mercury
Spectro-photometer Cyanide	Calibration Curve – a minimum of a 6-point calibration	Daily, each time the instrument is set up, or after a calibration failure.	Each standard must be within 30% of true value. Correlation coefficient must be ≥0.995.	Re-calibrate.	Analyst/Supervisor	ISM02.3 Cyanide

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
Spectro-photometer Cyanide	ICV	Immediately after calibration.	Must be within 85 – 115 %R.	Terminate analysis, correct problem, recalibrate, and verify.	Analyst/Supervisor	ISM02.3 Cyanide
Spectro-photometer Cyanide	CCV	At the beginning and end of the sequence, and every 1 hour.	Must be within 85 – 115 %R.	Terminate analysis, correct problem, recalibrate, and verify. Reanalyze associated samples.	Analyst/Supervisor	ISM02.3 Cyanide
Analytical Balance	Calibration	Balance will be calibrated daily	NA	NA	Analyst/Supervisor	Laboratory TBD
Analytical Balance	Calibration Check	Prior to and following the measurement of each analysis set using a 2 mg and 100 mg Class S Weight	The results must meet the following acceptance criteria: 2 ± 0.2 mg 100 ± 5 mg	If results do not meet acceptance criteria, re-calibrate the balance and re-weigh samples	Analyst/Supervisor	Laboratory TBD
TOC Analyzer	ICAL	Calibrate monthly, anytime there is major instrument maintenance such as catalyst change, and as needed.	Linear calibration, r ≥ 0.995;	Correct problem then repeat ICAL Flagging is not appropriate.	Analyst/Supervisor	SW-846 9060A
TOC Analyzer	ICV	Immediately following the initiation calibration and prior to sample analysis	Result must be within ±15% of the true value	Re-prepare ICV and re-run. If re-analysis is not successful, identify and correct the source of the problem. Re-calibrate Flagging is not appropriate.	Analyst/Supervisor	SW-846 9060A
TOC Analyzer	Calibration Verification	After every ten samples or sets of quadruplicates and at the end of an analysis sequence	Result must be within ±10% of true value	Re-prepare calibration verification standard and re-run. If re-analysis is not successful, identify and correct the source of the problem. Re-calibrate. All samples analyzed since the last passing calibration verification must be re-analyzed if possible.	Analyst/Supervisor	SW-846 9060A

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for CA	SOP Reference[1]
TOC Analyzer	ICAL	Calibrate monthly, anytime there is major instrument maintenance such as catalyst change, and as needed.	Linear calibration, r ≥ 0.995;	Correct problem then repeat ICAL Flagging is not appropriate.	Analyst/Supervisor	SW-846 9060A

SAP Worksheet #25 - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

The following analytical instrument maintenance information is for CLP SOW method analyses at fixed-based laboratories only. The USEPA ERT mobile laboratory PCB analysis instrument calibration information can be found in Appendix H.

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC/MS	Check pressure and gas supply daily. Bake out trap and column, manual tune if not in criteria, change septa as needed, cut column as needed, change trap as needed.	Instrument Performance Check, ICAL, CCV for VOCs and SVOC analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	SOM02.4 VOCs SVOC/PAHs
GC/ECD	Check pressure and gas supply daily. Bake out column, change septa and/or liner as needed, replace or cut column as needed.	Instrument Performance Check, ICAL, CCV for Pesticides and PCB analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	SOM02.4 Pesticides/PCB Aroclors
HRGC/ HRMS	Check pressure and gas supply daily. Bake out trap and column, manual tune if not in criteria, change septa as needed, cut column as needed, change trap as needed.	Instrument Performance Check, ICAL, CCV for Dioxin/Furans and PCB Congener analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	HRSM01.2 Dioxin/ Furans PCB Congeners
ICP/MS	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, and replace peristaltic pump tubing as needed.	ICAL, CCV for metals analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	ISM02.4 Metals

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference1
CVAA	Change or replace parts as needed.	ICAL, CCV for mercury analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	ISM02.4 Mercury
Spectro-photometer	Change or replace parts as needed.	ICAL, CCV for cyanide analysis	Daily calibration activities	Must meet frequencies described in Worksheet #24.	Must meet calibration criteria described in Worksheet #24.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	ISM02.4 Cyanide
TOC Analyzer	Check pressure and gas supply daily. Change catalyst	Initial calibration and calibration Verification	See Worksheet #24	See Worksheet #24	See Worksheet #24	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	SW-846 9060A
Analytical Balance	Clean tray and enclosure of debris. Level the balance	Initial calibration and calibration Verification	See Worksheet #24	See Worksheet #24	See Worksheet #24	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data. Record maintenance activities in logbook.	Analyst/ Supervisor	Laboratory TBD

[1] Specify the appropriate reference letter or number from Analytical SOP References table (Worksheet #23).

SAP Worksheet #26 and 27- Sample Handling, Custody, and Disposal

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FOL or designee, Tetra Tech
Sample Packaging (Personnel/Organization): FOL or designee, Tetra Tech
Coordination of Shipment (Personnel/Organization): FOL or designee, Tetra Tech
Type of Shipment/Carrier: Overnight, Federal Express or laboratory courier
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodians/TBD
Sample Custody and Storage (Personnel/Organization): Sample Custodians/TBD
Sample Preparation (Personnel/Organization): Extraction Laboratory/TBD
Sample Determinative Analysis (Personnel/Organization): GC/MS, GC/ECD, HRGC/HRMS, ICP-MS, CVAA, Spectrophotometer Analysts / Laboratory TBD
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): no more than 48 hours; except for soil Encore samples, they must be shipped daily
Sample Extract/Digestate Storage (number of days from extraction/digestion): as per CLP requirements, 3 months from sample digestion/extraction for non-CLP samples
Biological Sample Storage (No. of days from sample collection): as per CLP requirement, 60 days for non-CLP samples
SAMPLE DISPOSAL
Personnel/Organization: Sample Custodians/TBD
Number of Days from Analysis: as per CLP requirement, 60 days for non-CLP samples
Sample Identification Procedures: The method of identification of a sample depends on the type of measurement or analysis performed. Identifying information such as project name, station number, station location, date and time, name of sampler, field observations, remarks, etc. will be recorded in the field logbook and/or on field forms. The environmental sample types collected will be reflected in the sample number following a letter code, along with the name and/or number that depicts the specific location. The depth of each discrete sediment sample will be incorporated into the sample number. Groundwater samples will include the date of sampling. Field and trip blanks will include the letter code corresponding to the

appropriate type of equipment and/or portion of the field investigation for which the blank sample was collected and the date of sampling. For more details on sample identification, see Worksheet #18 Sampling Locations.

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Tetra Tech will order and maintain custody of pre-preserved sample containers prior to sample collection. Following sample collection into the appropriate bottleware, all samples will be immediately placed on ice in a cooler. Glass sample containers will be enclosed in bubble-wrap to protect the bottle/jar during shipment. The cooler will be secured using strapping tape along with a signed custody seal. Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected laboratory for analysis. Samples will be preserved as appropriate based on the analytical method. Samples will be maintained at ≤6 °C until delivery to the laboratories.

Chain-of-custody protocols will be used throughout sample handling to establish the evidentiary integrity of sample containers. These protocols will be used to demonstrate that the samples were handled and transferred in a manner that would eliminate possible tampering. Samples for the laboratory will be packaged and shipped in accordance with the USEPA's guidance document "Contract Laboratory Program Guidance for Field Samplers" (USEPA, 2014) and Tetra Tech SOP SA-6.1.

After recovery, each sample will be maintained in the sampler's custody until formally transferred to another party (e.g., FedEx). For all samples recovered, custody records will document the date and time of sample collection, the sampler's name, and the names of all other who subsequently held custody of the samples. Specification for chemical analyses will also be documented on the custody record. All sample information will be maintained in SCRIBE. The chain-of-custody documents will be generated by SCRIBE in addition to the sample bottle labels and tags.

In addition to the USEPA-required documentation (e.g., chain-of-custody documents) and QC of samples, certain standard forms will be completed for sample description and documentation. These will include the sample log sheet (for soil, sediment, surface water, and groundwater samples) and project sample shipping logs. Examples of these forms can be found in Tetra Tech SOP SA-6.3 (Appendix D). The type of preservative(s) used for each sample will be noted on the sample log sheet. The source of the preservatives and any other reagents will be documented in the site logbook.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

A sample custodian at the laboratory will accept custody of the samples, and check them for discrepancies, proper preservation, integrity, etc., according to laboratory and CLP requirements. If noted, issues will be forwarded to the laboratory PM who will in turn contact the Region 3 Client Team and the Tetra Tech QAM to determine if corrective action is necessary. The sample custodian will relinquish custody to the appropriate department for analysis. Disposal of the samples will occur only after analyses, QA/QC checks, and validation are completed.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – VOCs in Solid/Aqueous

The following analytical quality control and corrective action information is for CLP SOW method analyses at fixed-based laboratories only. The USEPA ERT mobile laboratory PCB analysis instrument calibration information can be found in Appendix H.

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**VOCs**
Analytical Method	SOM02.4 Trace/Low VOCs
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	DQI	MPC
Method Blank	One every 12 hours prior to sample analysis	No target compounds >CRQL except common laboratory contaminants, which should be ≤2x CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision/ Accuracy	Same as QC Acceptance Limits.
Deuterated Monitoring Compounds	3 per sample	Recoveries must be within method-specific limits.	Re-prep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Internal Standards (ISs)	3 per sample	Retention time $\pm$ 20 seconds; Extracted Ion Current Profile (EICP) area within 50-200% of opening CCV for each IS.	Check calculations, spike solution, and instrument performance. Take CA to technical acceptance criteria. Narrate.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – SVOCs in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**SVOCs**
Analytical Method	SOM02.4 SVOCs
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One every 12 hours prior to sample analysis	No target compounds >CRQL except bis(2-ethylhexyl) phthalate, which should be ≤5x CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision/ Accuracy	Same as QC Acceptance Limits.
Deuterated Monitoring Compounds	3 per sample	Recoveries must be within method-specific limits.	Re-prep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
ISs	3 per sample	Retention time must be within ± 20 seconds; EICP area must be within 50-200% of opening CCV for each IS.	Check calculations, spike solution, and instrument performance. Take CA to technical acceptance criteria. Narrate.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – SVOC-SIM in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**Low Level 1,4-Dioxane, PAHs, and PCP**
Analytical Method	SOM02.4 SVOCs-SIM, or equivalent
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One every 12 hours prior to sample analysis	No target compounds >CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision/ Accuracy	Same as QC Acceptance Limits.
Deuterated Monitoring Compounds	3 per sample	Recoveries must be within method-specific limits.	Re-prep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
ISs	3 per sample	Retention time must be within $\pm$ 20 seconds; EICP area must be within 50-200% of opening CCV for each IS.	Check calculations, spike solution, and instrument performance. Take CA to technical acceptance criteria. Narrate.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – TCL Pesticides in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**TCL Pesticides**
Analytical Method	SOM02.4 Pesticides
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples	No target compounds >CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision / Accuracy	Same as QC Acceptance Limits.
Surrogates	2 per sample	Recoveries must be within method-specific limits.	Re-prep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
GC/MS Confirmation	All positive results must be confirmed by GC/MS if the concentration is sufficient for that purpose	Examination of the GC/MS library search results may be used as one of three options for confirmation.	None. Discuss in the case narrative.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – PCB Congeners in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, Wipe Samples, and Field QC Samples**
Analytical Group	**PCB Congeners**
Analytical Method	HRSM01.2
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per 20 samples collected	WHO Toxic Congener analytes must be <1/2 CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision/ Accuracy	Same as QC Acceptance Limits.
LCS	One per 20 samples collected	%Rs in Table 5 of the Method	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable LCS.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
LCSD	One per 20 samples collected	%Rs in Table 5 of the Method RPD ±30%	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable LCSD.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.
Labeled Standards	One per target analyte	%Rs in Table 5 of the Method	If positive identification is not possible due to non-compliant m/z ratio, report the target analyte as an EMPC. Document in the SDG Narrative as necessary.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Internal Standards (IS)	2 per sample	%Rs in Table 5 of the Method	If positive identification is not possible due to non-compliant m/z ratio, report the target analyte as an EMPC. Document in the SDG Narrative as necessary.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – TCL PCB Aroclors in Solid/Aqueous

Matrix	**Solid, Aqueous, and Field QC Samples**
Analytical Group	**Aroclors**
Analytical Method	SOM02.4 Aroclors
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch of 20 or fewer samples	No target compounds >CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision / Accuracy	Same as QC Acceptance Limits.
Surrogates	2 per sample	Recoveries within method-specific limits.	Re-prep and reanalyze for confirmation of matrix interference when appropriate.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
GC/MS Confirmation	All positive results must be confirmed by GC/MS if the concentration is sufficient for that purpose	Examination of the GC/MS library search results may be used as one of three options for confirmation.	None. Discuss in the case narrative.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – Dioxin/Furans in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**Dioxin/Furans**
Analytical Method	HRSM01.2
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per 20 samples collected	Target analytes must be <1/2 CRQL. OCDD/OCDF must be <3X CRQL.	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable blank.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS/MSD, if required	One per 20 samples collected	Recoveries must be within method-specific limits.	Narrate in report. No action unless data needs qualification based upon professional judgment.	Analyst, Supervisor	Precision/ Accuracy	Same as QC Acceptance Limits.
LCS	One per 20 samples collected	%Rs in Table 5 of the Method	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable LCS.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
LCSD	One per 20 samples collected	%Rs in Table 5 of the Method RPD ±30%	Re-clean, retest, re-extract, reanalyze blank. Reanalyze all sample associated with unacceptable LCSD.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.
Labeled Standards	One per target analyte	%Rs in Table 5 of the Method	If positive identification is not possible due to non-compliant m/z ratio, report the target analyte as an EMPC. Document in the SDG Narrative as necessary.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Internal Standards (IS)	2 per sample	%Rs in Table 5 of the Method	If positive identification is not possible due to non-compliant m/z ratio, report the target analyte as an EMPC. Document in the SDG Narrative as necessary.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – ICP-MS Metals in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**Metals**
Analytical Method	ISM02.4 Metals
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One for each sample batch or SDG	No target compounds >CRQL.	If the blank concentration >CRQL, it must be < 10x the lowest concentration in the samples. If not, samples must be re-digested and analyzed with appropriate QC for that analyte. If the blank concentration <-CRQL then the samples must be re-digested and analyzed.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
ICB/CCB	After each calibration verification	The absolute value of each result must be ≤ the CRQL for aqueous samples.	If the blank concentration >CRQL, samples must be re-digested and analyzed with appropriate QC for that analyte.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
Interference Check Standard (ICS)	One per 20 samples	Must be within ±2x CRQL or ±20% of true value.	Correct problem, recalibrate instrument, re-digest and analyze samples since last good ICS.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
MS	One per batch or SDG	Should be within 75 – 125 %R.	Flag with “N” and perform post digestion spike.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Laboratory Duplicate	One per batch or SDG	Must be <20% RPD, use CRQL if one value below the CRQL.	Flag data with “*”.	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
Laboratory Control Sample (LCS)	One per batch or SDG	Must be within 70 – 130 %R.	Correct problem, re-digest and analyze samples with new QC.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Serial Dilution	One per batch or SDG	If analyte >50x MDL, then results must be ≤ 10% RPD.	Interference must be suspected, flag the result as “E”.	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**Metals**
Analytical Method	ISM02.4 Metals
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
ISs	3 per sample	Response must be within 60-125% of original response in calibration blank.	Check calculations, spike solution, and instrument performance. Dilute sample by 2 and add IS, reanalyze. Take CA to technical acceptance criteria. Narrate.	Analyst, Supervisor	Precision / Accuracy / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – Mercury in Solid/Aqueous

Matrix	**Soil, Sediment, Surface Water, Groundwater, and Field QC Samples**
Analytical Group	**Mercury**
Analytical Method	ISM02.4 Mercury
Field Sampling Organization	Tetra Tech
No. of Samples	See Worksheet #20

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One for each sample batch or SDG	No target compounds >CRQL.	If the blank concentration >CRQL, it must be < 10x the lowest concentration in the samples. If not, samples must be re-digested and analyzed with appropriate QC for that analyte. If the blank concentration <-CRQL then the samples must be re-digested and analyzed.	Analyst, Supervisor	Bias / Contamination	Same as QC Acceptance Limits.
MS	One per batch or SDG	Should be within 75 – 125 %R.	Flag data with "*".	Analyst, Supervisor	Accuracy / Bias	Same as QC Acceptance Limits.
Laboratory Duplicate	One per batch or SDG	Should be within 20% RPD if both values are > 5x CRQL; use CRQL if one or both values are below 5x CRQL.	Flag data with "*".	Analyst, Supervisor	Precision	Same as QC Acceptance Limits.
LCS	One per batch or SDG	Must be within 80 – 120 %R.	Correct problem, re-digest and analyze samples with new QC.	Analyst, Supervisor	Precision / Bias	Same as QC Acceptance Limits.

SAP Worksheet #28 – Analytical Quality Control and Corrective Action – TOC in Solid

Matrix	Solid
Analytical Group	TOC
Analytical Method/SOP Reference	SW-846 9060A
Field Sampling Organization	Tetra Tech
Analytical Organization	TBD
No. of Sample Locations	See Worksheet #20

Laboratory QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	Beginning of run, every ten samples and at the end of the run	TOC is not detected > 500 mg/kg or >1/10 sample concentration or >1/10 regulatory limit, whichever is greater. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Correct problem. If required, re-prep and reanalyze method blank and all QC samples and field samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative.	Analyst/Supervisor	Bias/ Contamination	Same as Acceptance Limits
CCV / LCS	At the beginning of an analysis sequence, after every ten samples and at the end of a run	±20% of expected value	If the recovery is high but the sample results are < CRQL request client approval to qualify and narrate. Otherwise, if sample volume available and < 2x holding time, re-prep and reanalyze. If reanalysis cannot be performed, data must be qualified and explained in the Case Narrative.	Analyst/Supervisor	Accuracy/Bias	Same as Acceptance Limits

Matrix	Solid
Analytical Group	TOC
Analytical Method/SOP Reference	SW-846 9060A
Field Sampling Organization	Tetra Tech
Analytical Organization	TBD
No. of Sample Locations	See Worksheet #20

Laboratory QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
MS/MSD or Matrix Duplicate	One every ten samples set. At least one per run	Accuracy: ±25% Precision: RPD ≤ 30	Examine the project-specific requirements. Contact the client as to additional measures to be taken. If sample volume is available and sample is < 2x holding time reanalyze MS/MSD. The data shall be evaluated to determine the source of difference. Qualify result from the parent sample if acceptance criteria are not met and explain in the Case Narrative.	Analyst/Supervisor	Accuracy/Bias (precision for MSD or Matrix Duplicate)	Same as Acceptance Limits

SAP Worksheet #29 - Project Documents and Records Table

Sample Collection Documents and Records	Documents and Records	Analysis Documents and Records	Data Assessment Documents and Records	Other
• SAP Project Personnel Sign-off Record • Field logbooks • Field forms • Chain-of-custody forms • Sample labels and shipping records • Field Change Requests	• Field logbooks • Field forms • Chain-of-custody forms • Field Change Requests • SAP • Field Sampling SOPs • HASP • Mobile lab Instrument calibration logs, preparation worksheets/logs, extraction/clean-up records, sample analysis worksheets/run logs • Mobile lab sample results/Form Is • Mobile lab QC sample results	• Laboratory sample receipt logs • Chain-of-custody forms • Standard traceability logs • Instrument calibration logs • Instrument maintenance logs • Sample preparation worksheets/logs • Sample analysis worksheets/run logs • Sample extraction/clean-up records • Chromatograms/raw data/instrument printouts • Sample results/Form Is • QC sample results • Telephone/email logs • Corrective action documentation • Sample storage and disposal; records • EDDs	• Laboratory data review checklists • Data validation and review reports (includes tabulated data summary forms) • Corrective action documentation • Design Reports	• Telephone/email logs/correspondence • Corrective action documentation • All versions of project reports

SAP Worksheet #31, 32, and 33 – Assessment and Corrective Action

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Nature of Documentation	Person(s) Responsible for Identifying and Implementing Corrective Actions (title and organizational affiliation)	Timeframe for Response
Field Supervision	Daily during sampling events	Internal	Tetra Tech	FOL	Entry in site log book	FOL and Samplers	24 hours
Project Supervision	Every sampling event	Internal	Tetra Tech	PM	Written memo	PM and FOL	Within a week of notification
Field Systems Audit	As required at the discretion of the QAM	Internal	Tetra Tech	Person assigned by QAM	Written memo	Auditor, FOL, PM, and QAM	Within 48 hours of notification
Laboratory System Audit(1)	Every two years	External	USEPA CLP	USEPA CLP	Letter	Laboratory TBD	Specified by USEPA CLP
Data Validation Report	Per sample delivery group	External	USEPA Validators	ESAT Validators	Written memo	ESAT Validators	Within 1 month of receipt of laboratory data
Major Analysis Problem Identification	When persistent analysis problems are detected	Internal	Laboratories and USEPA Region 3 Client Services Team	ESAT Validators	Written memo	PM, Project Chemist	Immediately
Field Progress Reports	Daily, oral, during sampling	Internal	Tetra Tech	FOL	Written memo	FOL and PM	Every day that field sampling is occurring

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Nature of Documentation	Person(s) Responsible for Identifying and Implementing Corrective Actions (title and organizational affiliation)	Timeframe for Response
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	External	Laboratory TBD	USEPA Region 3 Client Services Team	Written memo	Laboratory TBD	Immediately

[1] USEPA Region 3 Client Services Team assign the CLP laboratories which have already been accredited and approved by CLP.
[2] Audits are scheduled at the Tetra Tech program level and may or may not include this project.

SAP Worksheet #34 – Data Verification and Validation Inputs

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Chain-of-Custody Forms	The Tetra Tech FOL or designee will review and sign the chain-of-custody form to verify that all samples listed are included in the shipment to the laboratory and the sample information is accurate. The forms will be signed by the sampler and a copy will be retained for the project file, the Tetra Tech PM.	Internal	Sampler and FOL, Tetra Tech
	The Laboratory Sample Custodian will review the sample shipment for completeness, integrity, and sign accepting the shipment. The Data Validators will check that the chain-of-custody form was signed/dated by the Tetra Tech FOL or designee relinquishing the samples and by the Laboratory Sample Custodian receiving the samples for analyses.	External	1 - Laboratory Sample Custodian 2 - Data Validators, ESAT
SAP Sample Tables/ Chain-of-Custody Forms	Verify that all proposed samples listed in the SAP tables, including QC samples listed on Worksheet #20, have been collected.	Internal	FOL or designee, Tetra Tech
Sample Log Sheets	Verify that information recorded in the log sheets is accurate and complete.	Internal	FOL or designee, Tetra Tech
Sample coordinates	Verify that actual sample locations are correct and in accordance with the SAP proposed locations. Document any discrepancies in the final report.	Internal	Tetra Tech, FOL or designee
SAP/ Field Logs/ Analytical Data Packages	Ensure that all sampling SOPs were followed. Verify that deviations have been documented and Measurement Performance Criteria (MPCs) have been achieved. Attention should be given to verify that samples were correctly identified, that sampling location coordinates are accurate, and that documentation establishes an unbroken trail of documented chain-of-custody from sample collection to report generation. Verify that the correct sampling and analytical methods/SOPs were applied. Verify that the sampling plan was implemented and carried out as written and that any deviations are documented.	Internal	PM or designee, Tetra Tech
SAP/ Laboratory SOPs/ Raw Data/ Applicable Control Limits Tables	Ensure that all laboratory SOPs were followed. Verify that the correct analytical methods/SOPs were applied. Establish that all method QC samples were analyzed and in control as listed in the analytical SOPs. If method QA is not in control, the Laboratory QAM will contact the Tetra Tech PM via telephone or e-mail for guidance prior to report preparation.	Internal	Laboratory QAM
Analytical Data Packages	All analytical data packages will be verified internally for completeness by the laboratory performing the work. The Laboratory QAM will sign the case narrative for each data package.	Internal	Laboratory QAM

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
EDDs / Analytical Data Packages	Each EDD will be verified against the chain-of-custody and hard copy data package for accuracy and completeness. Laboratory analytical results will be verified and compared to the electronic analytical results for accuracy. Sample results will be evaluated for laboratory contamination and will be qualified for false positives using the laboratory method/preparation blank summaries. Positive results reported between the MDL and the CRQL will be qualified as estimated. Extraneous laboratory qualifiers will be removed from the validation qualifier.	External	Data Validators, ESAT
Analytical Data Packages	Each data package will be verified for completeness by the Data Validator. Missing information will be requested by the Data Validator from the Laboratory PM and included in the data validation report.	External	Data Validators, ESAT

SAP Worksheet #35 – Data Verification Procedures

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Chain-of-Custody Forms	Custody - Ensure that the custody and integrity of the samples was maintained from collection to analysis and the custody records are complete and any deviations are recorded. Review that the samples were shipped and stored at the required temperature and meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times listed in Worksheet #19.	Data Validators, ESAT
IIa/IIb	SAP/ Laboratory Data Packages/ EDDs	Accuracy - Ensure that the laboratory QC samples listed in Worksheet #28 were analyzed and that the MPCs listed in Worksheet #12 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed and that the analytical QC criteria set up for this project were met.	Data Validators, ESAT
		Precision - Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSD, if available. Ensure compliance with the methods and project MPCs accuracy goals listed in Worksheet #12.	
		Representativeness - Check that the laboratory recorded the temperature at sample receipt to ensure sample integrity from sample collection to analysis.	
		Completeness - Review the chain-of-custody forms generated in the field to ensure that the required analytical samples have been collected, appropriate sample identifications have been used, and correct analytical methods have been applied. The Data Validator will verify that elements of the data package required for validation are present, and if not, the laboratory will be contacted, and the missing information will be requested. Validation will be performed as per Worksheet #36. .	

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIb	SAP/ Laboratory Data Packages/ EDDs	Sensitivity - Ensure that the project CRQLs listed in Worksheet #15 were achieved.	Project Chemist, Tetra Tech
		PSLs – If analysis interferences are encountered or dilutions are incurred, discuss the impact on reported DLs on target compounds reported as non-detected. Document this usability issue and inform the Tetra Tech PM. Review and add PSLs to the laboratory EDDs. Flag samples and notify the Tetra Tech PM of sample results, including non-detect values that exceed PSPDILs listed in Worksheet #15.	
		QA/QC - Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within prescribed SAP acceptance limits. Ensure that QC samples and standards prescribed in analytical SOPs were analyzed and within the prescribed control limits. If any significant QC deviations occur, the Laboratory QAM shall have contacted the USEPA Region 3 Client Services Team and subsequently the Tetra Tech PM.	
		Deviations - Summarize deviations from methods, procedures, or contracts in the Data Validation Report. Determine the impact of any deviation from sampling or analytical methods and SOPs requirements and matrix interferences effect on the analytical results. Qualify data results based on method or QC deviation and explain all the data qualifications. Print a copy of the project database qualified data depicting data qualifiers and data qualifiers codes that summarize the reason for data qualifications. Determine if the data met the MPCs and determine the impact of any deviations on the technical usability of the data.	

SAP Worksheet #36 – Data Validation Procedures

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Soil Groundwater Surface Water Sediment Wipe Samples	VOCs SVOC/PAHs Pesticides PCB Congeners, PCB Aroclors, Dioxin/Furans	Stage 4 Level (S4VEM) or M3 validation will be performed on 100 percent of the definitive data using criteria listed in the USEPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Method Data Review USEPA-540/R-2017-002 (USEPA, 2017a).	Data Validator, ESAT
IIa and IIb	Soil Groundwater Surface Water Sediment	Metals Mercury Cyanide	Stage 4 Level (S4VEM) or IM2 validation will be performed on 100 percent of the definitive data using criteria listed in the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review USEPA-540/R-2017-001 (USEPA, 2017b).	Data Validator, ESAT

See Appendix H USEPA ERT mobile laboratory SOP 1709 Section 10.0 for data validation requirements for PCB field screening data.
Grain size will not undergo data validation.

SAP Worksheet #37 – Data Usability Assessment

The Data Usability Assessment will be performed by Tetra Tech for data associated with the RI investigation. Documentation generated during the usability assessment will consist of data validation checklists with a summary of overall data usability.

The Data Usability Assessment process involves reconciling the validation data and the project DQOs. The data quality indicators used to evaluate conformance with the project DQOs are presented below.

Data quality indicators are generally defined in terms of six parameters:

1. Representativeness
2. Comparability
3. Completeness
4. Precision
5. Accuracy
6. Sensitivity

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this SAP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions and depends on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. This SAP presents the rationale for sample quantities and location. This SAP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements is intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability among phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this SAP, established QA/QC procedures, and use of appropriately trained personnel.

One hundred percent of the samples will be analyzed for PCB congeners (NOAA plus WHO congener lists) with 20 percent of the samples for PCB Aroclor analysis. The total PCB Aroclor data will then be plotted against the congener data (i.e., TEQs, total PCBs estimated from NOAA congeners, and possible individual congeners) to determine whether a statistically significant correlation exists between the total PCB Aroclor concentrations and congener concentrations (including TEQs). Linear regression/residual analysis will be used to define the mathematical relationship between total PCB Aroclor concentrations and PCB congener concentrations (including TEQs) and determine whether there is a statistically significant correlation (coefficient of determination [r2] greater than 0.6). To do this, the samples selected for 20 percent analysis need to span the range of detections among the samples. If statistically significant correlations do not exist, then consideration would be given to analyzing some or all of the 80 percent of the samples on hold at the laboratory.

Additionally, the Tetra Tech PM or designee, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical property data generated by different methods and for samples collected using different procedures and under different property conditions. This will be accomplished by comparing overall precision and bias among data sets for each

matrix and analytical fraction. This will not require quantitative comparisons unless the Project Chemist indicates that such quantitative analysis is required.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the project objectives. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the SAP. Checks for analytical precision will include the analysis of matrix spikes/matrix spike duplicates, laboratory duplicates, and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:
A = Analytical result from one of two duplicate measurements
B = Analytical result from the second measurement

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, matrix spikes, blank spikes, and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\%\ \text{Recovery} = \frac{A-X}{B} \times 100$$

Where:
A = Value measured in spiked sample or standard
X = Value measured in original sample
B = True value of amount added to sample or true value of standard

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated method detection limits can satisfy the project

requirements as they relate to the project action limits. Method detection limits are updated annually by the laboratory. The current method detection limits for the analytical laboratories are presented in Worksheet #15.

RECONCILIATION WITH DATA USABILITY REQUIREMENTS

The data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating to incomplete information, questionable results, or inconsistent data may include any or all of the following:

- Retrieval of missing information
- Request for additional explanation or clarification
- Reanalysis of sample from extract (when appropriate)
- Recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty, and eliminate the need to qualify or reject data.

If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- Extrapolation of missing data from existing data points
- Use of historical data
- Evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken: additional sample collection and analysis.

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FIGURES

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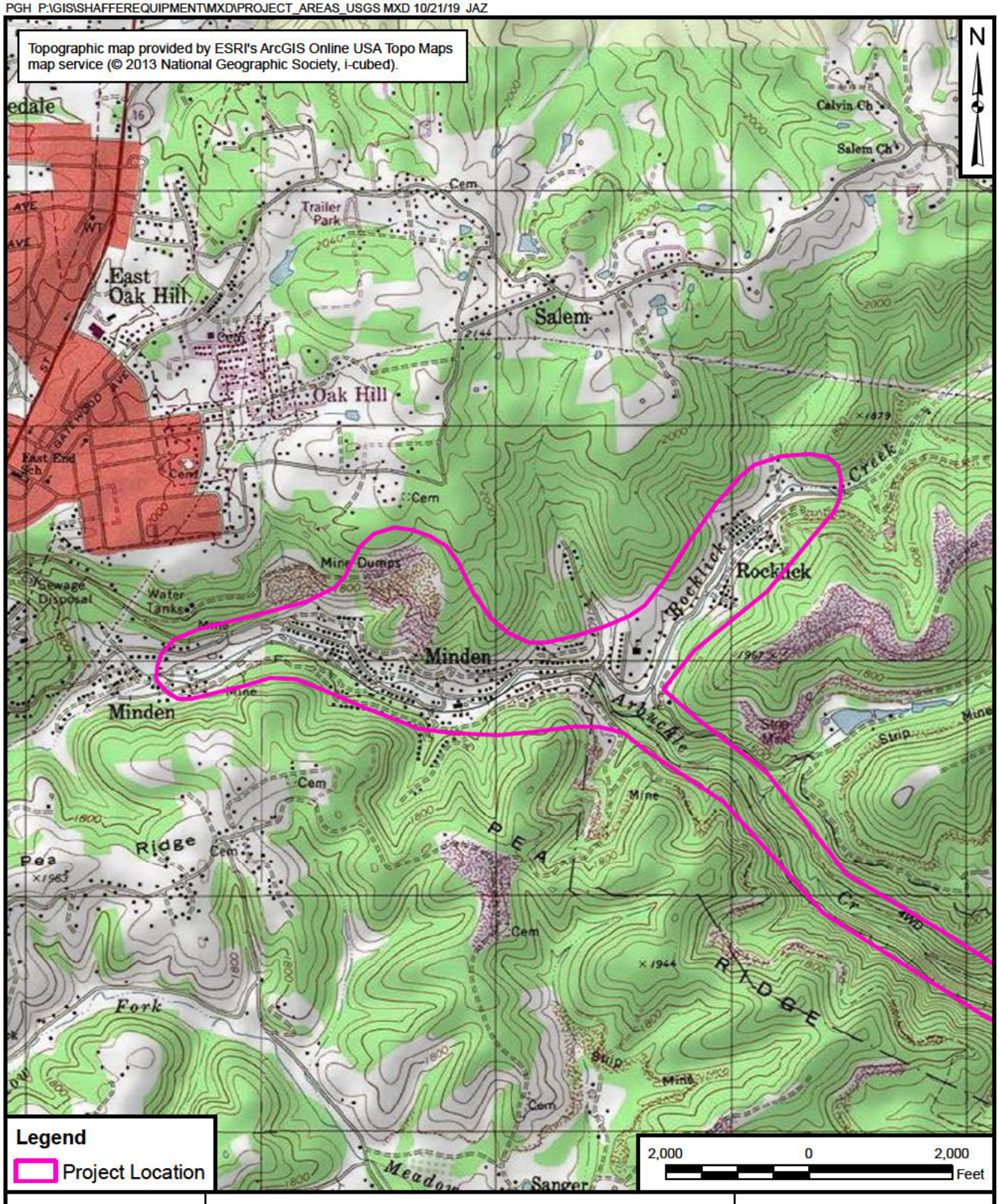

TETRA TECH

PROJECT LOCATION MAP

SHAFFER EQUIPMENT/ARBUCKLE CREEK PROJECT
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER	REV
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N

Berwind Green Hill Mine Dump Area (Needles Eye)

Britt Bath House Area

Possible Transformer Storage Area

Shaffer Equipment Company Property

NR&P Supply House

Rocklick Road

Rocklick Creek

Arbuckle Creek

Johnson St
Coleman's Cir
S Loop Dr
Butler St
Young St
Huff St
Blevins Cir
Delta Road 133
CR-14/2
Delta Road 136
CR-14/3
Delta Road 21
Beaver Rd
CR-17/1
CR-17/3
Tyree Land Ltd
CR-17/7
CR-17/10
Delta Road 17
CR-14/8
Minden Rd
Duncan Rd
CR-11/2
Old Minden Rd
Hamilton Rd
Delta Road 23
CR-17
Delta Road 22
Delta Road 20
Delta Road 14
Delta Road 16
Crouse Rd
CR-18/16
CR-18/12
Evans Rd
Pea Ridge Rd

700 0 700 Feet

Legend

- Stream
- Unnamed Tributary
- Wetland Boundary
- Project Areas

TETRA TECH

PROJECT AREAS

SHAFFER EQUIPMENT/
ARBUCKLE CREEK PROJECT
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 2

REVISION 1

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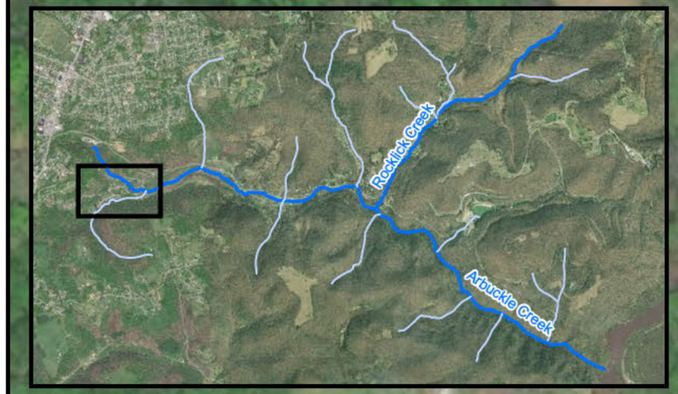

N

Minden Rd
CR-17/2
Delta Road 28
Old Minden Rd
Arbuckle Creek
Hamilton Rd
Dickerson Rd
100

SB303
SB306
SB301
SB300
SB304
SB305
SB307
SB308
SB309
SB302

SD-71
SD25
SW25
SS11
SS12
SW24
SD24
SEC-SS-R5-01
SW20
SS-208
SD21
SW21
SS-207
SD-72
SW23
SW22
SD23
SD22
SS-210
SS-211
SS-209
SD-82
SD-81

MW-107S/D
SS-152
SS-156
SS-155
SS-150
SS-153
SS-154
SS-256
SS-151
SS-221

150 0 150
Feet

Legend

- Proposed Monitoring Well
- Proposed Soil Boring Location
- Historical Surface Soil Location
- Historical Sediment Location
- Historical Surface Water Loca ion
- Stream
- Unnamed Tributary

TETRA TECH

PROPOSED BACKGROUND SOIL BORING AND MONITORING WELL LOCATIONS
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/29/19
APPROVED BY: [redacted] 10/29/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER
3

REVISION
1

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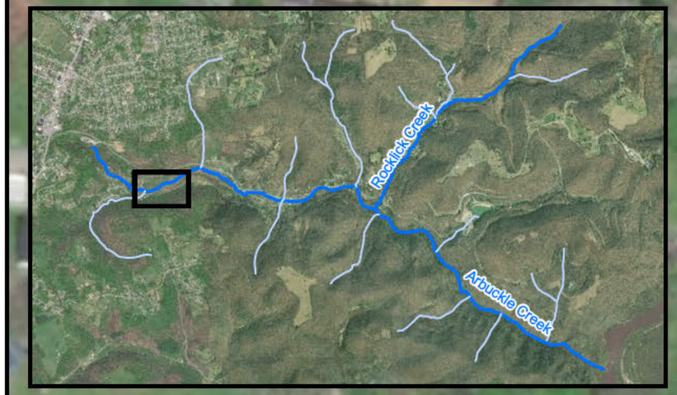

N

CR-17/2
SW19
SD-76
SD19
SS-248/249
GW-01/02
SD-95
SD-75
SD-82
SD-81
SB366
SD-74
MW-103D
SD-73
SB328
GW004
MW-104S
SS33
Arbuckle Creek
SEC-SS-SE-02
SB327
SS-205
GW003
GW002
SB326
SEC-SS-R5-01
SW20
SB325
GW005
GW006
GW007
SB369
GW001
SS-206
SS-208
SD-98
MW-101D
MW-102S
SB324
SD21
SW21
MW-100S/D
SB323
SB316
SB317
SS-207
SB320
SD-72
SW22
SB322
Hamilton Rd
SD22
SW23
SD23
SS-210
SS-152
MW-105S/D
SB321
SS-211
SB310
SB312
SB314
SB318
MW-106S/D
SEC-SS-SE-01
SB319
Old Minden Rd
SS-150
SB315
SS-209
22L-9999
0002-0000
SS-153
SS-154
SS-256
SB313
SS-155
SB311
Hamilton Rd
Hamilton Rd
Old Minden Rd

100 0 100 Feet

Legend

- Proposed Monitoring Well
- Proposed Soil Boring Location
- Historical Monitoring Well Location
- Historical Surface Soil Location
- Historical Sediment Location
- Historical Surface Water Loca ion
- Stream
- Unnamed Tributary
- Area of Future Soil Removal Action
- Area of Past Soil Removal Action
- Approximate Area of Cap
- Onsite Area
- 75' x 75' Sampling Grid

TETRA TECH

PROPOSED SHAFFER EQUIPMENT COMPANY
PROPERTY SOIL BORING AND MONITORING
WELL LOCATIONS
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/28/19
APPROVED BY: [redacted] 10/28/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER
4

REVISION
1

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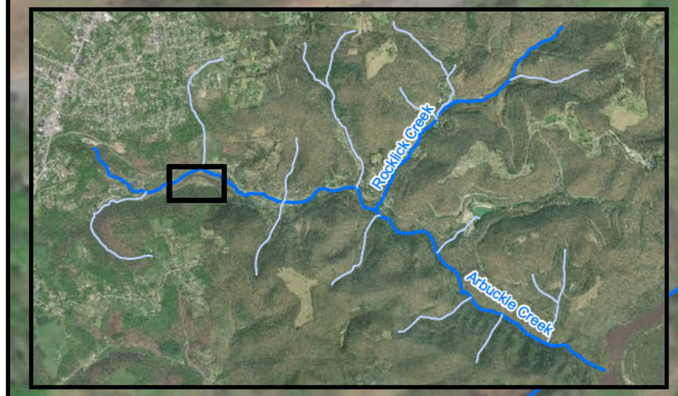

N

Arbuckle Creek
Rockdick Creek
Minden Rd
Minden Rd
Road 13

SW01
SD01
SW19
SD19
SW02
SD02

SD-78
SD-77
SD-76
SD-87
SD-105
SD-75
SD-74
SD-73
SD-95
SD-98
SD-70
SD-106
SD-69

SS-254
SS-222
SS-216
SS17
SS16
SS15
SS14
SS20
SS13
SS-123
SS-119
SS21
SS35
SS-202
SS34
SS40
SS33
SS36
SS37
SS08
SS31
SS32

SB368
SB336
SB367
SB333
SB334
SB05
SB332
SB331
SB07
SB330
SB329
SB335
SB08
SB03
SB02

SEC-SS-BH-01
SEC-SS-SE-02

GW-01/02
SS-248/249
GW004
GW002
GW006
GW005
GW007

100 0 100 Feet

Legend

- Proposed Soil Boring Location
- Historical Surface Soil / Soil Boring Location
- Historical Monitoring Well Location
- Historical Surface Soil Location
- Historical Soil Boring Location
- Historical Sediment Location
- Historical Surface Water Loca ion
- Stream
- Unnamed Tributary
- Possible Transformer Area
- 150' x 150' Sampling Grid
- Pit Area

TETRA TECH

PROPOSED SOIL BORING LOCATIONS NEAR
POSSIBLE TRANSFORMER STORAGE AREA
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/29/19
APPROVED BY: [redacted] 10/29/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER
5

REVISION
1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\BRITT_BATH_LOCS.MXD 10/21/19 JAZ

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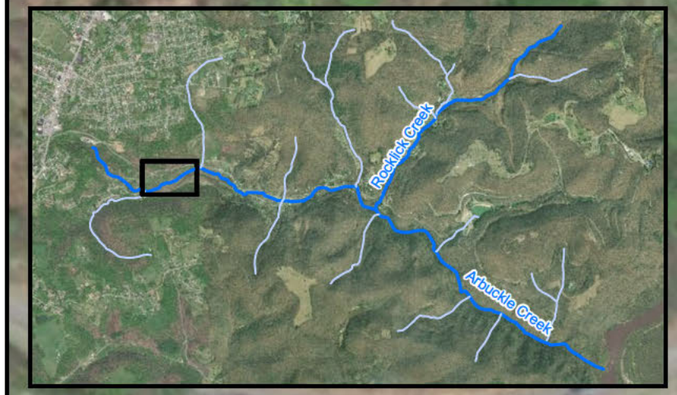

N

Minden Rd

Minden Rd

Minden Rd

Arbuckle Creek

CR-17/2

Delta Road 28

Hamilton Rd

SD-78
SD-77
SD-87
SD-105
SD-76
SW19
SD19
SB337
SB339
SB344
SS-248/249
GW-01/02
SD-95
SW/SD340
SD-75
SS35
SS-202
SB05
SS34
SS40
SD-82
SD-81
SB341
SB340
SB338
SB342
SD-74
SD-73
SW/SD341
SEC-SS-SE-02
GW004
SS33
SB343
SS-205
GW003
GW002
GW007
GW006
GW005
SW20
SS-206
GW001
SD-98
SS-208
SW21
SD21
SS-207
SS-210
SEC-SS-SE-01

100 0 100 Feet

Legend

- Proposed Soil Boring Location
- Proposed Surface Water/Sediment Sample Location
- Historical Well Monitoring Location
- Historical Surface Soil Location
- Historical Sediment Location
- Historical Surface Water Loca ion
- Stream
- Unnamed Tributary
- Britt Bath House Area
- Wetland Boundary
- 150' x 150' Sampling Grid

TETRA TECH

PROPOSED SOIL BORING, SURFACE WATER, AND SEDIMENT LOCATIONS AT BRITT BATH HOUSE AREA
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER
6

REVISION
1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\BERW ND_DUMP_AREA_LOCS MXD 10/21/19 JAZ

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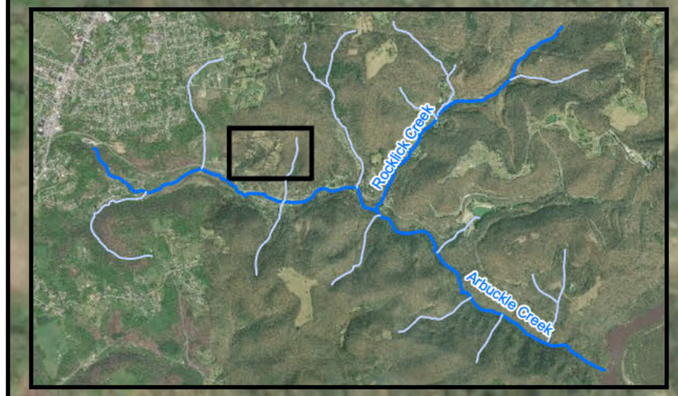

N

SS-229
SS-230
SB350
SS-227
SS-228
SB347
SB346
SB349
SS-233
SS-234
SS-225
SS-226
SS-231
SS-232
SB348
SB345
SS-235
SS-236
SB351
SB352
SS-212
SS-240
SS-241
SS-239
SS-237
SS-238
SD-92
SS-124
SS-246
Road 23

150 0 150 Feet

TETRA TECH

PROPOSED SOIL BORING LOCATIONS AT BERWIND
GREEN HILL MINE DUMP AREA (NEEDLES EYE)
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 7

REVISION 1

Legend

- Proposed Soil Boring Location
- Historical Surface Soil Location
- Sediment Location
- Unnamed Tributary
- Mine Dump Area
- 150' x 150' Sampling Grid

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\ROCKLICK_ROAD_LOCS MXD 10/21/19 JAZ

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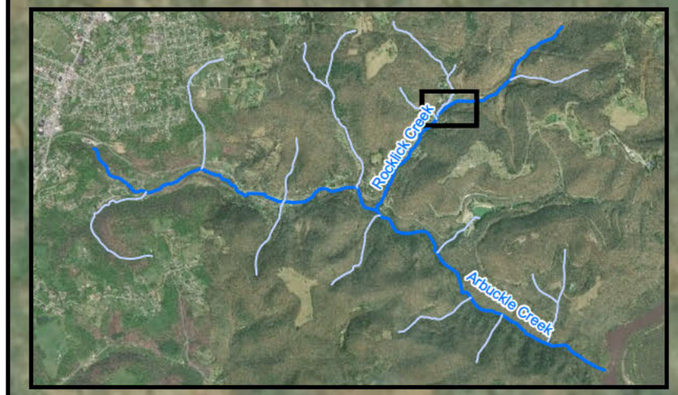

N

SB360
SB361
SW/SD347
CR-17/1
SB359
SW/SD346
SB358
CR-17/3
Rocklick Creek
FLOW
SB357
Marshy Area
SW/SD344
SW/SD345
SB362
CR-17/1
Beaver Rd
Potential Area of Dredged Sediment
Rocklick Road
SB356
SB355
SB354
SB353
SW/SD343
Tyree Land Rd
Tyree Land Rd
SW/SD342
CR-17/7

Legend

- Proposed Soil Boring Location
- Proposed Surface Water/Sediment Sample Location
- Stream
- Unnamed Tributary
- Surface Water Flow
- Rocklick Rd (unpaved)
- Potential Area of Dredged Sediment
- Marshy Area

100 0 100 Feet

TETRA TECH

PROPOSED SOIL BORING, SURFACE WATER, AND SEDIMENT LOCATIONS ALONG ROCKLICK ROAD
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/12/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 8

REVISION 1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\NRP_SUPPLY_HOUSE_LOCS MXD 10/21/19 JAZ

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N

SD-102
SB365
SB364
SB363
SD-101

30 0 30 Feet

Legend

- Proposed Soil Boring Location
- Sediment Location
- Approximate Area of NR&P Supply House
- Approximate Area of Building Foundation

TETRA TECH

PROPOSED SOIL BORINGS AT NR&P
SUPPLY HOUSE
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 09/30/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 9

REVISION 1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\SWSD_PCB_RESULTS_WEST_2019.MXD 10/21/19 JAZ

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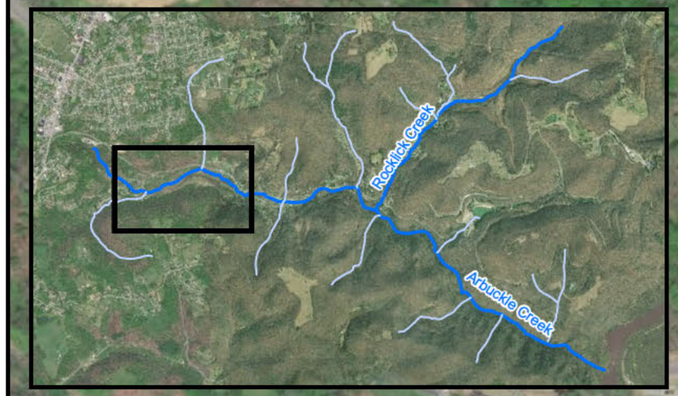

N

SW/SD300
SD-71
CR-17/2
SD25
SW25
SW/SD301
SD24
SW24
Old Minden Rd
SW/SD302
SD-72
SW23
SW22
SD23
SD22
SW21
SD21
SD20
SW20
SW/SD303
SD-82
SD-81
SW/SD304
SD-74
SD-73
SD-75
SD-95
Britt Bath House Area
Shaffer Equipment Company Property
Hamilton Rd
Possible Transformer Storage Area
SD-98
SW19
SD-76
SD19
SD-77
SD-78
Minden Rd
SW01
SD01
SW/SD305
SW/SD306
SD-87
SD-105
SD-96
SD-97
Duncan Rd
SD02
SW02
SW/SD318
SW/SD307
SW/SD308
SEC-SD-T8-02
SEC-SD-T8-01
SEC-SD-T8-03
SW/SD327
SD-70
SD-106
SW03
SD03
SEC-SD-TL-03
SW/SD319
SW/SD320
SW/SD312
SW/SD309
SD-69
SW/SD311
SW/SD313
SW/SD321
SW/SD310
SEC-SD-T7-02
SEC-SD-T7-03
SEC-SD-T7-01
SEC-SD-CL-01
SD04
SD-68
SD-67
SW04
SD-93
SW/SD325
SW/SD326
SD-92
SW/SD334
SW/SD333
Dolla Road 28

250 0 250 Feet

Legend

- Proposed Surface Water/Sediment Location
- Historical Surface Water Location

Historical Sediment Sample Concentration of PCBs (ug/kg)

- ≤60
- >60 - 100
- >100 - 1,000
- >1,000 - 10,000
- ≥10,000
- Stream
- Unnamed Tributary
- Wetland Boundary
- Project Areas

TETRA TECH

PROPOSED SURFACE WATER AND SEDIMENT LOCATIONS ALONG SEGMENT 1 OF ARBUCKLE CREEK
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/22/19
CHECKED BY [redacted] 10/21/19
APPROVED BY [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 10

REVISION 1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\SWSD_PCB_RESULTS_CENTRAL_2019.MXD 10/21/19 JAZ

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Berwin Green Hill Mine Dump Area (Needles Eye)

Rocklick Creek

Arbuckle Creek

N

SD-84 SD-83

SD-85 SD-99

Delta Road 22

Delta Road 23

Delta Road 29

Duncan Rd

Minden Rd

SEC-SD-CL-01 SW/SD325 SD-91 SD-90

SEC-SD-T6-02 SW/SD317 SEC-SD-T5-02 SEC-SD-T5-03 SEC-SD-T5-01

SW05 SD05 SW/SD314 SW/SD324 SEC-SD-T4-03 SEC-SD-T4-02 SD06 SW06 SW/SD322 SEC-SD-T3-02 SEC-SD-T3-01 SEC-SD-T3-03

SW/SD326 SEC-SD-T6-03 SEC-SD-T6-01 SW/SD316 SEC-SD-T4-01 SEC-SD-TL-06 SW/SD315 SW/SD323 SEC-SD-T2-03 SD07 SW07

SEC-SD-T2-01 SEC-SD-T2-02

SEC-SD-T1-02 SEC-SD-T1-03 SEC-SD-T1-01

SW10 SD11 SW09 SD09 SW18 SW08 SD08 SD18

SW12 SD10 SW11 SD12 SW13 SW/SD328

SW/SD331 SD-86 SD13 SW/SD332 SD-100

SW14 SD14 SD15 SW15 SW16 SD16 SW/SD329 SD17 SW17

SD-55 SD-53 SD-54 SD-52 SD-51 SD-50 SD-65 SD-63/66 SD-64 SD-56 SD-57 SD-58

SD-88

SW/SD330 SD-59 SD-60 SD-61 SD-62

NR&P Supply House SD-102 SD-101

Crouse Rd

250 0 250 Feet

Legend

- Proposed Surface Water/Sediment Location
- Historical Surface Water Location

Historical Sediment Sample Concentration of PCBs (ug/kg)

- ≤60
- >60 - 100
- >100 - 1,000
- >1,000 - 10,000
- ≥10,000
- Stream
- Unnamed Tributary
- Wetland Boundary
- Project Area

TETRA TECH

PROPOSED SURFACE WATER AND SEDIMENT LOCATIONS ALONG SEGMENT 2 OF ARBUCKLE CREEK SHAFFER EQUIPMENT/ ARBUCKLE CREEK AREA SITE MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/22/19
CHECKED BY [redacted] 10/21/19
APPROVED BY [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 11

REVISION 1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\SWSD_LOCS_EAST_AUG2019.MXD 10/21/19 JAZ

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SW/SD335
SW/SD336
SW/SD337
SW/SD338
SW/SD339

Minden Rd
Rocklick Creek
CR-17/5
Arbuckle Creek
New River

N

600 0 600 Feet

Legend

- Proposed Surface Water/Sediment Location
- Stream
- Unnamed Tributary
- Wetland Boundary

TETRA TECH

PROPOSED SURFACE WATER AND SEDIMENT LOCATIONS ALONG SEGMENT 3 OF ARBUCKLE CREEK
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 08/22/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER 12

REVISION 1

PGH P:\GIS\SHAFFEREQUIPMENT\MXD\NEW_RIVER_LOCS.MXD 10/21/19 JAZ

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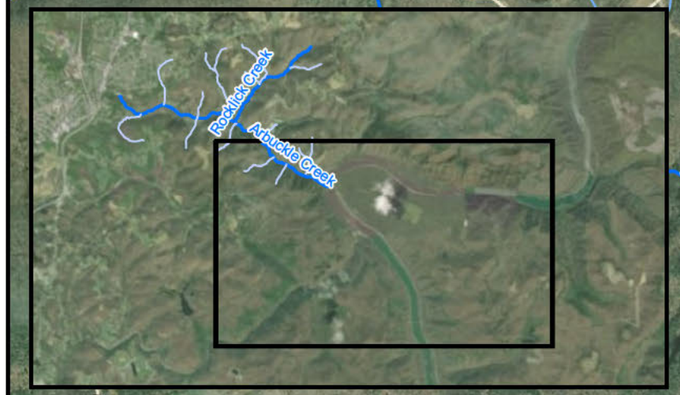

N

SD353
SD352
SD351
SD350
SD354
SD349
SD348

Arbuckle Creek
W End Rush Run
Thurmond St
Main St
Beury Mountain Rd
Beury Mountain Rd
Beury Mountain Rd
Beury Mountain Rd
Beury Mountain Rd
River Crest Rd
New River
Thurmond Riverfront Rd
Thurmond Rd
Elderberry Ln
Homestead Ln

1,500 0 1,500 Feet

Legend

- Proposed Sediment Sample Loca ion
- Stream
- Unnamed Tributary

TETRA TECH

PROPOSED SEDIMENT LOCATIONS
ALONG NEW RIVER
SHAFFER EQUIPMENT/
ARBUCKLE CREEK AREA SITE
MINDEN, FAYETTE COUNTY, WEST VIRGINIA

DRAWN BY: [redacted] 10/01/19
CHECKED BY: [redacted] 10/21/19
APPROVED BY: [redacted] 10/21/19

CONTRACT NUMBER: 112G08863

FIGURE NUMBER
13

REVISION
1

APPENDIX A

SCOPING SESSIONS MINUTES

SHAFFER EQUIPMENT/ARBUCKLE CREEK
PROPOSED SAMPLING – PHASES I AND II

As discussed during the April 17, 2019 scoping meeting, sampling at the site will be conducted in a phased approach. Per the scoping meeting minutes, the investigation phases will include:

- Phase I – On-site soil and groundwater sampling (potentially late summer/early fall 2019).
- Phase II – Residential soil sampling and sediment sampling (potentially fall 2019).
- Phase III – Pore water, mine pool discharge, and biological sampling along with any other data that will be needed to be collected to complete RI report.

For the purposes of this submittal, sampling at the Britt Bath House and the possible transformer storage area east of the existing cap area is included as part of Phase I because of the proximity to the on-site source area. Background soil sampling is also included in Phase I. Sampling at off-site areas including the Rocklick Road and Berwind Green Hill Area (aka Needles Eye) have been included as part of Phase II because the list of parameters to be analyzed will be based on the results of the Phase I sampling at the source areas.

It has been assumed that:

- No soil sampling underneath the capped area is required.
- No additional sampling will be conducted at the N R & P Supply House (aka Power House) because the property owner is not amenable to sampling on their property and PCBs have not been detected in samples collected during previous sampling events.
- No sampling inside the residences (e.g., wipe samples) is planned at this time.

PHASE I

All samples will be analyzed for a full suite of parameters – TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, Dioxins/Furans, and TAL metals (total and dissolved for aqueous samples)

<u>Capped Area (1 acre)</u>

- Install 3 additional wells at deeper intervals immediately outside of the capped area near existing wells to create well clusters since existing wells (4) within capped area are screened at shallow depths only; collect groundwater samples
- Will not be able to install a deeper well at one of the existing well locations near Arbuckle Creek because of accessibility issues

<u>Uncapped Areas Adjacent to Capped Area (5 acres)</u>

- Install 10 borings to a depth of 10 ft bgs and collect samples (3) from 0-2’ bgs, 2-4’ bgs, and one deeper interval based on field observations
- Install 2 well clusters and collect groundwater samples
- Install one upgradient well cluster and collect groundwater samples

<u>Britt Bath House</u>

- Install 3 borings to a depth of 10 ft bgs and collect samples (3) from 0-2’ bgs, 2-4’ bgs, and one deeper interval based on field observations
- Collect water sample from seep/mine discharge
- Collect water sample from crevice area
- Consider additional well installation(s) during subsequent phases if contaminants are found at concentrations of concern during Phase I

<u>Possible Transformer Storage Area (east of capped area)</u>

- Install 5 borings to a depth of 10 ft bgs and collect samples (3) from 0-2' bgs, 2-4' bgs, and one deeper interval based on field observations
- Install one upgradient well cluster and collect groundwater samples
- Consider additional well installation(s) during subsequent phases if contaminants are found at concentrations of concern during Phase I

Background Soil

- Install 10 borings and collect samples from 0-2' bgs and 2-4' bgs.

PHASE II

For the purposes of the Work Plan and Cost Estimate, it is assumed that all samples will be analyzed for a full suite of parameters – TCL VOCs, TCL SVOCs, TCL Pesticides, PCB Congeners, Dioxins/Furans, and TAL metals (total and dissolved for aqueous samples). However, the results of the Phase I sampling may be used to reduce the analyte list.

Residences (15 occupied residences within floodplain and 10 additional requests)

- Collect composite soil samples from 4-8 borings at each residence; the number of borings will be dependent on the size of the property (i.e., 4 borings for a half-acre or smaller parcel)
    - Composite samples from 0-1' bgs, 1-2' bgs, and 2-4' bgs
    - Exposure to soil greater than 4' bgs (anticipated depth for utility worker exposure) is not expected to occur; therefore, sampling at deeper depths will not be conducted
- Collect a discrete/grab sample from 0-3" bgs if there is a sensitive receptor exposure zone, such as a play area for a child resident

Wetlands and Creek

- Collect surface water and sediment samples from 40 locations in the wetlands and creek, including at the confluence of Arbuckle Creek and the New River

Rocklick Road

- Collect surface water and sediment samples from 6 locations in the drainage feature along Rocklick Road

Berwind Green Hill (aka Needles Eye)

- Install 8 borings to a depth of 10 ft bgs and collect samples (3) from 0-2' bgs, 2-4' bgs, and one deeper interval based on field observations

Final Meeting Minutes – 4/17/2019 Scoping Session

Remedial Investigation / Feasibility Study – Shaffer Equipment / Arbuckle Creek Area Site

1. ATTENDEES

- USEPA Region III – Stepan Nevshehirlian, Justin Bleiler, Melissa Linden, Andrea Bain, Kathy Davies, Bruce Pluta, Cathleen Kennedy, Evelyn Sorto
- WVDEP – Bill Huggins, Ross Brittain, Jake McDougal
- ATSDR – Christine Lloyd, Anthony Trubiano, Jill Dyken
- Tetra Tech – [redacted], [redacted], [redacted]
- Weston – [redacted]

2. SITE BACKGROUND

- Site is located in Minden, WV. Minden is a small former mining town. City of Oak Hill has taken over Minden.
- Entire area has been underground mined.
- Shaffer Equipment operated from 1970 to 1984/1985. Material was then stored at the site into the 1990s that they were unable to sell or dispose of. Shaffer Equipment built electrical sub-stations for mining industry.
- Transformers stored at Shaffer Equipment leaked PCB oil onto the ground surface on-site and historical site reports indicated that off-site disposal could have occurred.
- Surrounding area is mainly residential and used for recreational purposes. Trespassers are current on-site receptors (evidence of ATV use).
- Main contaminants of concern are PCBs, Primarily Aroclor-1260.
- Potential for ecological risk was the driver for NPL Listing. PCB-contaminated soil/sediment has been found ½ mile downstream of site in Arbuckle Creek.
- Site is under heavy scrutiny from community. In general, local community is concerned that the site is causing adverse health effects (e.g., cancer) among local residents.
- A Community Relations Plan is currently being developed.
- Site gets a lot of media and political interest.

3. PRIOR INVESTIGATIONS / ACTIONS

Justin Bleiler (Site Assessment Program) and Melissa Linden (Removal Action Program) gave an overview of previous activities. Below is a summary:

- 1984 – 1987: Removal Action – Excavation and off-Site disposal of PCB-contaminated material.
- 1986: Preliminary Assessment – Site Assessment designates the Site a "Higher Priority for Further Assessment."
- 1991: Site Inspection – Site Assessment designates the Site a "Higher Priority for Further Assessment."
- 1990 – 1991: Removal Action – Excavation and off-Site disposal of PCB-contaminated material.
- 1997: Vandalism results in fire on-Site. Removal conducts emergency response action in coordination with local fire department. This fire also causes the need for a subsequent Removal Action (2001-2003).

- 2001 – 2003: Removal Action – One-acre cap constructed on-Site to contain PCB-contaminated soils and building debris. Other engineering controls also installed to prevent off-Site migration of PCBs.
- 2004: Site Reassessment – Site Assessment assigns a "Referred to Removal – Needs Further Remedial Assessment" status.
- December 2016: Residents contact EPA and the WVDEP to express their continued concern about the potential migration of contaminants from the Site.
- February 2017: EPA, WVDEP, ATSDR, WVBPH had a conference call to listen to residents' concerns and gather information.
- March 2017: EPA and WVDEP meet with residents to discuss their concerns and gather information.
- June 2017: Removal Assessment (Part 1) – Surface water, sediment, soil, and groundwater samples collected.
- December 2017: Removal Assessment (Part 2) – Sediment and soil samples collected.
- March 2018: Expanded Site Inspection (Part 1) – Sediment and soil samples collected.
- May 2018: Expanded Site Inspection (Part 2) – Sediment samples collected.
- June 2018: Expanded Site Inspection (Part 3) – Sediment, soil, and groundwater samples collected.
- September 13, 2018: Proposal to add the Site to the NPL

Christine Lloyd (ATSDR) gave an overview of past and planned ATSDR activities for the site. Below is a summary:

- CDC declared the site an imminent threat to public health in 1984, and ATSDR began a fairly extensive historical involvement at this site in 1989 at the request of the state health department.
- In 1993, ATSDR published a Public Health Assessment (PHA), reviewing of environmental sampling and health outcome data for this community; an addendum to this document was published in 1994.
    - A public health hazard existed for onsite workers and for adults and children exposed to contaminants as they trespass on the site. ATSDR found no significant human exposures in off-site soils, sediments, or through air.
    - PCBs could build up in snapping turtles and fish in the nearby Arbuckle Creek, and could pose a public health concern for pregnant women eating them.
    - The biomonitoring information for Minden residents did not show an increased exposure to PCBs compared to other people from MA, OH, WV, MI, and LA. ATSDR studied the results of PCB analysis of fat tissue in 20 residents and former employees. We also reviewed the results of blood samples from Minden residents from 1986-1987 and 1990. The biomonitoring results for Minden residents were similar to results for the general population.
    - Cancer rates in Fayette County, WV were similar to U.S. cancer rates. ATSDR reviewed available information on health statistics for the area. This included reports by the state of West Virginia that evaluated cancer mortality data for the local Oak Hill area from 1979-1981 and a report by the National Cancer Institute (NCI) that evaluated U.S. cancer mortality rates and trends from 1950-1979 including information for Fayette County, WV.
- In 2017, due to resurgent community concerns, EPA R3 requested ATSDR's health education support.

- In early 2017, at EPA and the state's request, ATSDR began providing technical support to EPA and to the West Virginia Bureau of Public Health (WVBPH) to help address current health questions from the community.
- After the Site was proposed to the NPL in September 2018, ATSDR began discussions about producing an updated public health exposure evaluation for the site. ATSDR plans to review any additional environmental and health data available since the 1994 report and will develop a new updated report for public comment in coordination with the state and local health departments. ATSDR does not have current plans to conduct a formal health study on disease rates in this community. However, ATSDR will continue discussions with our partners about future activities in this community.

4. FIELD/DATA ACQUISITION

The project team brainstormed and discussed objectives for the site, possible sampling activities that could address the objectives, and the use of the historical data.

- All available site data will be used qualitatively in the RI. However, historic site data from 1980s/1990s will not be used to quantitatively assess site risks during the RI; recent site data from SI (2017/2018) will be used in the risk assessments.
    - Potential on-site receptors include trespassers, utility workers, and ecological receptors.
    - Potential off-site receptors include residents, recreational users, utility workers, and ecological receptors.
- Capped Area
    - Removal Program plans to complete cap repairs. EPA would like to know early on in the process if removal of all waste/contaminated soil at the site, including those underneath the cap, would be a likely remedy. The project team did not think that this would be a likely remedy. In fact, extension of the cap may be a likely remedial action. Essentially, the cap is in relatively good shape, even though no maintenance has been conducted for 18 years. Cost comparisons of various remedial alternatives (removal, long-term maintenance of cap, etc.) will be evaluated as part of the FS.
    - Impacted PCB soil and building debris is underneath the cap.
    - Team consensus was not to collect any data (soil and groundwater) from under the cap area, but to collect groundwater samples around the cap to get a better understanding of the groundwater underlying the site and whether it is contaminated with PCBs and discharging to Arbuckle Creek. It was also determined that additional soil samples around the cap and from uncapped areas were needed to fully characterize the on-site areas.
- On-Site Soil Sampling
    - Sampling will be done across the entire site, excluding the capped area, to determine current baseline conditions.
    - Borings will be installed to 10' below ground surface (bgs). Bedrock is expected to be around 10' bgs. But as discussed above samples will be analyzed from the 0-4' bgs interval, unless signs of impact are seen deeper.
    - On-site soil analysis will include a full suite of parameters, including: VOCs, SVOCs, Metals, PCBs, dioxins/furans, and pesticides/herbicides. The potential need for PCB congener analysis was raised because of the weathering of Aroclor mixtures.

  - Trespassers at the site are assumed to be exposed to surface soil, 0-2' bgs. Utility workers are assumed to be exposed to soil to a depth of 4' bgs.
  - Tetra Tech will consider the use of PCB test kits (e.g., Dexsil Clor-N-Soil) (https://www.dexsil.com/products/clor-n-soil) when developing the Work Plan and cost estimate.
- On-Site Groundwater
  - 4 shallow wells (approx. 10' bgs) exist at the site. The wells were installed in 2001.
  - During the RI both deep (bedrock wells) and additional shallow wells will be installed. At a minimum 4 deep wells will be installed around the capped area. The need for additional wells will be discussed during the site visit.
  - On-site groundwater analysis will include a full suite of parameters, including: VOCs, SVOCs, Metals, PCBs, dioxins/furans, and pesticides/herbicides.
  - The need to collect groundwater samples during high- and low-flow conditions will be considered.
- Residential Properties
  - Team consensus was to identify potentially impacted properties and treat each property as its own exposure unit.
  - ATSDR asked that the Team consider the possibility of including interior dust sampling for a certain percentage of the homes with concentrations of PCBs in soil above screening criteria and the possibility of conducting separate soil sampling at children's play areas. For the ATSDR public health assessment, ATSDR is most concerned with soil from 0-3" bgs. The Team agreed to collect residential soil samples, assess those results, and then make decisions on whether additional (interior or other) samples is warranted.
  - Tetra Tech will consider the use of incremental or composite sampling at each property parcel when developing the Work Plan and cost estimate. An understanding of excavation and soil movement activities will need to be obtained for each property to determine the depth of sampling to be conducted. In general, soil sampling to a maximum depth of 4' bgs will be conducted to address potential risks for a utility worker involved in excavation activities. Residential receptors are assumed to be exposed to shallower depths (0-2' bgs). Samples will be analyzed for COPCs that were identified from the on-site soil sampling. Sampling at specific children's play areas will be considered when developing the sampling approach and selecting sampling locations at a given residential property.
- Sediment
  - Sediment sampling to be conducted during Phase II (i.e., after the onsite and residential sampling is done) primarily based on the desire to mobilize onsite and in the residential areas as soon as possible.
  - Additional sediment sampling to take place in depositional areas in Arbuckle Creek near SI sample locations. Samples are also needed further downstream in depositional areas; however, there may be possible safety concerns with accessing the depositional areas because of the rocky, steep terrain.
  - Additional sediment sampling to be done to delineate contamination in wetland areas in Arbuckle Creek.
  - Additional sediment sampling to take place in depositional areas in the New River, including bank and shoreline areas.

  - The potential need for PCB congener analysis was raised because of the weathering of Aroclor mixtures.
- Porewater
  - Team consensus was to reevaluate the need for porewater sampling after groundwater data is evaluated.
- Mine Pool Discharge
  - Team consensus was to reevaluate the need for mine pool discharge sampling after groundwater data is evaluated. A map of the mine workings in the vicinity of the site should be assembled for use in evaluating data. WVDEP was going to look for the US Bureau of Mines 1995 Report.
- Biological
  - Team consensus was to develop the scope of work for the biological testing (biota/toxicity testing) after the additional sediment sampling was conducted.
  - The need for up to date and more site-specific T&E species info was raised. This info may have a significant impact on the scope of any biological investigations.
- The field work will be done in phases:
  - Phase I to include on-site soil and groundwater sampling (potentially late summer/early fall 2019).
  - Phase II to include residential soil sampling and sediment sampling (potentially fall 2019).
  - Phase III to include pore water, mine pool discharge, and biological sampling along with any other data that will be needed to be collected to complete RI report.

5. ACTION ITEMS

- Tetra Tech to create a Sharepoint for the project team
- Weston to share SI data with Tetra Tech
- EPA to supply Tetra Tech with summary of historic activities
- Team to supply EPA with possible dates of site visit
- Tetra Tech to purchase an EDR Report for the site

FINAL

Meeting Minutes – 5/21/2019 Scope of Work Teleconference

Remedial Investigation / Feasibility Study – Shaffer Equipment / Arbuckle Creek Area Site

1. ATTENDEES

- USEPA Region III – Stepan Nevshehirlian, Justin Bleiler
- Tetra Tech – [redacted], [redacted]

2. Field Assessment and Data Collection

The purpose of the teleconference was to discuss the Scope of Work and Cost Estimate for the site and to agree upon the field effort needed to conduct the initial phases of investigation. The basis of the discussion was the Shaffer Equipment/Arbuckle Creek Proposed Sampling – Phases I and II document submitted to EPA on May 17, 2019 (document is attached for reference).

Items discussed and agreed upon:

- The field work will be divided into three phases. The three phases generally are: Phase I to include on and near site soil and groundwater sampling, Phase II to include sampling residents, Arbuckle Creek, and other areas of concern. Phase III will be any other data needed to complete the RI report.
- In the SOW submitted to EPA, costing for only Phase I and II of field work will be given.
- At this time no soil sampling will be performed under the cap.
- Sampling for PCBs will be performed via the NOAA PCB congener list.
- No sampling will be performed inside residences at this time.
- In general EPA, agreed with the sampling proposed in the May 17, 2019 document, some additions were:
    - Addition of 2 shallow wells near the outside of the cap
    - Addition of 6-8 additional borings immediately outside of the cap
    - Addition of 4-6 shallow surface samples near the unpaved area of Rocklick Road.
- In the SAP, Tetra Tech will provide an historic summary of each area of concern and make justifications to whether additional sampling is needed.
- Residential sampling will be performed via compositing samples.
- In the SAP, Tetra Tech will develop a sampling protocol for the number of samples needed resident (i.e. 4 samples per each ½ acre).

3. ACTION ITEMS

- EPA to upload historic documents to Tetra Tech Sharepoint Site

APPENDIX B

DATA AND FIGURES – SHAFFER EQUIPMENT COMPANY PROPERTY ACTIVITIES

002001

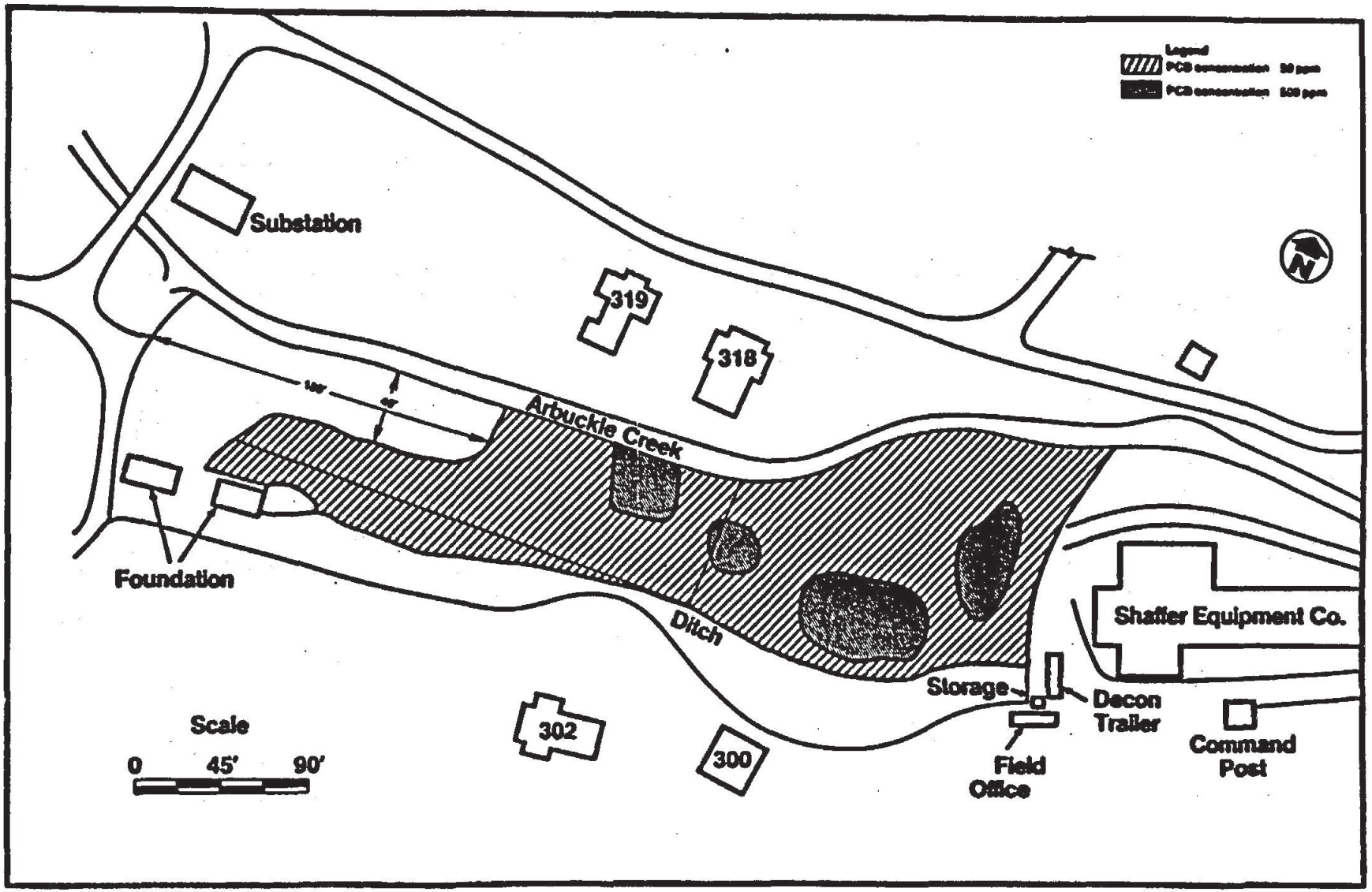

Figure 3. PCB concentration, Shaffer Equipment Co. Minden, West Virginia.

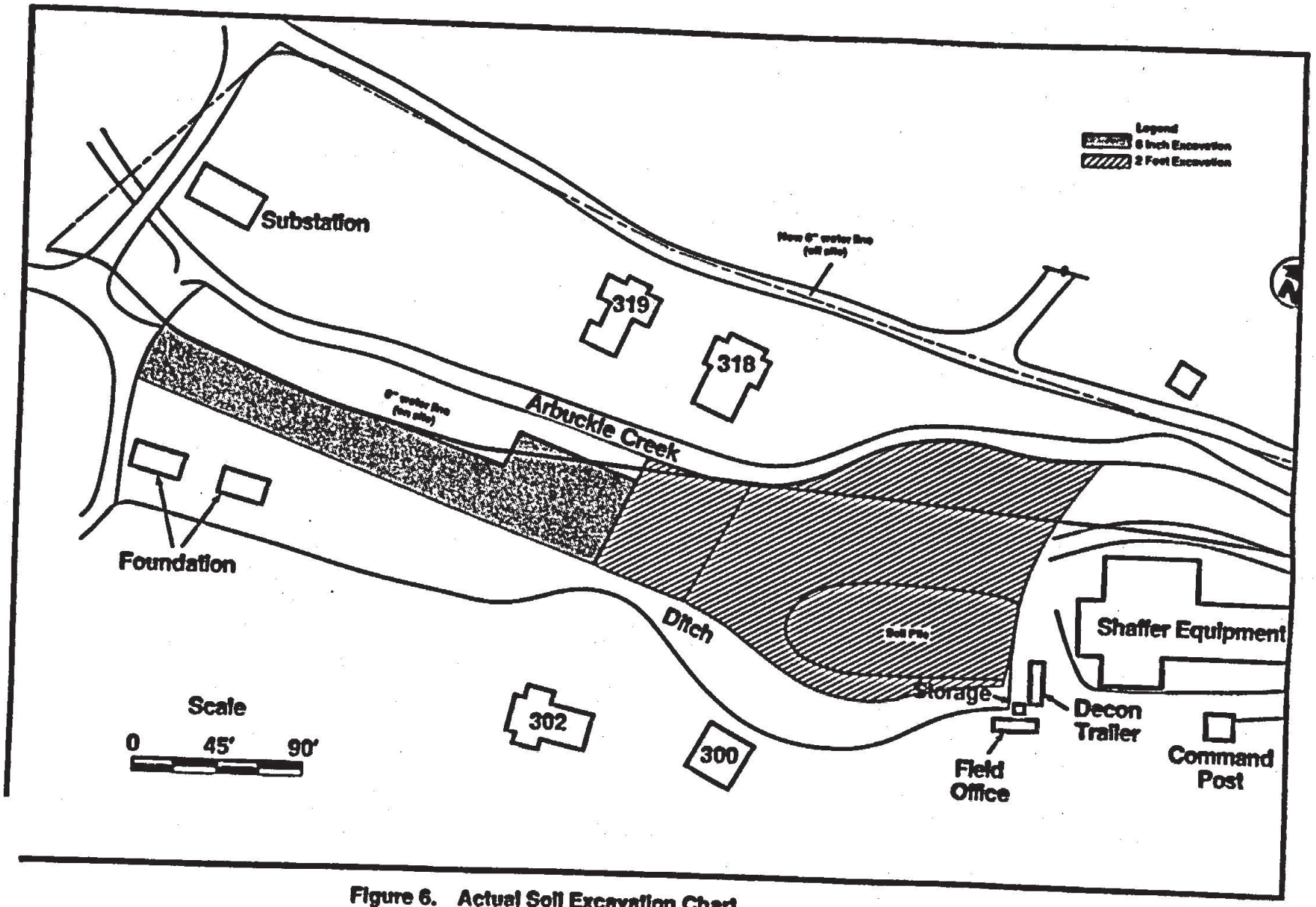

Figure 6. Actual Soil Excavation Chart
Shaffer Equipment Co., Minden, West Virginia.

100212

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF00	CDF01	CDF02	CDF03	CDF04	CDF05
	SAMPLE ID:	SW-1F	SW-2F	SW-3F	SW-4F	SW-5F	SW-6F
	LOCATION:	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only
	PH:	7.4	7.5	6.9	6.3	6.0	6.1
	FIELD MEASUREMENTS:	882 UMHOS/CM	313 UMHOS/CM	793 UMHOS/CM	841 UMHOS/CM	842 UMHOS/CM	875 UMHOS/CM
	PERCENT SOLIDS:						
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:						

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF00	CDF01	CDF02	CDF03	CDF04	CDF05
	UNITS:	n/a	n/a	n/a	n/a	n/a	n/a
5.00	methylene chloride						
10.00	acetone						
5.00	1,1-dichloroethane						
5.00	chloroform						
5.00	1,1,1-trichloroethane						
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	0.0	0.0	0.0	0.0	0.0	0.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF00	CDF01	CDF02	CDF03	CDF04	CDF05
	UNITS:	n/a	n/a	n/a	n/a	n/a	n/a
10.00	phenol						
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol						
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene						
10.00	naphthalene						
10.00	4-chloroaniline						
10.00	2-methylnaphthalene						
10.00	acenaphthylene						
10.00	acenaphthene						
10.00	dibenzofuran						
10.00	fluorene						
50.00	pentachlorophenol						
10.00	phenanthrene						
10.00	anthracene						
10.00	fluoranthene						
10.00	pyrene						
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene						
10.00	chrysene						
10.00	bis(2-ethylhexyl) phthalate						
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene						
10.00	benzo(k)fluoranthene						
10.00	benzo(a)pyrene						
10.00	indeno(1,2,3-cd)pyrene						
10.00	dibenz(a,h)anthracene						
10.00	benzo(g,h,i)perylene						
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	1.0	1.0

ORIGINAL (Red)

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF00	CDF01	CDF02	CDF03	CDF04	CDF05
	UNITS:	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

TYPE OF DATA: PESTICIDES

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF00	CDF01	CDF02	CDF03	CDF04	CDF05
	SAMPLE ID:	SW-1F	SW-2F	SW-3F	SW-4F	SW-5F	SW-6F
	LOCATION:	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only	filtered pest/pcb only
	PH:	7.4	7.5	6.9	6.3	6.0	6.1
	FIELD MEASUREMENTS:	882 UMHOS/CM	313 UMHOS/CM	793 UMHOS/CM	841 UMHOS/CM	842 UMHOS/CM	875 UMHOS/CM
	PERCENT SOLIDS:						
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	1.0	1.0
	UNITS:	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
0.10	4,4'-DDT						
0.10	endrin ketone						
1.00	aroclor-1260						

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red) RC

SITE NAME: SHAFFER EQUIPIMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	on site ind-lim acss veg drk brn loam	on site ind-lim acss no veg drk brn sndy	on site ind-lim acss no veg lght tan cly	on site ind-lim acss no veg brn/red clay	on site ind-lim acss veg drk brn sndy	on site ind-lim acss lim veg drk brn sndy
	PH:						
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	70.0%	86.0%	85.0%	81.0%	78.0%	84.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.4	1.2	74.0	1.2	1.3	1.2

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
5.00	methylene chloride						
10.00	acetone	79.00 B					
5.00	1,1-dichloroethane			170.00 J			
5.00	chloroform						
5.00	1,1,1-trichloroethane	12.00		1900.00		1.00 J	
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	41.0	39.0	42.0	400.0	38.0	37.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
10.00	phenol	210.00J					
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol	350.00J					
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene	1900.00	520.00	150.00J	1100.00J	370.00J	1300.00
10.00	naphthalene	240.00J	520.00			440.00	300.00J
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	470.00	1400.00			490.00	430.00
10.00	acenaphthylene	68.00J				160.00J	110.00J
10.00	acenaphthene					99.00J	
10.00	dibenzofuran	120.00J	190.00J			260.00J	140.00J
10.00	fluorene	61.00J	62.00J			110.00J	79.00J
50.00	pentachlorophenol						
10.00	phenanthrene	560.00	930.00			1200.00	730.00
10.00	anthracene	87.00J	39.00J			330.00J	150.00J
10.00	fluoranthene	500.00	230.00J			4400.00	820.00
10.00	pyrene	410.00J	340.00J			4100.00	640.00
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene	200.00J	180.00J			1700.00	380.00
10.00	chrysene	400.00J	650.00			1600.00	530.00
10.00	bis(2-ethylhexyl) phthalate	1600.00 B	380.00 B	130.00 B		230.00 B	160.00 B
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene	310.00J	300.00J			1600.00	450.00
10.00	benzo(k)fluoranthene	310.00J	77.00J			1100.00	450.00
10.00	benzo(a)pyrene	160.00J	96.00J			1200.00	330.00J
10.00	indeno(1,2,3-cd)pyrene	100.00J				480.00	170.00J
10.00	dibenz(a,h)anthracene					130.00J	
10.00	benzo(g,h,i)perylene	99.00J	65.00J			400.00	150.00J
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	16000.0	5100.0	1000.0	770.0	1800.0	360.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg

Comments:

result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL Recy

RC

SITE NAME: SHAFFER EQUIPIMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	on site ind-lim acss veg drk brn loam	on site ind-lim acss no veg drk brn sndy	on site ind-lim acss no veg lght tan cly	on site ind-lim acss no veg brn/red clay	on site ind-lim acss veg drk brn sndy	on site ind-lim acss lim veg drk brn sndy
	PH:						
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	70.0%	86.0%	85.0%	81.0%	78.0%	84.0%
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	16000.0	5100.0	1000.0	770.0	1800.0	360.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF20	CDF21	CDF22	CDF23	CDF24	CDF25
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
0.10	4,4'-DDT						
0.10	endrin ketone						
1.00	aroclor-1260	240000.00 C	17000.00 C	4700.00	55000.00CJ	7200.00 C	36000.00 C

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF26	CDF27	CDF28	CDF29	CDF30	CDF31
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	on site depth-36" slt grvl water - 30"	on site ind-lim acss lim veg lgt brn grvl	on site depth- 15" loamy drk brown	on site ind-lim acss veg drk loam org	on site ind-lim acss veg red brn sndy	on site ind-lim acss lim veg brn loam grv
	PH:		6.8	6.6	6.2	6.2	6.4
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	84.0%	91.0%	81.0%	72.0%	87.0%	87.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.2	1.1	1.2	1.4	1.1	1.1

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF26 ug/kg	CDF27 ug/kg	CDF28 ug/kg	CDF29 ug/kg	CDF30 ug/kg	CDF31 ug/kg
5.00	methylene chloride		3.00 B				
10.00	acetone					20.00 B	
5.00	1,1-dichloroethane						
5.00	chloroform						
5.00	1,1,1-trichloroethane	2.00 J					
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	58.5	36.0	40.0	140.0	46.0	38.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF26 ug/kg	CDF27 ug/kg	CDF28 ug/kg	CDF29 ug/kg	CDF30 ug/kg	CDF31 ug/kg
10.00	phenol						
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol						
50.00	benzoic acid			140.00J			
10.00	1,2,4-trichlorobenzene	7100.00			960.00J		
10.00	naphthalene			350.00J			
10.00	4-chloroaniline			1400.00	3800.00	640.00	40.00J
10.00	2-methylnaphthalene	110.00J	70.00J	2100.00	6500.00	850.00	72.00J
10.00	acenaphthylene			290.00J			
10.00	acenaphthene			160.00J			
10.00	dibenzofuran			640.00	1300.00J	190.00J	
10.00	fluorene			180.00 J	230.00J		
50.00	pentachlorophenol						
10.00	phenanthrene	130.00J	74.00J	2100.00	4100.00	880.00	130.00J
10.00	anthracene			620.00	220.00J		
10.00	fluoranthene	59.00J		2000.00	1000.00J	100.00J	78.00J
10.00	pyrene	60.00J		2200.00	1200.00J	130.00J	70.00J
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene			1400.00	900.00J	77.00J	46.00J
10.00	chrysene	64.00J	43.00J	1800.00	1700.00	320.00J	92.00J
10.00	bis(2-ethylhexyl) phthalate	290.00 B	180.00 B	700.00 B	640.00 B	46.00 B	69.00 B
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene			1800.00	1100.00J	82.00J	
10.00	benzo(k)fluoranthene			960.00	640.00J		
10.00	benzo(a)pyrene			1000.00	610.00J		
10.00	indeno(1,2,3-cd)pyrene			360.00J	320.00J		
10.00	dibenz(a,h)anthracene			89.00J			
10.00	benzo(g,h,i)perylene			290.00J	390.00J		
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	19000.0	170.0	960.0	2200.0	190.0	180.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF26 ug/kg	CDF27 ug/kg	CDF28 ug/kg	CDF29 ug/kg	CDF30 ug/kg	CDF31 ug/kg
Comments:							

result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (RED)

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF26	CDF27	CDF28	CDF29	CDF30	CDF31
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	on site depth-36" slt grvl water - 30"	on site ind-lim acss lim veg lgt brn grvl	on site depth- 15" loamy drk brown	on site ind-lim acss veg drk loam org	on site ind-lim acss veg red brn sndy	on site ind-lim acss lim veg brn loam grv
	PH:		6.8	6.6	6.2	6.2	6.4
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	84.0%	91.0%	81.0%	72.0%	87.0%	87.0%
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	19000.0	170.0	960.0	2200.0	190.0	180.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF26	CDF27	CDF28	CDF29	CDF30	CDF31
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
0.10	4,4'-DDT						
0.10	endrin ketone						
1.00	aroclor-1260	110000.00 C		10000.00 C		240.00	560.00

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	SAMPLE ID:	S-13	S-14	S-0	Sd-7	Sd-8	S-100
	LOCATION:	on site depth- 12" stoney drk brn loam	dup S-1	AQUEOUS TRIP BLANK FOR SOLID SAMPLE	on site bldg area drain ditch lght brn cly	on site excav area drain ditch drk brn grvl	off site bckgrnd soil veg drk brn loam
	PH:	6.4	6.4		6.1	5.3	5.3
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	NO HNU RDNGS	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	87.0%	76.0%		80.0%	82.0%	74.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.1	1.3	1.0	1.2	1.2	1.4

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	UNITS:	ug/kg	ug/kg	ug/l	ug/kg	ug/kg	ug/kg
5.00	methylene chloride	6.00 B		3.00 J			
10.00	acetone	28.00B		10.00	3.00 B		
5.00	1,1-dichloroethane						
5.00	chloroform						
5.00	1,1,1-trichloroethane	5.00 J	4.00 J				
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	42.0	47.0	0.0	49.0	340.0	240.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	UNITS:	ug/kg	ug/kg	n/a	ug/kg	ug/kg	ug/kg
10.00	phenol		470.00				
10.00	1,4-dichlorobenzene				200.00J		
10.00	4-methylphenol		250.00J				
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene		2300.00		3700.00	45000.00	
10.00	naphthalene	550.00	270.00J		170.00J	460.00J	
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	850.00	580.00		660.00	820.00J	
10.00	acenaphthylene	51.00J	76.00J				
10.00	acenaphthene						
10.00	dibenzofuran	230.00J	150.00J		68.00J		
10.00	fluorene	52.00J	59.00J		59.00J		
50.00	pentachlorophenol						
10.00	phenanthrene	860.00	710.00		470.00J	1700.00J	260.00 J
10.00	anthracene	120.00J	97.00J				
10.00	fluoranthene	630.00	690.00		270.00J	1200.00J	260.00 J
10.00	pyrene	690.00	700.00		230.00J	1100.00J	310.00 J
10.00	butylbenzyl phthalate				49.00 B		
10.00	benzo(a)anthracene	350.00J	360.00J		120.00J	1000.00J	
10.00	chrysene	790.00	540.00		250.00J	1500.00J	560.00 J
10.00	bis(2-ethylhexyl) phthalate	310.00 B	320.00 B		220.00 B		
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene	620.00	470.00		180.00J	750.00J	500.00 J
10.00	benzo(k)fluoranthene	320.00J	170.00J		120.00J	630.00J	280.00 J
10.00	benzo(a)pyrene	220.00J	220.00J		110.00J	500.00J	
10.00	indeno(1,2,3-cd)pyrene	120.00J	150.00J		87.00J		
10.00	dibenz(a,h)anthracene	46.00J	57.00J				
10.00	benzo(g,h,i)perylene	120.00J	150.00J		83.00J		
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	200.0	10000.0	0.0	7000.0	62000.0	230.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	UNITS:	ug/kg	ug/kg	n/a	ug/kg	ug/kg	ug/kg

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (red)

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

TYPE OF DATA: PESTICIDES

	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	SAMPLE ID:	S-13	S-14	S-0	Sd-7	Sd-8	S-100
	LOCATION:	on site depth- 12" stoney drk brn loam	dup S-1	AQUEOUS TRIP BLANK FOR SOLID SAMPLE	on site bldg area drain ditch lght brn cly	on site excav area drain ditch drk brn grvl	off site bckgrnd soil veg drk brn loam
	PH:	6.4	6.4		6.1	5.3	5.3
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	NO HNU RDNGS	no hnu rdngs	no hnu rdngs	no hnu rdngs
	PERCENT SOLIDS:	87.0%	76.0%		80.0%	82.0%	74.0%
	DILUTION FACTOR:	200.0	10000.0		7000.0	62000.0	230.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF32	CDF33	CDF34	CDF35	CDF36	CDF37
	UNITS:	ug/kg	ug/kg	n/a	ug/kg	ug/kg	ug/kg
0.10	4,4'-DDT						
0.10	endrin ketone						
1.00	aroclor-1260	440.00	160000.00 C		110000.00 C	660000.00 C	

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red)

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	SAMPLE ID:	S-101	S-102	S-103	S-104	S-105	S-106
	LOCATION:	OFF SITE ACCESSIBLE (b) (6)	OFF-SITE ACCESSIBLE	OFF-SITE (b) (9) MINE NO VEG	on site red fill 100' S of bldg	on site depth 20" 100' S of bldg	on site blw 3 transf oil stained N side bldg
	PH:	DRK.BRN.LOAM 6.6	DRK.BRN.LOAM 4.7	OIL STAINED 5.4	6.1	5.3	5.5
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	74.0%	97.0%	73.0%	87.0%	85.0%	94.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.4	1.0	1.4	1.1	1.2	1.1

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
5.00	methylene chloride	15.00 B	10.00 B		11.00 B		
10.00	acetone	24.00 B					
5.00	1,1-dichloroethane						
5.00	chloroform						
5.00	1,1,1-trichloroethane	16.00	2.00 J				
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	45.0	37.0	61.5	39.0	40.0	390.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
10.00	phenol						
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol			250.00 J			
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene		170.00 J				
10.00	naphthalene	110.00 J	120.00 J	100.00 J		59.00 J	
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	140.00 J	210.00 J	180.00 J		210.00 J	1500.00 J
10.00	acenaphthylene		57.00 J				
10.00	acenaphthene						
10.00	dibenzofuran		50.00 J	61.00 J		100.00 J	
10.00	fluorene			100.00 J			
50.00	pentachlorophenol						
10.00	phenanthrene	310.00 J	440.00	490.00 J		260.00 J	1300.00 L
10.00	anthracene		87.00 J				1100.00 J
10.00	fluoranthene	190.00 J	680.00	69.00 J		80.00 J	
10.00	pyrene	170.00 J	580.00	120.00 J		71.00 J	
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene	110.00 J	420.00				
10.00	chrysene	230.00 J	490.00	260.00 J		56.00 J	
10.00	bis(2-ethylhexyl) phthalate	210.00 B	96.00 B	240.00 B	44.00 B	63.00 B	7100.00 B
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene	140.00 J	580.00	94.00 J		71.00 J	
10.00	benzo(k)fluoranthene	99.00 J	370.00 J				
10.00	benzo(a)pyrene	96.00 J	430.00	110.00 J			
10.00	indeno(1,2,3 cd)pyrene	49.00 J	260.00 J				
10.00	dibenz(a,h)anthracene		53.00 J				
10.00	benzo(g,h,i)perylene	44.00 J	240.00 J				
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	210.0	360.0	190.0	190.0	190.0	950.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
	Comments:						

result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (Red)

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	SAMPLE ID:	S-101	S-102	S-103	S-104	S-105	S-106
	LOCATION:	OFF SITE ACCESSIBLE (b) (6)	OFF-SITE ACCESSIBLE	OFF-SITE MINDEN MINE NO VEG	on site red fill 100' S of bldg	on site depth 20" 100' S of bldg	on site blw 3 transf oil stained N side bldg
		DRK.BRN.LOAM	DRK.BRN.LOAM	OIL STAINED			
	PH:	6.6	4.7	5.4	6.1	5.3	5.5
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	74.0%	97.0%	73.0%	87.0%	85.0%	94.0%
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	210.0	360.0	190.0	190.0	190.0	950.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF38	CDF39	CDF40	CDF41	CDF42	CDF43
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
0.10	4,4'-DDT			71.00 R			
0.10	endrin ketone			29.00 R			
1.00	aroclor-1260	960.00	2100.00 C				5800.00

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic ; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	SAMPLE ID:	S-107	PW-3	PW-2	SD-1	SD-2	Sd-3
	LOCATION:	off site btwn houses (b) (6) N of Arbkl. Cr	ARBKLE PBLC. SERVICE DIST (b) (9) INTAK NON-CHLOR	WV AMRCN WTR CO., (b) (9) MINE INTAKE CHLORINATED	ARBUCKLE CK. 200 FEET UPSTRM OF BRDG. W BANK	TRIBUTARY OF ARBKLE CK. 15 FT. UPSTM OF CONFLNCE.	Arbuckle Cr 25 ft upstrm of drn ditch
	PH:	5.9	7.2	6.8	6.0	6.2	6.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	710 UMHOS/CM	744 UMHOS/CM	NO HNU RDNGS	NO HNU RDNGS	no hnu rdngs
	PERCENT SOLIDS:	47.0%			47.0%	84.0%	88.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	2.1	1.0	1.0	2.1	1.2	1.1

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	UNITS:	ug/kg	ug/l	ug/l	ug/kg	ug/kg	ug/kg
5.00	methylene chloride	4.00 B	2.00 B	2.00 B			
10.00	acetone	27.00 B			160.00 B		33.00 B
5.00	1,1-dichloroethane						
5.00	chloroform			1.00 J			
5.00	1,1,1-trichloroethane						
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	52.0	1.0	1.0	69.0	46.0	43.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	UNITS:	ug/kg	ug/l	ug/l	ug/kg	ug/kg	ug/kg
10.00	phenol						
10.00	1,4-dichlorobenzene				380.00 J		630.00
10.00	4-methylphenol						
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene						
10.00	naphthalene					59.00 J	
10.00	4-chloroaniline				940.00		
10.00	2-methylnaphthalene	100.00 J			240.00 J	140.00 J	66.00 J
10.00	acenaphthylene	89.00 J					
10.00	acenaphthene				94.00 J		47.00 J
10.00	dibenzofuran				100.00 J		
10.00	fluorene				140.00 J		64.00 J
50.00	pentachlorophenol						
10.00	phenanthrene	450.00 J			1300.00	150.00 J	600.00
10.00	anthracene	58.00 J			290.00 J		100.00 J
10.00	fluoranthene	590.00			2100.00	120.00 J	690.00
10.00	pyrene	500.00 J			2000.00	140.00 J	550.00
10.00	butylbenzyl phthalate				280.00 B		
10.00	benzo(a)anthracene	280.00 J			870.00		230.00 J
10.00	chrysene	430.00 J			1100.00	110.00 J	290.00 J
10.00	bis(2-ethylhexyl) phthalate	180.00 B			4000.00 R	160.00 B	1000.00 B
10.00	di-n-octyl phthalate				170.00 B		66.00 B
10.00	benzo(b)fluoranthene	360.00 J			1400.00	64.00 J	280.00 J
10.00	benzo(k)fluoranthene	250.00 J			970.00	74.00 J	240.00 J
10.00	benzo(a)pyrene	260.00 J			830.00	65.00 J	250.00 J
10.00	indeno(1,2,3-cd)pyrene	140.00 J			370.00 J		140.00 J
10.00	dibenz(a,h)anthracene						
10.00	benzo(g,h,i)perylene	130.00 J			290.00 J		130.00 J
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	250.0	1.0	1.0	330.0	220.0	210.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	UNITS:	ug/kg	ug/l	ug/l	ug/kg	ug/kg	ug/kg

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCC046 rep'd from another lab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-celmic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	SAMPLE ID:	S-107	PW-3	PW-2	SD-1	SD-2	Sd-3
	LOCATION:	off site btwn houses (b) (6) N of Arbkl. Cr	ARBKLE PBLC. SERVICE DIST (b) (6) INTAK NON CHLOR	WV AMRCN WTR CO., (b) (6) MINE INTAKE CHLORINATED	ARBUCKLE CK. 200 FEET UPSTRM OF BRDG. W BANK	TRIBUTARY OF ARBKLE CK. 15 FT. UPSTM OF CONFLNCE.	Arbuckle Cr 25 ft upstrm of drn ditch
	PH:	5.9	7.2	6.8	6.0	6.2	6.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	710 UMHOS/CM	744 UMHOS/CM	NO HNU RDNGS	NO HNU RDNGS	no hnu rdngs
	PERCENT SOLIDS:	47.0%			47.0%	84.0%	88.0%
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	250.0	1.0	1.0	330.0	220.0	210.0

DET. LIMIT (RQL (@=IDL)	SAMPLE NUMBER:	CDF44	CDF45	CDF46	CDF47	CDF48	CDF49
	UNITS:	ug/kg	ug/l	ug/l	ug/kg	ug/kg	ug/kg
0.10	4,4'-DDT	78.00 R					
0.10	endrin ketone						
1.00	aroclor-1260						

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SELECTED SAMPLE ORDER
SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756
STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF50	CDF51	CDF52	CDF53	CDF54	CDF55
	SAMPLE ID:	Sd-4	Sd-5	SW-1	SW-2	SW-3	SW--4
	LOCATION:	Arbuckle Cr 25 ft dwnstr of drain dch	Arbuckle Cr 40 ft dwnstr of bridge	Arbuckle Cr 200 ft upstr brdg s bank	trib to Arbk 15 ft upstr of conf	ARBKLE CRK. 25 FEET UPSTREAM OF DRAING DITCH	ARBKLE CRK. 25 FEET DWNSTREAM OF DRAING DITCH
	PH:	6.3	6.1	6.3	7.5	6.7	6.4
	FIELD MEASUREMENTS:	no hnu rdngs	no hnu rdngs	882 UMHOS/CM	313 UMHOS/CM	793 UMHOS/CM	841 UMHOS/CM
	PERCENT SOLIDS:	83.0%	82.0%				
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.2	1.2	1.0	1.0	1.0	1.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF50 ug/kg	CDF51 ug/kg	CDF52 ug/l	CDF53 ug/l	CDF54 ug/l	CDF55 ug/l
5.00	methylene chloride			3.00 B	5.00 B	4.00 B	4.00 B
10.00	acetone			39.00 B		26.00 B	29.00 B
5.00	1,1,1-trichloroethane						
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	37.0	48.0	1.0	1.0	1.0	1.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF50 ug/kg	CDF51 ug/kg	CDF52 ug/l	CDF53 ug/l	CDF54 ug/l	CDF55 ug/l
10.00	1,4-dichlorobenzene	140.00J	150.00J				
10.00	1,2,4-trichlorobenzene		160.00J				
10.00	2-methylnaphthalene	93.00J	98.00J				
10.00	phenanthrene	96.00J	510.00				
10.00	anthracene		87.00J				
10.00	fluoranthene	110.00J	830.00				
10.00	pyrene	99.00J	750.00				
10.00	butylbenzyl phthalate		51.00J				
10.00	benzo(a)anthracene	48.00J	330.00J				
10.00	chrysene	82.00J	390.00J				
10.00	bis(2-ethylhexyl) phthalate	270.00 B	780.00 B	2.00 B		1.00B@	2.00 B
10.00	benzo(b)fluoranthene	65.00 J	400.00 J				
10.00	benzo(k)fluoranthene		270.00J				
10.00	benzo(a)pyrene	56.00J	310.00J				
10.00	indeno(1,2,3-cd)pyrene		140.00J				
10.00	benzo(g,h,i)perylene		110.00J				
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	180.0	1100.0	1.0	1.0	1.0	1.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CDF50 ug/kg	CDF51 ug/kg	CDF52 ug/l	CDF53 ug/l	CDF54 ug/l	CDF55 ug/l
1.00	aroclor-1260		5200.00				

Comments: ********** @= result reported from re-analysis C= confirmed by GC/MS

ORIGINAL (Red)

RC

SELECTED SAMPLE ORDER

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	CDF56	CDF57	CDF58	CDF59
	SAMPLE ID:	SW-5	SW-6	SW-00	SP-1
	LOCATION:	ARBKLE CRK, 40 FEET DOWNSTREAM OF BRIDGE	DUPLICATE SW-5	AQUEOUS BLANK	SPRNG DSCHRG NO USES ON SITE CLR, NO ODOR
	PH:	6.0	5.9	6.7	6.8
	FIELD MEASUREMENTS:	842 UMHOS/CM	875 UMHOS/CM		548 UMHOS/CM
	PERCENT SOLIDS:				
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF56	CDF57	CDF58	CDF59
	UNITS:	ug/l	ug/l	ug/l	ug/l
5.00	methylene chloride	11.00 B			
10.00	acetone	31.00 B	14.00 B		
5.00	1,1,1-trichloroethane		2.00 J		
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF56	CDF57	CDF58	CDF59
	UNITS:	ug/l	ug/l	ug/l	ug/l
10.00	1,4-dichlorobenzene				
10.00	1,2,4-trichlorobenzene				
10.00	2-methylnaphthalene				
10.00	phenanthrene				
10.00	anthracene				
10.00	fluoranthene				
10.00	pyrene				
10.00	butylbenzyl phthalate				
10.00	benzo(a)anthracene				
10.00	chrysene				
10.00	bis(2-ethylhexyl) pnthalate	2.00 B	2.00B@		
10.00	benzo(b)fluoranthene				
10.00	benzo(k)fluoranthene				
10.00	benzo(a)pyrene				
10.00	indeno(1,2,3-cd)pyrene				
10.00	benzo(g,h,i)perylene				
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDF56	CDF57	CDF58	CDF59
	UNITS:	ug/l	ug/l	ug/l	ug/l
1.00	aroclor-1260				

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

SAMPLE NUMBER:		MCAA20	MCAA21	MCAA22	MCAA23	MCAA24	MCCD25
SAMPLE ID:		S-1	S-2	S-3	S-4	S-5	S-6
LOCATION:		ON SITE IND-LIM ACSS VEG DRK BRN LOAM	ON SITE IND-LIM ACSS NO VEG DRK,BRN,SNDY	ON SITE IND LIM ACSS NO VEG LGHT TAN CLY	ON SITE IND-LIM ACSS NO VEG BRN,RED CLAY	ON SITE IND-LIM ACSS VEG DRK BRN SNDY	ON SITE IND-LIM ACSS LIM VEG DRK,BRN SNDY
PH:							
FIELD MEASUREMENTS:		NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
PERCENT SOLIDS:		76.6%	85.9%	78.2%	81.3%	80.5%	85.0%
TYPE OF DATA:	INORGANICS						
DILUTION FACTOR:	: GFAA	0.251	0.226	0.251	0.230	0.228	0.231
	: ICP	0.247	0.218	0.251	0.226	0.236	0.228
	: Hg	0.653	0.582	0.608	0.559	0.564	0.470
	: CN	0.064	0.057	0.065	0.061	0.062	0.059

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	MCAA20 mg/kg	MCAA21 mg/kg	MCAA22 mg/kg	MCAA23 mg/kg	MCAA24 mg/kg	MCCD25 mg/kg
12.00	aluminum	6180.00	7700.00	7300.00	4830.00	8010.00	4160.00
2.00	arsenic	11.90	18.40	4.30	6.60	6.10	7.30
3.00	barium	105.00	143.00	79.50	68.50	148.00	65.00
2.00	beryllium	0.76	0.58	0.78	0.70	0.73	0.81
5.00	cadmium						1.20
25.00	calcium	1400.00	161.00	540.00	24500.00	727.00	13700.00
5.00	chromium	21.60	28.70	10.50	14.40	12.20	20.30
4.00	cobalt	6.90	5.70	8.40	6.40	5.90	5.90
5.00	copper	78.70	109.00	15.40 B	25.40	35.10	27.30
27.00	iron	18500.00	38100.00	16100.00	18400.00	21300.00	19300.00
1.00	lead (anal. by GFAA)	99.90	69.70	44.50	50.10	244.00	53.80
27.40	lead (anal. by ICP)						
47.00	magnesium	1380.00	2740.00	686.00	2240.00	611.00	1660.00
1.00	manganese	231.00	176.00	316.00	322.00	445.00	259.00
0.20	mercury	0.25	0.82		0.44	0.12	
5.00	nickel	17.30	17.90	8.20	14.40	11.20	16.00
82.00	potassium	1640.00	1900.00	829.00	1230.00	813.00	1060.00
3.00	selenium	1.20 B	2.30 B	0.80 B		0.95 B	1.20 B
6.00	silver						
64.00	sodium	137.00	96.90	44.10 B	98.40	58.00 B	87.30 B
1.00	thallium						
2.00	vanadium	12.80	16.30	16.20	10.60	16.90	8.90
4.00	zinc	150.00	174.00	49.30	52.00	82.30	70.30
10.00	cyanide	1.30			1.30		1.30

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPIMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD26	MCCD27	MCCD28	MCCD29	MCCD30	MCCD31
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	ON SITE	ON SITE	ON SITE	ON SITE	ON SITE	ON SITE
		DEPTH - 36"	IND-LIM ACSS	DEPTH- 15"	IND-LIM ACSS	IND-LIM ACSS	IND-LIM ACSS
		SLT,GRVL	LIM VEG	LOAMY	VEG	VEG	LIM VEG
		WATER - 30"	LGT,BRN,GRVL	DRK BROWN	DRK LOAM,ORG	RED,BRN,SNDY	BRN LOAM,GRV
	PH:						
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	86.4%	90.9%	80.1%	74.8%	89.4%	89.1%
TYPE OF DATA:	INORGANICS						
	DILUTION FACTOR: : GFAA	0.231	0.204	0.235	0.255	0.207	0.218
	: ICP	0.218	0.204	0.240	0.248	0.218	0.224
	: Hg	0.526	0.500	0.594	0.637	0.484	0.488
	: CN	0.057	0.055	0.062	0.068	0.045	0.056

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	MCCD26 mg/kg	MCCD27 mg/kg	MCCD28 mg/kg	MCCD29 mg/kg	MCCD30 mg/kg	MCCD31 mg/kg
12.00	aluminum	4230.00	2980.00	4730.00	2790.00	11300.00	3330.00
2.00	arsenic	6.60	5.70	11.90	8.90	10.50	8.70
3.00	barium	39.20	29.90	100.00	162.00	159.00	39.60
2.00	beryllium	0.77	0.63	0.64	1.30	1.10	0.79
5.00	cadmium						
25.00	calcium	5710.00	431.00	6490.00	1970.00	2360.00	756.00
5.00	chromium	9.60	10.60	13.40	15.90	12.30	9.90
4.00	cobalt	4.50	18.40	6.20	5.20	8.30	6.80
5.00	copper	11.80 B	4.80 B	40.70	42.40	21.10	9.50 B
27.00	iron	11300.00	15500.00	20300.00	14700.00	19500.00	14500.00
1.00	lead (anal. by GFAA)	14.30	10.10	190.00	141.00	16.30	41.60
27.40	lead (anal. by ICP)						
47.00	magnesium	1250.00	897.00	1150.00	546.00	2630.00	960.00
1.00	manganese	158.00	410.00	292.00	200.00	439.00	222.00
0.20	mercury			0.13			
5.00	nickel	12.60	19.80	13.40	14.60	18.70	14.50
82.00	potassium	854.00	933.00	998.00	720.00	2430.00	824.00
3.00	selenium		0.82 B	1.50 B	0.91 B	0.64 B	1.10 B
6.00	silver					4.10 L	
64.00	sodium	44.80 B	40.60 B	107.00	88.80 B	276.00	48.80 B
1.00	thallium						
2.00	vanadium	8.00	7.60	13.30	13.30	16.90	7.70
4.00	zinc	20.40	24.20	216.00	93.40	45.10	32.10
10.00	cyanide	1.20		1.40	1.40		

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (Red)

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD32	MCCD33	MCCD35	MCCD36	MCCD37	MCCD38
	SAMPLE ID:	S-13	S-14	SD-7	SD-8	S-100	S-101
	LOCATION:	ON SITE DEPTH - 12" STONEY DRK,BRN LOAM	DUP S-1	on site bldg area drain ditch LGHT BRN CLY	on site excav area drain ditch DRK,BRN GRVL	off site bckgrnd soil VEG DRK BRN LOAM	OFF SITE ACCESSIBLE (b) (6) DRK,BRN,LOAM
	PH:						
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
TYPE OF DATA:	PERCENT SOLIDS: INORGANICS	87.7%	76.6%	73.3%	82.1%	75.5%	78.4%
	DILUTION FACTOR: : GFAA	0.228	0.251	0.260	0.222	0.252	0.241
	: ICP	0.217	0.253	0.257	0.241	0.249	0.248
	: Hg	0.495	0.543	0.650	0.580	0.575	0.555
	: CN	0.057	0.065	0.067	0.060	0.065	0.063

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	MCCD32 mg/kg	MCCD33 mg/kg	MCCD35 mg/kg	MCCD36 mg/kg	MCCD37 mg/kg	MCCD38 mg/kg
12.00	aluminum	4010.00	4890.00	6630.00	4940.00	7150.00	6840.00
2.00	arsenic	19.30	6.90	11.70	31.20	7.40	13.80
3.00	barium	89.30	90.80	99.00	130.00	101.00	97.40
2.00	beryllium	0.77	1.00	1.00	1.10	0.99	0.77
5.00	cadmium						
25.00	calcium	1080.00	1270.00	1760.00	692.00	551.00	3590.00
5.00	chromium	17.40	22.20	20.40	17.30	17.30	45.00
4.00	cobalt	3.30	4.70	10.20	4.80	12.20	7.50
5.00	copper	46.90	55.00	79.10	95.00	18.60 B	25.80
27.00	iron	19000.00	14300.00	27200.00	31900.00	18700.00	19100.00
1.00	lead (anal. by GFAA)	50.70	53.00	69.80	81.60	92.10	39.40
27.40	lead (anal. by ICP)						
47.00	magnesium	549.00	1110.00	1590.00	875.00	560.00	1250.00
1.00	manganese	157.00	191.00	313.00	162.00	764.00	307.00
0.20	mercury	0.13	0.18	0.14	0.32	0.25	0.12
5.00	nickel	8.30	14.50	22.30	13.00	12.90	15.40
82.00	potassium	1040.00	1260.00	1310.00	1390.00	602.00	1340.00
3.00	selenium	0.90 B		0.86 B	2.20 B		
6.00	silver	8.90 L					
64.00	sodium	139.00	102.00 B	85.40 B	126.00	47.50 B	134.00
1.00	thallium				0.69		
2.00	vanadium	11.30	10.60	13.70	13.90	18.40	14.50
4.00	zinc	43.20	159.00	240.00	42.70	71.50	59.50
10.00	cyanide		1.40			1.40	1.40

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (red)

2C

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic ; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD39	MCCD40	MCCD41	MCCD42	MCCD43	MCCD44
	SAMPLE ID:	S-102	S-103	S-104	S-105	S-106	S-107
	LOCATION:	OFF SITE ACCESSIBLE (b) (6)	OFF SITE (b) (9) MINE NO VEG	on site red fill 100' S of bldg	on site depth 20" 100' S of bldg	on site blw 3 transf oil stained N of bldg	off site btw houses (b) (6) of Arbkl Cr
	PH:	DRK,BRN,LOAM	OIL STAINED				
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	75.2%	82.5%	75.1%	78.3%	88.3%	63.0%
TYPE OF DATA:	INORGANICS						
	DILUTION FACTOR: : GFAA	0.259	0.232	0.251	0.245	0.219	0.300
	: ICP	0.253	0.229	0.261	0.248	0.223	0.300
	: Hg	0.633	0.577	0.579	0.581	0.563	0.756
	: CN	0.067	0.068	0.066	0.063	0.056	0.086

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	MCCD39 mg/kg	MCCD40 mg/kg	MCCD41 mg/kg	MCCD42 mg/kg	MCCD43 mg/kg	MCCD44 mg/kg
12.00	aluminum	5990.00	2480.00	7350.00	8660.00	5000.00	4390.00
2.00	arsenic	46.40	7.00	8.10	9.10	15.20	9.10
3.00	barium	120.00	42.60	84.50	132.00	83.60	80.10
2.00	beryllium	0.67	0.71	1.10	1.30	0.59	1.20
5.00	cadmium						
25.00	calcium	2460.00	312.00	479.00	869.00	267.00	1860.00
5.00	chromium	18.20	7.70 B	16.20	27.50	23.30	11.90
4.00	cobalt	5.80	3.10	16.40	19.60	11.20	6.20
5.00	copper	82.40	93.60	25.30	19.20 B	108.00	47.30
27.00	iron	30300.00	23600.00	31500.00	49700.00	24200.00	15000.00
1.00	lead (anal. by GFAA)	79.30	38.30	20.50	37.90	93.50 J	167.00
27.40	lead (anal. by ICP)						
47.00	magnesium	1660.00	692.00	1380.00	1170.00	1250.00	463.00
1.00	manganese	123.00	97.50	566.00	780.00	207.00	258.00
0.20	mercury	0.35				0.63	0.21
5.00	nickel	15.00	10.60	21.40	25.60	23.10	9.80
82.00	potassium	1740.00	673.00	1420.00 J	1400.00 J	1530.00 J	487.00 J
3.00	selenium	3.40 B				1.00 B	
6.00	silver						
64.00	sodium	277.00	55.80 B	76.70 B	119.00	187.00	143.00
1.00	thallium	1.10				0.50	0.34
2.00	vanadium	11.50	7.20	15.10	19.20	19.60	12.10
4.00	zinc	68.00	26.10	40.20 J	63.00 J	283.00 J	156.00 J
10.00	cyanide	1.30				1.20	2.00

Comments:
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#- Hg res. for MCCD46 rep'd from another lab

ORIGINAL (red)

AC

SITE NAME: SHAFFER EQUIPIMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD45	MCCD46	MCCD47	MCCD48	MCCD49	MCCD50
	SAMPLE ID:	PW-3	PW-2	SD-1	SD-2	SD-3	SD-4
	LOCATION:	Arbkl Public Service Dist (b)(6) intake non chlor	WV Amrcn Wtr Co (b)(9) mine intake chlorinated	ARBUCKLE CRK 700 FEET . UPSTREAM OF BRDG,W. BANK	TRIBUTARY ARBUCKLE CR. 15 FT USTRM OF CONFLNCE.	ARBUCKLE CR. 25 FT UPSTRM OF DRAINAGE DITCH	Arbuckle Cr 25 ft dwnstr of drain dch
	PH:	7.1	7.4				
	FIELD MEASUREMENTS:	503 umhos/cm	691 umhos/cm	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:			48.7%	77.6%	66.7%	85.6%
TYPE OF DATA:	INORGANICS						
	DILUTION FACTOR: : GFAA	1.000	1.000	0.399	0.252	0.285	0.222
	: ICP	1.000	1.000	0.407	0.241	0.288	0.229
	: Hg	1.000	1.000	0.934	0.644	0.651	0.487
	: CN	1.000	1.000	0.104	0.066	0.074	0.059

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	MCCD45 ug/l	MCCD46 ug/l	MCCD47 mg/kg	MCCD48 mg/kg	MCCD49 mg/kg	MCCD50 mg/kg
12.00	aluminum	29.20 B	21.80 B	11300.00	3400.00	10400.00	5760.00
2.00	arsenic			5.60	4.90	3.70	3.00
3.00	barium	87.20	72.30	200.00	63.10	83.50	50.40
2.00	beryllium			2.90	0.95	2.50	0.90
5.00	cadmium						
25.00	calcium	30500.00	37800.00	5250.00	20700.00	8000.00	6070.00
5.00	chromium			16.80	38.40	37.30	26.90
4.00	cobalt			35.50	3.20	19.10	17.80
5.00	copper			76.90	24.40	30.70	16.20 B
27.00	iron	323.00	1520.00	16600.00	27000.00	14100.00	11900.00
1.00	lead (anal. by GFAA)	2.10 B	1.00 B		30.90	43.00	21.40
27.40	lead (anal. by ICP)			580.00 J			
47.00	magnesium	10900.00	14400.00	1200.00	1410.00	1720.00	3760.00
1.00	manganese	88.50	215.00	571.00	256.00	198.00	104.00
0.20	mercury		#	0.36			
5.00	nickel			62.90	11.00	35.20	27.90
82.00	potassium	2200.00 J	2580.00 J	576.00 J	836.00 J	546.00 J	849.00 J
3.00	selenium						
6.00	silver			4.10 L		2.50 L	
64.00	sodium	68900.00	104000.00	207.00	191.00	111.00	111.00
1.00	thallium						
2.00	vanadium			9.60	7.20	5.90	7.00
4.00	zinc			345.00 J	42.90 J	182.00 J	85.10 J
10.00	cyanide			2.50			1.30

Comments:
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#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER: 13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD51	MCCD52	MCCD53	MCCD54	MCCD55	MCCD56
	SAMPLE ID:	SD-5	SW-1	SW-2	SW-3	SW-4	SW-5
	LOCATION:	Arbuckle Cr 40 ft dwnstr of bridge	ARBUCKLE CRK 200 FT. UPSTRM OF BRDGE. S.BNK	15 FT UPSTRM TRIBUTARY 15 ARBKLE CK 15 FT UPTM CNFL	ARBUCKLE CRK 25 FEET UPPSTREAM OF DRAING.DITCH	ARBUCKLE CRK 25 FEET DOWNSTRM OF DRAINAG DTCH	ARBUCKLE CRK 40 FEET DOWNSTREAM OF BRIDGE
	PH:		7.2	7.5	6.7	6.7	6.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	882 umhos/cm	313 umhos/cm	793 umhos/cm	841 umhos/cm	842 umhos/cm
	PERCENT SOLIDS:	70.1%					
TYPE OF DATA:	INORGANICS						
	DILUTION FACTOR: : GFAA	0.269	1.000	1.000	1.000	1.000	1.000
	: ICP	0.280	1.000	1.000	1.000	1.000	1.000
	: Hg	0.680	1.000	1.000	1.000	1.000	1.000
	: CN	0.072	1.000	1.000	1.000	1.000	1.000

DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	MCCD51 mg/kg	MCCD52 ug/l	MCCD53 ug/l	MCCD54 ug/l	MCCD55 ug/l	MCCD56 ug/l
12.00	aluminum		7490.00	9230.00	53.40 B	6950.00	8990.00	8840.00
2.00	arsenic		4.10					
3.00	barium		49.10	34.00	46.20	36.70	35.70	33.70
2.00	beryllium		1.60	3.70		3.30	3.70	3.70
5.00	cadmium							
25.00	calcium		1020.00	46500.00	16500.00	45600.00	47300.00	45800.00
5.00	chromium		240.00					
4.00	cobalt		18.50	53.60		37.10	48.30	47.70
5.00	copper		208.00	7.50 B		5.50 B	5.40 B	
27.00	iron		15100.00	13700.00	144.00 B	10400.00	13300.00	13300.00
1.00	lead (anal. by GFAA)		32.30	4.00 B	1.50 B	4.00 B	3.40 B	3.60 B
27.40	lead (anal. by ICP)							
47.00	magnesium		1010.00	28100.00	5680.00	26500.00	28700.00	27800.00
1.00	manganese		285.00	2660.00	21.30	1890.00	2460.00	2490.00
0.20	mercury			0.28 J				
5.00	nickel		29.80	95.00		71.40	89.00	86.90
82.00	potassium		814.00 J	4730.00 J	1970.00 J	4020.00 J	4330.00 J	4120.00 J
3.00	selenium							
6.00	silver							
64.00	sodium		150.00	73400.00	31300.00	55900.00	65500.00	62100.00
1.00	thallium							
2.00	vanadium		9.60					
4.00	zinc		100.00 J	151.00 J		114.00 J	151.00 J	142.00 J
10.00	cyanide		1.70	12.50				

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red)

RC

SITE NAME: SHAFFER EQUIPMENT
TDD NUMBER: F3-9001-39
LAB NAMES: org-ceimic; inorg.- skinner and sherman

SAMPLING DATE(s): 3-16-90
CASE NUMBER:13756

STATE/COUNTY CODE:
EPA NUMBER: WV-248

	SAMPLE NUMBER:	MCCD57	MCCD58	MCCD59
	SAMPLE ID:	SW-6	SW-00	SP-1
	LOCATION:	DUPLICATE SW-5	AQ BLANK	SPRNG DSCHRG NO USES ON SITE
	PH:	6.1	6.7	CLR, NO ODOR 6.7
	FIELD MEASUREMENTS:	875 umhos/cm		548 umhos/cm
	PERCENT SOLIDS:			
TYPE OF DATA:	INORGANICS			
	DILUTION FACTOR: : GFAA	1.000	1.000	1.000
	: ICP	1.000	1.000	1.000
	: Hg	1.000	1.000	1.000
	: CN	1.000	1.000	1.000

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	MCCD57 ug/l	MCCD58 ug/l	MCCD59 ug/l
12.00	aluminum	8990.00	33.00	361.00
2.00	arsenic			
3.00	barium	34.70		27.40
2.00	beryllium	3.30		
5.00	cadmium			
25.00	calcium	46700.00	48.60	42900.00
5.00	chromium			
4.00	cobalt	50.70		
5.00	copper			
27.00	iron	13600.00		392.00
1.00	lead (anal. by GFAA)	3.10 B		1.10 B
27.40	lead (anal. by ICP)			
47.00	magnesium	28500.00		22200.00
1.00	manganese	2560.00		111.00
0.20	mercury			
5.00	nickel	92.20		23.20
82.00	potassium	4300.00 J		2650.00 J
3.00	selenium			
6.00	silver			
64.00	sodium	63300.00	85.80	21400.00
1.00	thallium			
2.00	vanadium	2.00 B		
4.00	zinc	144.00 J		20.60 B
10.00	cyanide			

Comments:
result reported from re-analysis C= confirmed by GC/MS
#- Hg res. for MCCD46 rep'd from anotherlab

ORIGINAL (Red)

RC

EAS 5304C

SAMPLE DATA SUMMARY

1) F3-9001-39	7) CDF06	7) CDF07	7) CDF08	7)
2) WV-248	8) PW-00	8) PW-2	8) PW-3	8) ORIGINAL (Red)
3) Shaffer Equip.	9) AQ BLK	9) AQ	9) AQ	9)
4)	10) Low	10) Low	10) Low	10)
5) Organic (PCBs)	11) 1	11) 1	11) 2	11)
6) EIRA	12) 7.6	12) 7.4	12) 7.1	12)
	13) —	13) —	13) —	13)
	14) —	14) —	14) —	14)
	15) ug/l	15) ug/l	15) ug/l	15)

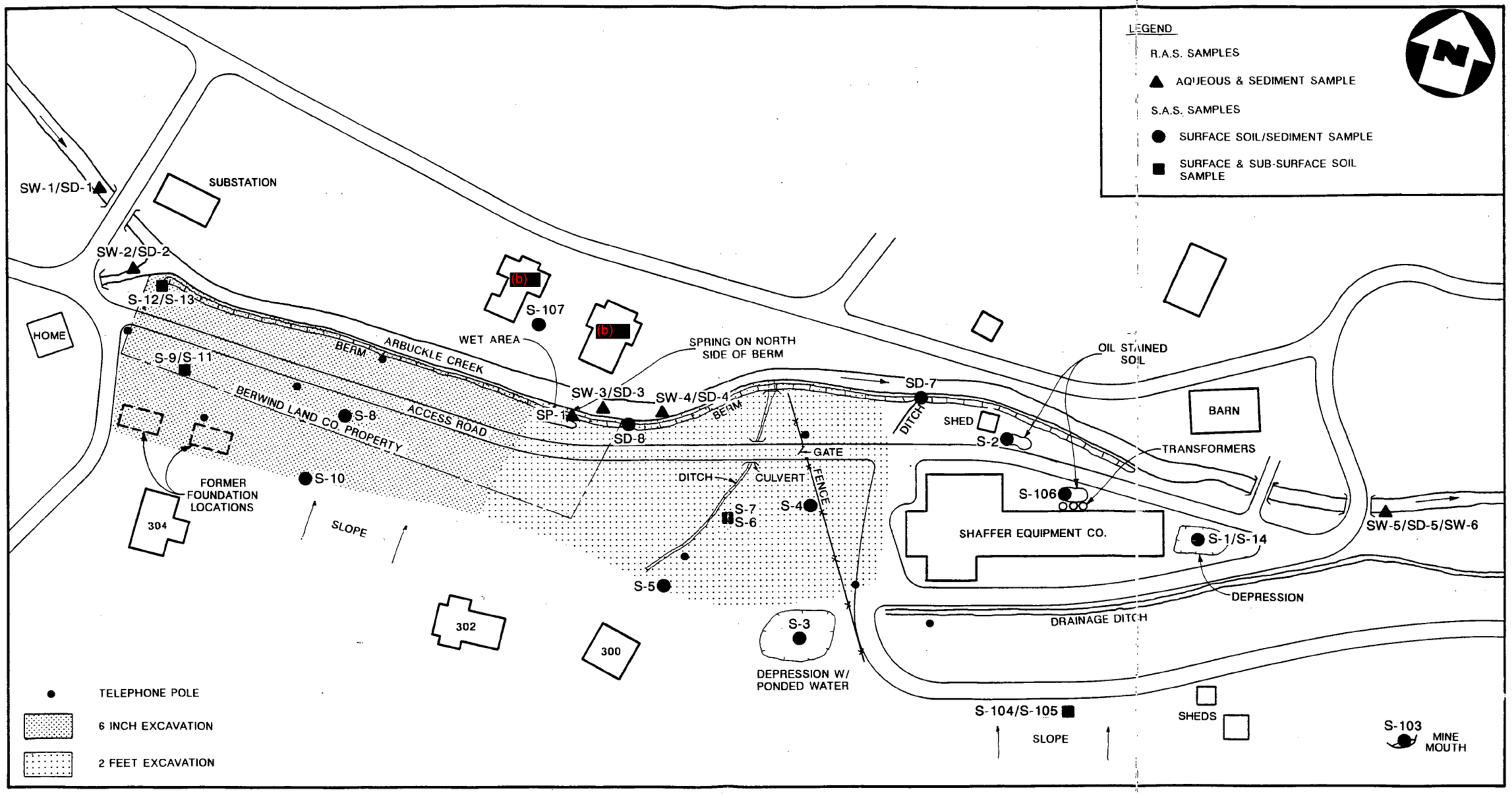
COMPOUNDS DETECTED	DETECT. LIMIT ug/l	RESULTS	RESULTS	RESULTS	RESULTS
Aroclor-1016	.005	ND	ND	ND	
Aroclor-1221	.005	ND	ND	ND	
Aroclor-1232	.005	ND	ND	ND	
Aroclor-1242	.005	ND	ND	ND	
Aroclor-1248	.005	ND	ND	ND	
Aroclor-1254	.005	ND	ND	ND	
Aroclor-1260	.005	ND	ND	ND	

KEY:

1) TDD NUMBER
2) EPA NUMBER
3) SITE NAME
4) STATE & COUNTY CODE
5) ORGANIC OR INORGANIC
6) LABORATORY NAME
7) TRAFFIC REPORT #
8) SAMPLE IDENTIFIER
9) PHASE
10) CONCENTRATION
11) DILUTION FACTOR
12) PH
13) FIELD MEASUREMENTS
14) PERCENT SOLID
15) UNITS

ND = NOT Detected

ORIGINAL (Red)



SAMPLE LOCATION MAP

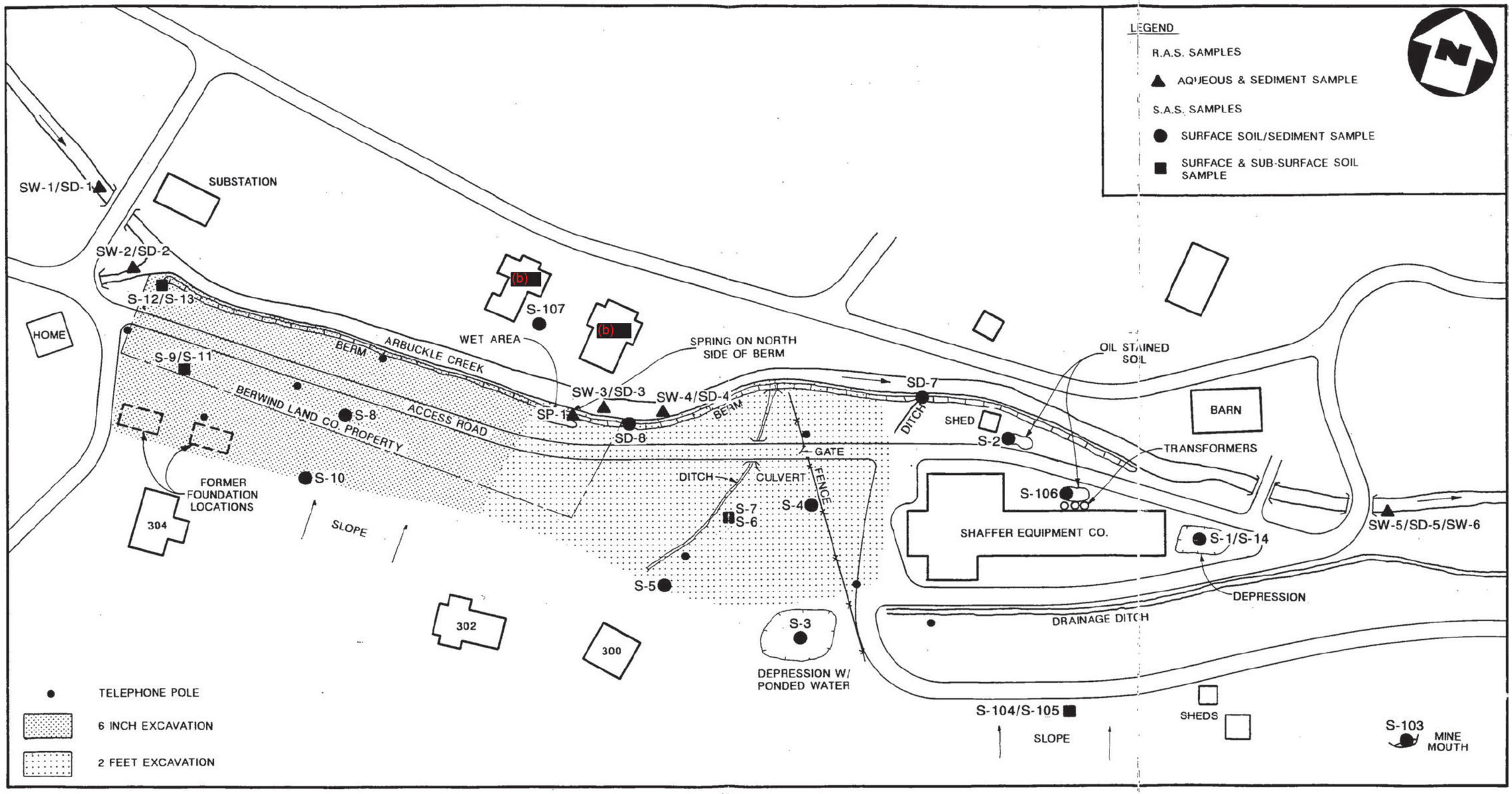
SHAFFER EQUIPMENT CO., MINDEN, WV

(NO SCALE)

FIGURE 2.1

NUS CORPORATION

ORIGINAL (Red)



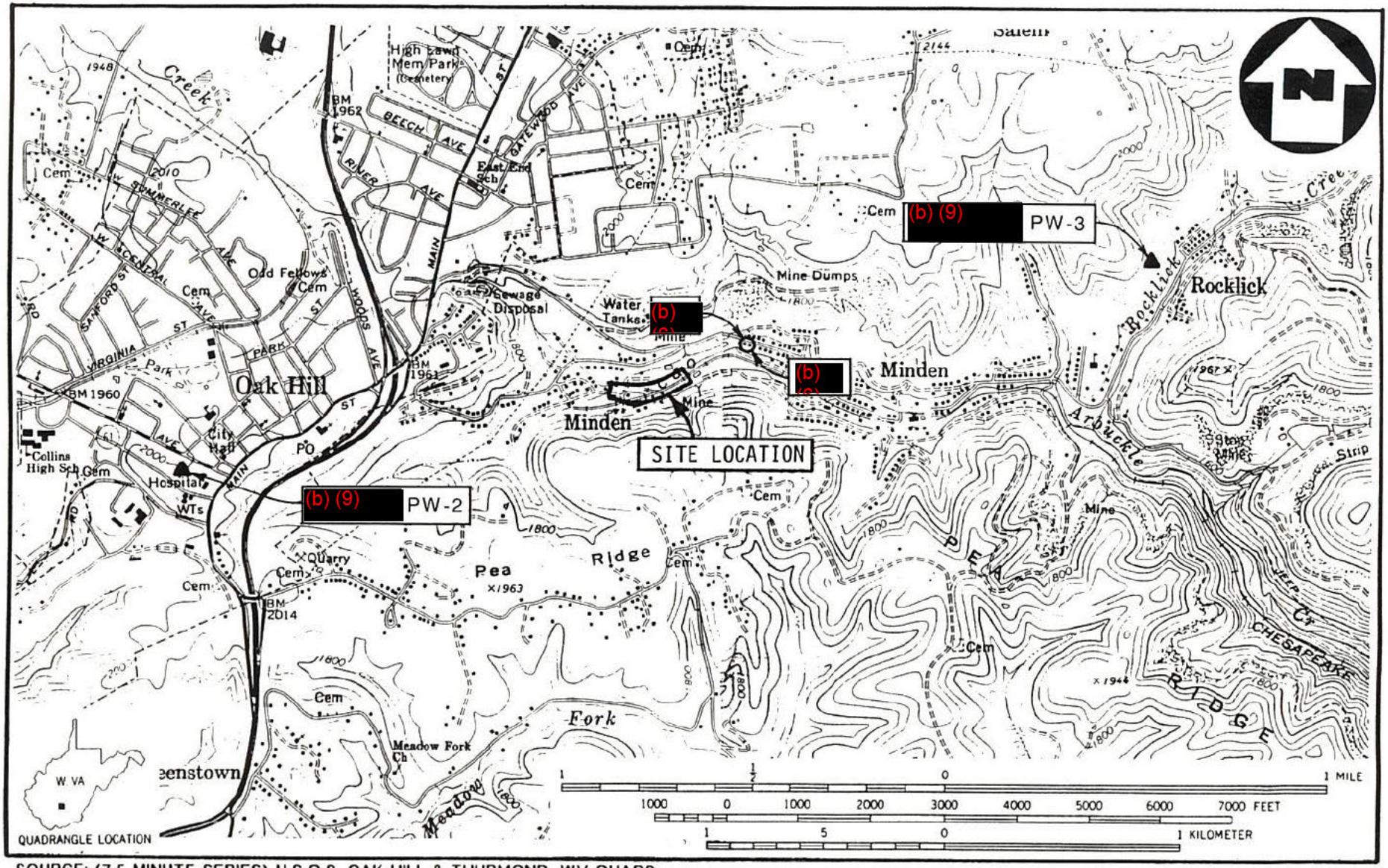
SAMPLE LOCATION MAP

SHAFFER EQUIPMENT CO., MINDEN, WV

(NO SCALE)

FIGURE 2.1

NUS CORPORATION



SOURCE: (7.5 MINUTE SERIES) U.S.G.S. OAK HILL & THURMOND, WV QUADS.

OFF-SITE SAMPLE LOCATIONS

SHAFFER EQUIPMENT CO., MINDEN, WV

SCALE 1: 24000

FIGURE 2.2

NUS CORPORATION

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TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-01	[redacted]	10/21/93	SAND, GRAVEL LIGHT & DARK BROWN, SOME REDDOG	X	X	<10	ND	ND		
SW-02	[redacted]	10/24/93	ARBUCKLE CREEK WATER, UPGRADE OF SITE	X		--	ND			
S-03	[redacted]	10/21/93	LIGHT BROWN SILTY, SANDY CLAY	X	X	<10	ND	ND		
S-04	[redacted]	10/19/93	DARK BROWN SILTY CLAY W/ TRACE SAND & REDDOG ROCK FRAGMENTS, MOIST			<10 <10				
S-05	[redacted]	10/19/93	DARK BROWN SILTY CLAY WITH SILT & HUMIC MATERIAL, MOIST			<10				
S-06	[redacted]	10/21/93	80% REDDOG, GRAVEL & COBBLES; W/ SAND SILT & VERY LITTLE FINES, DARK BROWN			<10				
S-07	[redacted]	10/21/93	80% REDDOG, GRAVEL & COBBLES; W/ DARK BROWN SILT & SAND; LITTLE FINES			<10				
S-08	[redacted]	10/21/93	SAME AS S-07			<10				
S-09	[redacted]	10/21/93	SAME AS S-07	X	X	<10	0.294	0.360		
S-10	[redacted]	10/19/93	DARK BROWN SILTY CLAY W/ ABUNDANT REDDOG AND ROOT FRAGMENTS			<10				
S-11	[redacted]	10/21/93	80% REDDOG GRAVEL, BROWN SILTY SAND, LITTLE FINES			<10				
S-12	[redacted]	10/19/93	MEDIUM BROWN SILTY CLAY W/ REDDOG AND ROOT FRAGMENTS, MOIST			<10				

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
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SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

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						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SC2-13	[redacted]	10/23/93	MEDIUM BROWN SANDY LOAM W/ SOME STONES & REDDOG	X	X	<10 <10	ND	ND		
SC3-14	[redacted]	10/23/93	DARK BROWN SANDY CLAY LOAM WITH SOME STONES AND REDDOG			<10				
S-15	[redacted]	10/19/93	MEDIUM TO DARK GRAY CLAY W/ LOAM & MINOR REDDOG, MOIST			>10, <50 <10				
S-16	[redacted]	10/19/93	MEDIUM BROWN TO GRAY SILTY CLAY W/ TRACE GRAVEL, MOIST			<10				
S-17	[redacted]	10/19/93	MEDIUM BROWN TO GRAY SILTY CLAY W/ ROOT FRAGMENTS, MOIST			<10				
S-18	[redacted]	10/19/93	DARK BROWN SILTY CLAY W/ ROOTS, REDDOG & SAND, MOIST TO WET			<10				
S-19	[redacted]	10/19/93	MEDIUM BROWN TO OLIVE SILTY CLAY W/ TRACE GRAVEL & ROOTS, MOIST			<10				
S-20	[redacted]	10/19/93	MEDIUM TO OLIVE BROWN SILTY CLAY, TRACE SAND, MOIST	X	X	<10 <10 <10	ND			
S-21	[redacted]	10/21/93	LIGHT TAN SAND & GRAVEL			<10				
S-22	[redacted]	10/20/93	DARK BROWN TO BLACK SILTY CLAY W/ LOAM & ROOT FRAGMENTS, MOIST			<10				

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						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-23	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-24	[redacted]	10/20/93	MEDIUM BROWN TO OLIVE SILTY CLAY W/ SAND, TRACE ROOT FRAGMENTS, MOIST			<10				
S-25	[redacted]	10/23/93	DARK GRAY CLAY			<10				
SC2-26	[redacted]	10/23/93	LIGHT TAN CLAY, LITTLE SAND			<10				
SC3-27	[redacted]	10/23/93	LIGHT TAN CLAY			<10				
S-28	[redacted]	10/24/93	SANDY LOAM DARK GRAY & SOME COAL			<10				
SED-29	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-30	[redacted]	10/20/93	CLAY, GRAVEL W/ REDDOG			>10, <50				
S-31	[redacted]	10/23/93	GRAY SANDY GRAVEL W/ SOME REDDOG			<10				
SC2-32	[redacted]	10/23/93	GRAY BROWN SILTY SANDY GRAVEL W/ SOME REDDOG			<10				
SC3-33	[redacted]	10/23/93	GRAY, BLACK SANDY GRAVEL W/ SOME REDDOG			>50				
SED-34	[redacted]	10/19/93	DARK BROWN, SOME COARSE GRAVEL	X	X	<10	10.600	3.270		
SED-35	[redacted]	10/19/93	0-1.5" DARK BROWN, SOME COARSE GRAVEL; 1.5 + " BLACK, MORE FINE			>50 >50				
S-36	[redacted]	10/20/93	BROWN SAND W/ GRAVEL, SOME REDDOG			>10, <50				

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SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-37	[redacted]	10/19/93	DARK BROWN W/ SOME GRAVEL, 3-6" MORE FINES			<10				
SED-38	[redacted]	10/19/93	DARK BROWN FINE SAND OVER RED/BROWN CLAY			>50				
SED-39	[redacted]	10/19/93	DARK BROWN FINE SAND W/ SOME GRAVEL	X	X	>50	20.200	8.350		
SED-40	[redacted]	10/19/93	AT 2.5" HIT WATER; 3.5" PLASTIC SIDE OF HOLE GRAY CLAY CLUMP @ 3.5"			>50				
S-41	[redacted]	10/20/93	0-2" BROWN SAND & GRAVEL; 2-6" REDDOG & TAN SAND			<10				
S-42	[redacted]	10/20/93	BROWN SAND & GRAVEL, LITTLE REDDOG			<10				
SED-43	[redacted]	10/19/93	GRAVEL, BROWN, ROCKS	X	X	>10, <50	14.700	4.420		
S-44	[redacted]	10/20/93	DARK BROWN SAND, SOME CLAY, LOT OF REDDOG			>10, <50				
S-45	[redacted]	10/20/93	BROWN SAND & GRAVEL LITTLE REDDOG			<10				
S-46	[redacted]	10/20/93	SANDY W/ REDDOG			<10				
S-47	[redacted]	10/20/93	BROWN SAND W/ SOME CLAY & FEW GRAVEL			>10,<50				
S-48	[redacted]	10/20/93	LIGHT BROWN SANDY GRAVEL, SOME REDDOG			<10				
S-49	[redacted]	10/20/93	MEDIUM BROWN SAND W/ REDDOG			<10				
S-50	[redacted]	10/20/93	DARK BROWN, SANDY, 10% REDDOG			<10				
S-51	[redacted]	10/20/93	GRAY BROWN SANDY W/ LARGE GRAVEL			>10, <50				

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SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
S-52	[redacted]	10/20/93	GRAY BROWN SANDY SOIL W/ GRAVEL			<10				
S-53	[redacted]	10/20/93	DARK SANDY SOIL W/ 60% GRAVEL			<10				
S-54	[redacted]	10/20/93	DARK SANDY SOIL W/ 60% GRAVEL			<10				
S-55	[redacted]	10/20/93	MEDIUM SANDY, BROWN, 35% GRAVEL			<10				
S-56	[redacted]	10/20/93	BROWN SANDY, 60% GRAVEL			<10				
S-57	[redacted]	10/20/93	GRAY BROWN SAND AND GRAVEL			<10				
SED-58	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-59	[redacted]	10/23/93	LIGHT BROWN/GRAY SAND, GRAVEL; 5-6" BLACK GRAY GRAVELY SAND W/ SOME REDDOG			<10				
SED-60	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
SW-61	[redacted]	10/24/93	ARBUCKLE CREEK WATER ACROSS FROM SHAFFER ELECTRIC BUILDING	X		--	0.000016 J			
S-62	[redacted]	10/23/93	BROWN GRAY SANDY GRAVEL, VERY LITTLE REDDOG			<10				
SC2-63	[redacted]	10/23/93	BLACK SILTY, SANDY CLAY, W/ LARGE COBBLES			>50				
SC3-64	[redacted]	10/23/93	BLACK SANDY GRAVEL, SOME FINES & 40% COAL-LIKE COBBLES			<10				
GW-65	[redacted]	10/24/93	FILM OF OIL ON SURFACE OF SAMPLE	X		--	0.00638			
S-66	[redacted]	10/23/93	LIGHT BROWN SANDY GRAVEL			<10				

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SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
S-67	[redacted]	10/24/93	LIGHT GRAY SANDY GRAVEL	X	X	>50	40.400	59.900		
S-68	[redacted]	10/23/93	LIGHT BROWN, SANDY GRAVEL			<10				
S-69	[redacted]	10/23/93	BROWN SANDY GRAVEL W/ SOME REDDOG; 5.5-6" TAN SAND			<10				
S-70	[redacted]	10/24/93	DARK GRAY CLAY/SAND, LITTLE REDDOG			>50				
S-71	[redacted]	10/24/93	DARK GRAY SANDY CLAY			<10				
S-72	[redacted]	10/23/93	LIGHT BROWN, SANDY GRAVEL			<10				
S-73	[redacted]	10/23/93	BLACK SANDY GRAVEL W/ SOME REDDOG			>50				
S-74	[redacted]	10/23/93	GRAY BROWN SANDY GRAVEL	X	X	<10	4.500	2.210		
S-75	[redacted]	10/24/93	LIGHT BROWN CLAY			<10				
SC2-76	[redacted]	10/24/93	LIGHT BROWN CLAY/SAND			<10				
SC3-77	[redacted]	10/24/93	LIGHT BROWN SANDY CLAY			<10				
S-78	[redacted]	10/23/93	GRAY BROWN CLAY, SILTY GRAVEL OVER GRAVELY TAN CLAY, BOTH W/ REDDOG			>10, <50				
SED-79	[redacted]	10/24/93	SANDY CLAY, DARK GRAY, SOME GRAVEL			>50				
S-80	[redacted]	10/23/93	SANDY GRAVEL, DARK GRAY BROWN			<10				
S-81	[redacted]	10/23/93	SANDY GRAVEL, LIGHT BROWN			<10				

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SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
S-82	[redacted]	10/24/93	GRAY SANDY GRAVEL, SOME FINE			<10				
S-83	[redacted]	10/24/93	GRAY, GRAVELY SAND, SOME REDDOG			>10,<50				
S-84	[redacted]	10/24/93	GRAY, GRAVELY, SANDY CLAY			>50				
S-85	[redacted]	10/21/93	GRAY/BLACK SILTY, GRAVELY, SAND W/ SOME COAL			<10				
S-86	[redacted]	10/23/93	BLACK SAND GRAVELY COBBLEY COAL REFUSE			<10 <10				
S-87	[redacted]	10/23/93	SAME AS S-86			<10				
S-88	[redacted]	10/23/93	SAME AS S-86			<10				
S-89	[redacted]	10/24/93	DARK GRAY, SOME GRAVEL W/ LITTLE FINES			<10				
S-90	[redacted]	10/24/93	DARK GRAY GRAVELY CLAY, SOME SAND	X	X	>50	41.900	20.200		
S-91	[redacted]	10/24/93	LIGHT BROWN SANDY CLAY W/ SOME GRAVEL			<10				
S-92	[redacted]	10/23/93	LIGHT BROWN GRAVELY CLAY			<10				
S-93	[redacted]	10/24/93	DARK GRAY, GRAVELY SAND, LITTLE FINES			>50				
S-94	[redacted]	10/23/93	TAN SANDY GRAVEL OVER DARK BROWN SANDY GRAVEL, SOME REDDOG			>50 >50				
S-95	[redacted]	10/23/93	BROWN GRAY, SILTY SANDY GRAVEL & COBBLES, VERY LITTLE REDDOG			<10				

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						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-96	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-97		10/24/93	LIGHT BROWN SANDY GRAVEL, LITTLE FINES	X	X	>10,<50	8.270	2.200		
S-98		10/24/93	DARK GRAY LOAM W/ SOME GRAVEL			<10				
SED-99		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-100		10/22/93	GRAY/BROWN SANDY GRAVEL W/ COBBLES	X	X	<10	3.210	1.140		
SC2-101		10/22/93	BLACK GRAVELY SAND			<10				
SC3-102		10/22/93	BLACK GRAVELY SAND			<10				
S-103		10/24/93	DARK GRAY SANDY GRAVEL			>50				
S-104		10/24/93	DARK GRAY SANDY GRAVEL			>50				
S-105		10/21/93	GRAY/BROWN SILTY SANDY CLAY W/ GRAVEL OVER TAN SANDY SILT W/ SOME CLAY & REDDOG	X	X	<10	3.990	1.030		
SED-106		10/24/93	ARBUCKLE CREEK SEDIMENT JUST UPSTREAM OF MIDDLE BRIDGE			<10				
S-107		10/23/93	BLACK SANDY GRAVEL W/ COAL REFUSE, W/ TAN OXIDIZED SHALE 30%			<10				
SC2-108		10/23/93	BLACK SANDY GRAVEL W/ COAL REFUSE W/ TAN SHALE 25%			<10				
SC3-109		10/23/93	BLACK SANDY GRAVEL W/ COAL REFUSE W/ TAN SHALE 40%	X	X	<10	ND	ND		

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
SW = Surface water GW = Groundwater R = Rinsate DW = Decontamination water P = Personal Protective Equipment

Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-110	[redacted]	10/21/93	TAN BROWN SILT OVER BLACK SILT			>10,<50				
S-111		10/21/93	BLACK, SILTY, SANDY SOME CLAY AND GRAVEL			<10				
S-112		10/22/93	TAN/BROWN CLAY OVER BLACK SILTY, SOME REDDOG, ALL W/ ROOTS			>50				
SC2-113		10/22/93	BLACK SAND WELL SORTED			<10				
SC3-114		10/22/93	BLACK COAL RESIDUE, FINE SILTY W/ LARGE GRAY COBBLES			<10				
S-115		10/21/93	DARK BROWN/BLACK SILTY SAND			<10				
SED-116		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-117		10/24/93	ARBUCKLE CREEK SEDIMENT			>10, <50 >10, <50				
SED-118		10/24/93	ARBUCKLE CREEK SEDIMENT	X	X	<10	7.040	2.200		
SED-119		10/24/93	ARBUCKLE CREEK SEDIMENT			>10,<50				
S-120		10/21/93	DARK BROWN/BLACK SILTY SAND, 40% REDDOG	X	X	<10	4.100	1.720		
S-121		10/22/93	TAN BROWN SILTY CLAY & GRAVEL			<10				
SC2-122		10/22/93	TAN CLAY W/ REDDOG OVER BLACK SILT AND CLAY			<10				
SC3-123		10/22/93	GRAY AND BLACK SILT & CLAY OVER BLACK SILT & SAND			<10				

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
SW = Surface water GW = Groundwater R = Rinsate DW = Decontamination water P = Personal Protective Equipment

Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
S-124	[redacted]	10/21/93	TAN SANDY CLAY W/ REDDOG OVER BLACK SAND & GRAVEL			<10				
S-125		10/21/93	TAN BROWN SILTY SANDY CLAY W/ VERY LITTLE REDDOG			<10				
S-126		10/21/93	LIGHT BROWN SILTY SANDY CLAY W/ SOME REDDOG			<10				
S-127		10/21/93	TAN SILTY CLAY W/ SOME GRAVEL			<10				
S-128		10/21/93	TAN SAND W/ REDDOG OVER BLACK SANDY SILTY CLAY	X	X	<10	3.640	0.520		
S-129		10/21/93	GRAVELY BLACK BROWN SILT			<10				
SED-130		10/21/93	TAN SILTY CLAY W/ GRAVEL			<10				
S-131		10/21/93	TAN SILTY CLAY W/ GRAVEL			<10				
S-132		10/22/93	GRAY/BLACK SANDY GRAVEL W/ SOME REDDOG			<10				
SC2-133		10/22/93	BLACK, SANDY GRAVEL, COAL CHUNKS & FINES			<10				
SC3-134		10/22/93	LIGHT BROWN WELL SORTED SAND, MEDIUM GRAIN, WET			<10				
S-135		10/21/93	BROWN GRAY SILTY, SANDY CLAY W/ GRAVEL & REDDOG			<10				
SED-136		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-137		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
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Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

Page 11 of 14

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
SED-138	[redacted]	10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-139		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
S-140		10/20/93	BLACK SAND SILTY, SOME GRAVEL REDDOG			<10				
S-141		10/21/93	GRAYISH BROWN			<10				
S-142		10/21/93	LIGHT BROWN CLAY			<10				
S-143		10/21/93	BROWN SILTY, CLAYEY, SAND W/ GRAVEL, SOME REDDOG	X	X	<10	0.122	0.190		
S-144		10/21/93	DARK GRAY SILTY GRAVEL			<10				
S-145		10/20/93	DARK GRAY GRAVEL W/ CLAY & SILT			<10				
S-146		10/20/93	FINE SILTY CLAY, LIGHT BROWN			<10				
S-147		10/20/93	DARK GRAY, SANDY, SOME GRAVEL			<10				
SED-148		10/24/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-149		10/23/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-150		10/23/93	ARBUCKLE CREEK SEDIMENT	X	X	<10	2.020	0.360		
SED-151		10/23/93	ARBUCKLE CREEK SEDIMENT			<10				
S-152		10/20/93	BLACK SANDY & GRAVEL, NOT WET			<10				

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
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Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
S-153	[redacted]	10/20/93	BLACK SILT, 5% REDDOG			<10				
SED-154		10/20/93	BLACK/BROWN CLAYEY SAND, SILT W/ REDDOG			<10				
S-155		10/20/93	LIGHT GRAY/BLACK, SILT CLAY, VERY WET, ORGANIC			>50				
S-156		10/20/93	BLACK, CLAYEY, SANDY & MOIST W/ SOME REDDOG, GRAVEL AND COBBLES			<10				
S-157		10/20/93	BLACK SANDY & GRAVEL, SOME COBBLES, NOT WET			<10				
SED-158		10/23/93	ARBUCKLE CREEK			<10				
S-159	BEYOND SITE, NO SAMPLE COLLECTED									
SED-160	[redacted]	10/23/93	ARBUCKLE CREEK SEDIMENT			<10				
SED-161		10/23/93	ARBUCKLE CREEK SEDIMENT			>10,<50 <10				
S-162	BEYOND SITE, NO SAMPLE COLLECTED									
SED-163	BEYOND SITE, NO SAMPLE COLLECTED									
SED-164	[redacted]	10/24/93	DUPLICATE SEDIMENT AT SED-118	X		>10,<50	16.600			
S-165		10/23/93	DUPLICATE SOIL AT S-74	X		>10, <50 >10, <50	4.830			
R-166		10/24/93	SPLIT SPOON RINSATE	X			ND			

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
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Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

SAMPLE #	SAMPLER	DATE	REMARKS SAMPLER	TO LAB	SPLIT	PCB RESULTS (ppm)				REMARKS
						ENSYS TEST KIT	LABORATORY ANALYSIS			
							TAT	WVDEP	BLC	
R-167	[redacted]	10/24/93	HAND AUGER RINSATE	X			ND			
S-168		10/25/93	LIGHT BROWN, WELL SORTED SAND W/ LITTLE REDDOG			<10				
S-169		10/25/93	LIGHT BROWN WELL SORTED SAND	X	X	>10,<50	18.200	4.900		
S-170		10/25/93	DARK GRAY SAND, SOME REDDOG, SOME CLAY			<10				
S-171		10/25/93	FINE SAND AND CLAY, DARK GRAY			<10				
S-172		10/25/93	SANDY GRAVEL, SMALL AMOUNT OF SILT, SOME - REDDOG			<10				
S-173		10/25/93	FINE SAND , WELL SORTED, DARK GRAY, LITTLE CLAY			<10				
S-174		10/25/93	FINE SAND, DARK GRAY SOME REDDOG			<10				
S-175		10/25/93	DARK GRAY SAND, WELL SORTED, LITTLE CLAY			<10				
S-176		10/25/93	DARK GRAY SAND, SOME REDDOG, SOME CLAY			<10				
DW-177		10/25/93	DECONTAMINATION WATER	X			0.0349			
P-178		10/25/93	PERSONAL PROTECTIVE EQUIPMENT	X			<0.1			

S = Surface soil SC2 = Soil between depths of 18" to 24" SC3 = Soil between depths of 30" to 36" SED = Sediment
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Site Review Trip Report
Attachment - 10
January 03, 1994

TABLE 5
ANALYTICAL DATA SUMMARY
SHAFFER ELECTRIC COMPANY SITE, MINDEN, FAYETTE COUNTY, WV

INDEX TABLE

EPA-TAT SAMPLING PERSONNEL

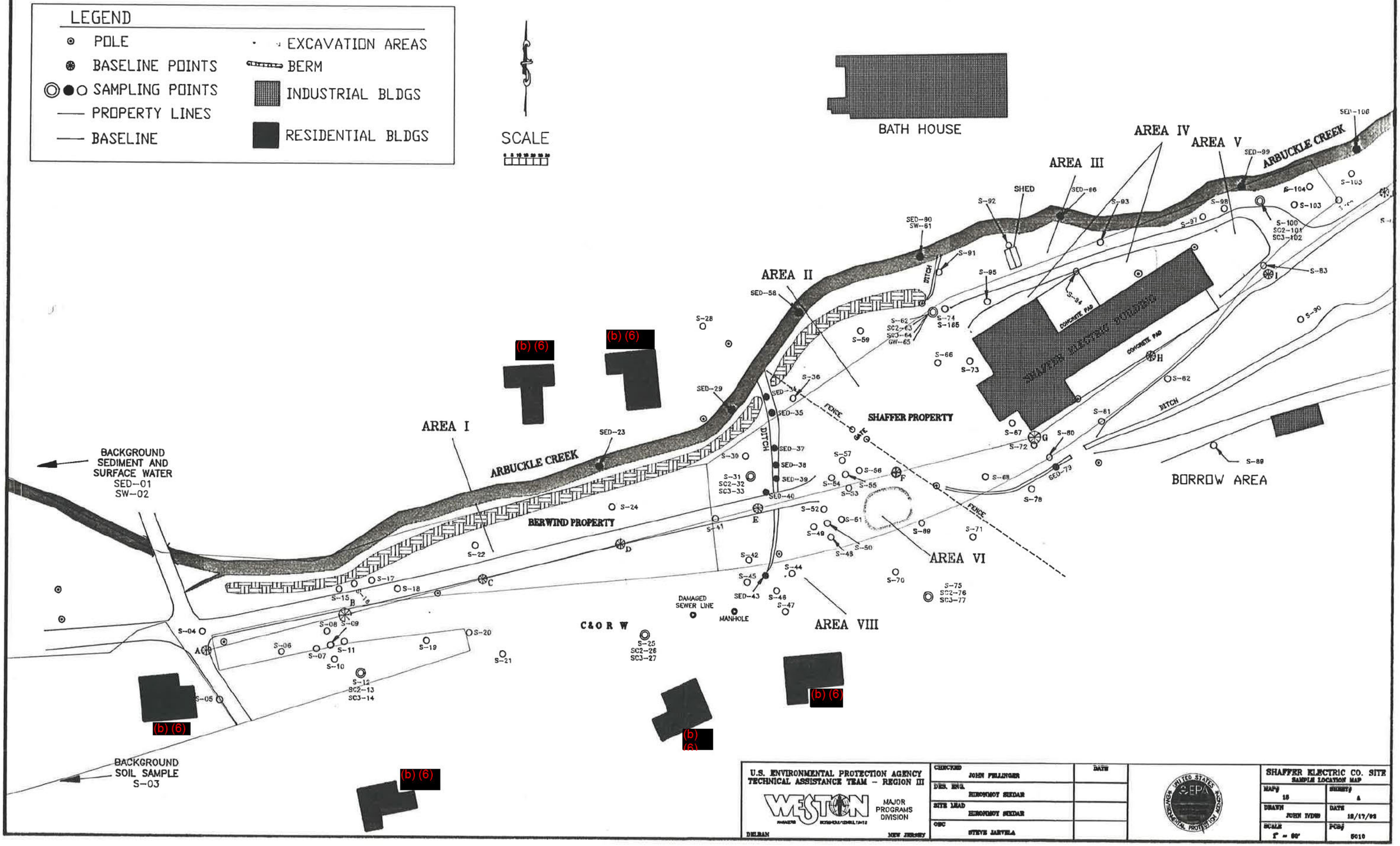
[redacted]

BERWIND LAND COMPANY CONTRACTORS

[redacted]

DEFINITIONS

More than one test results indicate confirmation testing
REDDOG = Red gravel for road bed
< = Less than
> = Greater than
ND = Not detected
J = Estimated value, below method detection limit

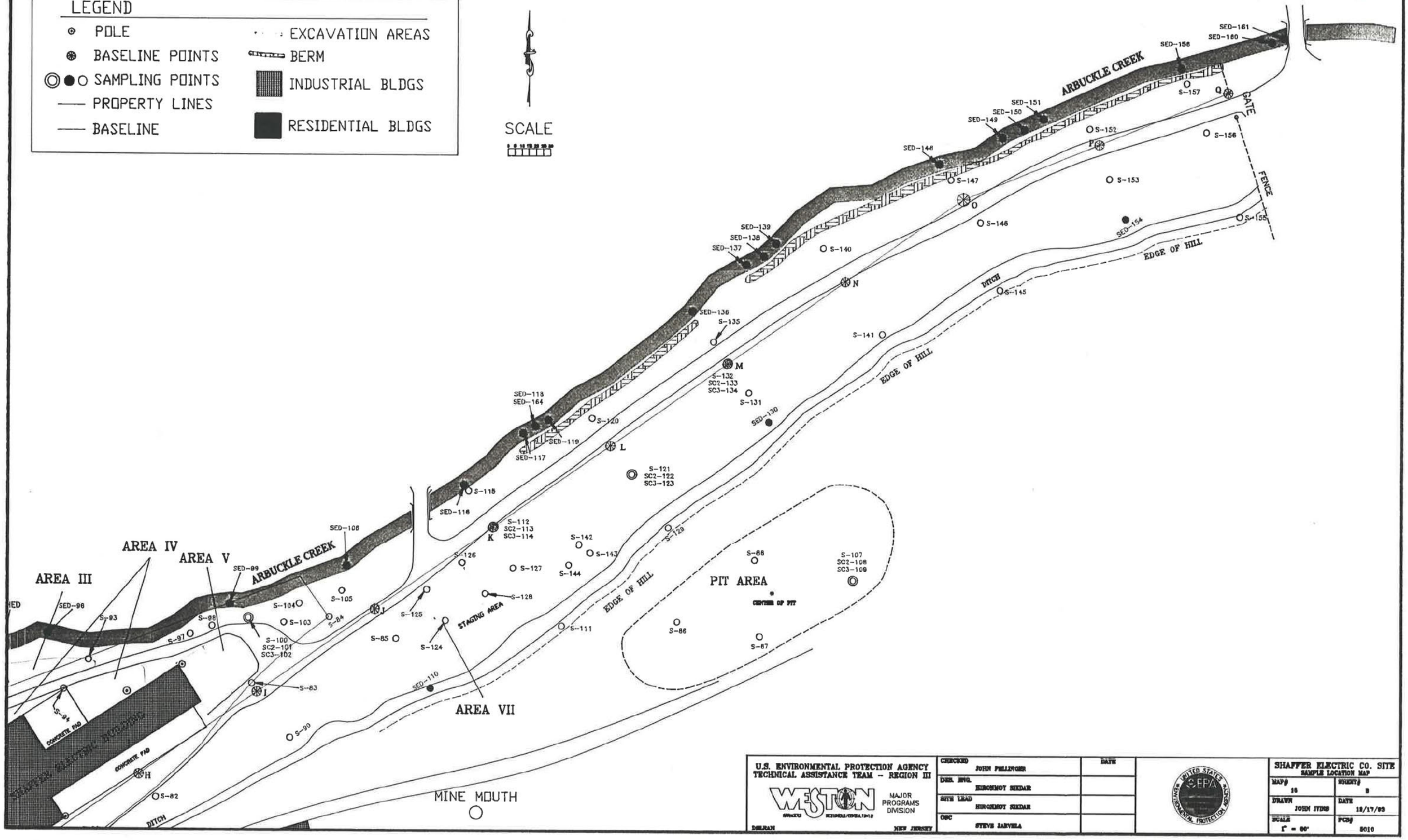

LEGEND
POLE
BASELINE POINTS
SAMPLING POINTS
PROPERTY LINES
BASELINE
EXCAVATION AREAS
BERM
INDUSTRIAL BLDGS
RESIDENTIAL BLDGS
SCALE
BATH HOUSE
AREA I
AREA II
AREA III
AREA IV
AREA V
AREA VI
AREA VIII
ARBUCKLE CREEK
BACKGROUND SEDIMENT AND SURFACE WATER SED--01 SW--02
BACKGROUND SOIL SAMPLE S--03
SHAFFER PROPERTY
BERWIND PROPERTY
BORROW AREA
C&O R W
DAMAGED SEWER LINE
MANHOLE
SHED
DITCH
FENCE
CONCRETE PAD
(b) (6)
U.S. ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ASSISTANCE TEAM - REGION III
WESTON
MAJOR PROGRAMS DIVISION
DELRAN NEW JERSEY
CHECKED JOHN FELLINGER
DES. ENG. HIRONMOY SIKDAR
SITE LEAD HIRONMOY SIKDAR
QAC STEVE JARVELA
DATE
SHAFFER ELECTRIC CO. SITE
SAMPLE LOCATION MAP
MAP# 15
SHEET# 4
DRAWN JOHN IVENS
DATE 12/17/93
SCALE 1" = 80'
PCS# 5010

ORIGINAL (Red)

LEGEND

- POLE
- BASELINE POINTS
- SAMPLING POINTS
- PROPERTY LINES
- BASELINE
- EXCAVATION AREAS
- BERM
- INDUSTRIAL BLDGS
- RESIDENTIAL BLDGS

SCALE



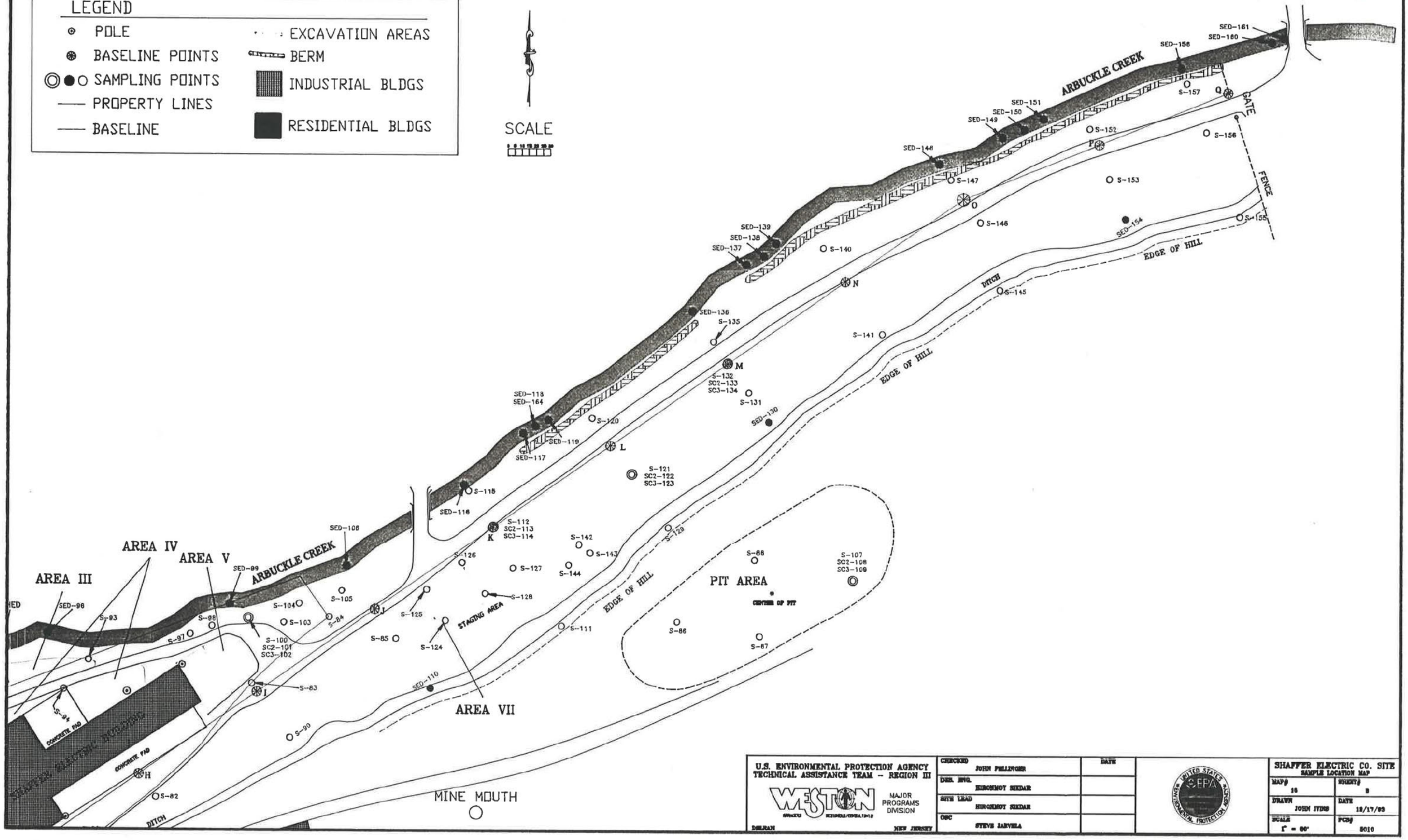
U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL ASSISTANCE TEAM – REGION III WESTON MAJOR PROGRAMS DIVISION DEPTFORD NEW JERSEY	CHECKED: JOHN FELLINGER	DATE:	SHAFFER ELECTRIC CO. SITE SAMPLE LOCATION MAP
	DES. ENG.: HIROSHOT SHIDAR		MAP# 16 / SHEET# 2
	SITE LEAD: HIROSHOT SHIDAR		DRAWN: JOHN IVINS / DATE: 12/17/93
	OSC: STEVE JARVELA		SCALE: 1" = 80' / FCS# 5010

ORIGINAL (Red)

LEGEND

- POLE
- BASELINE POINTS
- SAMPLING POINTS
- PROPERTY LINES
- BASELINE
- EXCAVATION AREAS
- BERM
- INDUSTRIAL BLDGS
- RESIDENTIAL BLDGS

SCALE



U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL ASSISTANCE TEAM – REGION III WESTON MAJOR PROGRAMS DIVISION DEPTFORD NEW JERSEY	CHECKED: JOHN FELLINGER	DATE:	SHAFFER ELECTRIC CO. SITE SAMPLE LOCATION MAP
	DES. ENG.: HIROSHOT SHIDAR		MAP# 16 / SHEET# 2
	SITE LEAD: HIROSHOT SHIDAR		DRAWN: JOHN IVINS / DATE: 12/17/93
	OSC: STEVE JARVELA		SCALE: 1" = 80' / FCS# 5010

SHEET	DESCRIPTION
1.	TITLE PAGE
2.	ORIGINAL SITE GRADE
3.	LINER GRADE – AS CONSTRUCTED
4.	FINAL GRADE – AS CONSTRUCTED
5.	AS-BUILT CAP PROFILE
6.	AS-BUILT DIVERSION DITCH PROFILE
7–13.	AS-BUILT CROSS SECTIONS
14.	VOLUME REPORT

US ARMY CORPS OF ENGINEERS

HUNTINGTON DISTRICT

FORMER SHAFFER ELECTRIC CO. SITE

MINDEN, WEST VIRGINIA

SITE CLOSURE CAP

AS-BUILT DRAWINGS

APRIL 2003

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25110
My Commission Expires January 8, 2007

(b) (4)

POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
TITLE PAGE

CONSTRUCTION COMPLETED OCTOBER 4, 2002

SCALE: N/A
CONTOUR INTERVAL: N/A
DATE PREPARED: APRIL 2002
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

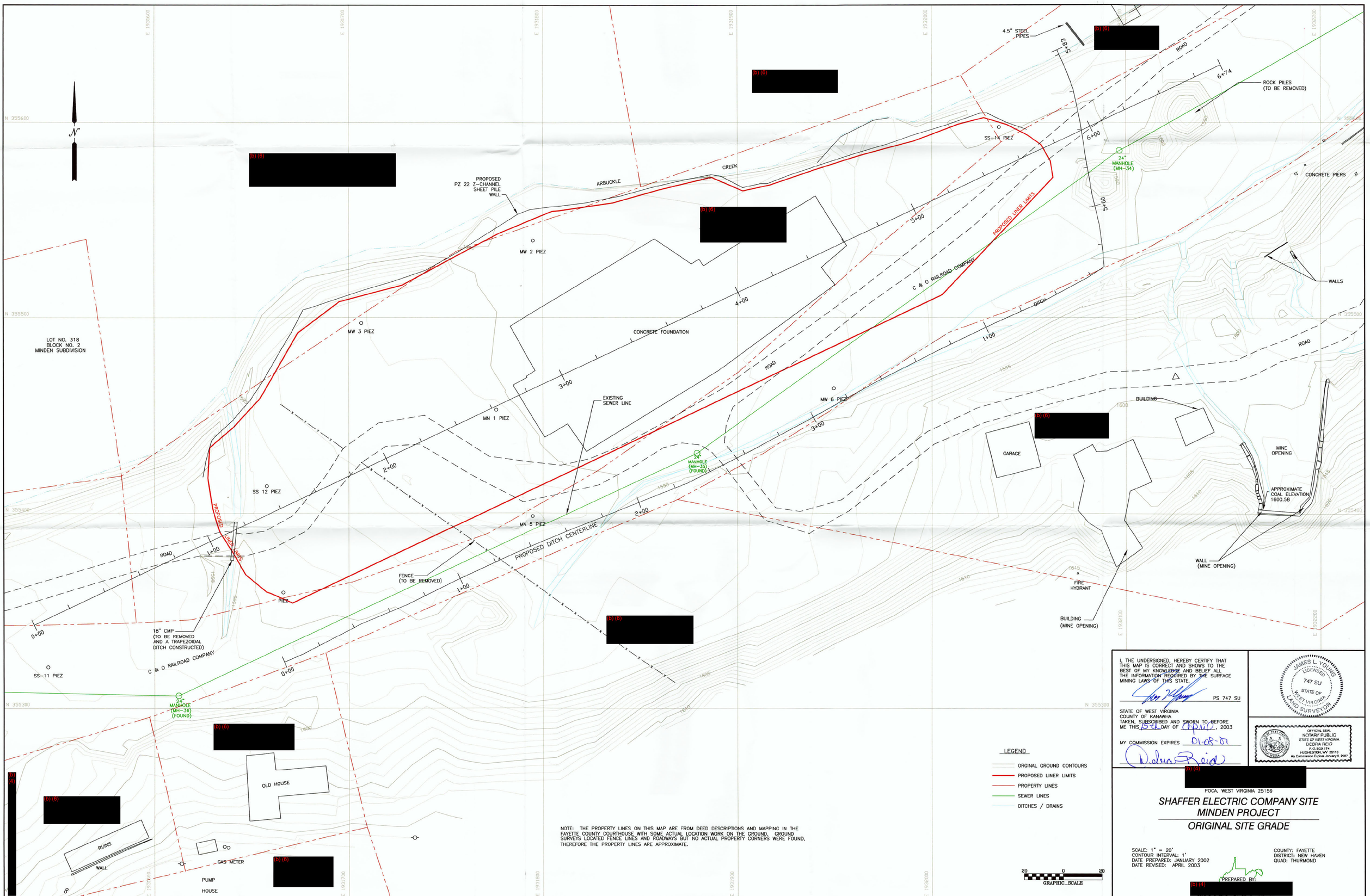
PREPARED BY:

(b) (4)

COVER

SHEET 1 OF 14

(b) (4)



NOTE: THE PROPERTY LINES ON THIS MAP ARE FROM DEED DESCRIPTIONS AND MAPPING IN THE FAYETTE COUNTY COURTHOUSE WITH SOME ACTUAL LOCATION WORK ON THE GROUND. GROUND SURVEYS LOCATED FENCE LINES AND ROADWAYS BUT NO ACTUAL PROPERTY CORNERS WERE FOUND, THEREFORE THE PROPERTY LINES ARE APPROXIMATE.

LEGEND

- ORGINAL GROUND CONTOURS
- PROPOSED LINER LIMITS
- PROPERTY LINES
- SEWER LINES
- DITCHES / DRAINS

20 0 20
GRAPHIC SCALE

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 25th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25110
My Commission Expires January 8, 2007

(b) (4)
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
ORIGINAL SITE GRADE

SCALE: 1" = 20'
CONTOUR INTERVAL: 1'
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

(PREPARED BY:
(b) (4)

N

E 1931600 E 1931700 E 1931800 E 1931900 E 1932000 E 1932100 E 1932200

N 355600 N 355500 N 355400 N 355300 N 355200

(b) (6)

(b) (6)

(b) (6)

(b) (6)

(b) (6)

(b) (6)

(b) (6)

(b) (4)

TOP OF WALL ELEV.: 1589.29

TOP OF WALL ELEV.: 1589.33

TOP OF WALL ELEV.: 1589.32

TOP OF WALL ELEV.: 1589.51

SURVEYED WALL (PZ 22 Z-CHANNEL)

TOP OF WALL ELEV.: 1590.12

TOP OF WALL ELEV.: 1590.74

CREEK

TOP OF WALL ELEV.: 1590.69

ARBUCKLE

TOP OF WALL ELEV.: 1591.15

TOP OF WALL ELEV.: 1592.41

TOP OF WALL ELEV.: 1593.22

TOP OF WALL ELEV.: 1595.54

TOP OF WALL ELEV.: 1596.03

TOP OF WALL ELEV.: 1596.97

MW-3 PIEZOMETER ELEV.: 1593.21

MW 4 PIEZOMETER ELEV.: 1595.36

MW 1 PIEZOMETER ELEV.: 1593.34

MW-2 PIEZOMETER ELEV.: 1600.60

24" MANHOLE (MH-34)

24" MANHOLE (MH-35) (FOUND)

24" MANHOLE (MH-36) (FOUND)

APPROXIMATE LINER LIMITS

C & O RAILROAD COMPANY

PROPOSED DITCH CENTERLINE

0+00 1+00 2+00 3+00 4+00 5+00 5+83 6+00 6+74

1590 1595

OLD HOUSE

RUINS

WALL

GAS METER

GAS METER

LEGEND

- LINER GRADE CONTOURS
- LINER LIMITS (APPROXIMATE)
- PROPERTY LINES
- SEWER LINE

NOTE: THE PROPERTY LINES ON THIS MAP ARE FROM DEED DESCRIPTIONS AND MAPPING IN THE FAYETTE COUNTY COURTHOUSE WITH SOME ACTUAL LOCATION WORK ON THE GROUND. GROUND SURVEYS LOCATED FENCE LINES AND ROADWAYS BUT NO ACTUAL PROPERTY CORNERS WERE FOUND, THEREFORE THE PROPERTY LINES ARE APPROXIMATE.

20 0 20
GRAPHIC SCALE

NOTE: LINER NOT LOCATED BY SURVEY. SOUTH AND SOUTHEAST LIMITS STAKED FOR CONSTRUCTION.

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15 DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

Debra Reid

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 774
HUGHESTON, WV 25110
My Commission Expires January 8, 2007

(b) (4)

POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
LINER GRADE - AS CONSTRUCTION

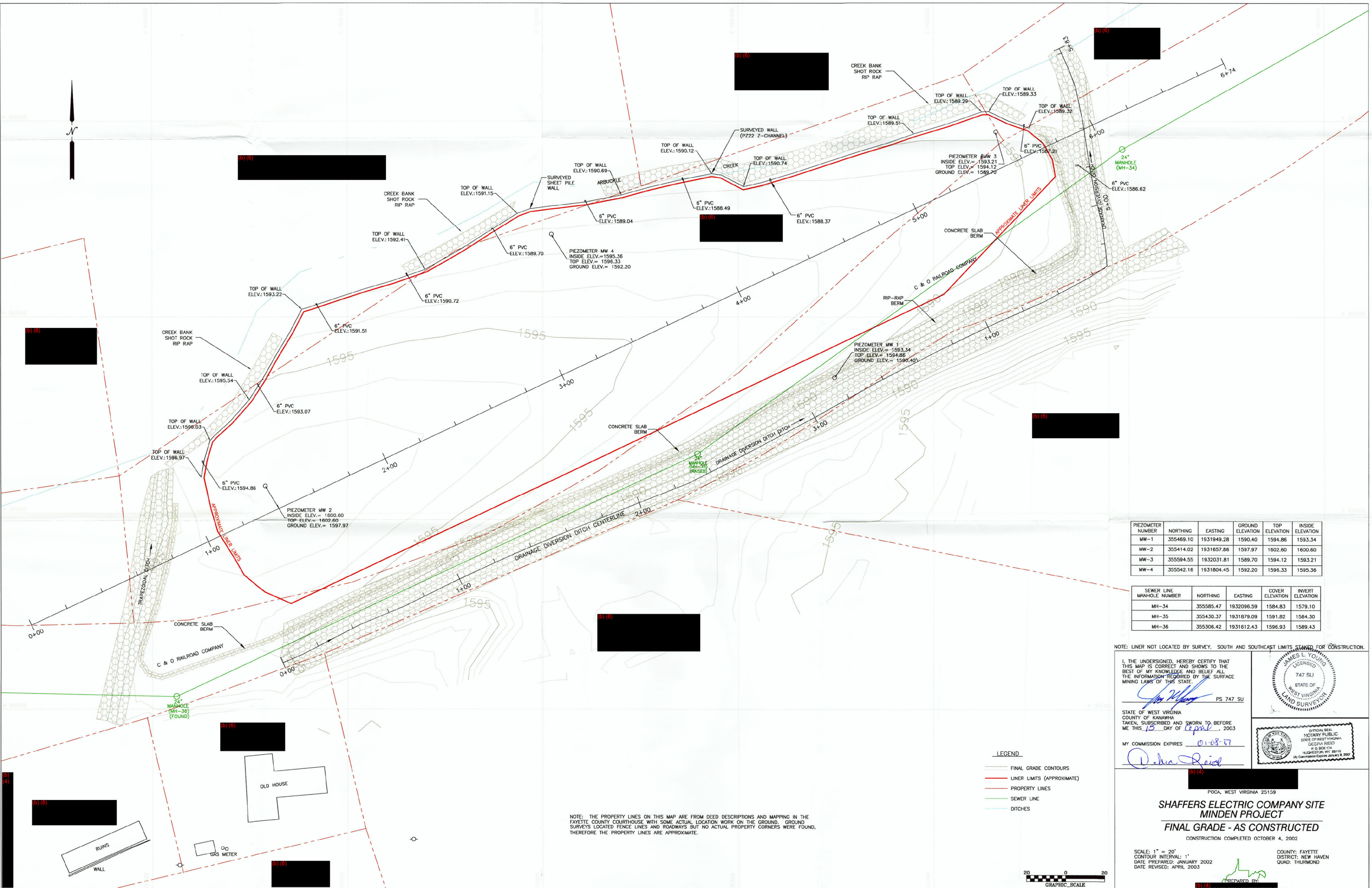
SCALE: 1" = 20'
CONTOUR INTERVAL: 1'
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

PREPARED BY:

(b) (4)

LINER_TOPO



PIEZOMETER NUMBER	NORTHING	EASTING	GROUND ELEVATION	TOP ELEVATION	INSIDE ELEVATION
MW-1	355469.10	1931949.28	1590.40	1594.86	1593.34
MW-2	355414.02	1931657.86	1597.97	1602.60	1600.60
MW-3	355594.55	1932031.81	1589.70	1594.12	1593.21
MW-4	355542.16	1931804.45	1592.20	1596.33	1595.36

SEWER LINE MANHOLE NUMBER	NORTHING	EASTING	COVER ELEVATION	INVERT ELEVATION
MH-34	355585.47	1932096.59	1584.83	1579.10
MH-35	355430.37	1931879.09	1591.82	1584.30
MH-36	355306.42	1931612.43	1596.93	1589.43

NOTE: LINER NOT LOCATED BY SURVEY. SOUTH AND SOUTHEAST LIMITS STAKED FOR CONSTRUCTION.

NOTE: THE PROPERTY LINES ON THIS MAP ARE FROM DEED DESCRIPTIONS AND MAPPING IN THE FAYETTE COUNTY COURTHOUSE WITH SOME ACTUAL LOCATION WORK ON THE GROUND. GROUND SURVEYS LOCATED FENCE LINES AND ROADWAYS BUT NO ACTUAL PROPERTY CORNERS WERE FOUND, THEREFORE THE PROPERTY LINES ARE APPROXIMATE.

LEGEND

- FINAL GRADE CONTOURS
- LINER LIMITS (APPROXIMATE)
- PROPERTY LINES
- SEWER LINE
- DITCHES

20 0 20
GRAPHIC SCALE

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15 DAY OF April, 2003

MY COMMISSION EXPIRES 01-28-07

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL NOTARY PUBLIC STATE OF WEST VIRGINIA DEERA REID P. O. BOX 174 HUGHESTON, WV 25110 My Commission Expires January 8, 2007

(b) (4)

POCA, WEST VIRGINIA 25159

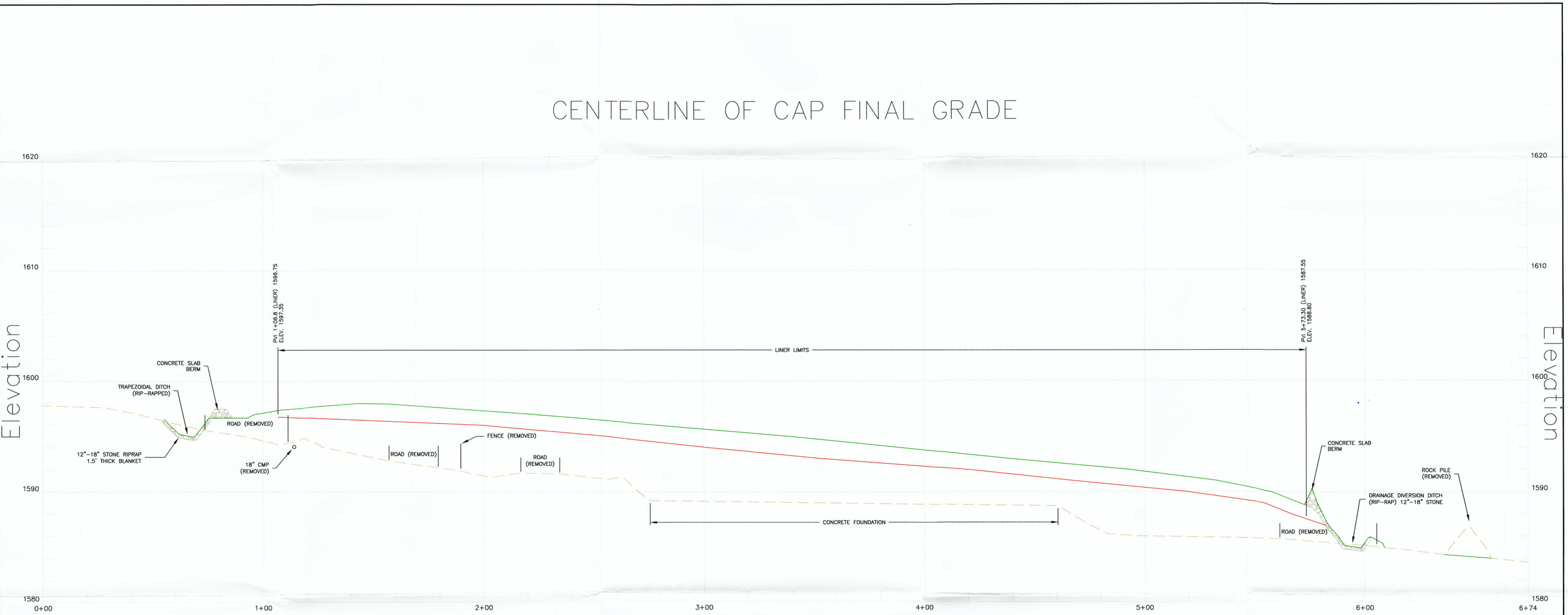
SHAFFERS ELECTRIC COMPANY SITE
MINDEN PROJECT
FINAL GRADE - AS CONSTRUCTED

CONSTRUCTION COMPLETED OCTOBER 4, 2002

SCALE: 1" = 20'
CONTOUR INTERVAL: 1'
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

PREPARED BY:
(b) (4)



LEGEND

- ORIGINAL GROUND
- LINER GRADE
- FINAL GROUND
- RIP-RAP

GRAPHIC_SCALE
0 20 4 0

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG, LICENSED, 747 SU, STATE OF WEST VIRGINIA, LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
S.S.N.XXX-XX-1792
HUNTINGTON, WV 25110
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CAP PROFILE

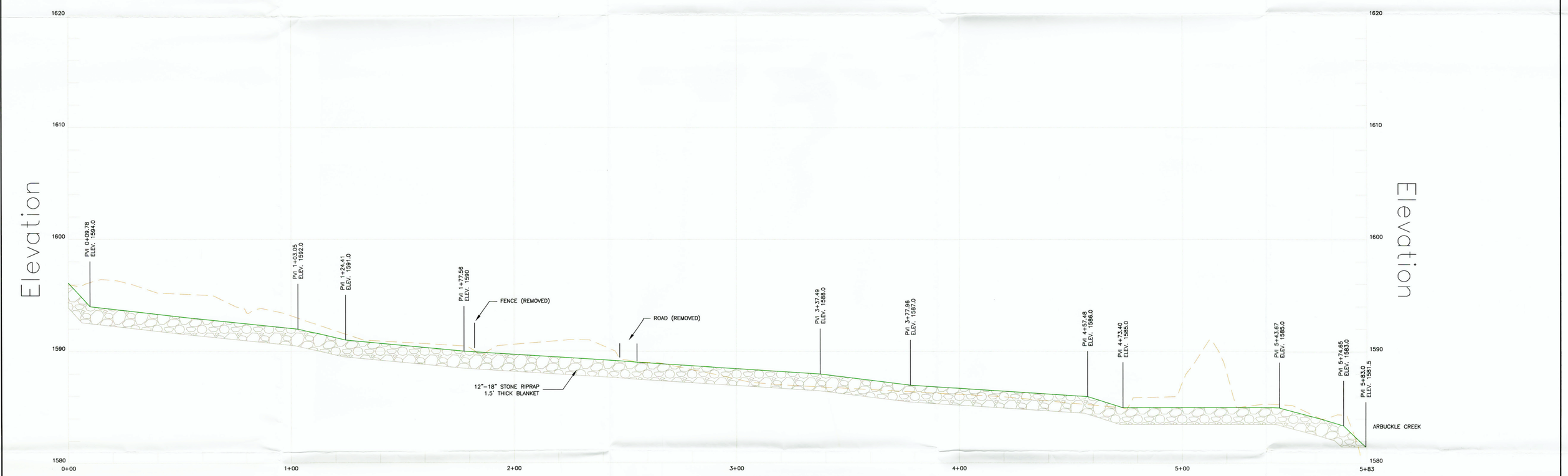
SCALE: AS SHOWN
CONTOUR INTERVAL: 1'
DATE PREPARED: JANUARY 2003
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

PREPARED BY:
Mountain State Company

G:\WASTETRON\Minden\FINAL_MAPS\MINDEN-PROF.dwg

CENTERLINE OF DRAINAGE DIVERSION DITCH BOTTOM



LEGEND

ORIGINAL GROUND
FINAL GROUND
RIP-RAP

GRAPHIC_SCALE
0 20 4 0

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-05-07

JAMES L. YOUNG
LICENSED
747 SU
STATE OF WEST VIRGINIA
LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25116
My Commission Expires January 5, 2007

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT

DRAINAGE DIVERSION DITCH AS-BUILT DITCH PROFILE

SCALE: AS SHOWN
CONTOUR INTERVAL: 1'
DATE PREPARED: JANUARY 2003
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

PREPARED BY:
Mountain State Company
P.O. BOX O • CEDAR GROVE, WV 25039
2318 E. DUPONT AVE. • BELLE, WEST VIRGINIA

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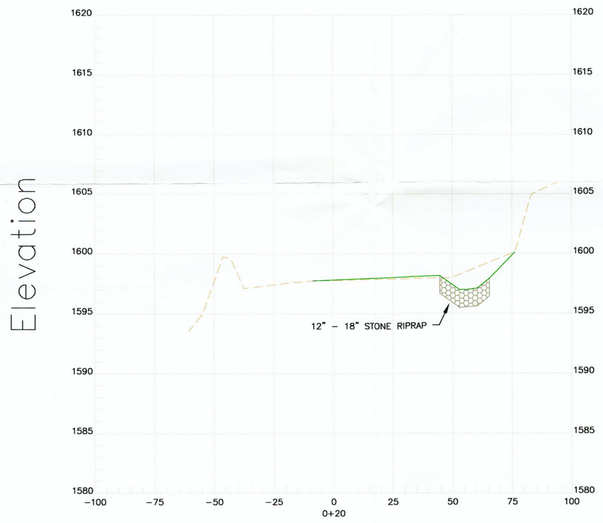

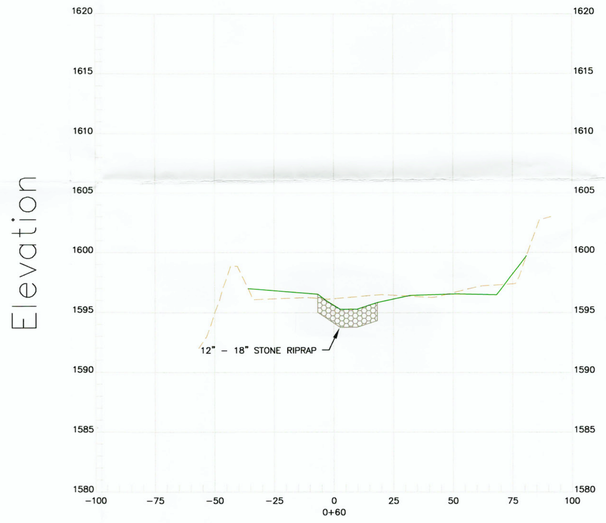

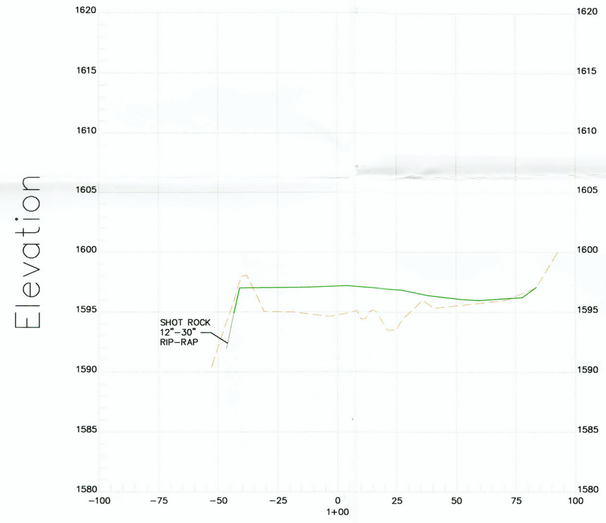

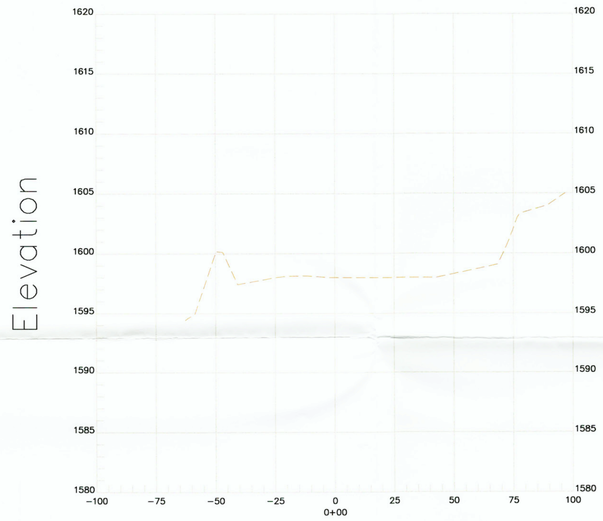

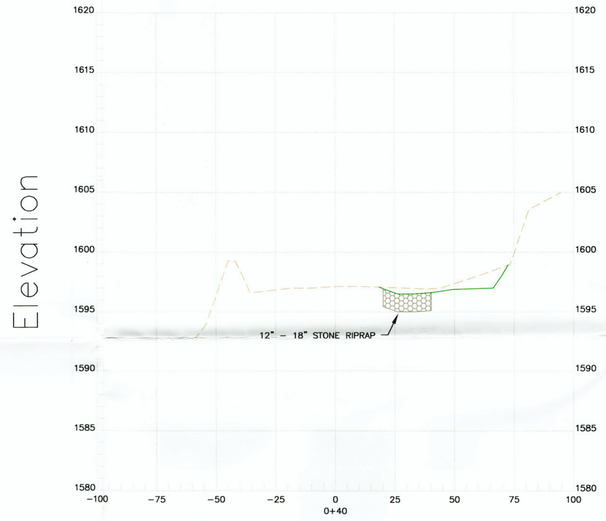

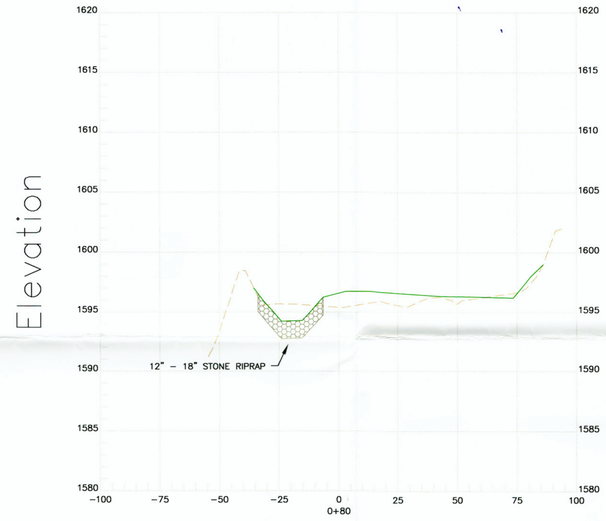

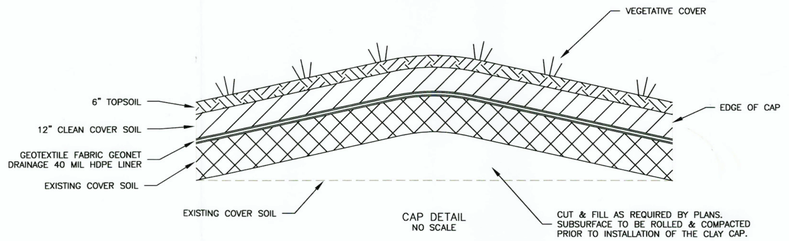

LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND

GRAPHIC_SCALE
0 30 60

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25118
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

PREPARED BY:
Mountain State Company
P.O. BOX 0 • CEDAR GROVE, WV 25039
2318 E. DuPONT AVE. • BELLE, WEST VIRGINIA

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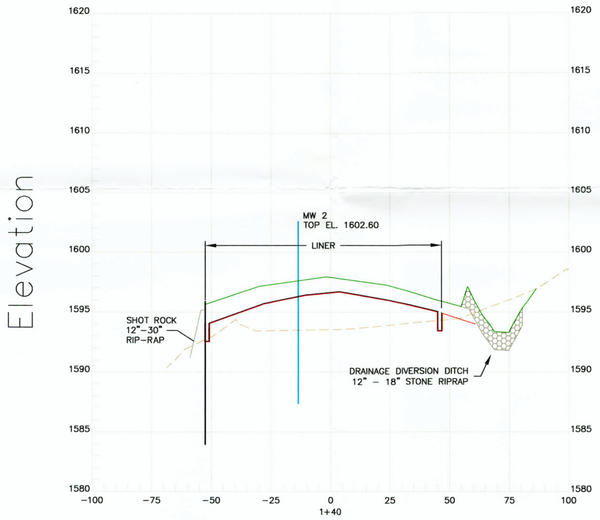
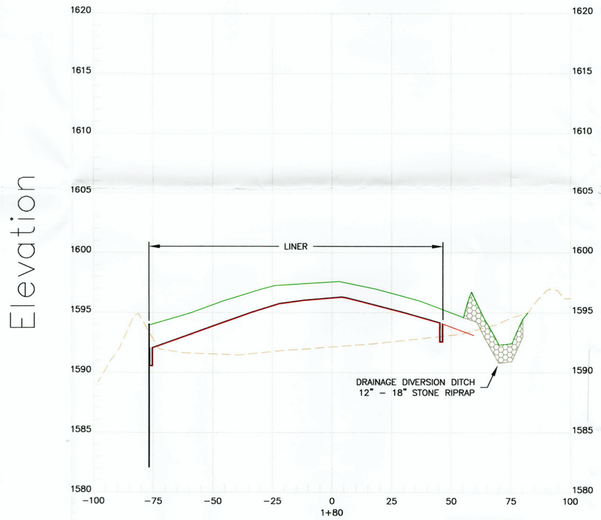
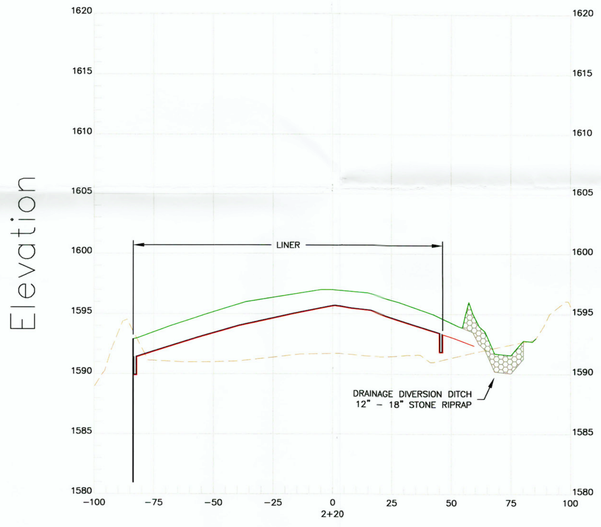
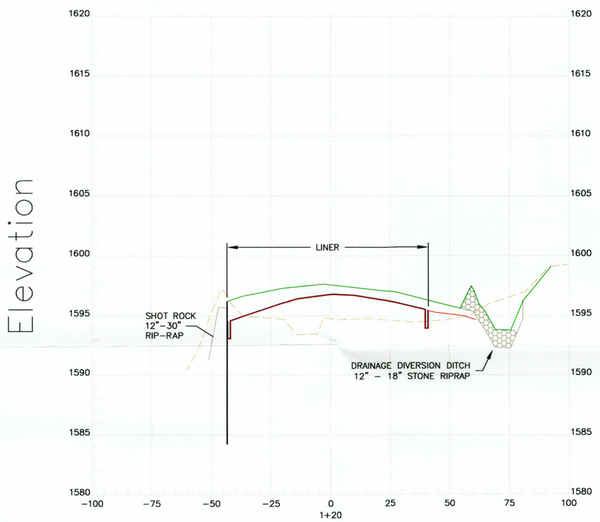
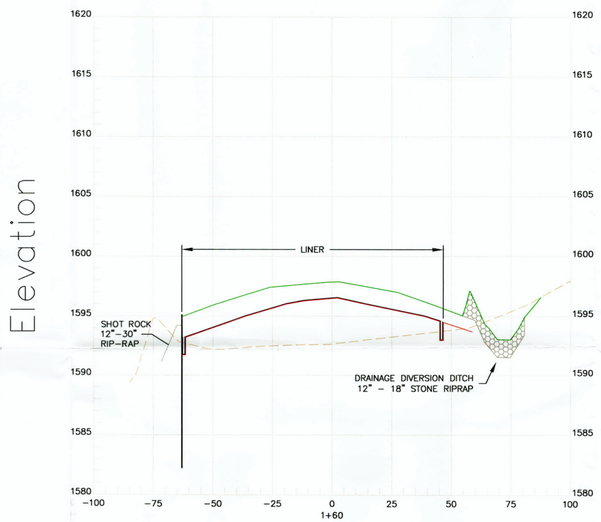
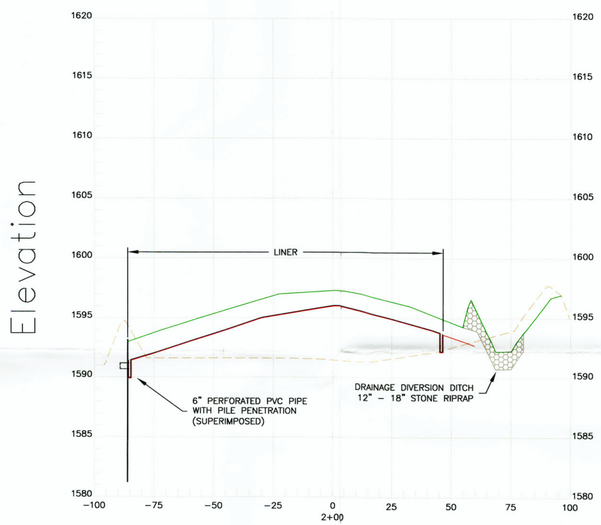


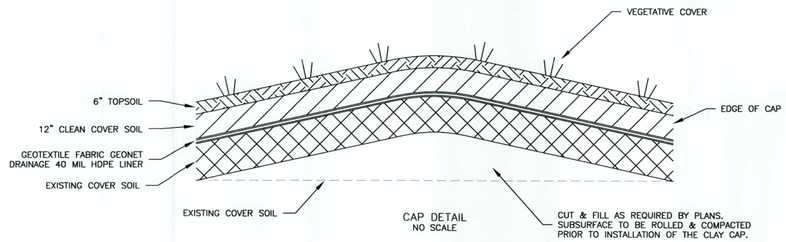












CAP DETAIL
NO SCALE

LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND

GRAPHIC_SCALE
0 30 6 0

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG
LICENSED
747 SU
STATE OF WEST VIRGINIA
LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25110
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

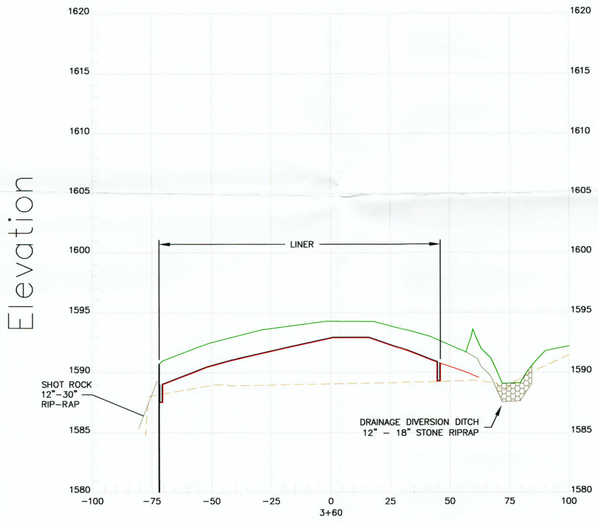
SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

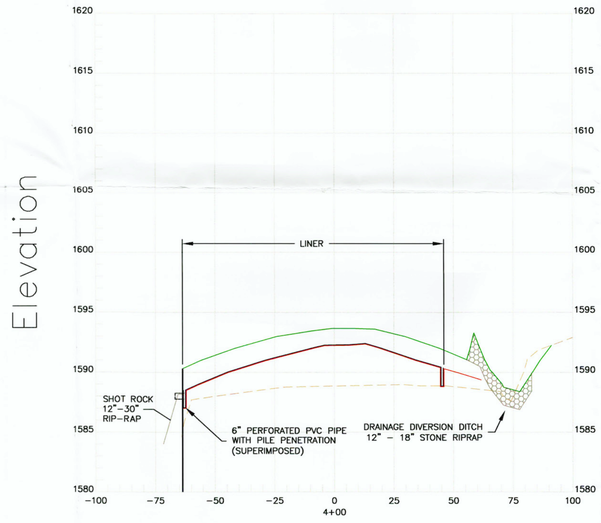
SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

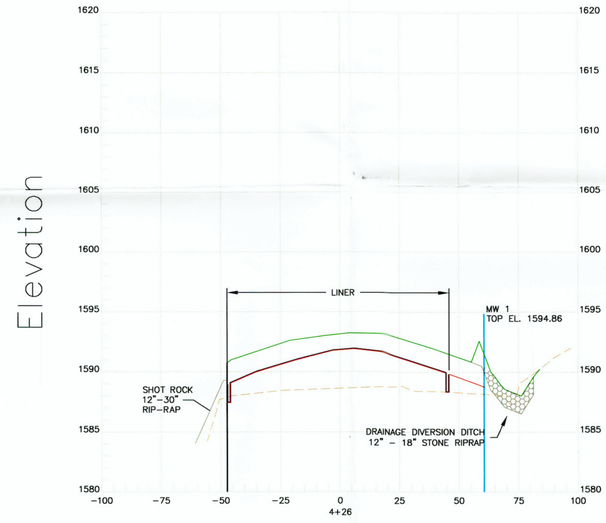
COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

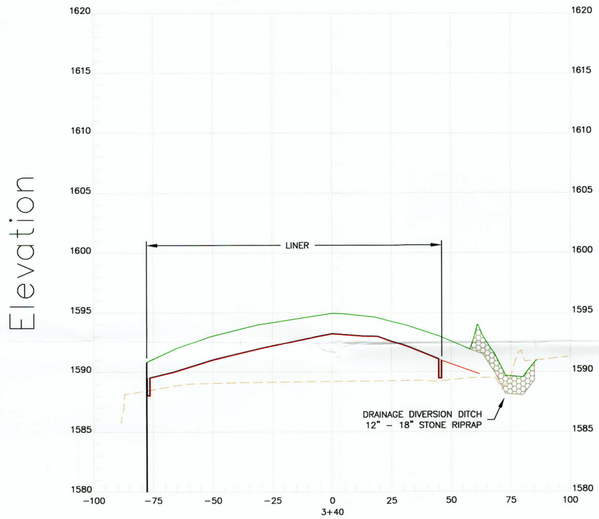
PREPARED BY:
Mountain State Company

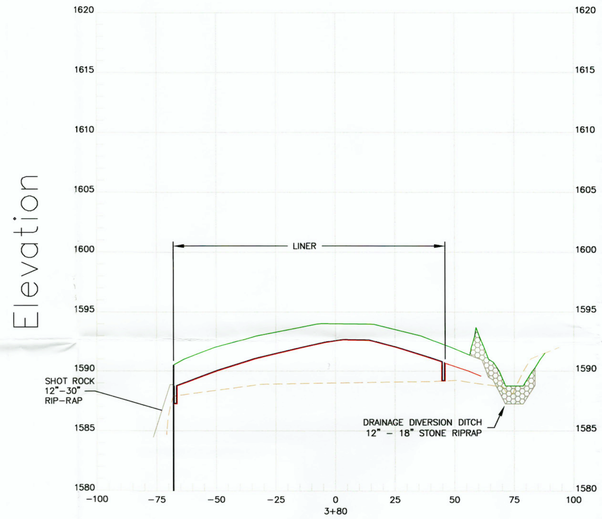
WASTETRON_Minden_FINAL_MAPS_MINDEN-SECTIONS.dwg

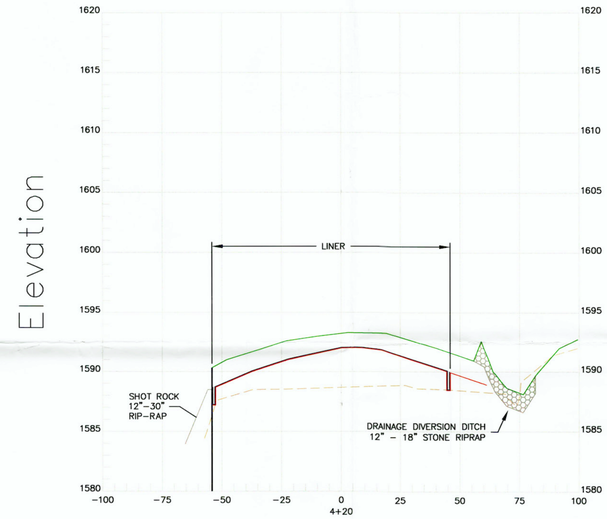


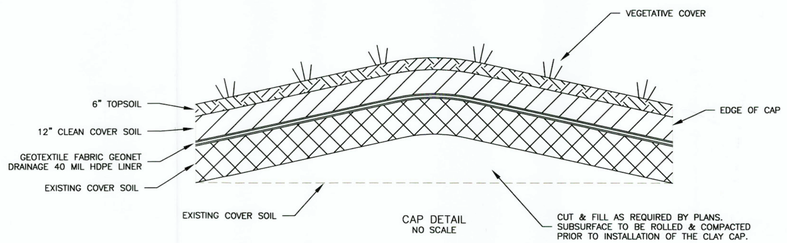












LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND
- SHEET PILING

GRAPHIC_SCALE
0 30 60

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15 DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P. O. BOX 174
HUGHESTON, WV 25110
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33–B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

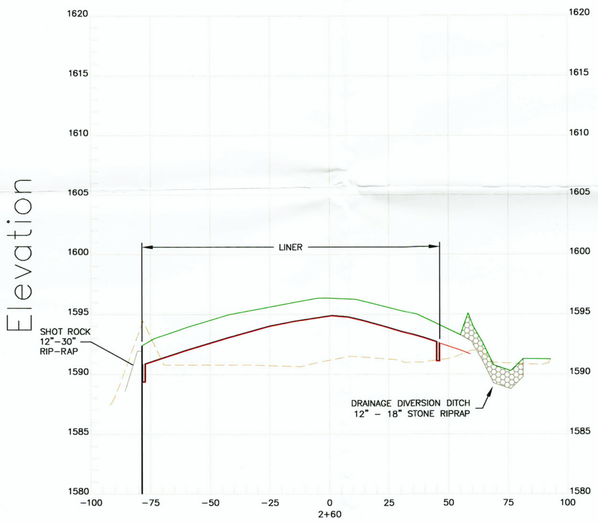
COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

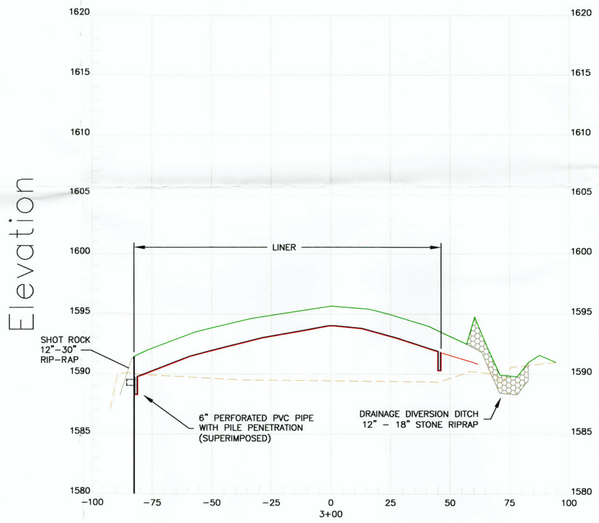
PREPARED BY:
Mountain State Company
P.O. BOX O • CEDAR GROVE, WV 25039
2318 E. DuPONT AVE. • BELLE, WEST VIRGINIA
PHONE (304) 949–4762 FAX (304) 949–4784

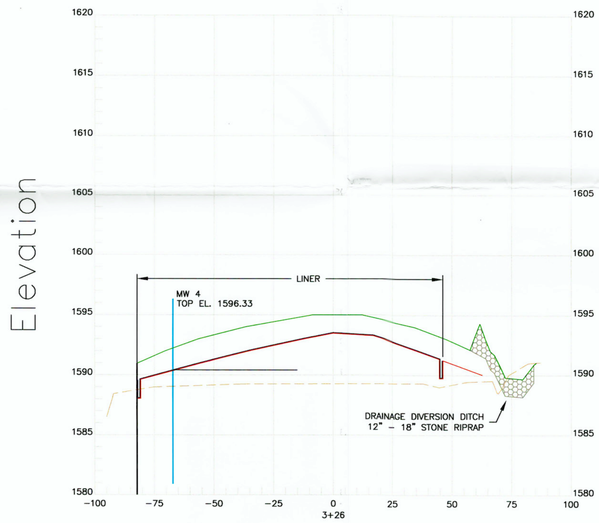
MINDEN–SECTIONS

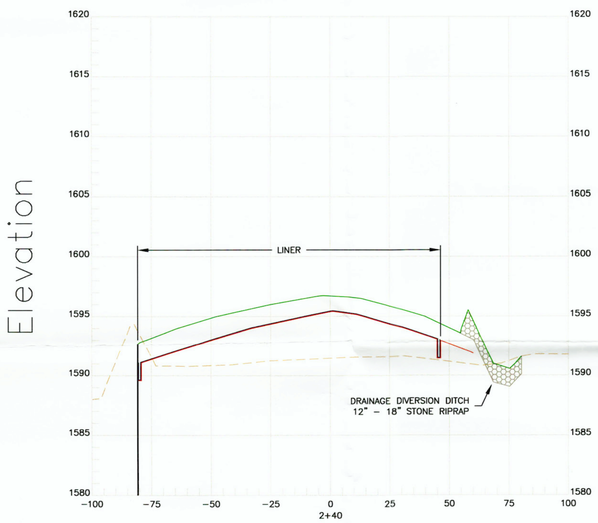
SHEET 9 OF 14

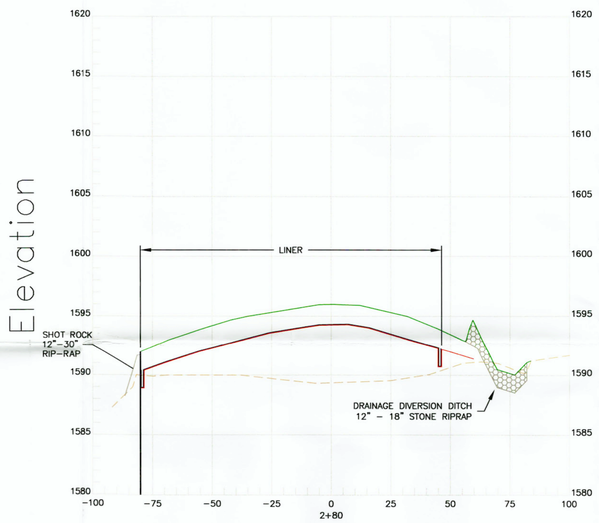
I:\WASTETRON\Minden\FINAL_MAPS\MINDEN–SECTIONS.dwg

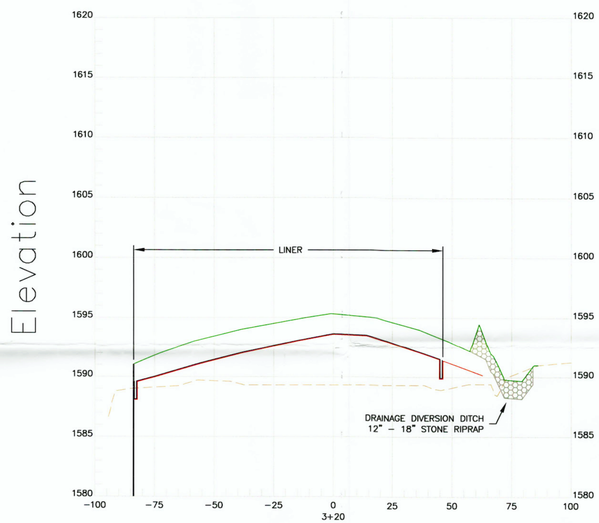


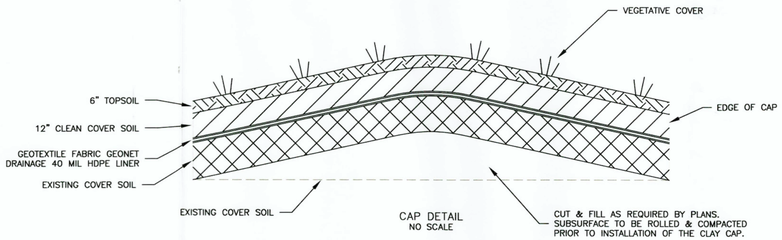












CAP DETAIL
NO SCALE

LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND
- I SHEET PILING

GRAPHIC_SCALE
0 30 60

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15 DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

JAMES L. YOUNG
LICENSED
747 SU
STATE OF WEST VIRGINIA
LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
DEBRA REID
P.O. BOX 174
HUGHESTON, WV 25119
My Commission Expires January 8, 2007

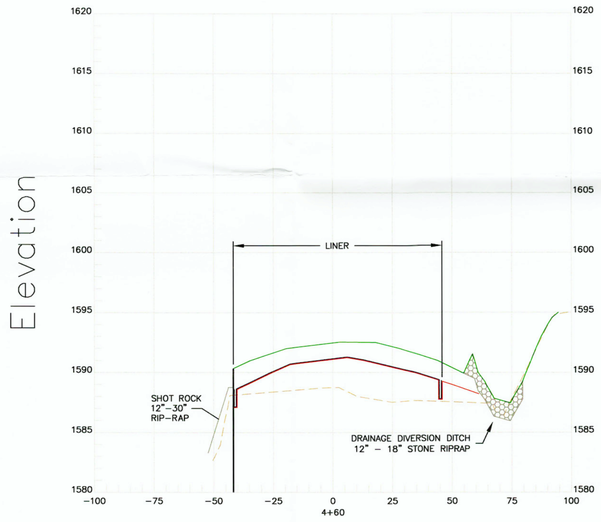
WASTETRON, INC.
RT. 1 BOX 33–B
POCA, WEST VIRGINIA 25159

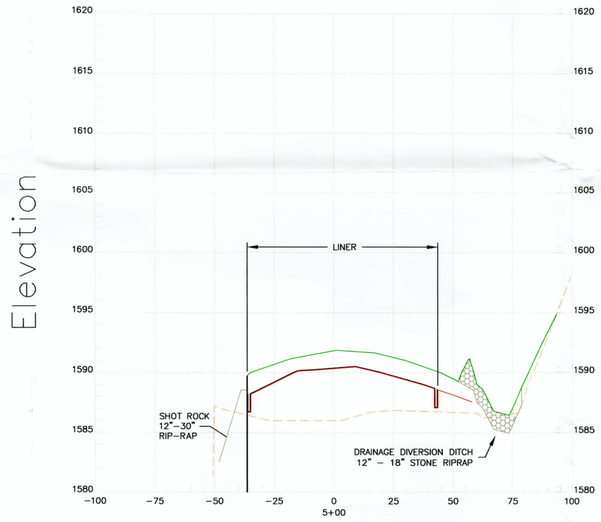
SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

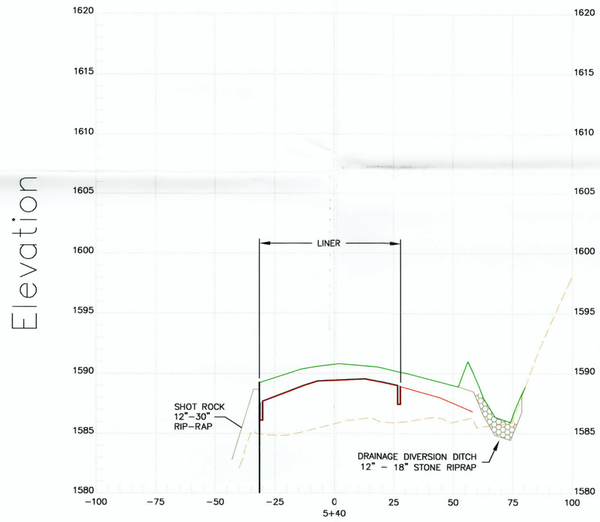
SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

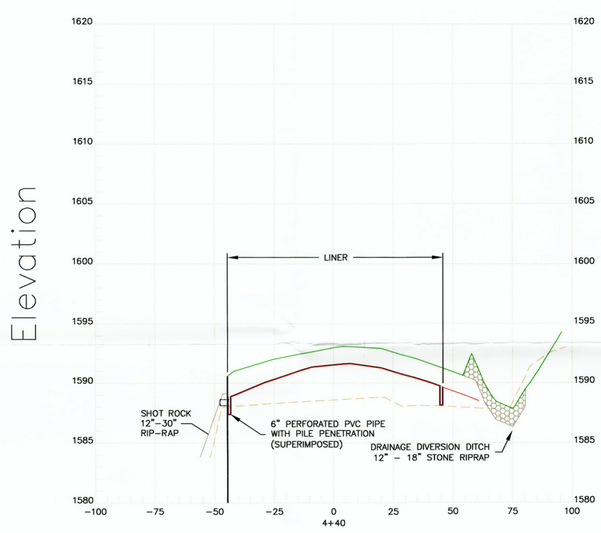
COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

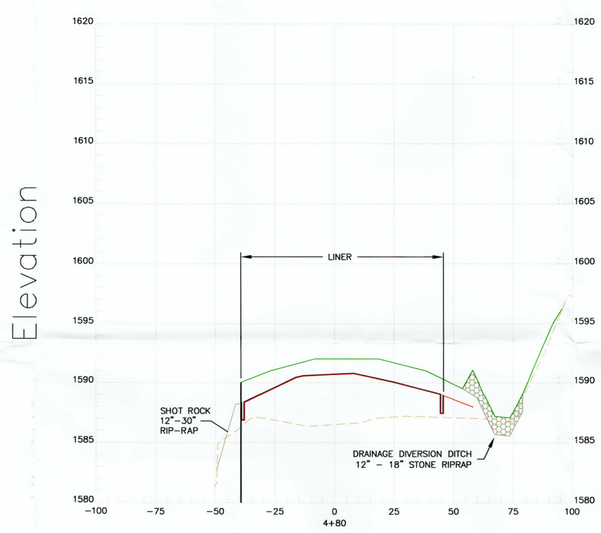
PREPARED BY:
Mountain State Company

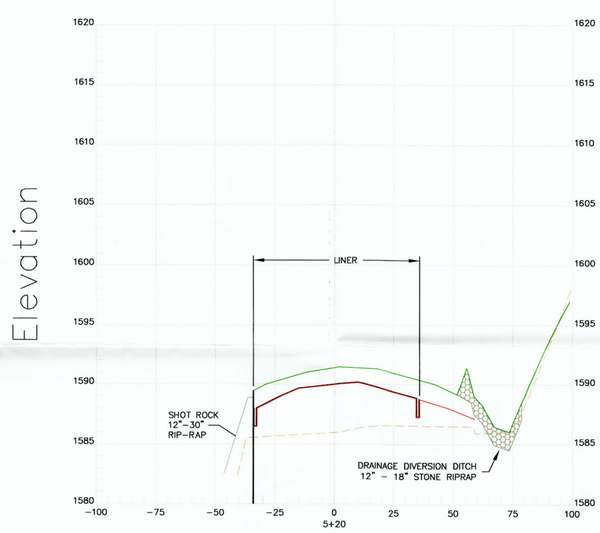


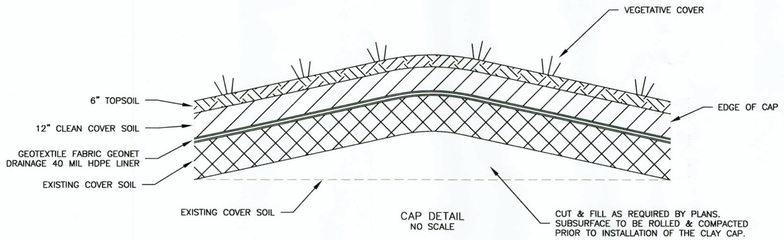












CAP DETAIL
NO SCALE

LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND
- I SHEET PILING

GRAPHIC_SCALE
0 30 6 0

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 5th DAY OF April, 2003

MY COMMISSION EXPIRES 01/08/07

Leslie A. Canterbury

JAMES L. YOUNG
LICENSED
747 SU
STATE OF
WEST VIRGINIA
LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
LESLIE A. CANTERBURY
MOUNTAIN STATE COMPANY
P.O. BOX O
CEDAR GROVE, WV. 25039
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33–B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

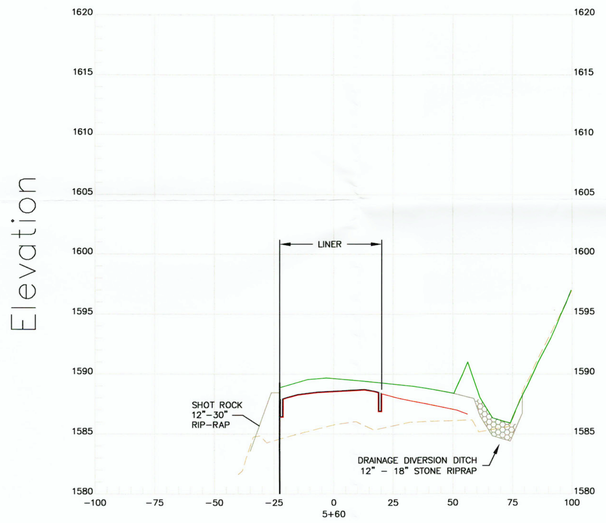
COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

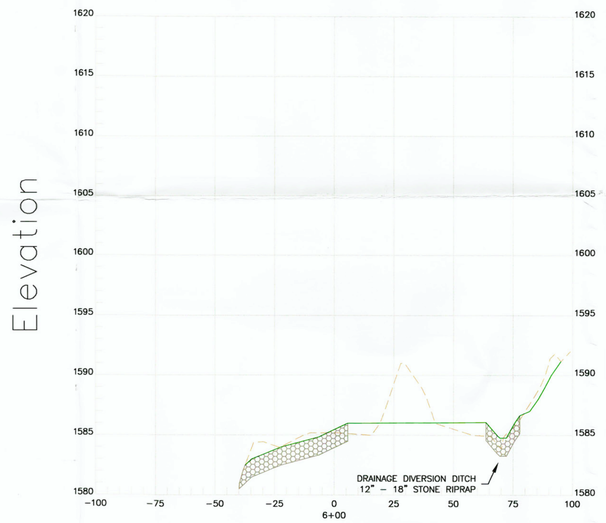
PREPARED BY:
Mountain State Company
P.O. BOX O • CEDAR GROVE, WV 25039
2318 E. DuPONT AVE. • BELLE, WEST VIRGINIA
PHONE (304) 949–4762 FAX (304) 949–4764

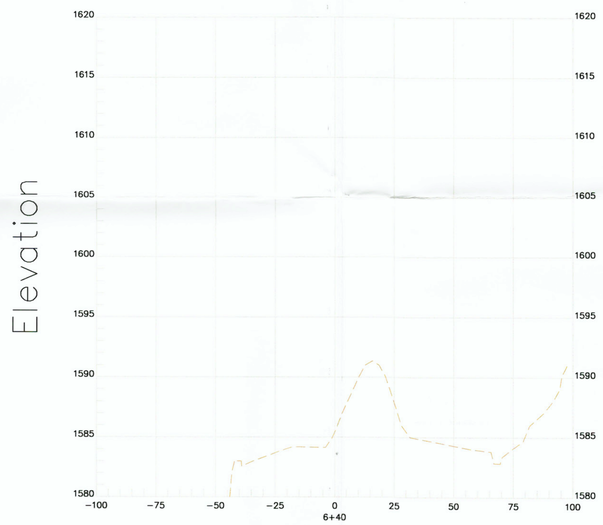
MINDEN–SECTIONS

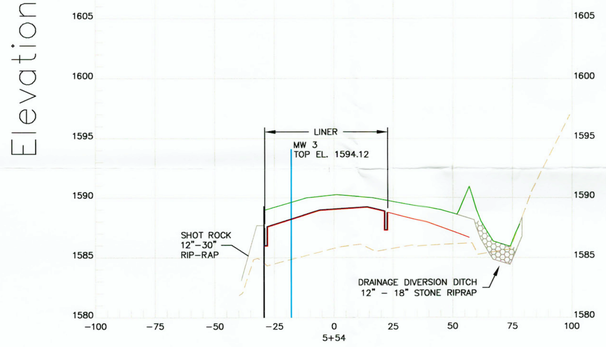
SHEET 11 OF 14

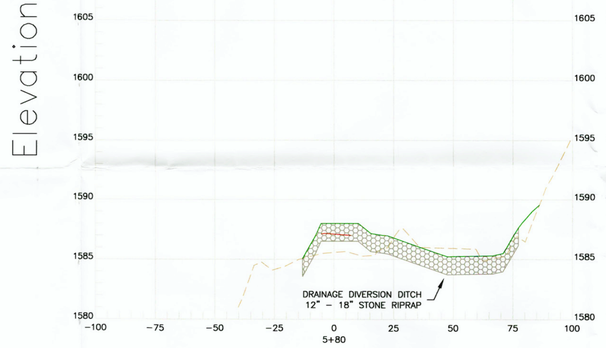
X:\WASTETRON\MINDEN\FINAL_MAPS\MINDEN-SECTIONS.dwg

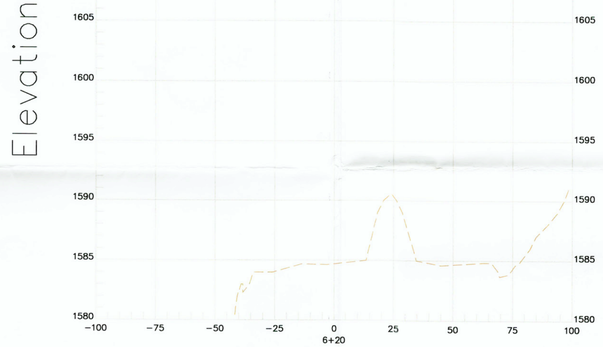


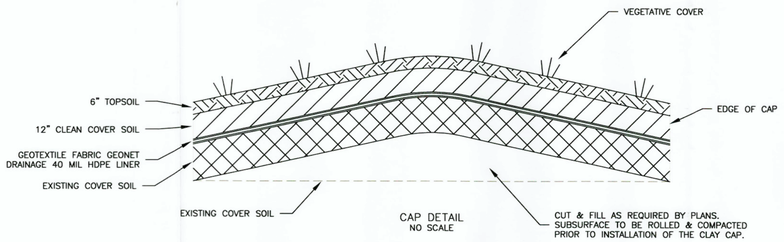












LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND
- SHEET PILING

GRAPHIC SCALE
0 30 6

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THIS MAP IS CORRECT AND SHOWS TO THE BEST OF MY KNOWLEDGE AND BELIEF ALL THE INFORMATION REQUIRED BY THE SURFACE MINING LAWS OF THIS STATE.

PS 747 SU

STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

Leslie A Canterbury

JAMES L. YOUNG LICENSED 747 SU STATE OF WEST VIRGINIA LAND SURVEYOR

OFFICIAL SEAL
NOTARY PUBLIC
STATE OF WEST VIRGINIA
LESLIE A. CANTERBURY
MOUNTAIN STATE COMPANY
P.O. BOX 0
CEDAR GROVE, WV 25039
My Commission Expires January 8, 2007

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY SITE
MINDEN PROJECT
AS-BUILT CROSS-SECTIONS

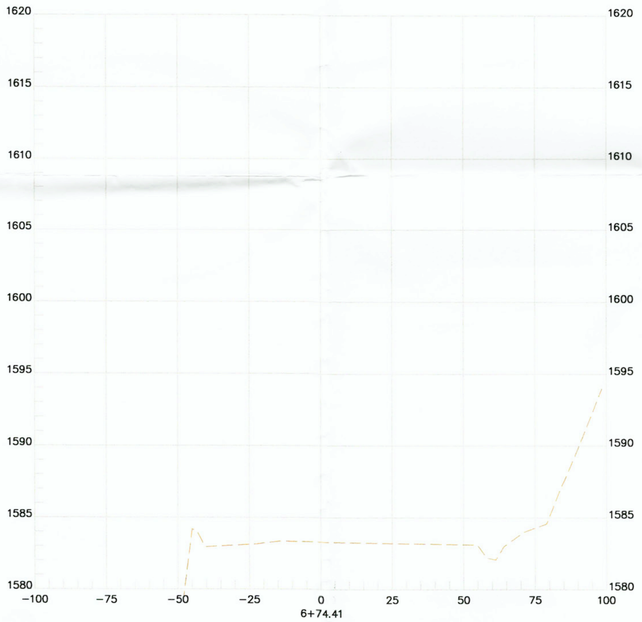
SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
DATE REVISED: APRIL 2003

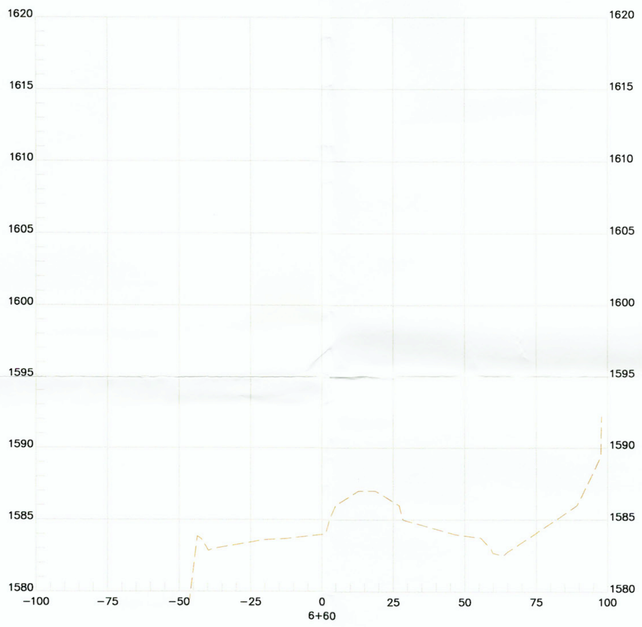
COUNTY: FAYETTE
DISTRICT: NEW HAVEN
QUAD: THURMOND

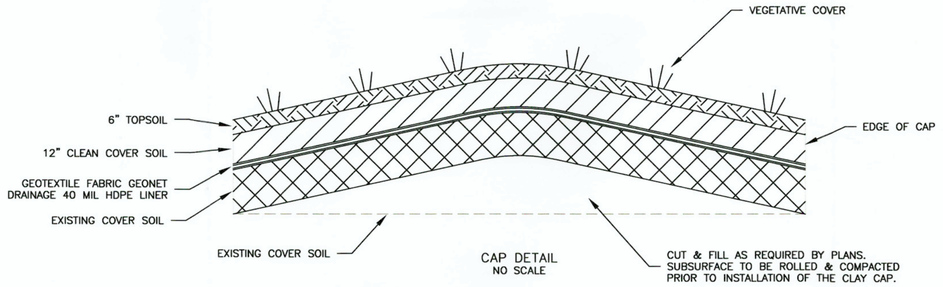
PREPARED BY:
Mountain State Company
P.O. BOX 0 • CEDAR GROVE, WV 25039
2318 E. DuPONT AVE. • BELLE, WEST VIRGINIA
PHONE (304) 949-4762 FAX (304) 949-4764

MINDEN-SECTIONS

SHEET 12 OF 14







CAP DETAIL
NO SCALE

LEGEND

- ORIGINAL GROUND
- LINER GRADE
- LINER
- FINAL GROUND
- I SHEET PILING

GRAPHIC_SCALE
0 30 6

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STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01-08-07

Leslie A. Canterbury

WASTETRON
RT. 1 BOX 33
POCA, WEST VIRGINI

SHAFFER ELECTRIC
MINDEN PRO
AS-BUILT CROSS-

SCALE: AS SHOWN
CONTOUR INTERVAL: N/A
DATE PREPARED: JANUARY 2002
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PREPARED BY
Mountain State
P.O. BOX 0 • CEDAR GROVE
2318 E. DUPONT AVE. • BELLE,
PHONE (304) 949-4762 FAX (

MINDEN-SECTIONS

ORIGINAL TO LINER

Volume Report 01/04/2002 13:29
Comparing GRID file: F:/WASTETRON/Minden/MINDEN_ORG.grd
and GRID file: F:/WASTETRON/Minden/LINRTOPO.grd
Grid corner locations: 1931552.40,355270.03 to 1932150.40,355656.03
Grid resolution X: 598, Y: 386 Grid cell size X: 1.00, Y: 1.00
Area in Cut : 864.3 S.F., 0.02 Acres
Area in Fill: 54,076.1 S.F., 1.24 Acres
Total inclusion area: 54,940.4 S.F., 1.26 Acres
Cut to Fill ratio: 0.00
Average Cut Depth: 0.55 Average Fill Depth: 2.51
Cut (C.Y.) / Area (acres): 14.00
Fill (C.Y.) / Area (acres): 3993.42
Cut volume: 476.8 C.F., 17.66 C.Y.
Fill volume: 135,991.70 C.F., 5,036.73 C.Y.

LINER TO FINAL

Volume Report 01/04/2002 10:45
Comparing GRID file: F:/WASTETRON/Minden/LINRTOPO.grd
and GRID file: F:/WASTETRON/Minden/MINDFINAL.grd
Grid corner locations: 1931552.40,355270.03 to 1932150.40,355656.03
Grid resolution X: 598, Y: 386 Grid cell size X: 1.00, Y: 1.00
Area in Cut : 0.0 S.F., 0.00 Acres
Area in Fill: 54,940.4 S.F., 1.26 Acres
Total inclusion area: 54,940.4 S.F., 1.26 Acres
Cut to Fill ratio: 0.00
Average Fill Depth: 1.58
Cut (C.Y.) / Area (acres): 0.00
Fill (C.Y.) / Area (acres): 2554.80
Cut volume: 0.0 C.F., 0.00 C.Y.
Fill volume: 87,000.85 C.F., 3,222.25 C.Y.

GRADING SUMMARY

LAYERS	LOCATION		AVERAGE FILL DEPTH	FILL VOLUME (CUBIC YARDS)
	BEGINNING STATION	ENDING STATION		
ORGINAL GROUND TO THE LINER	0+67.5	5+40	2.51'	5036.73
THE LINER TO FINAL GROUND	0+67.5	5+40	1.58'	3222.25

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STATE OF WEST VIRGINIA
COUNTY OF KANAWHA
TAKEN, SUBSCRIBED AND SWORN TO BEFORE ME THIS 15th DAY OF April, 2003

MY COMMISSION EXPIRES 01 08 07

Debra Reid

JAMES L
LICEN
747 S
STATE
WEST VIRG
LAND SURV

NO
STATE
My Commis

WASTETRON, INC.
RT. 1 BOX 33-B
POCA, WEST VIRGINIA 25159

SHAFFER ELECTRIC COMPANY S
MINDEN PROJECT
VOLUME REPORT

SCALE: N/A
CONTOUR INTERVAL: N/A
DATE PREPARED: APRIL 2002
DATE REVISED: APRIL 2003

COUNTY: FAY
DISTRICT: NE
QUAD: THURM

PREPARED BY:
Mountain State Company
P.O. BOX 0 • CEDAR GROVE, WV 25039
EAST DuPONT AVENUE • BELLE, WEST VIRGINIA
PHONE (304) 949-4782 FAX (304) 949-4764

VOL_REPORT

Table 1
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 PCBs in Soil Sample

Sample Number	CLP Sample Number	Sample Date	PCB	Result	Q
SS-11	C0AD8	6/15/2017	Aroclor-1260	11	J
SS-12	C0AD9	6/15/2017	Aroclor-1260	15	J
SS-13	C0AE0	6/15/2017	Aroclor-1260	**450**	
SS-14 (SS-15)	C0AE1	6/15/2017	Aroclor-1260	**91**	
SS-15 (SS-14)	C0AE2	6/15/2017	Aroclor-1260	**90**	
SS-16	C0AE3	6/15/2017	Aroclor-1260	**260**	
SS-17	C0AE4	6/15/2017	Aroclor-1260	**130**	J
SS-18	C0AE5	6/15/2017	Aroclor-1260	**340**	
SS-19	C0AE6	6/15/2017	Aroclor-1260	**210**	
SS-20	C0AE7	6/15/2017	Aroclor-1260	**160**	
SS-21	C0AE8	6/15/2017	Aroclor-1260	**280**	
SS-22	C0AE9	6/15/2017	Aroclor-1260	**200**	
SS-23	C0AF0	6/15/2017	Aroclor-1260	25	J
SS-24	C0AF1	6/15/2017	Aroclor-1260	6.4	J
SS-25	C0AF2	6/15/2017	Aroclor-1260	**100**	
SS-26	C0AF3	6/15/2017	Aroclor-1260	**660**	
SS-27	C0AF4	6/15/2017	Aroclor-1260	**350**	
SS-28 (SS-39)	C0AF5	6/13/2017	Aroclor-1260	**460**	
SS-29	C0AF6	6/13/2017	Aroclor-1260	**190**	
SS-30	C0AF7	6/13/2017	Aroclor-1260	**270**	

Sample Number	CLP Sample Number	Sample Date	PCB	Result	Q
SS-31	C0AF8	6/13/2017	Aroclor-1260	**680**	
SS-32	C0AF9	6/13/2017	Aroclor-1260	24	J
SS-33 SS-02	C0AG0	6/13/2017	Aroclor-1260	17	J
SS-34	C0AG1	6/13/2017	Aroclor-1260	3.5	J
SS-35	C0AG2	6/13/2017	Aroclor-1260	5.2	J
SS-36 SS-26	C0AG3	6/13/2017	Aroclor-1260	2	J
SS-037	C0AG4	6/13/2017	Aroclor-1260	1.8	J
SS-39 (SS-28)	C0AG5	6/13/2017	Aroclor-1260	**410**	
SS-40 (SS-34)	C0AL2	6/13/2017	Aroclor-1260	3.2	J
SS-41	C0AM0	6/14/2017	Aroclor-1260	**130**	
SS-42	C0AM7	6/15/2017	Aroclor-1260	**230**	
SS-43	C0AM8	6/15/2017	Aroclor-1260	**1300**	
SS-44	C0AN1	6/15/2017	Aroclor-1260	**1200**	
SB-01	C0AB9	6/13/2017	Aroclor-1260	52	U
SB-02	C0AC0	6/13/2017	Aroclor-1260	46	U
SB-03	C0AC1	6/13/2017	Aroclor-1260	38	U
SB-05	C0AC3	6/13/2017	Aroclor-1260	38	U
SB-07	C0AC5	6/13/2017	Aroclor-1260	37	U
SB-08	C0AC6	6/13/2017	Aroclor-1260	38	U
SB-09	C0AM9	6/15/2017	Aroclor-1260	48	U
SB-10	C0AN1	6/15/2017	Aroclor-1260	43	U

Notes:
Units are in micrograms per kilogram (µg/kg)
Results compared to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Green Highlight indicates background soil samples
Gold Highlight indicates soil sample from occupied residential properties with concentrations above background
Bolded value indicates concentration elevated above background (The RDL of 48U for Samples SS-150 and SS-152 collected in March 2018)
Sample ID in parentheses indicates duplicate pair
Blue text indicates inconsistency in Sample ID between logbook notes and Laboratory data sheets
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyl
Q = Qualifier
RDL = Reporting Detection Limit
RML = Removal Management Level
SS = Surface soil sample
SB = Subsurface soil sample
U = Not detected

Table 2
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 Dioxins in Soil Samples

Sample Number	SS11		SS16		SS17		SS30		SS31		SS32	
CLP Sample Number	PC0AD8		PC0AE3		PC0AE4		PC0AF7		PC0AF8		PC0AF9	
Sample Date	6/15/2017		6/15/2017		6/15/2017		6/15/2017		6/15/2017		6/15/2017	
Analyte	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2,3,7,8-TCDD	0.54	J	0.31	J	0.39	J	0.20	U	0.29	U	0.20	U
1,2,3,7,8-PeCDD	1.0	J	0.86	Z	0.61	J	0.17	U	0.26	U	0.23	U
1,2,3,4,7,8-HxCDD	2.0	J	0.90	J	0.40	U	0.20	U	0.31	U	0.20	U
1,2,3,6,7,8-HxCDD	4.3	J	2.3	J	1.4	J	0.35	U	0.51	U	0.51	J
1,2,3,7,8,9-HxCDD	3.5	J	2.3	J	1.2	Z	0.25	Z	0.34	U	0.38	Z
1,2,3,4,6,7,8-HpCDD	110		53		46		6.2		10		5.3	
OCDD	1000		590		990		71		130		75	
2,3,7,8-TCDF	3.0		1.3		2.7		0.33	J	0.43	Z	0.90	J
1,2,3,7,8-PeCDF	1.9	J	1.9	J	1.8	J	0.23	U	0.34	J	0.49	J
2,3,4,7,8-PeCDF	2.3	J	1.2	J	1.8	J	0.17	U	0.34	J	0.61	J
1,2,3,4,7,8-HxCDF	2.9	J	2.6	J	3.5	J	0.41	U	0.60	U	0.58	J
1,2,3,6,7,8-HxCDF	1.8	J	1.1	J	1.1	J	0.20	U	0.31	Z	0.40	J
1,2,3,7,8,9-HxCDF	0.61	J	0.36	J	0.39	J	0.14	U	0.25	U	0.25	U
2,3,4,6,7,8-HxCDF	2.5	J	1.4	J	1.1	J	0.18	Z	0.39	J	0.42	J
1,2,3,4,6,7,8-HpCDF	37		16		9.6		1.9	J	3.7	J	1.9	J
1,2,3,4,7,8,9-HpCDF	2.0	J	1.4	J	2.3	J	0.17	U	0.30	Z	0.26	Z
OCDF	88		32		38		4.2	J	8.6	J	2.9	J
Total TCDD	8.1	J	9.5	J	17	J		UJ	0.22	J	3.2	J
Total PeCDD	11	J	13	J	11	J		UJ	0.52	J	2.8	J
Total HxCDD	40	J	33	J	16	J	1.0	J	2.4	J	5.0	J
Total HpCDD	220	J	110	J	170	J	12	J	21	J	11	J
Total TCDF	21	J	10	J	36	J	1.0	J	0.88	J	10	J
Total PeCDF	28	J	20	J	19	J	1.1	J	2.3	J	5.9	J
Total HxCDF	43	J	21	J	16	J	1.7	J	4.2	J	3.2	J
Total HpCDF	92	J	37	J	27	J	4.5	J	9.0	J	1.9	J
TEQ (Mammal)	6.2		2.8		3.5		0.14		0.33		0.58	
TEQ (Bird)	9.2		4.2		6.6		0.36		0.47		1.7	
TEQ (Fish)	5.4		2.4		3.0		0.049		0.29		0.55	

Notes:
Units are in nanograms per kilogram (ng/kg)

The TEQ (mammal) results were compared to EPA RML for residential soil of 51 ng/kg for 2,3,7,8-TCDD (based on a target hazard quotient of 1; carcinogenic RML based on a target risk of 1E-04 is 477 ng/kg) (EPA, 2018)
Green Highlight indicates background soil samples
Sample ID in parentheses indicates duplicate pair
Blue text indicates inconsistency in Sample ID between logbook notes and Laboratory data sheets
CLP = Contract Laboratory Program
J = Estimated quantity
RML = Removal Management Level
TEQ = Toxic Equivalent
U = Not detected
Z = Estimated maximum possible concentration

Table 2
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 Dioxins in Soil Samples

Sample Number	SS02	SS33	SS34 (SS40)		SS35		SS26		SS37		SS40 (SS34)	
CLP Sample Number	PC0AG0		PC0AG1		PC0AG2		PC0AG3		PC0AG4		PC0AL2	
Sample Date	6/15/2017		6/15/2017		6/15/2017		6/15/2017		6/15/2017		6/15/2017	
Analyte	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2,3,7,8-TCDD	0.18	U	0.19	U	0.18	U	0.20	U	0.20	U	0.19	U
1,2,3,7,8-PeCDD	0.16	U	0.19	U	0.16	U	0.18	U	0.17	U	0.17	U
1,2,3,4,7,8-HxCDD	0.34	J	0.32	U	0.23	J	0.37	J	0.20	U	0.20	U
1,2,3,6,7,8-HxCDD	0.37	J	0.32	U	0.32	U	0.46	J	0.34	U	0.33	U
1,2,3,7,8,9-HxCDD	0.46	Z	0.33	U	0.40	J	0.53	Z	0.33	J	0.28	Z
1,2,3,4,6,7,8-HpCDD	21		18		14		21		15		19	
OCDD	2200		2400		1500		1800		1100		2400	
2,3,7,8-TCDF	0.22	J	0.29	U	0.16	U	0.29	U	0.20	U	0.37	U
1,2,3,7,8-PeCDF	0.21	U	0.21	U	0.21	U	0.22	U	0.23	U	0.22	U
2,3,4,7,8-PeCDF	0.25	J	0.25	J	0.16	U	0.17	U	0.17	U	0.27	J
1,2,3,4,7,8-HxCDF	0.37	U	0.38	U	0.38	U	0.40	U	0.41	U	0.39	U
1,2,3,6,7,8-HxCDF	0.19	J	0.19	U	0.19	U	0.20	U	0.20	U	0.21	Z
1,2,3,7,8,9-HxCDF	0.19	U	0.14	U	0.15	U	0.26	U	0.14	U	0.18	U
2,3,4,6,7,8-HxCDF	0.14	U	0.19	Z	0.12	J	0.21	U	0.13	U	0.19	J
1,2,3,4,6,7,8-HpCDF	1.3	J	1.1	J	1.1	J	1.0	Z	0.65	J	1.2	J
1,2,3,4,7,8,9-HpCDF	0.15	U	0.18	U	0.19	U	0.16	U	0.16	U	0.19	U
OCDF	1.5	J	1.1	Z	1.4	J	1.1	J	0.69	J	1.0	J
Total TCDD	0.31	J		UJ	0.27	J	0.23	J		UJ	0.82	J
Total PeCDD	1.3	J	0.85	J	0.71	J	0.53	J	0.70	J	0.24	J
Total HxCDD	5.3	J	2.4	J	4.0	J	5.6	J	1.9	J	0.57	J
Total HpCDD	43	J	35	J	30	J	46	J	31	J	38	J
Total TCDF	2.0	J	2.7	J	0.49	J	0.40	J	0.26	J	1.0	J
Total PeCDF	2.7	J	2.6	J	0.89	J	1.0	J	0.41	J	1.4	J
Total HxCDF	1.3	J	0.22	J	0.69	J	0.48	J	0.47	J	1.3	J
Total HpCDF	2.1	J	1.9	J	1.1	J	0.53	J	1.0	J	2.0	J
TEQ (Mammal)	1.1		0.98		0.66		0.82		0.53		1.0	
TEQ (Bird)	0.76		0.52		0.24		0.22		0.17		0.56	
TEQ (Fish)	0.58		0.39		0.30		0.39		0.14		0.42	

Notes:
Units are in nanograms per kilogram (ng/kg)

The TEQ (mammal) results were compared to EPA RML for residential soil of 51 ng/kg for 2,3,7,8-TCDD (based on a target hazard quotient of 1; carcinogenic RML based on a target risk of 1E-04 is 477 ng/kg) (EPA, 2018)
Green Highlight indicates background soil samples
Sample ID in parentheses indicates duplicate pair
Blue text indicates inconsistency in Sample ID between logbook notes and Laboratory data sheets
CLP = Contract Laboratory Program
J = Estimated quantity
RML = Removal Management Level
TEQ = Toxic Equivalent
U = Not detected
Z = Estimated maximum possible concentration

Table 3
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
December 2017 PCBs in Soil Samples

Sample Number:	SEC-SS-T1-04	SEC-SS-T1-05	SEC-SS-T2-04	SEC-SS-T2-05	SEC-SS-T3-04	SEC-SS-T3-05
CLP Number:	C0AA3	C0AA4	C0AA8	C0AA9	C0AB3	C0AB4
Matrix:	Soil	Soil	Soil	Soil	Soil	Soil
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	7.7 J	25 J	ND	24 J	8 J	27 J

Sample Number:	SEC-SS-T4-04	SEC-SS-T4-05	SEC-SS-T5-04	SEC-SS-T5-04-D	SEC-SS-T5-05
CLP Number:	C0AB8	C0AB9	C0AD2	C0AD3	C0AD7
Matrix:	Soil	Soil	Soil	Soil	Soil
Sample Date:	12/12/2017	12/12/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	10 J	**210 J**	**200**	**180**	**290**

Sample Number:	SEC-SS-T6-04	SEC-SS-T6-05	SEC-SS-T6-05-D	SEC-SS-T7-04	SEC-SS-T7-05
CLP Number:	C0AE2	C0AE0	C0AE1	C0AE4	C0AE9
Matrix:	Soil	Soil	Soil	Soil	Soil
Sample Date:	12/13/2017	12/13/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	33 J	**140**	**240**	**60**	**59**

Sample Number:	SEC-SS-T8-04	SEC-SS-T8-05	SEC-SS-R2-01	SEC-SS-R3-01	SEC-SS-R4-01	SEC-SS-R5-01
CLP Number:	C0AF6	C0AF2	C0AF9	C0AF7	C0AG1	C0AG6
Matrix:	Soil	Soil	Sediment	Soil	Soil	Soil
Sample Date:	12/13/2017	12/13/2017	12/13/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	**220**	**410**	**140**	**310**	ND	ND

Notes:
Results compared to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Green Highlight indicates background soil sample
Gold Highlight indicates soil sample from occupied residential properties with concentrations above background
Bolded value indicates concentration elevated above background (The RDL of 48U for Samples SS-150 and SS-152 collected in March 2018)
Red value indicates exceedance of EPA RML of 24,000 µg/kg
CLP = Contract Laboratory Program
J = Estimated quantity
RDL = Reporting Detection Limit
RML = Removal Management Level
ND = Not detected

Table 3
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
December 2017 PCBs in Soil Samples

Sample Number:	SEC-SS-R1-01	SEC-SS-R1-02	SEC-SS-R1-03	SEC-SS-R1-04	SEC-SS-R1-05
CLP Number:	C0AC1	C0AC2	C0AC3	C0AC4	C0AC5
Matrix:	Soil	Soil	Soil	Soil	Soil
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Unit	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260)	ND	ND	ND	ND	ND

Sample Number:	SEC-SS-R1-06	SEC-SS-R1-07	SEC-SS-R1-08	SEC-SS-R1-09	SEC-SS-R1-10
CLP Number:	C0AC6	C0AC7	C0AC8	C0AC9	C0AD0
Matrix:	Soil	Soil	Soil	Soil	Soil
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	**64**	14 J	ND	ND	20 J

Sample Number:	SEC-SS-TL-43-A	SEC-SS-TL-43-B	SEC-SS-TL-43-C	SEC-SS-TL-43
CLP Number:	C0AG9	C0AG2	C0AG4	C0AG5
Matrix:	Soil	Soil	Soil	Soil
Sample Date:	12/13/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	21 J	8.9 J	**58**	**120 J**

Sample Number:	SEC-SS-SE-01	SEC-SS-SE-02	SEC-SS-BH-01
CLP Number:	C0AG7	C0AG8	C0AH0
Matrix:	Soil	Soil	Soil
Sample Date:	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	**54,000**	**270**	**58 J**
PCB (Aroclor 1254):	ND	**260**	ND

Notes:
Results compared to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Green Highlight indicates background soil sample
Gold Highlight indicates soil sample from occupied residential properties with concentrations above background
Bolded value indicates concentration elevated above background (The RDL of 48U for Samples SS-150 and SS-152 collected in March 2018)
Red value indicates exceedance of EPA RML of 24,000 µg/kg
µg/kg = micrograms per kilogram
CLP = Contract Laboratory Program
J = Estimated quantity
RDL = Reporting Detection Limit
RML = Removal Management Level
ND = Not detected

Table 4
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
March 2018 PCBs in Soil Samples

Sample Number	CLP Sample Number	Sample Date	PCB	Result
SS-100	C0AF3	3/20/2018	Aroclor-1260	75U
SS-101	C0AA1	3/20/2018	Aroclor-1260	69U
SS-102	C0AA2	3/20/2018	Aroclor-1260	47U
SS-103	C0AA3	3/20/2018	Aroclor-1260	57U
SS-104	C0AA4	3/20/2018	Aroclor-1260	**72J**
SS-105	C0AA5	3/20/2018	Aroclor-1260	**67J**
SS-106	C0AA6	3/20/2018	Aroclor-1260	49U
SS-107	C0AA7	3/20/2018	Aroclor-1260	47U
SS-108	C0AA8	3/20/2018	Aroclor-1260	48U
SS-109	C0AA9	3/20/2018	Aroclor-1260	48U
SS-110	C0AB0	3/20/2018	Aroclor-1260	11J
SS-111	C0AB1	3/20/2018	Aroclor-1260	89U
SS-111D	C0AB2	3/20/2018	Aroclor-1260	91U
SS-112	C0AB3	3/20/2018	Aroclor-1260	49U
SS-113	C0AB4	3/20/2018	Aroclor-1260	48U
SS-115	C0AB6	3/20/2018	Aroclor-1260	63U
SS-116	C0AB7	3/20/2018	Aroclor-1260	41U
SS-117	C0AB8	3/20/2018	Aroclor-1260	69U
SS-118	C0AB9	3/20/2018	Aroclor-1260	65U
SSS-119	C0AC0	3/20/2018	Aroclor-1260	23J
SS-120	C0AC1	3/20/2018	Aroclor-1260	46U

Sample Number	CLP Sample Number	Sample Date	PCB	Result
SS-121	C0AA0	3/20/2018	Aroclor-1260	69U
SS-122	C0AC2	3/20/2018	Aroclor-1260	54U
SS-123	C0AC3	3/20/2018	Aroclor-1260	44U
SS-124	C0AC4	3/20/2018	Aroclor-1260	40U
SS-125	C0AC5	3/20/2018	Aroclor-1260	**58**
SS-150	C0AE6	3/20/2018	Aroclor-1260	48U
SS-151	C0AE7	3/20/2018	Aroclor-1260	47U
SS-152	C0AE8	3/20/2018	Aroclor-1260	48U
SS-153	C0AE9	3/20/2018	Aroclor-1260	46U
SS-154	C0AF0	3/20/2018	Aroclor-1260	46U
SS-155	C0AF1	3/20/2018	Aroclor-1260	46U
SS-156	C0AF2	3/20/2018	Aroclor-1260	52UJ
SS-202	C0AD5	3/20/2018	Aroclor-1260	44U
SS-205	C0AD8	3/20/2018	Aroclor-1260	46U
SS-206	C0AD9	3/20/2018	Aroclor-1260	45U
SS-206B	C0AE0	3/20/2018	Aroclor-1260	43U
SS-207	C0AE1	3/20/2018	Aroclor-1260	25J
SS-208	C0AE2	3/20/2018	Aroclor-1260	45U
SS-209	C0AE3	3/20/2018	Aroclor-1260	38J
SS-210	C0AE4	3/20/2018	Aroclor-1260	6.3J
SS-211	C0AE5	3/20/2018	Aroclor-1260	22J

Notes:
Units are in micrograms per kilogram (µg/kg)
Results compared to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Green Highlight indicates background soil samples
Gold Highlight indicates soil sample from occupied residential properties with concentrations above background

Bolded value indicates concentration elevated above background (The RDL of 48U for Samples SS-150 and SS-152 collected in March 2018)
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyl
RDL = Reporting Detection Limit
RML = Removal Management Level
U = Not detected

Table 5
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 PCBs in Soil Samples

		Station:	SS-212		SS-213		SS-216		SS-217		SS-218		SS-219		SS-220		SS-221		SS-222		SS-223	
		Field Sample ID:	SEC-SS-212		SEC-SS-213		SEC-SS-216		SEC-SS-217		SEC-SS-218		SEC-SS-219		SEC-SS-220		SEC-SS-221		SEC-SS-222		SEC-SS-223	
		Date:	6/27/2018		6/26/2018		6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	C0AM6		C0AM8		C0AN2		C0AN3		C0AN4		C0AN5		C0AN6		C0AW0		C0AN8		C0AN9	
PCB	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	24000	µg/kg	41	U	44	U	39	U	**1400**	J	51	U	53	U	44	U	42	U	46	U	**510**	J

		Station:	SS-224		SS-225		SS-226		SS-227		SS-228		SS-229		SS-230		SS-231		SS-232		SS-233		SS-234	
		Field Sample ID:	SEC-SS-224		SEC-SS-225		SEC-SS-226		SEC-SS-227		SEC-SS-228		SEC-SS-229		SEC-SS-230		SEC-SS-231		SEC-SS-232		SEC-SS-233		SEC-SS-234	
		Date:	6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AP0		C0AP2		C0AP3		C0AP4		C0AP5		C0AP6		C0AP7		C0AP8		C0AP9		C0AQ0		C0AQ1	
PCB	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	24000	µg/kg	39	U	41	U	38	U	40	U	37	U	40	U	37	U	40	U	37	U	40	U	40	U

		Station:	SS-235		SS-236		SS-237		SS-238		SS-239		SS-240		SS-241		SS-242		SS-243		SS-244		SS-245	
		Field Sample ID:	SEC-SS-235		SEC-SS-236		SEC-SS-237		SEC-SS-238		SEC-SS-239		SEC-SS-240		SEC-SS-241		SEC-SS-242		SEC-SS-243		SEC-SS-244		SEC-SS-245	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	C0AQ2		C0AQ3		C0AQ4		C0AQ5		C0AQ6		C0AQ7		C0AQ8		C0AQ9		C0AR0		C0AR1		C0AR2	
PCB	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	24000	µg/kg	39	U	38	U	39	U	38	U	37	U	37	U	36	U	47	U	39	U	64	U	110	U

		Station:	SS-246		SS-247		SS-248		SS-249		SS-250		SS-251		SS-252		SS-253		SS-254		SS-255		SS-256	
		Field Sample ID:	SEC-SS-246		SEC-SS-247		SEC-SS-248		SEC-SS-249		SEC-SS-250		SEC-SS-251		SEC-SS-252		SEC-SS-253		SEC-SS-254		SEC-SS-255		SEC-SS-256	
		Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018		6/27/2018		6/28/2018	
		Lab Sample ID:	C0AR3		C0AR4		C0AR5		C0AR6		C0AS1		C0AS2		C0AS3		C0AS4		C0AT4		C0AT5		C0AT9	
PCB	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	24000	µg/kg	39	U	89	U	38	U	39	U	94	U	82	U	48	U	53	U	43	U	40	U	39	U

Notes:
Results compared to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Gold Highlight indicates soil sample from occupied residential properties with concentrations above background
Bolded value indicates concentration elevated above background (The RDL of 48U for Samples SS-150 and SS-152 collected in March 2018)
µg/kg = micrograms per kilogram
J = Estimated quantity
PCB = Polychlorinated biphenyl
RDL = Reporting Detection Limit
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 6
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Soil Samples

		Station:	SS-212		SS-213		SS-221		SS-225		SS-226		SS-227	
		Field Sample ID:	SEC-SS-212		SEC-SS-213		SEC-SS-221		SEC-SS-225		SEC-SS-226		SEC-SS-227	
		Date:	6/27/2018		6/26/2018		6/28/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AM6		C0AM8		C0AW0		C0AP2		C0AP3		C0AP4	
Pesticide	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	1900	µg/kg	2 3	J	6 8	J	51	J	4.1	U	9.6		4	U
4,4'-DDE	23000	µg/kg	4.1	U	6.3	J	71	J	4.1	U	4.8	J	4	U
4,4'-DDT	37000	µg/kg	1 8	J	10	J	160	J	4.1	U	3.8	R	4	U
beta-BHC	30000	µg/kg	0.34	R	0.55	R	3.6	J	0.23	R	0.44	R	0.36	R
cis-Chlordane *	35000	µg/kg	0.26	R	2 9	J	3 5	J	2.1	U	1.9	U	2.1	U
delta-BHC	NL	µg/kg	0.45	J	0.96	J	1.1	J	2.1	U	1.9	U	2.1	U
Dieldrin	3200	µg/kg	0.93	R	4.4	U	1.9	R	4.1	U	4.3	R	4	U
Endosulfan I *	470000	µg/kg	0.37	J	2 3	U	2.2	U	2.1	U	1.9	U	2.1	U
Endosulfan sulfate *	470000	µg/kg	0.87	J	3 5	J	2.6	J	0.66	J	3.8	U	4	U
Endrin	19000	µg/kg	1 5	R	2 3	R	20	J	4.1	U	3.8	R	4	U
Endrin aldehyde *	19000	µg/kg	2 3	J	4.4	U	4.2	U	4.1	U	3.4	R	0.84	J
Endrin ketone *	19000	µg/kg	3 3	J	7 8		4.5	J	0.39	J	12		0.61	J
gamma-BHC (Lindane)	21000	µg/kg	2.1	U	2 3	U	2.2	U	0.51	J	1.9	U	2.1	U
Heptachlor	13000	µg/kg	2.1	U	0.69	J	2.1	J	2.1	U	1.9	U	2.1	U
Heptachlor epoxide	1000	µg/kg	0.66	J	2.7	J+	2.8	J	2.1	U	3.8	J	0.58	J
trans-Chlordane *	35000	µg/kg	0.43	R	1 3	J	4.5	J	2.1	U	0.64	R	0.54	J

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
* Indicates RML shown is for Endosulfan, Endrin, and Chlordane, respectively.
µg/kg = micrograms per kilogram
J+ = Estimated quantity; actual value is expected to be lower
J = Estimated quantity
NL = No listed value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample
RML = Removal Management Level
Q = Qualifier
U = Not Detected

Table 6
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Soil Samples

		Station:	SS-228		SS-229		SS-230		SS-231		SS-232		SS-233	
		Field Sample ID:	SEC-SS-228		SEC-SS-229		SEC-SS-230		SEC-SS-231		SEC-SS-232		SEC-SS-233	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AP5		C0AP6		C0AP7		C0AP8		C0AP9		C0AQ0	
Pesticide	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	1900	µg/kg	16	J	4	U	16	J	4	U	10	J	4	U
4,4'-DDE	23000	µg/kg	3.7	U	4	U	3.7	U	4	U	4 5	J	4	U
4,4'-DDT	37000	µg/kg	3.7	R	4	U	3.7	R	4	U	4.4	J	4	U
beta-BHC	30000	µg/kg	1.5	R	0.23	R	1.1	R	2.1	U	0.24	R	0.26	R
cis-Chlordane *	35000	µg/kg	1.9	U	2	U	1 9	U	2.1	U	6.1	J	2	U
delta-BHC	NL	µg/kg	0.36	R	2	U	1 9	U	0.39	J	1 9	U	0.63	J
Dieldrin	3200	µg/kg	6.6	R	4	U	6	R	4	U	3.7	U	0.44	J
Endosulfan I *	470000	µg/kg	1.9	U	2	U	1 9	U	2.1	U	1.4	R	2	U
Endosulfan sulfate *	470000	µg/kg	3.7	U	4	U	3.7	U	4	U	5 2	J	0.24	J
Endrin	19000	µg/kg	3.7	R	4	U	3.7	R	4	U	4.4	R	1.5	J
Endrin aldehyde *	19000	µg/kg	5.7	R	0.81	J	4 8	R	0.6	J	3.7	U	4	U
Endrin ketone *	19000	µg/kg	23	J	0.92	J	19	J	1 5	J	13	J	4	U
gamma-BHC (Lindane)	21000	µg/kg	2	R	0.31	J	1.6	R	2.1	U	1 9	U	0.35	J
Heptachlor	13000	µg/kg	1.9	U	2	U	1 9	U	2.1	U	1 9	U	2	U
Heptachlor epoxide	1000	µg/kg	6.9	J	0.74	J	5.4	J	0.95	J	3.6	J	2	U
trans-Chlordane *	35000	µg/kg	1.5	R	0.56	J	2 9	J	0.64	J	0.63	R	0.36	J

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
* Indicates RML shown is for Endosulfan, Endrin, and Chlordane, respectively.
µg/kg = micrograms per kilogram
J+ = Estimated quantity; actual value is expected to be lower
J = Estimated quantity
NL = No listed value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample
RML = Removal Management Level
Q = Qualifier
U = Not Detected

Table 6
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Soil Samples

		Station:	SS-234		SS-235		SS-236		SS-237		SS-238		SS-239	
		Field Sample ID:	SEC-SS-234		SEC-SS-235		SEC-SS-236		SEC-SS-237		SEC-SS-238		SEC-SS-239	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AQ1		C0AQ2		C0AQ3		C0AQ4		C0AQ5		C0AQ6	
Pesticide	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	1900	µg/kg	11	J	3.9	U	15	J	3.9	U	13	J	17	J
4,4'-DDE	23000	µg/kg	4	U	3.9	U	3.8	U	0.57	J	4.5	J	5.7	J
4,4'-DDT	37000	µg/kg	4	R	3.9	U	3.8	R	3.9	U	6.9	J	6.6	R
beta-BHC	30000	µg/kg	0.46	R	2	U	0.8	J	0.31	R	1.3	R	1.6	R
cis-Chlordane *	35000	µg/kg	2.1	U	2	U	2	U	0.33	J	1.9	U	11	J
delta-BHC	NL	µg/kg	0.4	R	0.57	J	2	U	2	U	0.41	R	1.7	J
Dieldrin	3200	µg/kg	4.8	R	3.9	U	6.1	R	3.9	R	5.3	R	3.7	U
Endosulfan I *	470000	µg/kg	2.1	U	2	U	2	U	2	U	1.9	U	13	J
Endosulfan sulfate *	470000	µg/kg	2 5	R	3.9	U	3.8	U	3.9	U	3.8	U	21	J
Endrin	19000	µg/kg	4	R	3.9	U	3.8	R	3.9	R	3.8	R	2.9	R
Endrin aldehyde *	19000	µg/kg	3 9	R	0.27	J	4.7	R	0.97	R	5	R	2.4	R
Endrin ketone *	19000	µg/kg	12	J	0.49	J	20	J	1.9	J	18	J	18	J
gamma-BHC (Lindane)	21000	µg/kg	1 2	R	2	U	1.5	R	0.32	R	1.7	R	1.9	U
Heptachlor	13000	µg/kg	0.19	R	0.5	J	2	U	2	U	1.9	U	1.4	R
Heptachlor epoxide	1000	µg/kg	3 9	J	0.77	J	5.2	J	0.93	J	5.3	J	8.7	J
trans-Chlordane *	35000	µg/kg	0.79	R	2	U	0.96	R	1	J	0.79	R	0.71	R

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* Indicates RML shown is for Endosulfan, Endrin, and Chlordane, respectively.

µg/kg = micrograms per kilogram

J+ = Estimated quantity; actual value is expected to be lower

J = Estimated quantity

NL = No listed value

R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample

RML = Removal Management Level

Q = Qualifier

U = Not Detected

Table 6
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Soil Samples

		Station:	SS-240		SS-241		SS-242		SS-243		SS-244		SS-245	
		Field Sample ID:	SEC-SS-240		SEC-SS-241		SEC-SS-242		SEC-SS-243		SEC-SS-244		SEC-SS-245	
		Date:	6/26/2018		6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	C0AQ7		C0AQ8		C0AQ9		C0AR0		C0AR1		C0AR2	
Pesticide	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	1900	µg/kg	3.7	U	3.6	U	16	R	0.93	R	6.4	U	11	U
4,4'-DDE	23000	µg/kg	14	J	16	J	5.4	J	3	R	1.8	J	1.6	R
4,4'-DDT	37000	µg/kg	13	J	16	J	11	J	5.6	J	6.4	U	11	U
beta-BHC	30000	µg/kg	4	R	4.8	R	4.9	R	2.5	R	3.3	U	0.45	R
cis-Chlordane *	35000	µg/kg	22	J	24	J	2.4	U	1.4	J	3.3	U	1.6	R
delta-BHC	NL	µg/kg	2.4	R	2.5	R	1.7	J	0.89	J	3.3	U	5.5	U
Dieldrin	3200	µg/kg	3.7	U	4.7	R	4	R	3.9	U	6.4	U	1.5	R
Endosulfan I *	470000	µg/kg	19	J	20	J	1.7	R	0.74	J	0.59	R	1.5	J
Endosulfan sulfate *	470000	µg/kg	17	J	25	J	17	J	8.3	R	5.6	J	1	J
Endrin	19000	µg/kg	19	R	2.7	R	4.7	U	1.8	R	1.6	J	4	J
Endrin aldehyde *	19000	µg/kg	16	R	19	R	11	R	3.9	U	0.82	R	11	U
Endrin ketone *	19000	µg/kg	31	J	35	J	41	J	18	J	1.2	R	11	U
gamma-BHC (Lindane)	21000	µg/kg	1.9	U	1.6	R	0.56	R	2	U	3.3	U	5.5	U
Heptachlor	13000	µg/kg	1.9	U	1.9	U	0.49	J	0.27	R	3.3	U	0.78	J
Heptachlor epoxide	1000	µg/kg	14	J	13	J	0.93	R	0.34	J	0.83	J	5.5	U
trans-Chlordane *	35000	µg/kg	1.3	R	1.4	R	5	J	1.5	R	0.99	R	5.5	U

Notes:

Results compared to EPA RML for residential (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
* Indicates RML shown is for Endosulfan, Endrin, and Chlordane, respectively.
µg/kg = micrograms per kilogram
J+ = Estimated quantity; actual value is expected to be lower
J = Estimated quantity
NL = No listed value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample
RML = Removal Management Level
Q = Qualifier
U = Not Detected

Table 6
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Soil Samples

		Station:	SS-246		SS-247		SS-248		SS-249		SS-250		SS-251		SS-252		SS-253		SS-256	
		Field Sample ID:	SEC-SS-246		SEC-SS-247		SEC-SS-248		SEC-SS-249		SEC-SS-250		SEC-SS-251		SEC-SS-252		SEC-SS-253		SEC-SS-256	
		Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/28/2018	
		Lab Sample ID:	C0AR3		C0AR4		C0AR5		C0AR6		C0AS1		C0AS2		C0AS3		C0AS4		C0AT9	
Pesticide	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	1900	µg/kg	4.6		8.9	U	7.8	J	7.3	J	9.4	U	8.2	U	4 8	U	5 3	U	3.9	U
4,4'-DDE	23000	µg/kg	2.4	J	2.1	R	2.1	R	2.4	J	23	J	3.4	J	3	J	2 2	J	1.2	J
4,4'-DDT	37000	µg/kg	5.6		13	J	2.2	R	2.7	R	16	J	8.2	U	4 8		11		3.9	U
beta-BHC	30000	µg/kg	0.3	R	0 98	R	0.47	R	0.35	R	0.48	R	4.2	U	0.32	R	0.36	R	2	U
cis-Chlordane *	35000	µg/kg	2	U	5.8	J	2	R	1.9	R	1.6	R	1.3	R	0.44	R	1 8	R	2	U
delta-BHC	NL	µg/kg	2	U	4.5	J	0.4	R	0.94	J	1 2	J	1.2	R	0.37	J	0.34	J	0.35	J
Dieldrin	3200	µg/kg	3.9	U	8.9	U	3.8	U	3.9	U	14	J	8.2	R	4 8	R	5.4	J	3.9	U
Endosulfan I *	470000	µg/kg	0.99	R	4.6	U	2.7	J	2	U	1.4	J	0.2	R	0.4	R	2.7	U	2	U
Endosulfan sulfate *	470000	µg/kg	7.3		8.5	J	7.5	J	6.4	J	13	J	2.5	R	1 2	J	2 9	J	2.9	J
Endrin	19000	µg/kg	3.9	U	12	J	17	J	14	J	9.4	R	8.2	R	4 8	R	5 3	R	1.1	R
Endrin aldehyde *	19000	µg/kg	3.9	U	9.2	R	8.9	J	7.3	J	9.4	U	10	J	1.6	J	2 2	J	0.38	R
Endrin ketone *	19000	µg/kg	11		1.2	R	11	J	9.2	J	24	J	7.4	J	2 5	J	9 2		1.4	J
gamma-BHC (Lindane)	21000	µg/kg	0.87	R	2.2	J	2	U	2	U	2	J	1	R	0.46	R	0.92	J	2	U
Heptachlor	13000	µg/kg	2	U	4.6	U	0 95	R	0.88	J	4 9	U	0.8	J	0.55	J	2.7	U	0.61	J
Heptachlor epoxide	1000	µg/kg	1.5	J	0.42	R	2.2	R	2.1	J	1 2	R	3.2	J	0.32	R	1.1	J	0.64	J
trans-Chlordane *	35000	µg/kg	1.2	J	0 31	R	4.5	J	3.6	J	3 8	J	3.8	R	2 5	R	2.7	J	0.75	J

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
* Indicates RML shown is for Endosulfan, Endrin, and Chlordane, respectively.
µg/kg = micrograms per kilogram
J+ = Estimated quantity; actual value is expected to be lower
J = Estimated quantity
NL = No listed value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample
RML = Removal Management Level
Q = Qualifier
U = Not Detected

Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-212		SS-213		SS-221		SS-225		SS-226	
		Field Sample ID:	SEC-SS-212		SEC-SS-213		SEC-SS-221		SEC-SS-225		SEC-SS-226	
		Date:	6/27/2018		6/26/2018		6/28/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AM6		C0AM8		C0AW0		C0AP2		C0AP3	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	210	U	230	U	220	U	210	U	240	
2-Methylnaphthalene	240000	ug/kg	210	U	230	U	220	U	210	U	490	
3-Nitroaniline	NL	ug/kg	57	J	440	U	420	U	410	U	380	U
4-Chloroaniline	250000	ug/kg	410	U	440	U	420	U	410	U	380	U
4-Methylphenol	6300000	ug/kg	410	U	440	U	420	U	410	U	380	U
Acenaphthene	3600000	ug/kg	210	U	230	U	220	U	210	U	200	U
Acenaphthylene	NL	ug/kg	210	U	230	U	120	J	210	U	200	U
Acetophenone	7800000	ug/kg	410	U	440	U	420	U	410	U	380	U
Anthracene	18000000	ug/kg	210	U	230	U	87	J	210	U	200	U
Benzaldehyde	7800000	ug/kg	410	U	440	U	420	U	410	U	380	U
Benzo(a)anthracene	110000	ug/kg	210	U	230	U	310		210	U	200	U
Benzo(a)pyrene	11000	ug/kg	210	U	230	U	390		210	U	200	U
Benzo(b)fluoranthene	110000	ug/kg	210	U	120	J	680		210	U	81	J
Benzo(g,h,i)perylene	NL	ug/kg	210	U	230	U	370		210	U	200	U
Benzo(k)fluoranthene	1100000	ug/kg	210	U	230	U	200	J	210	U	200	U
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	210	U	230	U	550		210	U	200	U
Butylbenzylphthalate	13000000	ug/kg	210	U	230	U	280		210	U	200	U
Carbazole	NL	ug/kg	410	U	440	UJ	420	UJ	410	UJ	380	UJ
Chrysene	11000000	ug/kg	210	U	130	J	370		210	U	260	
Dibenzo(a,h)anthracene	11000	ug/kg	210	U	230	U	88	J	210	U	200	U
Dibenzofuran	73000	ug/kg	210	U	230	U	220	U	210	U	310	
Fluoranthene	2400000	ug/kg	410	U	180	J	740		410	U	130	J
Fluorene	2400000	ug/kg	210	U	230	U	220	U	210	U	200	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	210	U	230	U	350		210	U	200	U
Naphthalene	130000	ug/kg	210	U	230	U	220	U	210	U	610	
Phenanthrene	NL	ug/kg	78	J	130	J	330		210	U	1200	
Pyrene	1800000	ug/kg	210	U	120	J	650		210	U	82	J
PAHs by SIM												
2-Methylnaphthalene	240000	ug/kg	31		37		16		4.1	U	330	J
Acenaphthene	3600000	ug/kg	3.1	J	4.4	U	9.2		4.1	U	7.7	
Acenaphthylene	NL	ug/kg	4.1	U	5 8		150		4.1	U	3.8	U
Anthracene	18000000	ug/kg	10		10		130		4.1	U	12	
Benzo(a)anthracene	110000	ug/kg	24		38		350		3 2	J	41	
Benzo(a)pyrene	11000	ug/kg	24		31		430	J	3 2	J	9	
Benzo(b)fluoranthene	110000	ug/kg	48		110		650	J	4.6		63	
Benzo(g,h,i)perylene	NL	ug/kg	15		20		340		4.1	U	13	
Benzo(k)fluoranthene	1100000	ug/kg	12		28		190		4.1	U	4.1	
Chrysene	11000000	ug/kg	54		140		400	J	3 3	J	250	J
Dibenzo(a,h)anthracene	11000	ug/kg	5.2		6 9		55		4.1	U	12	
Fluoranthene	2400000	ug/kg	49		190		740	J	9.6		120	
Fluorene	2400000	ug/kg	2.7	J	4.4	U	23		4.1	U	7.8	
Indeno(1,2,3-cd)pyrene	110000	ug/kg	17		24		400	J	2 5	J	4.7	
Naphthalene	130000	ug/kg	16		25		15		4.1	U	540	J
Pentachlorophenol	100000	ug/kg	8.3	U	9	U	1.7	J	8.4	U	1.2	J
Phenanthrene	NL	ug/kg	70		140		320		4.1	U	1100	J
Pyrene	1800000	ug/kg	30		110		460	J	4.1	U	61	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
µg/kg = micrograms per kilogram
J = Estimated quantity
NL = No listed value
PAH = Polycyclic Aromatic Hydrocarbon
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
RML = Removal Management Level
Q = Qualifier
SIM = Selective Ion Monitoring
SVOC = Semivolatile Organic Compound
U = Not Detected
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-227		SS-228		SS-229		SS-230		SS-231	
		Field Sample ID:	SEC-SS-227		SEC-SS-228		SEC-SS-229		SEC-SS-230		SEC-SS-231	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AP4		C0AP5		C0AP6		C0AP7		C0AP8	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	210	U	140	J	200	U	100	J	210	U
2-Methylnaphthalene	240000	ug/kg	210	U	490		200	U	270		210	U
3-Nitroaniline	NL	ug/kg	400	U	370	U	400	U	370	U	400	U
4-Chloroaniline	250000	ug/kg	400	U	370	U	400	U	370	U	400	U
4-Methylphenol	6300000	ug/kg	400	U	370	U	400	U	370	U	400	U
Acenaphthene	3600000	ug/kg	210	U	190	U	200	U	190	U	210	U
Acenaphthylene	NL	ug/kg	210	U	190	U	200	U	190	U	210	U
Acetophenone	7800000	ug/kg	400	U	52	J	400	U	370	U	400	U
Anthracene	18000000	ug/kg	210	U	190	U	200	U	190	U	210	U
Benzaldehyde	7800000	ug/kg	400	U	370	U	400	U	370	U	400	U
Benzo(a)anthracene	110000	ug/kg	210	U	59	J	200	U	190	U	210	U
Benzo(a)pyrene	11000	ug/kg	210	U	190	U	200	U	190	U	210	U
Benzo(b)fluoranthene	110000	ug/kg	210	U	110	J	200	U	110	J	210	U
Benzo(g,h,i)perylene	NL	ug/kg	210	U	190	U	200	U	190	U	210	U
Benzo(k)fluoranthene	1100000	ug/kg	210	U	190	U	200	U	190	U	210	U
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	210	U	190	U	200	U	190	U	210	U
Butylbenzylphthalate	13000000	ug/kg	210	U	190	U	200	U	190	U	210	U
Carbazole	NL	ug/kg	400	UJ	370	UJ	400	UJ	370	UJ	400	UJ
Chrysene	11000000	ug/kg	210	U	320		200	U	330		210	U
Dibenzo(a,h)anthracene	11000	ug/kg	210	U	190	U	200	U	190	U	210	U
Dibenzofuran	73000	ug/kg	210	U	130	J	200	U	87	J	210	U
Fluoranthene	2400000	ug/kg	400	U	150	J	400	U	140	J	400	U
Fluorene	2400000	ug/kg	210	U	190	U	200	U	190	U	210	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	210	U	190	U	200	U	190	U	210	U
Naphthalene	130000	ug/kg	210	U	420		200	U	210		210	U
Phenanthrene	NL	ug/kg	210	U	910		200	U	730		210	U
Pyrene	1800000	ug/kg	210	U	97	J	200	U	94	J	210	U
2-Methylnaphthalene	240000	ug/kg	1 5	J	380	J	2	J	210		1.2	J
Acenaphthene	3600000	ug/kg	4	U	8		4	U	7		4	U
Acenaphthylene	NL	ug/kg	4	U	3.7	U	4	U	3.7	U	4	U
Anthracene	18000000	ug/kg	4	U	3.7	U	4	U	7.9		4	U
Benzo(a)anthracene	110000	ug/kg	4	U	55		4	U	58		4	U
Benzo(a)pyrene	11000	ug/kg	4	U	19		4	U	16		4	U
Benzo(b)fluoranthene	110000	ug/kg	4	U	100		2 2	J	93		4	U
Benzo(g,h,i)perylene	NL	ug/kg	4	U	17		4	U	18		4	U
Benzo(k)fluoranthene	1100000	ug/kg	4	U	7.5		4	U	6.8		4	U
Chrysene	11000000	ug/kg	2.6	J	340	J	3 5	J	320	J	3.1	J
Dibenzo(a,h)anthracene	11000	ug/kg	4	U	14		4	U	18		4	U
Fluoranthene	2400000	ug/kg	2 3	J	150		2 3	J	130		1.7	J
Fluorene	2400000	ug/kg	4	U	11		4	U	9.3		4	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	4	U	6.9		4	U	6.2		4	U
Naphthalene	130000	ug/kg	4	U	410	J	4	U	200		4	U
Pentachlorophenol	100000	ug/kg	8 2	U	7.4	U	8	U	7.6	U	8.1	U
Phenanthrene	NL	ug/kg	6		870	J	6.7		670	J	5.4	
Pyrene	1800000	ug/kg	4	U	88		4	U	80		4	U

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
µg/kg = micrograms per kilogram
J = Estimated quantity
NL = No listed value
PAH = Polycyclic Aromatic Hydrocarbon
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
RML = Removal Management Level
Q = Qualifier
SIM = Selective Ion Monitoring
SVOC = Semivolatile Organic Compound
U = Not Detected
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-232		SS-233		SS-234		SS-235		SS-236		SS-237	
		Field Sample ID:	SEC-SS-232		SEC-SS-233		SEC-SS-234		SEC-SS-235		SEC-SS-236		SEC-SS-237	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	C0AP9		C0AQ0		C0AQ1		C0AQ2		C0AQ3		C0AQ4	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	190	U	200	U	53	J	200	U	100	J	200	U
2-Methylnaphthalene	240000	ug/kg	62	J	200	U	120	J	200	U	250		200	U
3-Nitroaniline	NL	ug/kg	370	U	400	U	400	U	380	U	380	U	390	U
4-Chloroaniline	250000	ug/kg	370	U	400	U	400	U	380	U	380	U	390	U
4-Methylphenol	6300000	ug/kg	370	U	400	U	400	U	380	U	380	U	390	U
Acenaphthene	3600000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Acenaphthylene	NL	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Acetophenone	7800000	ug/kg	370	U	400	U	400	U	380	U	380	U	390	U
Anthracene	18000000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Benzaldehyde	7800000	ug/kg	370	U	32	J	400	U	380	U	380	U	390	U
Benzo(a)anthracene	110000	ug/kg	190	U	200	U	210	U	200	U	59	J	200	U
Benzo(a)pyrene	11000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Benzo(b)fluoranthene	110000	ug/kg	62	J	200	U	75	J	200	U	120	J	200	U
Benzo(g,h,i)perylene	NL	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Benzo(k)fluoranthene	1100000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Butylbenzylphthalate	13000000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Carbazole	NL	ug/kg	370	UJ	400	UJ	400	UJ	380	UJ	380	UJ	390	UJ
Chrysene	11000000	ug/kg	140	J	200	U	240		200	U	340		200	U
Dibenzo(a,h)anthracene	11000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Dibenzofuran	73000	ug/kg	190	U	200	U	210	U	200	U	110	J	200	U
Fluoranthene	2400000	ug/kg	370	U	400	U	92	J	380	U	150	J	390	U
Fluorene	2400000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	190	U	200	U	210	U	200	U	200	U	200	U
Naphthalene	130000	ug/kg	190	U	200	U	92	J	200	U	250		200	U
Phenanthrene	NL	ug/kg	210		200	U	500		200	U	1000		200	U
Pyrene	1800000	ug/kg	190	U	200	U	210	U	200	U	89	J	200	U
2-Methylnaphthalene	240000	ug/kg	49		4	U	84		1.3	J	160		15	
Acenaphthene	3600000	ug/kg	3.7	U	4	U	5.2		3.8	U	6.5		0.87	J
Acenaphthylene	NL	ug/kg	3.7	U	4	U	4	U	3.8	U	3.8	U	3.9	U
Anthracene	18000000	ug/kg	3.8		4	U	4.6		3.8	U	8.9		3.9	U
Benzo(a)anthracene	110000	ug/kg	19		4	U	31		3.8	U	54		5.4	
Benzo(a)pyrene	11000	ug/kg	9.2		4	U	7.7		3.8	U	13		3.6	J
Benzo(b)fluoranthene	110000	ug/kg	53		2.6	J	62		2.2	J	90		10	
Benzo(g,h,i)perylene	NL	ug/kg	13		4	U	10		3.8	U	13		2.6	J
Benzo(k)fluoranthene	1100000	ug/kg	4.5		4	U	4	U	3.8	U	6.1		3.9	U
Chrysene	11000000	ug/kg	150		5.6		220	J	5.8		310	J	22	
Dibenzo(a,h)anthracene	11000	ug/kg	9.7		4	U	11		3.8	U	14		3.9	U
Fluoranthene	2400000	ug/kg	48		3.1	J	83		2.4	J	130		12	
Fluorene	2400000	ug/kg	3.7	U	4	U	6		3.8	U	7.8		3.9	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	7.1		4	U	4.2		3.8	U	5.2		2.2	J
Naphthalene	130000	ug/kg	40		4	U	81		3.8	U	210		10	
Pentachlorophenol	100000	ug/kg	7.5	U	8.1	U	8.1	U	7.7	U	7.7	U	7.9	U
Phenanthrene	NL	ug/kg	210		8.8		440	J	10		860	J	45	
Pyrene	1800000	ug/kg	29		2.8	J	47		3.8	U	70		7.5	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
µg/kg = micrograms per kilogram
J = Estimated quantity
NL = No listed value
PAH = Polycyclic Aromatic Hydrocarbon
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
RML = Removal Management Level
Q = Qualifier
SIM = Selective Ion Monitoring
SVOC = Semivolatile Organic Compound
U = Not Detected
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-238		SS-239		SS-240		SS-241		SS-242		SS-243	
		Field Sample ID:	SEC-SS-238		SEC-SS-239		SEC-SS-240		SEC-SS-241		SEC-SS-242		SEC-SS-243	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	C0AQ5		C0AQ6		C0AQ7		C0AQ8		C0AQ9		C0AR0	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	87	J	81	J	110	J	120	J	64	J	200	U
2-Methylnaphthalene	240000	ug/kg	200		80	J	89	J	91	J	220	J	97	J
3-Nitroaniline	NL	ug/kg	370	U	370	U	360	U	360	U	460	U	390	U
4-Chloroaniline	250000	ug/kg	370	UJ	370	U	360	UJ	360	UJ	110	J	390	U
4-Methylphenol	6300000	ug/kg	370	U	370	U	360	U	360	U	460	U	55	J
Acenaphthene	3600000	ug/kg	190	U	190	U	190	U	190	U	270		53	J
Acenaphthylene	NL	ug/kg	190	U	190	U	190	U	190	U	1700		720	
Acetophenone	7800000	ug/kg	370	U	370	U	360	U	360	U	460	U	390	U
Anthracene	18000000	ug/kg	190	U	190	U	190	U	190	U	1500		400	
Benzaldehyde	7800000	ug/kg	370	U	370	U	360	U	360	U	460	U	390	U
Benzo(a)anthracene	110000	ug/kg	190	U	190	U	190	U	190	U	4800		1100	
Benzo(a)pyrene	11000	ug/kg	190	U	190	U	190	U	190	U	5700		1500	
Benzo(b)fluoranthene	110000	ug/kg	89	J	66	J	82	J	86	J	10000		3000	
Benzo(g,h,i)perylene	NL	ug/kg	190	U	190	U	190	U	190	U	3100		1000	
Benzo(k)fluoranthene	1100000	ug/kg	190	U	190	U	190	U	190	U	3100		1000	
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	190	U	190	U	190	U	190	U	240	U	200	U
Butylbenzylphthalate	13000000	ug/kg	190	U	190	U	190	U	190	U	240	U	200	U
Carbazole	NL	ug/kg	370	UJ	370	UJ	360	UJ	360	UJ	360	J	100	J
Chrysene	11000000	ug/kg	280		220		280		320		5700		1400	
Dibenzo(a,h)anthracene	11000	ug/kg	190	U	190	U	190	U	190	U	880		350	
Dibenzofuran	73000	ug/kg	77	J	190	U	190	U	190	U	300		120	J
Fluoranthene	2400000	ug/kg	100	J	70	J	100	J	110	J	9200		1700	
Fluorene	2400000	ug/kg	190	U	190	U	190	U	190	U	290		200	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	190	U	190	U	190	U	190	U	3500		1200	
Naphthalene	130000	ug/kg	220		74	J	60	J	61	J	290		120	J
Phenanthrene	NL	ug/kg	630		480		710		790		1600		430	
Pyrene	1800000	ug/kg	91	J	190	U	190	U	190	U	6800		1600	
2-Methylnaphthalene	240000	ug/kg	140		56		57		58				94	
Acenaphthene	3600000	ug/kg	5.6		3.7	U	3.6	U	3.6	U			44	
Acenaphthylene	NL	ug/kg	3.7	U	3.7	U	3.6	U	3.6	U			730	J
Anthracene	18000000	ug/kg	12		3.7	U	3.6	U	3.6	U			530	J
Benzo(a)anthracene	110000	ug/kg	44		13		12		13				1200	J
Benzo(a)pyrene	11000	ug/kg	11		3.7		4.7		4.2				1400	J
Benzo(b)fluoranthene	110000	ug/kg	78		62		73		84				2400	J
Benzo(g,h,i)perylene	NL	ug/kg	5.4		10		9.7		9.9				1000	J
Benzo(k)fluoranthene	1100000	ug/kg	5 8		3.7	U	3.6	U	3.6	U			710	J
Chrysene	11000000	ug/kg	270		210	J	240	J	310	J			1300	J
Dibenzo(a,h)anthracene	11000	ug/kg	5 9		11		11		13				390	J
Fluoranthene	2400000	ug/kg	110		70		78		95				1400	J
Fluorene	2400000	ug/kg	5 9		3.7	U	3.6	U	3.6	U			42	
Indeno(1,2,3-cd)pyrene	110000	ug/kg	3.7	U	3.8		4.6		4				1400	J
Naphthalene	130000	ug/kg	220		72		49		49				110	
Pentachlorophenol	100000	ug/kg	7.6	U	7.6	U	7.3	U	7.4	U			17	
Phenanthrene	NL	ug/kg	600	J	450	J	520	J	630	J			370	J
Pyrene	1800000	ug/kg	55		28		33		37				1100	J

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
µg/kg = micrograms per kilogram
J = Estimated quantity
NL = No listed value
PAH = Polycyclic Aromatic Hydrocarbon
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
RML = Removal Management Level
Q = Qualifier
SIM = Selective Ion Monitoring
SVOC = Semivolatile Organic Compound
U = Not Detected
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-244		SS-245		SS-246		SS-247		SS-248		SS-249	
		Field Sample ID:	SEC-SS-244		SEC-SS-245		SEC-SS-246		SEC-SS-247		SEC-SS-248		SEC-SS-249	
		Date:	6/27/2018		6/27/2018		6/26/2018		6/27/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	C0AR1		C0AR2		C0AR3		C0AR4		C0AR5		C0AR6	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
2-Methylnaphthalene	240000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
3-Nitroaniline	NL	ug/kg	640	U	1100	U	390	U	900	U	380	U	390	U
4-Chloroaniline	250000	ug/kg	640	U	1100	U	390	UJ	900	U	380	U	390	U
4-Methylphenol	6300000	ug/kg	640	U	1100	U	390	U	490	J	380	U	390	U
Acenaphthene	3600000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Acenaphthylene	NL	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Acetophenone	7800000	ug/kg	640	U	1100	R	390	U	900	U	380	U	390	U
Anthracene	18000000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Benzaldehyde	7800000	ug/kg	640	U	1100	U	390	U	130	J	380	U	390	U
Benzo(a)anthracene	110000	ug/kg	330	U	540	U	200	U	460	U	73	J	200	U
Benzo(a)pyrene	11000	ug/kg	330	U	540	U	200	U	460	U	86	J	200	U
Benzo(b)fluoranthene	110000	ug/kg	110	J	540	U	200	U	130	J	210		80	J
Benzo(g,h,i)perylene	NL	ug/kg	330	U	540	U	200	U	460	U	67	J	200	U
Benzo(k)fluoranthene	1100000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	330	U	540	U	200	U	230	J	200	U	200	U
Butylbenzylphthalate	13000000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Carbazole	NL	ug/kg	640	UJ	1100	UJ	390	UJ	900	UJ	380	UJ	390	UJ
Chrysene	11000000	ug/kg	330	U	540	U	200	U	460	U	180	J	130	J
Dibenzo(a,h)anthracene	11000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Dibenzofuran	73000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Fluoranthene	2400000	ug/kg	130	J	1100	U	390	U	900	U	130	J	66	J
Fluorene	2400000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	330	U	540	U	200	U	460	U	69	J	200	U
Naphthalene	130000	ug/kg	330	U	540	U	200	U	460	U	200	U	200	U
Phenanthrene	NL	ug/kg	330	U	540	U	200	U	460	U	130	J	120	J
Pyrene	1800000	ug/kg	110	J	540	U	200	U	460	U	100	J	200	U
2-Methylnaphthalene	240000	ug/kg	3 3	J	11	U	6.8		24		26		20	
Acenaphthene	3600000	ug/kg	2 2	J	11	U	1.1	J	2.5	J	6 5		5	
Acenaphthylene	NL	ug/kg	17		1 5	J	3.9	U	27		37		8 5	
Anthracene	18000000	ug/kg	20		2 8	J	3.9	U	25		32		7.4	
Benzo(a)anthracene	110000	ug/kg	70		11	U	4.9		64		80		31	
Benzo(a)pyrene	11000	ug/kg	78		11	U	2	J	77		86		27	
Benzo(b)fluoranthene	110000	ug/kg	100		7.4	J	6.3		120		180		78	
Benzo(g,h,i)perylene	NL	ug/kg	50		11	U	3.9	U	58		62		23	
Benzo(k)fluoranthene	1100000	ug/kg	28		11	U	3.9	U	33		53		12	
Chrysene	11000000	ug/kg	69		5 8	J	12		74		160		130	
Dibenzo(a,h)anthracene	11000	ug/kg	15		11	U	3.9	U	16		29		14	
Fluoranthene	2400000	ug/kg	150		14		21		84		110		62	
Fluorene	2400000	ug/kg	2 5	J	5 5	J	1.2	J	9	U	7.8		7.6	
Indeno(1,2,3-cd)pyrene	110000	ug/kg	58		11	U	3.9	U	64		82		19	
Naphthalene	130000	ug/kg	2 9	J	11	U	5.7		19		13		8 2	
Pentachlorophenol	100000	ug/kg	13	U	21	U	7.9	U	18	U	7.7	U	7 9	U
Phenanthrene	NL	ug/kg	45		11	U	22		35		120		120	
Pyrene	1800000	ug/kg	85		10	J	6.2		68		83		36	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
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J = Estimated quantity
NL = No listed value
PAH = Polycyclic Aromatic Hydrocarbon
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample.
RML = Removal Management Level
Q = Qualifier
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SVOC = Semivolatile Organic Compound
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Table 7
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Soil Samples

		Station:	SS-250		SS-251		SS-252		SS-253		SS-256	
		Field Sample ID:	SEC-SS-250		SEC-SS-251		SEC-SS-252		SEC-SS-253		SEC-SS-256	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/28/2018	
		Lab Sample ID:	C0AS1		C0AS2		C0AS3		C0AS4		C0AT9	
SVOC	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,1'-Biphenyl	47000	ug/kg	480	U	420	U	240	U	270	U	200	U
2-Methylnaphthalene	240000	ug/kg	140	J	420	U	240	U	270	U	200	U
3-Nitroaniline	NL	ug/kg	930	U	820	U	470	U	530	U	390	U
4-Chloroaniline	250000	ug/kg	930	UJ	820	U	470	U	530	U	390	U
4-Methylphenol	6300000	ug/kg	930	U	820	U	470	U	530	U	390	U
Acenaphthene	3600000	ug/kg	480	U	420	U	240	U	270	U	200	U
Acenaphthylene	NL	ug/kg	480	U	240	J	240	U	270	U	200	U
Acetophenone	7800000	ug/kg	930	U	820	U	470	U	530	U	390	U
Anthracene	18000000	ug/kg	480	U	420	U	240	U	270	U	200	U
Benzaldehyde	7800000	ug/kg	930	U	820	U	470	U	530	U	390	U
Benzo(a)anthracene	110000	ug/kg	350	J	650		240	U	85	J	76	J
Benzo(a)pyrene	11000	ug/kg	390	J	880		240	U	90	J	73	J
Benzo(b)fluoranthene	110000	ug/kg	810		1500		240	U	150	J	130	J
Benzo(g,h,i)perylene	NL	ug/kg	260	J	860		240	U	270	U	200	U
Benzo(k)fluoranthene	1100000	ug/kg	190	J	400	J	240	U	270	U	200	U
Bis(2-ethylhexyl)phthalate	1300000	ug/kg	160	J	420	U	240	U	270	U	95	J
Butylbenzylphthalate	13000000	ug/kg	480	U	420	U	240	U	270	U	200	U
Carbazole	NL	ug/kg	930	UJ	320	J	470	UJ	530	UJ	390	UJ
Chrysene	11000000	ug/kg	640		960		240	U	130	J	93	J
Dibenzo(a,h)anthracene	11000	ug/kg	480	U	270	J	240	U	270	U	200	U
Dibenzofuran	73000	ug/kg	480	U	420	U	240	U	270	U	200	U
Fluoranthene	2400000	ug/kg	870	J	1900		470	U	180	J	160	J
Fluorene	2400000	ug/kg	480	U	420	U	240	U	270	U	200	U
Indeno(1,2,3-cd)pyrene	110000	ug/kg	250	J	780		240	U	270	U	200	U
Naphthalene	130000	ug/kg	480	U	420	U	240	U	270	U	200	U
Phenanthrene	NL	ug/kg	590		1400		100	J	160	J	78	J
Pyrene	1800000	ug/kg	780		1600		240	U	140	J	120	J
2-Methylnaphthalene	240000	ug/kg	140		35		11		55		9.1	
Acenaphthene	3600000	ug/kg	19		13		1.6	J	4.7	J	3.9	U
Acenaphthylene	NL	ug/kg	95		280		4.7	U	5 3	U	10	
Anthracene	18000000	ug/kg	120		150		4.7	U	20		18	
Benzo(a)anthracene	110000	ug/kg	370		710	J	21		81		82	
Benzo(a)pyrene	11000	ug/kg	390		930	J	21		95		80	
Benzo(b)fluoranthene	110000	ug/kg	670		1300	J	49		150		110	
Benzo(g,h,i)perylene	NL	ug/kg	130		690		14		40		43	
Benzo(k)fluoranthene	1100000	ug/kg	190		430		10		42		34	
Chrysene	11000000	ug/kg	590		980	J	59		130		96	
Dibenzo(a,h)anthracene	11000	ug/kg	58		260		5.7		14		14	
Fluoranthene	2400000	ug/kg	860		1900	J	47		180		150	
Fluorene	2400000	ug/kg	28		58		4.7	U	5	J	3.9	
Indeno(1,2,3-cd)pyrene	110000	ug/kg	270		810	J	16		53		51	
Naphthalene	130000	ug/kg	91		44		9.1		41		6	
Pentachlorophenol	100000	ug/kg	5.4	J	3.1	J	1.2	J	11	U	8	U
Phenanthrene	NL	ug/kg	550		1300	J	91		140		77	
Pyrene	1800000	ug/kg	480		1100	J	29		110		97	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
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Table 8
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Soil Samples

		Station:	SS-212		SS-213		SS-221		SS-225		SS-226		SS-227	
		Field Sample ID:	SEC-SS-212		SEC-SS-213		SEC-SS-221		SEC-SS-225		SEC-SS-226		SEC-SS-227	
		Date:	6/27/2018		6/26/2018		6/28/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	MC0AM6		MC0AM8		MC0AW0		MC0AP2		MC0AP3		MC0AP4	
	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	77000	mg/kg	4120		7040	J	5710		8330	J	5470	J	6430	J
Arsenic	35	mg/kg	8.5		10.2		14.3		5.4		23.9		5.5	
Barium	15000	mg/kg	40.9		78.2		155		50.9		84.3		43.5	
Beryllium	160	mg/kg	0.95		1.7		0.76		0.72		1.2		0.53	
Cadmium	71	mg/kg	0.21	J	0.44	J	1.7		0.52	U	0.37	J	0.52	U
Calcium	NL	mg/kg	369	J	1460		6320		541		456	J	564	
Chromium*	120000	mg/kg	23.7		15.1		19		14		19.5		14.3	
Cobalt	23	mg/kg	6.9		13.5		8.6		14		6.2		2.3	J
Copper	3100	mg/kg	15.6		40.2		37.7		22.6		36.4		9.2	
Iron	55000	mg/kg	53800		27700		18900		22900		24400		18800	
Lead**	400	mg/kg	21		80.4		527		17.1		13.7		10.7	
Magnesium	NL	mg/kg	438	J	1430		749		1250		969		341	J
Manganese	1800	mg/kg	451		904		384		217		96.8		56.4	
Nickel	1500	mg/kg	18.7		41.1		11.2		15.8		15.4		5.6	
Potassium	NL	mg/kg	709		1170		723		1360		1390		815	
Selenium	390	mg/kg	3.8	U	3.6	U	4.1	U	3.6	U	3.5	U	3.6	U
Silver	390	mg/kg	1.1	U	1	U	1.2	U	1	U	1	U	1	U
Sodium	NL	mg/kg	542	U	514	U	579	U	516	U	504	U	519	U
Thallium	0.78	mg/kg	1.4	J	2.2	J	0.97	J	0.88	J	0.7	J	2.6	U
Vanadium	390	mg/kg	5.8		9.8		11.8		14.3		11.9		13.4	
Zinc	23000	mg/kg	53.2		183		471		59.5		34.5		23.2	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* The RML for chromium is based on toxicity data for chromium III, the more common form.

** There is no RML for lead; analytical results compared to the EPA recommened soil lead level for residential soil of 400 mg/kg

Red value indicates exceedance of EPA RML

mg/kg = milligrams per kilogram

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Not Detected

Table 8
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Soil Samples

		Station:	SS-228		SS-229		SS-230		SS-231		SS-232		SS-233	
		Field Sample ID:	SEC-SS-228		SEC-SS-229		SEC-SS-230		SEC-SS-231		SEC-SS-232		SEC-SS-233	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	MC0AP5		MC0AP6		MC0AP7		MC0AP8		MC0AP9		MC0AQ0	
	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	77000	mg/kg	4620	J	10000		4840		7400	J	3460	J	7490	J
Arsenic	35	mg/kg	24.8		7.5		23.3		5.6		21.6		10	
Barium	15000	mg/kg	80.7		49		89.3		48.3		71.3		46.3	
Beryllium	160	mg/kg	1.4		1		1.3		1.1		1.6		0.71	
Cadmium	71	mg/kg	0.41	J	0.17	J	0.34	J	0.15	J	0.32	J	0.24	J
Calcium	NL	mg/kg	475	J	430	J	442	J	586		440	J	742	
Chromium*	120000	mg/kg	36.5		19.6	J	11.4	J	17		11.9		23.8	
Cobalt	23	mg/kg	4.8	J	7.5		6.3		16.7		6.3		5.1	J
Copper	3100	mg/kg	44.5		24.2		40.1		18.4		34.1		18	
Iron	55000	mg/kg	19100		50300	J	19500	J	44500		15800		41500	
Lead**	400	mg/kg	13.7		14.8		14.1		13.2		14.2		12.3	
Magnesium	NL	mg/kg	751		528		1310		1000		1140		696	
Manganese	1800	mg/kg	74		150		88.1		328		65.7		130	
Nickel	1500	mg/kg	24.6		10.3		14.4		14.9		16		11.3	
Potassium	NL	mg/kg	1210		1140		1300		1020		869		890	
Selenium	390	mg/kg	3.5	U	3.7	UJ	3.7	UJ	3.5	U	1.2	J	3.7	U
Silver	390	mg/kg	1	U	1.1	U	1.1	U	1	U	1	U	0.31	J
Sodium	NL	mg/kg	311	J	531	U	530	U	502	U	516	U	533	U
Thallium	0.78	mg/kg	2.5	U	0.96	J	0.77	J	1.2	J	2.6	U	0.73	J
Vanadium	390	mg/kg	13.5		13.7		12.5		13.1		18.8		21.5	
Zinc	23000	mg/kg	28.9		35		35.5		61.4		29.9		50	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* The RML for chromium is based on toxicity data for chromium III, the more common form.

** There is no RML for lead; analytical results compared to the EPA recommened soil lead level for residential soil of 400 mg/kg

Red value indicates exceedance of EPA RML

mg/kg = milligrams per kilogram

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Not Detected

Table 8
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Soil Samples

		Station:	SS-234		SS-235		SS-236		SS-237		SS-238		SS-239	
		Field Sample ID:	SEC-SS-234		SEC-SS-235		SEC-SS-236		SEC-SS-237		SEC-SS-238		SEC-SS-239	
		Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
		Lab Sample ID:	MC0AQ1		MC0AQ2		MC0AQ3		MC0AQ4		MC0AQ5		MC0AQ6	
	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	77000	mg/kg	5860		8800		5510		5110		4660		2240	
Arsenic	35	mg/kg	24		8.4		26.4		5		18.8		50.9	
Barium	15000	mg/kg	78.8		54.9		84.2		82.3		81.5		65.4	
Beryllium	160	mg/kg	1		0.89		1.4		0.93		1.1		1.4	
Cadmium	71	mg/kg	0.4	J	0.17	J	0.45	J	0.14	J	0.34	J	0.83	
Calcium	NL	mg/kg	784		867		942		491	J	415	J	1630	
Chromium*	120000	mg/kg	12.7	J	15.1	J	10.8	J	9.3	J	23.4	J	11.8	J
Cobalt	23	mg/kg	8.5		8.7		6.8		8.2		8		13	
Copper	3100	mg/kg	33.3		23.6		41.6		9.3		28		83.4	
Iron	55000	mg/kg	25300	J	26800	J	18500	J	25500	J	14800	J	100000	J
Lead**	400	mg/kg	15.3		16.1		16.9		25.2		19.8		10.5	
Magnesium	NL	mg/kg	957		1370		1120		240	J	676		421	J
Manganese	1800	mg/kg	136		202		120		674		264		149	
Nickel	1500	mg/kg	13.5		13.4		15.3		7.1		17.8		21.6	
Potassium	NL	mg/kg	1360		1220		1370		525		982		762	
Selenium	390	mg/kg	3.7	UJ	3.9	UJ	1.7	J-	3.7	UJ	3.5	UJ	3.6	UJ
Silver	390	mg/kg	1.1	U	1.1	U	0.98	U	1.1	U	1	U	1	U
Sodium	NL	mg/kg	526	U	560	U	260	J	527	U	189	J	202	J
Thallium	0.78	mg/kg	0.86	J	0.79	J	0.78	J	1.7	J	1	J	0.91	J
Vanadium	390	mg/kg	12.9		15.6		11.9		10		10.8		5.1	U
Zinc	23000	mg/kg	36		54.2		35.5		26.6		29.1		69.2	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* The RML for chromium is based on toxicity data for chromium III, the more common form.

** There is no RML for lead; analytical results compared to the EPA recommened soil lead level for residential soil of 400 mg/kg

Red value indicates exceedance of EPA RML

mg/kg = milligrams per kilogram

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Note Detected

Table 8
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Soil Samples

		Station:	SS-240		SS-241		SS-242		SS-243		SS-244		SS-245	
		Field Sample ID:	SEC-SS-240		SEC-SS-241		SEC-SS-242		SEC-SS-243		SEC-SS-244		SEC-SS-245	
		Date:	6/26/2018		6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/27/2018	
		Lab Sample ID:	MC0AQ7		MC0AQ8		MC0AQ9		MC0AR0		MC0AR1		MC0AR2	
	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	77000	mg/kg	2380		2550		4450		7620		2960		194	
Arsenic	35	mg/kg	36.7		29.2		10.5		6.7		9.6		5.4	
Barium	15000	mg/kg	81.3		61.4		68.2		72.2		449		140	
Beryllium	160	mg/kg	1.5		1.1		0.74		0.83		0.32	J	1.1	U
Cadmium	71	mg/kg	0.53		0.41	J	0.37	J	0.23	J	0.54	J	0.51	J
Calcium	NL	mg/kg	1110		812		10600		79500		5200		2460	
Chromium*	120000	mg/kg	13.1	J	8.9	J	13.3		11.9		14.7		2.3	U
Cobalt	23	mg/kg	5.8		4.5	J	7.7		9.9		152		10.8	
Copper	3100	mg/kg	39.2		31.6		31.7		22.1		23.7		1.9	J
Iron	55000	mg/kg	21600	J	16800	J	26400		21700		182000		300000	
Lead**	400	mg/kg	12.6		10.1		63.9		32.7		27.2		4.9	
Magnesium	NL	mg/kg	547		745		1040		1890		789	J	1130	U
Manganese	1800	mg/kg	40.7		70.8		245		373		25100		1430	
Nickel	1500	mg/kg	15.9		10.9		13.9		11.1		44.3		15.4	
Potassium	NL	mg/kg	979		791		715		592	J	946	J	1130	U
Selenium	390	mg/kg	2.2	J-	3.5	UJ	4.4	U	4.3	U	8.6	U	7.9	U
Silver	390	mg/kg	1	U	1	U	1.2	U	1.2	U	2.4	U	2.3	U
Sodium	NL	mg/kg	157	J	337	J	622	U	611	U	1220	U	1130	U
Thallium	0.78	mg/kg	2.5	U	2.5	U	0.89	J	1.1	J	3.6	J	4.2	J
Vanadium	390	mg/kg	18.1		10.9		8.8		13.7		12.2	U	11.3	U
Zinc	23000	mg/kg	28.9		30.4		75.2		44.3		183		193	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* The RML for chromium is based on toxicity data for chromium III, the more common form.

** There is no RML for lead; analytical results compared to the EPA recommened soil lead level for residential soil of 400 mg/kg

Red value indicates exceedance of EPA RML of 24,000 µg/kg

mg/kg = milligrams per kilogram

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Note Detected

Table 8
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Soil Samples

		Station:	SS-246		SS-247		SS-248		SS-249		SS-250		SS-251		SS-252		SS-253		SS-256	
		Field Sample ID:	SEC-SS-246		SEC-SS-247		SEC-SS-248		SEC-SS-249		SEC-SS-250		SEC-SS-251		SEC-SS-252		SEC-SS-253		SEC-SS-256	
		Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/28/2018	
		Lab Sample ID:	MC0AR3		MC0AR4		MC0AR5		MC0AR6		MC0AS1		MC0AS2		MC0AS3		MC0AS4		MC0AT9	
	Residential Soil RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	77000	mg/kg	3970	J	5970		1970		1720		7470	J	8620	J	6480	J	6840	J	6280	
Arsenic	35	mg/kg	7.8		5.6		12.9		15.4		15.5		9.2		9.8		8.9		3.9	
Barium	15000	mg/kg	50		117		43.3		44.1		151		80.8		58.9		123		59	
Beryllium	160	mg/kg	0.87		1.2	J	1.3		2		1.7		2.8		1.6		1		0.38	J
Cadmium	71	mg/kg	0.17	J	0.5	J	0.23	J	0.28	J	0.98		0.83	J	0.51	J	1.1		0.3	J
Calcium	NL	mg/kg	672		4020		1380		1500		2800		1560		2740		1660		5980	
Chromium*	120000	mg/kg	9.3		36.7		8.1		7.8		14.8		15.2		15.8		11.8		13	
Cobalt	23	mg/kg	22.7		6.4	J	3.9	J	4	J	11.7		12.3	J	31.4		21.7		3.6	J
Copper	3100	mg/kg	8.6		43		23.9		16.3		48.8		95		33.1		43.8		12.6	
Iron	55000	mg/kg	12200		15000		9110		13100		18900		13100		54900		16300		10400	
Lead**	400	mg/kg	40.4		103		9.9		10.6		213		376		79.9		114		63.1	
Magnesium	NL	mg/kg	505	J	1190	J	523	J	483	J	898		1020	J	1770		1010		938	
Manganese	1800	mg/kg	444		167		48.9		116		347		129		1110		1100		127	
Nickel	1500	mg/kg	12.5		34.6		9		9.7		23.6		26.1		48.8		31.5		10.9	
Potassium	NL	mg/kg	774		1820		708		627		955		1080	J	1210		954		371	J
Selenium	390	mg/kg	3.7	U	8.9	U	3.8	U	3.5	U	5.4	U	8.9	U	4.5	U	5.6	U	3.5	U
Silver	390	mg/kg	1.1	U	2.5	U	1.1	U	1	U	0.19	J	2.5	U	1.3	U	0.25	J	1	U
Sodium	NL	mg/kg	533	U	1270	U	407	J	527		776	U	1270	U	638	U	802	U	500	U
Thallium	0.78	mg/kg	1.2	J	6.3	U	2.7	U	2.5	U	1.1	J	6.3	U	3	J	2.5	J	2.5	U
Vanadium	390	mg/kg	6.5		11.4	J	11.9		11.3		17.2		14.8		13.1		14.5		10.6	
Zinc	23000	mg/kg	40.2		226		25.5		22.3		275		124		221		260		65.8	

Notes:

Results compared to EPA RML for residential soil (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)

* The RML for chromium is based on toxicity data for chromium III, the more common form.

** There is no RML for lead; analytical results compared to the EPA recommened soil lead level for residential soil of 400 mg/kg

Red value indicates exceedance of EPA RML of 24,000 µg/kg

mg/kg = milligrams per kilogram

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Note Detected

Table 9
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 PCBs and Dioxins in Soil Samples

Sample Number	CLP Sample Number	Sample Date	Location	Matrix	Analyte	Result	Q
GW-001	PC0AG6	6/12/2017	MW1	Ground Water	Total PCB	3.7	J
GW-002	PC0AG7	6/13/2017	MW2	Ground Water	Total PCB	0.078	J
GW-003	PC0AG8	6/12/2017	MW3	Ground Water	Total PCB	0.039	J
GW-004	PC0AG9	6/12/2017	MW4	Ground Water	Total PCB	0.2	J
GW-005	PC0AH0	6/12/2017	Mine Outfall	Ground Water	Total PCB	0.00014	J
GW-006	PC0AH1	6/12/2017	Mine Outfall	Ground Water	Total PCB	0.000041	J
GW-007	PC0AH2	6/12/2017	Mine Outfall	Ground Water	Total PCB	0.00019	J

Notes:
Units are in micrograms per liter (µg/L)
Results compared to EPA MCL of 0.5 µg/L for PCBs (EPA, 2009) and the EPA RML for tapwater of 0.78 µg/L (1E-04 risk level for carcinogens and a hazard quotient of 1 for non carcinogens) (EPA, 2018)
Red value indicates exceedance of MCL and RML
µg/L = micrograms per liter
J = Reported value is an estimated concentration; actual value may be higher or lower than reported
MCL = Maximum Contaminant Level
PCB = Polychlorinated biphenyl
Q = Qualifier
RML Removal Management Level

Table 9
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 PCBs and Dioxins in Soil Samples

Field Sample ID:	MW3		Mine Outfall		Mine Outfall		Mine Outfall	
Date:	6/12/2017		6/12/2017		6/12/2017		6/12/2017	
Lab Sample ID:	PC0AG8		PC0AH0		PC0AH1		PC0AH2	
Analyte	Result	Q	Result	Q	Result	Q	Result	Q
2,3,7,8-TCDD	0.98	UJ	0.49	U	0.47	U	0.74	UJ
1,2,3,7,8-PeCDD	51	U	1.2	U	1.1	U	1.3	U
1,2,3,4,7,8-HxCDD	51	U	0.63	U	0.61	U	0.98	UJ
1,2,3,6,7,8-HxCDD	51	U	0.74	U	0.71	U	0.98	UJ
1,2,3,7,8,9-HxCDD	51	U	1.4	U	1.4	U	1.6	U
1,2,3,4,6,7,8-HpCDD	51	U	1.4	U	1.3	U	1.6	U
OCDD	100	U	3.8	U	3.7	U	120	U
2,3,7,8-TCDF	1.2	UJ	0.44	U	0.42	UJ	0.78	UJ
1,2,3,7,8-PeCDF	51	U	0.71	U	0.68	U	0.81	U
2,3,4,7,8-PeCDF	51	U	0.80	U	0.77	U	0.92	U
1,2,3,4,7,8-HxCDF	51	U	1.1	U	1.0	U	1.2	U
1,2,3,6,7,8-HxCDF	51	U	1.1	U	1.0	U	1.2	U
1,2,3,7,8,9-HxCDF	51	U	0.87	Z	49	U	1.1	UJ
2,3,4,6,7,8-HxCDF	2.0	Z	1.4	U	1.4	U	1.6	U
1,2,3,4,6,7,8-HpCDF	51	U	1.6	U	1.5	U	1.8	U
1,2,3,4,7,8,9-HpCDF	1.5	UJ	1.4	U	1.3	U	1.6	U
OCDF	100	U	3.0	U	2.9	U	3.5	U
Total TCDD		UJ		UJ		UJ		UJ
Total PeCDD	1.6	J		UJ		UJ		UJ
Total HxCDD	3.4	J		UJ		UJ		UJ
Total HpCDD	12	J		UJ		UJ		UJ
Total TCDF		UJ		UJ		UJ		UJ
Total PeCDF	8.3	J		UJ		UJ		UJ
Total HxCDF	22	J		UJ		UJ		UJ
Total HpCDF	56	J		UJ		UJ		UJ
TEQ (Mammal)	3.8		0.0		0.0		0.0016	
TEQ (Bird)	5.6		0.0		0.0		0.00053	
TEQ (Fish)	4.1		0.0		0.0		0.00053	

Notes:

Units are in picograms per liter (pg/L)

The TEQ (mammal) results were compared to the EPA MCL of 30 pg/L (EPA, 2009) and the EPA RML for tapwater of 12 pg/L (EPA, 2018) for 2,3,7,8-TCDD (1E 04 risk level for carcinogens)

CLP = Contract Laboratory Program

J = Estimated quantity

RML = Removal Management Level

TEQ = Toxic Equivalency

U = Not detected

UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise

Z = Estimated maximum possible concentration

Table 10
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Results for Groundwater Samples

			Station:	GW-01		GW-02	
			Field Sample ID:	SEC-GW-01		SEC-GW-02	
			Date:	6/27/2018		6/27/2018	
			Lab Sample ID:	C0AR9		C0AS0	
SVOCs	MCL	Tapwater RML	Units:	Result	Q	Result	Q
Benzo(a)anthracene	NL	3	µg/L	0.035	J	0.019	J
Benzo(a)pyrene	0.2	2.5	µg/L	0.027	J	0.012	J
Benzo(b)fluoranthene	NL	25	µg/L	0.044	J	0.025	J
Benzo(g,h,i)perylene	NL	NL	µg/L	0.014	J	ND	
Chrysene	NL	2500	µg/L	0.056	J	0.036	J
Fluoranthene	NL	800	µg/L	0.068	J	0.038	J
Indeno(1,2,3-cd)pyrene	NL	25	µg/L	0.018	J	ND	
Phenanthrene	NL	NL	µg/L	0.085	J	0.057	J
Pyrene	NL	120	µg/L	0.057	J	ND	
PCB							
Aroclor-1260	0.5	0.78	µg/L	ND		ND	

			Station:	GW-01		GW-02	
			Field Sample ID:	SEC-GW-01		SEC-GW-02	
			Date:	6/27/2018		6/27/2018	
			Lab Sample ID:	MC0AR9		MC0AS0	
Inorganic	MCL	Tapwater RML	Units:	Result	Q	Result	Q
Aluminum	NL	20000	µg/L	143		738	
Arsenic	10	5.2	µg/L	1		2.4	
Barium	2000	3800	µg/L	40.2		68.7	
Calcium	NL	NL	µg/L	19900	J	21500	J
Chromium*	100	22,000	µg/L	1.1	J	1.7	J
Cobalt	NL	6	µg/L	ND		1.7	
Copper	1300	800	µg/L	3.5		12.7	
Iron	NL	14000	µg/L	450		2970	
Lead*	15	15	µg/L	1.3		8.9	
Magnesium	NL	NL	µg/L	2780		3040	
Manganese	NL	430	µg/L	22.3	J	93.6	J
Nickel	NL	390	µg/L	1.3		4.5	
Potassium	NL	NL	µg/L	4600		4760	
Sodium	NL	NL	µg/L	4360		4380	
Thallium	2	0.2	µg/L	ND		**0.25**	J
Vanadium	NL	86	µg/L	ND		1.1	J
Zinc	NL	6000	µg/L	4.1		24.7	

Notes:

Results compared to EPA MCLs (EPA, 2009) and EPA RMLs for tapwater (1E-04 risk level for carcinogens a hazard quotient of 1 for non carcinogens) (EPA, 2018)
* The RML for chromium is based on toxicity data for chromium III, the more common form.
**There is no RML for lead in drinking water; however, EPA's current standard for lead in drinking water is 15 .
Bolded value indicates exceedance of RML
µg/L = micrograms per liter
J = Reported value is an estimated concentration; actual value may be higher or lower than reported
MCL = Maximum Contaminant Level
ND = Not Detected
NL = No listed value
PCB = Polychlorinated biphenyl
Q = Qualifier
RML Removal Management Level
SVOC = Semivolatile organic compound

Table 11
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 PCBs in Surface Water Samples

Sample Number	CLP Sample Number	Sample Date	Analyte	Result	Q
SW-001	PC0AH9	6/14/2017	Total PCB	**0.0018**	J
SW-002	PC0AJ0	6/14/2017	Total PCB	**0.0027**	J
SW-003	PC0AK8	6/14/2017	Total PCB	**0.0094**	J
SW-004	PC0AJ2	6/14/2017	Total PCB	**0.0064**	J
SW-005	PC0AJ3	6/14/2017	Total PCB	**0.004**	J
SW-006	PC0AJ4	6/14/2017	Total PCB	**0.0055**	J
SW-007	PC0AJ5	6/14/2017	Total PCB	**0.0035**	J
SW-008 (SW-018)	PC0AJ6	6/14/2017	Total PCB	**0.0035**	J
SW-009	PC0AJ7	6/14/2017	Total PCB	**0.0032**	J
SW-010	PC0AK9	6/14/2017	Total PCB	**0.006**	J
SW-011	PC0AJ9	6/14/2017	Total PCB	**0.005**	J
SW-012	PC0AK0	6/14/2017	Total PCB	**0.0035**	J
SW-013	PC0AK1	6/14/2017	Total PCB	**0.003**	J
SW-014	PC0AK2	6/14/2017	Total PCB	**0.0031**	J
SW-015	PC0AK3	6/14/2017	Total PCB	**0.0037**	J
SW-016	PC0AK4	6/14/2017	Total PCB	**0.0048**	J
SW-017	PC0AL0	6/14/2017	Total PCB	**0.0052**	J
SW-018 (SW-008)	PC0AK6	6/14/2017	Total PCB	**0.003**	J
SW-019 SW-006	PC0AK7	6/14/2017	Total PCB	**0.0024**	J
SW-020	PC0AL9	6/14/2017	Total PCB	**0.018**	J
SW-021	PC0AL8	6/14/2017	Total PCB	**0.00088**	J
SW-022 (SW-023)	PC0AL6	6/14/2017	Total PCB	**0.00054**	J
SW-023 (SW-022)	PC0AL7	6/14/2017	Total PCB	**0.00054**	J
SW-024	PC0AL5	6/14/2017	Total PCB	0.00045	J
SW-025	PC0AL4	6/14/2017	Total PCB	0.00043	J

Notes:
Units are in micrograms per liter (µg/l)
Results represent total PCB cogener detections in sample

Results compared to EPA BTAG screening value for freshwater of 0.000074 µg/l (EPA, 2006)
Green Highlight indicates background surface water sample
Bolded value indicates 3X background (3x analytical result for SW-24)
Red value indicates exceedance of EPA BTAG sreening value
Sample IDs in parentheses indicates duplicate pair

Blue text indicates inconsistency in Sample ID between logbook notes and Laboratory data sheets
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated byphenyl

Table 12
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Investigation
June 2017 Dioxins in Surface Water Samples

CLP Sample Number:	PC0AH9		PC0AJ2		PC0AJ6		PC0AJ7		PC0AK4		PC0AL4	
Sample #:	SW-001		SW-004		SW-008		SW-009		SW-016		SW-025	
Units:	pg/L		pg/L		pg/L		pg/L		pg/L		pg/L	
Date Sampled:	6/14/2017		6/14/2017		6/14/2017		6/14/2017		6/14/2017		6/14/2017	
Parameter	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,2,3,4,6,7,8-HpCDD	49	U	50	U	50	U	52	U	49	U	51	U
1,2,3,4,6,7,8-HpCDF	1.5	U	1.6	U	1.6	U	1.6	U	49	U	1.6	U
1,2,3,4,7,8,9-HpCDF	1.3	U	1.3	U	1.3	U	1.4	U	1.3	U	1.4	U
1,2,3,4,7,8-HxCDD	0.61	U	0.62	U	0.66	UJ	0.65	U	1.4	UJ	0.64	U
1,2,3,4,7,8-HxCDF	1	U	1	U	1	U	1.1	U	49	U	1.1	U
1,2,3,6,7,8-HxCDD	0.71	U	0.73	U	0.73	U	0.76	U	1.3	UJ	0.75	U
1,2,3,6,7,8-HxCDF	1	U	1.1	U	1.1	U	1.1	U	49	U	1.1	U
1,2,3,7,8,9-HxCDD	1.4	U	1.4	U	1.4	U	1.5	U	49	U	1.4	U
1,2,3,7,8,9-HxCDF	49	U	50	U	50	U	0.67	U	49	U	0.66	U
1,2,3,7,8-PeCDD	1.1	U	1.1	U	1.2	U	1.2	U	49	U	1.2	U
1,2,3,7,8-PeCDF	0.68	U	0.7	U	0.7	U	0.73	U	49	U	0.71	U
2,3,4,6,7,8-HxCDF	1.4	U	1.4	U	1.4	U	1.5	U	1.4	U	1.4	U
2,3,4,7,8-PeCDF	0.77	U	0.79	U	0.79	U	0.83	U	49	U	0.81	U
2,3,7,8-TCDD	0.47	U	0.48	U	0.59	UJ	0.5	U	1.3	UJ	0.49	U
2,3,7,8-TCDF	0.42	U	0.43	U	0.55	UJ	0.45	U	1.4	UJ	0.44	U
OCDD	98	U	100	U	100	U	100	U	98	U	100	U
OCDF	2.9	U	3	U	100	U	3.1	U	98	U	3.1	U
TEQ (Mammal)	**0.099**		**0.1**		0.0064		0.0051		**2.3**		0.024	
TEQ (Bird)	0.073		0.08		0.0021		0.0017		3.1		0.0038	
TEQ (Fish)	0.073		0.08		0.0021		0.0017		2.4		0.0038	

Notes:
pg/L = picograms per liter

The TEQ (mammal) results were compared to the EPA BTAG screening value 0.0031 pg/L for 2,3,7,8-TCDD (EPA, 2009)
Green Highlight indicates background surface water sample
Bolded value indicates 3X background (3x analytical result for SW-24)
Red value indicates exceedance of EPA BTAG sreening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
RML = Removal Management Level
TEQ = Toxic Equivalent
U = Not detected
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise
Z = Estimated maximum possible concentration

Table 13
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 PCBs in Sediment Samples

Sample Number	CLP Sample Number	Sample Date	PCB	Result	Q
SD-001	C0AA0	6/14/2017	Aroclor-1260	32	J
SD-002	C0AA1	6/14/2017	Aroclor-1260	**140**	
SD-003	C0AA2	6/14/2017	Aroclor-1260	**6200**	
SD-004	C0AA3	6/14/2017	Aroclor-1260	**350**	
SD-005	C0AA4	6/14/2017	Aroclor-1260	**230**	
SD-006	C0AA5	6/14/2017	Aroclor-1260	**50000**	C
SD-007	C0AA6	6/14/2017	Aroclor-1260	**85**	
SD-008 (SD-018)	C0AA7	6/14/2017	Aroclor-1260	**120**	
SD-009	C0AA8	6/14/2017	Aroclor-1260	**130**	
SD-010	C0AA9	6/14/2017	Aroclor-1260	**300**	
SD-011	C0AAB0	6/14/2017	Aroclor-1260	**980**	J+
SD-012	C0AAB1	6/14/2017	Aroclor-1260	**130**	
SD-013	C0AAB2	6/14/2017	Aroclor-1260	**180**	J+
SD-014	C0AAB3	6/14/2017	Aroclor-1260	**340**	
SD-015	C0AAB4	6/14/2017	Aroclor-1260	**61**	
SD-016	C0AAB5	6/14/2017	Aroclor-1260	**70**	
SD-017	C0AAB6	6/14/2017	Aroclor-1260	**190**	
SD-018 (SD-008)	C0AAB7	6/14/2017	Aroclor-1260	**86**	
SD-019	C0AAB8	6/14/2017	Aroclor-1260	**50**	
SD-020	C0AM1	6/14/2017	Aroclor-1260	**270**	J+
SD-021	C0AM2	6/14/2017	Aroclor-1260	43	U
SD-022	C0AM3	6/14/2017	Aroclor-1260	7.5	J
SD-023	C0AM4	6/14/2017	Aroclor-1260	9.1	J
SD-024	C0AM5	6/14/2017	Aroclor-1260	6.4	J
SD-025	C0AM6	6/14/2017	Aroclor-1260	39	U

Notes:
Units are in micrograms per kilogram (µg/kg)

Results compared to EPA BTAG screening value for total PCBs in freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)
Green Highlight indicates background sediment sample
Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG screening value
Yellow highlight indicates exceedance of EPA RML
Sample ID in parentheses indicates duplicate pair
BTAG = Biological Technical Assistance Group

C = The target Pesticide or Aroclor analyte identification has been confirmed by Gas Chromatography/Mass Spectrometry (GC/MS). This qualifier may be added to other qualifiers
CLP = Contract Laboratory Program
J = Estimated quantity
J+ = Estimated quantity; the result may be biased high.
PCB = Polychlorinated biphenyls
Q = Qualifier
RML = Removal Management Level
U = Not detected above the sample quantitation limit

Table 14
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2017 Dioxins in Sediment Samples

CLP Sample Number:	C0AA0		PC0AA3		PC0AA8		PC0AB2		C0AB4		C0AB6		PC0AM6	
Sample #:	SD-001		SD-004		SD-009		SD-013		SD-015		SD-017		SD-025	
Units:	ng/kg		ng/kg		ng/kg		ng/kg		ng/kg		ng/kg		ng/kg	
Date Sampled:	6/14/2017		6/14/2017		6/14/2017		6/14/2017		6/14/2017		6/14/2017		6/14/2017	
Parameter	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
1,2,3,4,6,7,8-HpCDD	3	J	100.00		27		25		8.8		78		14	
1,2,3,4,6,7,8-HpCDF	1.5	J	30.00		11		9.6		3.3	J	28		6.7	
1,2,3,4,7,8,9-HpCDF	0.17	Z	2.10	J	0.57	J	0.67	J	0.26	Z	1.5	J	0.34	Z
1,2,3,4,7,8-HxCDD	0.2	U	1.30	J	0.38	J	0.46	J	0.41	J	1.1	J	0.26	Z
1,2,3,4,7,8-HxCDF	0.46	J	2.90	J	0.92	Z	0.7	Z	0.74	J	2.4	J	0.44	J
1,2,3,6,7,8-HxCDD	0.35	U	3.50	J	0.99	J	1.1	Z	1.4	J	3.1	J	0.62	J
1,2,3,6,7,8-HxCDF	0.21	U	1.50	J	0.71	J	0.54	J	0.33	Z	1.7	J	0.33	Z
1,2,3,7,8,9-HxCDD	0.24	U	2.90	J	0.97	J	0.97	J	0.72	J	2.1	J	0.61	Z
1,2,3,7,8,9-HxCDF	0.17	U	0.55	J	0.18	U	0.19	U	0.15	J	0.48	J	0.21	U
1,2,3,7,8-PeCDD	0.18	U	0.82	J	0.35	Z	0.32	J	0.46	J	0.64	J	0.25	J
1,2,3,7,8-PeCDF	0.23	U	1.40	J	0.41	J	0.34	J	0.37	J	1	J	0.22	U
2,3,4,6,7,8-HxCDF	0.19	Z	2.00	J	0.87	J	0.65	J	0.35	J	2	J	0.54	J
2,3,4,7,8-PeCDF	0.2	J	1.60	J	0.72	J	0.46	Z	0.4	J	1.8	J	0.42	J
2,3,7,8-TCDD	0.2	U	0.46	J	0.19	U	0.19	U	0.19	U	0.41	J	0.2	U
2,3,7,8-TCDF	0.39	J	1.50		0.6	J	0.56	Z	0.47	J	1.5		0.32	U
OCDD	35		1100.00		500		270		90		1200		190	
OCDF	2.5	J	71.00		23		22		7.2	J	59		13	
TEQ (Mammal)	0.2		**5.10**		1.2		1		1.2		**4.5**		0.81	
TEQ (Bird)	0.66		5.80		1.8		0.74		1.6		5.9		0.88	
TEQ (Fish)	0.19		4.20		0.97		0.85		1.1		3.8		0.67	

Notes:
Units are in nanograms per kilogram (ng/kg)

The TEQ (mammal) results were compared to the EPA BTAG screening value for freshwater sediment of 0.85 ng/kg (EPA, 2006) and the EPA RML for residential soil of 477 ng/kg for 2,3,7,8-TCDD (based on a 1E-04 risk level for carcinogens; noncarcinogenic RML based on a THQ of 10 is 511 ng/kg) (EPA, 2018)
Green Highlight indicates background soil samples
Bolded value indicates concentration elevated above background (The TEQ (Mammal) for sample SD-25)
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
RML = Removal Management Level
THQ = Target Hazard Quotient
TEQ = Toxic Equivalent
U = Not detected
Z = Estimated maximum possible concentration

Table 15
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
December 2017 PCBs in Sediment Samples

Sample Number:	SEC-SD-T1-01	SEC-SD-T1-02	SEC-SD-T1-03	SEC-SD-T2-01	SEC-SD-T2-02	SEC-SD-T2-03
CLP Number:	C0AA0	C0AA1	C0AA2	C0AA5	C0AA6	C0AA7
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	37 J	31 J	**50**	21 J	**55**	**160**

Sample Number:	SEC-SD-T3-01	SEC-SD-T3-01-D	SEC-SD-T3-02	SEC-SD-T3-03
CLP Number:	C0AB0	C0AC0	C0AB1	C0AB2
Matrix:	Sediment	Sediment	Sediment	Sediment
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/12/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	15 J	7.5 J	**55**	**41 J**

Sample Number:	SEC-SD-T4-01	SEC-SD-T4-02	SEC-SD-T4-03	SEC-SD-T5-01	SEC-SD-T5-02	SEC-SD-T5-03
CLP Number:	C0AB5	C0AB6	C0AB7	C0AD4	C0AD5	C0AD6
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	12/12/2017	12/12/2017	12/12/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	**1,800**	**62 J**	**62 J**	**440 J**	38J	30 J

Notes:
µg/kg = micrograms per kilogram

Results compared to EPA BTAG value for freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCBs (1E-04 risk level for carcinogens) (EPA, 2018)

Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG value
BTAG = Biologucal Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyls
RML = Removal Management Level

Table 15
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
December 2017 PCBs in Sediment Samples

Sample Number:	SEC-SD-T6-01	SEC-SD-T6-02	SEC-SD-T6-03	SEC-SD-T7-01	SEC-SD-T7-02	SEC-SD-T7-03
CLP Number:	C0AD8	C0AD9	C0AE3	C0AE5	C0AE6	C0AE8
Matrix:	Sediment	Sediment	Sediment	Sediment	Sediment	Sediment
Sample Date:	12/13/2017	12/13/2017	12/13/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	**78**	35 J	22 J	25 J	31 J	**41 J**

Sample Number:	SEC-SD-T8-01	SEC-SD-T8-02	SEC-SD-T8-03	SEC-SD-CL-01
CLP Number:	C0AF3	C0AF5	C0AF4	C0AF8
Matrix:	Sediment	Sediment	Sediment	Sediment
Sample Date:	12/13/2017	12/13/2017	12/13/2017	12/13/2017
Unit:	µg/kg	µg/kg	µg/kg	µg/kg
PCB (Aroclor 1260):	27 J	36 J	39 J	32 J

Sample Number:	SEC-SD-TL-03	SEC-SD-TL-06
CLP Number:	C0AF7	C0AF0
Matrix:	Sediment	Sediment
Sample Date:	12/13/2017	12/13/2017
Unit:	ppm	ppm
PCB (Aroclor 1260):	25 J	**180**

Notes:
µg/kg = micrograms per kilogram

Results compared to EPA BTAG screening value for total PCBs in freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)

Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyls
RML = Removal Management Level

Table 16
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
March and May 2018 PCBs in Sediment Samples

Sample Number	CLP Sample Number	Sample Date	Analyte	Result
SD-50	C0AC6	3/20/2018	Aroclor-1260	34J
SD-51	C0AC7	3/20/2018	Aroclor-1260	**100**
SD-51B	C0AC8	3/20/2018	Aroclor-1260	**44**
SD-52	C0AC9	3/20/2018	Aroclor-1260	37J
SD-53	C0AD0	3/20/2018	Aroclor-1260	**100**
SD-54	C0AD1	3/20/2018	Aroclor-1260	**52**
SD-55	C0AD2	3/20/2018	Aroclor-1260	46U
SEC-SD-56	C0AG8	5/15/2018	Aroclor-1260	**45J**
SEC-SD-57	C0AG9	5/15/2018	Aroclor-1260	**45**
SEC-SD-58	C0AH0	5/15/2018	Aroclor-1260	**55J**
SEC-SD-59	C0AH1	5/15/2018	Aroclor-1260	**140**
SEC-SD-60	C0AH2	5/15/2018	Aroclor-1260	**61J**
SEC-SD-61	C0AH3	5/15/2018	Aroclor-1260	**71**
SEC-SD-62	C0AH4	5/15/2018	Aroclor-1260	29J
SEC-SD-63 (SEC-SD-66)	C0AH5	5/15/2018	Aroclor-1260	**110J**
SEC-SD-64	C0AH6	5/15/2018	Aroclor-1260	**41J**
SEC-SD-65	C0AH7	5/15/2018	Aroclor-1260	**70**
SEC-SD-66 (SEC-SD-63)	C0AH8	5/15/2018	Aroclor-1260	**80J**
SEC-SD-67	C0AH9	5/16/2018	Aroclor-1260	99U
SEC-SD-68	C0AJ0	5/16/2018	Aroclor-1260	15J
SEC-SD-69	C0AJ1	5/16/2018	Aroclor-1260	**78**
SEC-SD-70	C0AJ2	5/16/2018	Aroclor-1260	200UJ

Notes:
Units are in micrograms per kilogram (µg/kg)

Results compared to EPA BTAG screening value for total PCBs in freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)

Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG screening value
Sample numbers in parenthesis indicate duplicate pairs.

Pink highlight indicates sample collected from tributary just prior to confluence with Arbuckle Creek
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyls
RML = Removal Management Level
U = Not detected

Table 17
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 PCBs in Sediment Samples

	Station:	SD-100		SD-101		SD-102		SD-103		SD-104		SD-105		SD-106	
	Field Sample ID:	SEC-SD-100		SEC-SD-101		SEC-SD-102		SEC-SD-103		SEC-SD-104		SEC-SD-105		SEC-SD-106	
	Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/28/2018		6/28/2018		6/28/2018	
	Lab Sample ID:	C0AS9		C0AT2		C0AT3		C0AT6		C0AT7		C0AT8		C0AW1	
	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	ug/kg	58	U	40	U	41	U	47	U	42	U	43	U	51	U

	Station:	SD-71		SD-72		SD-73		SD-74		SD-75		SD-76		SD-77	
	Field Sample ID:	SEC-SD-71		SEC-SD-72		SEC-SD-73		SEC-SD-74		SEC-SD-75		SEC-SD-76		SEC-SD-77	
	Date:	6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018		6/26/2018	
	Lab Sample ID:	C0AK2		C0AJ5		C0AJ6		C0AJ7		C0AJ8		C0AJ9		C0AK0	
	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	ug/kg	38	J	40	U	28	J	40	J	**64**	J	**89**	J	**69**	J

	Station:	SD-78		SD-79		SD-80		SD-81		SD-82		SD-83		SD-84	
	Field Sample ID:	SEC-SD-78		SEC-SD-79		SEC-SD-80		SEC-SD-81		SEC-SD-82		SEC-SD-83		SEC-SD-84	
	Date:	6/26/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/27/2018		6/27/2018	
	Lab Sample ID:	C0AK1		C0AK4		C0AK5		C0AK6		C0AK7		C0AK8		C0AK9	
	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	ug/kg	39	J	48	U	54	U	120	U	140	U	41	U	48	U

Notes:
µg/kg = micrograms per kilogram
Results compared to EPA BTAG screening value for total PCBs in freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)

Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyls
Q = Qualifier
RML = Removal Management Level

Table 17
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 PCBs in Sediment Samples

	Station:	SD-85		SD-86		SD-87		SD-88		SD-90		SD-91		SD-92	
	Field Sample ID:	SEC-SD-85		SEC-SD-86		SEC-SD-87		SEC-SD-88		SEC-SD-90		SEC-SD-91		SEC-SD-92	
	Date:	6/27/2018		6/27/2018		6/28/2018		6/27/2018		6/26/2018		6/26/2018		6/27/2018	
	Lab Sample ID:	C0AL0		C0AL1		C0AL2		C0AL3		C0AL5		C0AL6		C0AL7	
	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	ug/kg	100	U	58	U	44	U	38	U	120	U	90	U	64	U

	Station:	SD-93		SD-95		SD-96		SD-97		SD-98		SD-99	
	Field Sample ID:	SEC-SD-93		SEC-SD-95		SEC-SD-96		SEC-SD-97		SEC-SD-98		SEC-SD-99	
	Date:	6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018	
	Lab Sample ID:	C0AL8		C0AM0		C0AM1		C0AM2		C0AS5		C0AS8	
	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aroclor-1260	ug/kg	89	U	43	U	43	U	47	U	46	U	49	U

Notes:
µg/kg = micrograms per kilogram
Results compared to EPA BTAG screening value for total PCBs in freshwater sediment of 59.8 µg/kg (EPA, 2006) and to EPA RML for residential soil of 24,000 µg/kg for PCB Aroclor-1260 (1E-04 risk level for carcinogens) (EPA, 2018)

Bolded value indicates concentration elevated above background (The RDL of 40U for Sample SD-72 collected in June 2018)
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
PCB = Polychlorinated biphenyls
RML = Removal Management Level
Q = Qualifier

Table 18
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Sediment Samples

			Station:	SD-100		SD-101		SD-102		SD-103		SD-104		SD-105	
			Field Sample ID:	SEC-SD-100		SEC-SD-101		SEC-SD-102		SEC-SD-103		SEC-SD-104		SEC-SD-105	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/28/2018		6/28/2018	
			Lab Sample ID:	C0AS9		C0AT2		C0AT3		C0AT6		C0AT7		C0AT8	
Pesticide	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	4.88	19000	µg/kg	5.8	U	4	U	4.1	U	0.63	R	4.2	U	4.3	U
4,4'-DDE	3.16	198000	µg/kg	4.7	J	0.47	R	0.46	J	0.76	R	0.42	J	1.1	R
4,4'-DDT	4.16	189000	µg/kg	12	J	4	U	0.5	R	4.7	U	4.2	U	13	J
Aldrin	2	3930	µg/kg	1.6	J	0.38	J	2.1	U	2.4	U	2.2	U	2.2	U
alpha-BHC	6	8610	µg/kg	3	U	2.1	U	2.1	U	2.4	U	2.2	U	2.2	U
cis-Chlordane*	3.24	170000	µg/kg	3	U	2.1	U	2.1	U	2.4	U	2.2	U	2.2	U
delta-BHC	6400	NL	µg/kg	1.2	R	2.1	U	2.1	U	0.63	J	2.2	U	0.83	J
Dieldrin	1.9	3390	µg/kg	5.8	U	4	U	4.1	U	0.67	J	4.2	U	0.88	R
Endosulfan I	2.9	470000	µg/kg	3	U	0.46	J	0.37	J	2.4	U	2.2	U	0.34	R
Endosulfan II	14	4700000	µg/kg	5.8	U	4	U	4.1	U	4.7	U	4.2	U	0.45	R
Endosulfan sulfate	5.4	470000	µg/kg	11	J	0.56	R	0.28	J	1 6	J	0.54	J	1.9	J
Endrin	2.22	19000	µg/kg	4.7	R	0.25	R	4.1	U	0.46	R	0.93	J	8.2	R
Endrin aldehyde*	2.22	19000	µg/kg	5.8	U	0.57	R	0.24	R	0.7	R	0.58	R	4.3	U
Endrin ketone*	2.22	19000	µg/kg	5.8	U	0.61	R	0.48	J	0.55	J	0.43	J	1.3	R
gamma-BHC (Lindane)	2.37	56800	µg/kg	3	U	2.1	U	2.1	U	2.4	U	2.2	U	2.2	U
Heptachlor	68	13000	µg/kg	1	R	2.1	U	2.1	U	2.4	U	2.2	U	0.32	J
Heptachlor epoxide	2.47	1000	µg/kg	3	U	2.1	U	0.27	J	1	J	0.58	J	0.84	J
Methoxychlor	18.7	3160000	µg/kg	18	R	21	U	21	U	1.5	R	1.5	J	1.8	R
trans-Chlordane*	3.24	35000	µg/kg	6	R	2.1	U	2.1	U	0.52	J	1.2	J	4.1	J

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
* Value in tables reflects the RML for Endrin, Endosulfan, Chlordane, respectively.
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biologucal Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No lised value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The
RML = Removcal Management Level
Q = Qualifier
U = Not detected

Table 18
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Sediment Samples

			Station:	SD-106		SD-79		SD-80		SD-81		SD-82		SD-83	
			Field Sample ID:	SEC-SD-106		SEC-SD-79		SEC-SD-80		SEC-SD-81		SEC-SD-82		SEC-SD-83	
			Date:	6/28/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	C0AW1		C0AK4		C0AK5		C0AK6		C0AK7		C0AK8	
Pesticide	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	4.88	19000	ug/kg	5.1	U	4.8	U	5.4	U	12	R	14	U	4.1	J
4,4'-DDE	3.16	198000	ug/kg	8 6		0.97	R	1.6	R	3.6	J	4.3	J	4.1	U
4,4'-DDT	4.16	189000	ug/kg	13	J	4.8	U	5.4	U	12	U	14	U	4.1	U
Aldrin	2	3930	ug/kg	0.45	J	2.5	U	0.68	J	6.1	U	7.1	U	2.1	U
alpha-BHC	6	8610	ug/kg	2 6	U	2.5	U	1.4	J	6.1	U	7.1	U	2.1	U
cis-Chlordane*	3.24	170000	ug/kg	1 3	J	0.83	J	2.8	U	6.1	U	1.1	R	0.56	J
delta-BHC	6400	NL	ug/kg	0.75	J	2.5	U	2.8	U	6.1	U	7.1	U	0.62	J
Dieldrin	1 9	3390	ug/kg	0.82	R	0.54	J	0.86	J	12	R	14	U	4.1	U
Endosulfan I	2 9	470000	ug/kg	2 8	U	2.5	U	2.8	U	1.2	J	1.2	J	0.27	R
Endosulfan II	14	4700000	ug/kg	0.71	R	4.8	U	5.4	U	12	U	14	U	0.64	R
Endosulfan sulfate	5.4	470000	ug/kg	1 3	R	1.3	J	0.82	J	3.4	R	14	J	1.7	J
Endrin	2.22	19000	ug/kg	8.7	R	0.6	R	1.4	J	12	U	14	R	4.1	U
Endrin aldehyde*	2.22	19000	ug/kg	5.1	U	0.16	R	5.4	U	6.9	R	6.3	J	1.4	J
Endrin ketone*	2.22	19000	ug/kg	10		4.8	U	1	J	6.4	J	7.7	J	2.9	J
gamma-BHC (Lindane)	2.37	56800	ug/kg	2 6	U	2.5	U	0.48	J	6.1	U	3.5	J	2.1	U
Heptachlor	68	13000	ug/kg	2 6	U	2.5	U	2.8	U	1	J	7.1	U	0.36	J
Heptachlor epoxide	2.47	1000	ug/kg	1 2	J	0.89	J	1	R	1.3	J	1.7	J	0.72	J
Methoxychlor	18.7	3160000	ug/kg	1.5	R	1.9	J	4.3	J	61	U	71	U	1.1	R
trans-Chlordane*	3.24	35000	ug/kg	3 3	J	0.69	J	2.6	J	1.8	R	5.3	J	2.1	U

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
* Value in tables reflects the RML for Endrin, Endosulfan, Chlordane, respectively.
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biologucal Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No lised value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The
RML = Removcal Management Level
Q = Qualifier
U = Not detected

Table 18
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Sediment Samples

			Station:	SD-84		SD-85		SD-86		SD-87		SD-88		SD-90	
			Field Sample ID:	SEC-SD-84		SEC-SD-85		SEC-SD-86		SEC-SD-87		SEC-SD-88		SEC-SD-90	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/27/2018		6/26/2018	
			Lab Sample ID:	C0AK9		C0AL0		C0AL1		C0AL2		C0AL3		C0AL5	
Pesticide	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	4.88	19000	ug/kg	1.2	R	10	U	10	R	4.4	U	3.8	U	12	R
4,4'-DDE	3.16	198000	ug/kg	0.96	R	10	J	7.9	J	2.9	R	3.8	U	6.6	J
4,4'-DDT	4.16	189000	ug/kg	2.7	J	4.9	J	12	J	4.4	U	2.4	J	56	J
Aldrin	2	3930	ug/kg	2.5	U	5.2	U	3	U	0.75	J	2	U	3.8	R
alpha-BHC	6	8610	ug/kg	2.5	U	5.2	U	1.2	J	2.3	U	2	U	6.1	U
cis-Chlordane*	3.24	170000	ug/kg	2.5	U	4.9	J	3	U	4.3		2	U	14	
delta-BHC	6400	NL	ug/kg	2.5	U	5.2	U	0.94	R	1.3	J	0.24	J	1.7	R
Dieldrin	1.9	3390	ug/kg	0.53	R	2.9	R	5.6	R	4.4	U	3.8	U	4.3	R
Endosulfan I	2.9	470000	ug/kg	2.5	U	1.3	R	2.2	R	0.81	J	0.85	J	4.2	R
Endosulfan II	14	4700000	ug/kg	0.38	R	1.1	R	3.9	R	0.42	R	0.17	R	12	
Endosulfan sulfate	5.4	470000	ug/kg	1.1	R	10	U	32	J	2.9	J	3.8	U	29	J
Endrin	2.22	19000	ug/kg	0.44	R	2.5	R	5.8	U	4.8	R	1.3	R	18	R
Endrin aldehyde*	2.22	19000	ug/kg	1.8	R	5.4	J	23	J	4.4	U	2	R	30	J
Endrin ketone*	2.22	19000	ug/kg	1.1	J	7.4	J	77	J	1.3	R	3.8	U	14	
gamma-BHC (Lindane)	2.37	56800	ug/kg	2.5	U	5.2	U	3	U	2.3	U	2	U	6.1	U
Heptachlor	68	13000	ug/kg	0.52	R	5.2	U	1.7	R	0.44	J	2	U	2.3	J
Heptachlor epoxide	2.47	1000	ug/kg	2.5	U	1.5	J	1.6	J	0.84	R	0.58	J	1.4	R
Methoxychlor	18.7	3160000	ug/kg	25	U	4.4	R	64	R	1.7	R	20	U	41	J
trans-Chlordane*	3.24	35000	ug/kg	0.67	R	5.2	U	15	J	4.1	R	2	U	2.6	J

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
* Value in tables reflects the RML for Endrin, Endosulfan, Chlordane, respectively.
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biologucal Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No lised value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The
RML = Removcal Management Level
Q = Qualifier
U = Not detected

Table 18
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Pesticides in Sediment Samples

			Station:	SD-91		SD-92		SD-93		SD-95		SD-96		SD-97		SD-98		SD-99	
			Field Sample ID:	SEC-SD-91		SEC-SD-92		SEC-SD-93		SEC-SD-95		SEC-SD-96		SEC-SD-97		SEC-SD-98		SEC-SD-99	
			Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	C0AL6		C0AL7		C0AL8		C0AM0		C0AM1		C0AM2		C0AS5		C0AS8	
Pesticide	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
4,4'-DDD	4.88	19000	ug/kg	9	U	8.4	J	8.9	U	6.6		4.3	U	5.9	J	4 6	U	0.4	R
4,4'-DDE	3.16	198000	ug/kg	4.9	J	6.4	U	8.9	U	4.3	U	4.6	J	4.8	J	0.7	J	4.9	U
4,4'-DDT	4.16	189000	ug/kg	9	U	3.4	J	13		26		8.1		8.7	J	4.6	U	4.9	U
Aldrin	2	3930	ug/kg	1.2	J	3.3	U	4.6	U	0.58	J	0.5	R	2.4	U	0.25	J	2.5	U
alpha-BHC	6	8610	ug/kg	1.1	J	3.3	U	4.6	U	2.2	U	2.2	U	2.4	U	2.4	U	2.5	U
cis-Chlordane*	3.24	170000	ug/kg	4.6	U	3.3	U	4.6	U	2.2	U	2.2	J	2.3	J	0.64	R	2.5	U
delta-BHC	6400	NL	ug/kg	0.97	J	0.7	J	4.6	U	0.63	J	0.73	J	1.1	J	2.4	U	0.63	J
Dieldrin	1.9	3390	ug/kg	0.31	R	6.3	R	8.9	U	13		4.3	U	4.7	U	4.6	U	4.9	U
Endosulfan I	2.9	470000	ug/kg	4.6	U	2.1	J	0.97	J	2.2	U	2.2	U	1.6	R	0.52	R	2.5	U
Endosulfan II	14	4700000	ug/kg	9	U	0.96	J	2.4	R	0.73	R	4.3	U	4.7	U	4 6	U	4.9	U
Endosulfan sulfate	5.4	470000	ug/kg	9	U	1.6	R	6.2	J	5.6	R	3.9	J	3.4	J	0.79	J	4.9	U
Endrin	2.22	19000	ug/kg	1.4	J	4	R	3.6	R	4.4	R	1	R	2.2	R	4.6	R	0.32	R
Endrin aldehyde*	2.22	19000	ug/kg	9	U	12	J	2	R	13		1.9	R	6.3	J	4.6	U	0.33	R
Endrin ketone*	2.22	19000	ug/kg	6	J	8.5		1.9	R	30		5.7		7.3	J	4.6	U	4.9	U
gamma-BHC (Lindane)	2.37	56800	ug/kg	4.6	U	0.71	R	0.67	J	0.58	R	2.2	U	2.4	U	0 9	J	2.5	U
Heptachlor	68	13000	ug/kg	4.6	U	3.3	U	1.4	J	0.33	R	0 91	J	0.73	J	0.24	R	2.5	U
Heptachlor epoxide	2.47	1000	ug/kg	1.1	J	2.3	J	1.6	J	1.8	R	0 68	R	1	J	0.62	J	0.45	J
Methoxychlor	18.7	3160000	ug/kg	3.4	R	6.5	R	33	J	4.7	R	3.8	R	5.4	R	24	U	25	U
trans-Chlordane*	3.24	35000	ug/kg	0.57	R	0.39	R	5.2	R	3.3	R	0 94	J	1.1	J	1.7	R	2.5	U

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
* Value in tables reflects the RML for Endrin, Endosulfan, Chlordane, respectively.
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biologucal Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No lised value
R = The data are unusable. The sample results are rejected due to serious deficiencies in meeting QC criteria. The
RML = Removcal Management Level
Q = Qualifier
U = Not detected

Table 19
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Sediment Samples

			Station:	SD-100		SD-101		SD-102		SD-103		SD-104		SD-105	
			Field Sample ID	SEC-SD-100		SEC-SD-101		SEC-SD-102		SEC-SD-103		SEC-SD-104		SEC-SD-105	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/28/2018		6/28/2018	
			Lab Sample ID:	C0AS9		C0AT2		C0AT3		C0AT6		C0AT7		C0AT8	
SVOCs	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2-Methylnaphthalene	20.2	2390000	ug/kg	300	U	210	U	210	U	240	U	210	U	220	U
3-Nitroaniline	NL	NL	ug/kg	580	U	400	U	410	U	470	U	410	U	420	U
4-Methylphenol	670	63200000	ug/kg	580	U	400	U	410	U	470	U	410	U	420	U
Acenaphthene	6.7	35900000	ug/kg	270	J	210	U	210	U	240	U	210	U	180	J
Acenaphthylene	5.9	NL	ug/kg	1900		210	U	210	U	240	U	210	U	120	J
Anthracene	57.2	179000000	ug/kg	2100		210	U	210	U	240	U	210	U	130	J
Benzo(a)anthracene	108	113000	ug/kg	5400		210	U	210	U	240	U	210	U	430	
Benzo(a)pyrene	150	11500	ug/kg	4300		210	U	210	U	240	U	210	U	410	
Benzo(b)fluoranthene	NL	115000	ug/kg	6300		210	U	210	U	240	U	210	U	820	
Benzo(g,h,i)perylene	170	NL	ug/kg	1800		210	U	210	U	240	U	210	U	220	
Benzo(k)fluoranthene	240	1150000	ug/kg	2200		210	U	210	U	240	U	210	U	230	
Bis(2-ethylhexyl)phthalate	180	3880000	ug/kg	300	U	210	U	210	U	240	U	210	U	420	
Carbazole	NL	NL	ug/kg	200	J	400	UJ	410	UJ	470	UJ	410	UJ	420	UJ
Chrysene	166	11500000	ug/kg	4500		210	U	210	U	240	U	210	U	470	
Dibenzo(a,h)anthracene	33	11500	ug/kg	590		210	U	210	U	240	U	210	U	63	J
Dibenzofuran	415	23900000	ug/kg	300		210	U	210	U	240	U	210	U	91	J
Fluoranthene	423	23900000	ug/kg	15000		71	J	410	U	470	U	410	U	1200	
Fluorene	77.4	115000	ug/kg	890		210	U	210	U	240	U	210	U	130	J
Indeno(1,2,3-cd)pyrene	17	382000	ug/kg	2200		210	U	210	U	240	U	210	U	240	
Naphthalene	176	382000	ug/kg	300	U	210	U	210	U	240	U	210	U	77	J
Phenanthrene	NL	NL	ug/kg	8500		60	J	210	U	240	U	210	U	320	
Pyrene	195	17900000	ug/kg	8200		210	U	210	U	240	U	210	U	890	
PAHs by SIM															
2-Methylnaphthalene	20.2	2390000	ug/kg	--		11		4.9		5.5		4.1	U	63	
Acenaphthene	6.7	35900000	ug/kg	--		2.4	J	0.6	J	4.7	U	4.1	U	190	
Acenaphthylene	5.9	NL	ug/kg	--		7.3		1.1	J	4.7	U	1.5	J	150	
Anthracene	57.2	179000000	ug/kg	--		8.8		1.6	J	0.96	J	1.2	J	190	
Benzo(a)anthracene	108	113000	ug/kg	--		28		4	J	3.4	J	2.8	J	510	J
Benzo(a)pyrene	150	11500	ug/kg	--		23		3.1	J	4.7	U	2.7	J	500	J
Benzo(b)fluoranthene	NL	115000	ug/kg	--		37		7.1		8.4		6.9		810	J
Benzo(g,h,i)perylene	170	NL	ug/kg	--		14		3.4	J	2.4	J	3	J	310	
Benzo(k)fluoranthene	240	1150000	ug/kg	--		10		4.1	U	4.7	U	4.1	U	250	
Chrysene	166	11500000	ug/kg	--		36		9.3		12		4.8		510	J
Dibenzo(a,h)anthracene	33	11500	ug/kg	--		4.5		4.1	U	4.7	U	4.1	U	61	
Fluoranthene	423	23900000	ug/kg	--		61		9.1		8.6		4.1		1200	J
Fluorene	77.4	23900000	ug/kg	--		8.3		1.2	J	1.6	J	4.1	U	150	
Indeno(1,2,3-cd)pyrene	17	115000	ug/kg	--		15		2.8	J	4.7	U	3.1	J	390	J
Naphthalene	176	382000	ug/kg	--		4.4		2.2	J	4.7	U	4.1	U	86	
Pentachlorophenol	504	102000	ug/kg	--		8.2	U	8.3	U	9.5	U	8.4	U	2.8	J
Phenanthrene	NL	NL	ug/kg	--		52		14		17		3.5	J	350	
Pyrene	195	17900000	ug/kg	--		35		6.1		7.7		3.9	J	830	J

Notes:

Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 19
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Sediment Samples

			Station:	SD-106		SD-79		SD-80		SD-81		SD-82		SD-83	
			Field Sample ID:	SEC-SD-106		SEC-SD-79		SEC-SD-80		SEC-SD-81		SEC-SD-82		SEC-SD-83	
			Date:	6/28/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	C0AW1		C0AK4		C0AK5		C0AK6		C0AK7		C0AK8	
SVOCs	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2-Methylnaphthalene	20.2	2390000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
3-Nitroaniline	NL	NL	ug/kg	510	U	470	U	540	U	1200	U	1400	U	410	U
4-Methylphenol	670	63200000	ug/kg	510	U	470	U	520	J	1200	U	1400	U	410	U
Acenaphthene	6.7	35900000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Acenaphthylene	5.9	NL	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Anthracene	57.2	179000000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Benzo(a)anthracene	108	113000	ug/kg	330		240	U	280	U	360	J	600	J	210	U
Benzo(a)pyrene	150	11500	ug/kg	370		240	U	280	U	380	J	630	J	210	U
Benzo(b)fluoranthene	NL	115000	ug/kg	660		240	U	280	U	600	J	960		210	U
Benzo(g,h,i)perylene	170	NL	ug/kg	200	J	240	U	280	U	220	J	380	J	210	U
Benzo(k)fluoranthene	240	1150000	ug/kg	180	J	240	U	280	U	610	U	350	J	210	U
Bis(2-ethylhexyl)phthalate	180	3880000	ug/kg	1200		240	U	280	U	610	U	710	U	210	U
Carbazole	NL	NL	ug/kg	510	UJ	470	UJ	540	UJ	1200	UJ	1400	UJ	410	U
Chrysene	166	11500000	ug/kg	410		240	U	280	U	410	J	660	J	210	U
Dibenzo(a,h)anthracene	33	11500	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Dibenzofuran	415	23900000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Fluoranthene	423	23900000	ug/kg	900		470	U	540	U	1000	J	1700		410	U
Fluorene	77.4	115000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Indeno(1,2,3-cd)pyrene	17	382000	ug/kg	210	J	240	U	280	U	230	J	390	J	210	U
Naphthalene	176	382000	ug/kg	260	U	240	U	280	U	610	U	710	U	210	U
Phenanthrene	NL	NL	ug/kg	380		240	U	280	U	520	J	800		210	U
Pyrene	195	17900000	ug/kg	610		240	U	280	U	620		1100		210	U
PAHs by SIM															
2-Methylnaphthalene	20.2	2390000	ug/kg	17		4.7	U	5.4	U	14		15		17	
Acenaphthene	6.7	35900000	ug/kg	13		4.7	U	5.4	U	19		25		1.4	J
Acenaphthylene	5.9	NL	ug/kg	44		4.7	U	4	J	77		120		4.1	U
Anthracene	57.2	179000000	ug/kg	69		0.78	J	7.1		110		170		4.1	U
Benzo(a)anthracene	108	113000	ug/kg	390		3.8	J	21		340		610		15	
Benzo(a)pyrene	150	11500	ug/kg	430	J	4.3	J	18		370		650		4.1	U
Benzo(b)fluoranthene	NL	115000	ug/kg	620	J	8.2		25		480		840		11	
Benzo(g,h,i)perylene	170	NL	ug/kg	290		4.3	J	9.4		160		390		2.6	J
Benzo(k)fluoranthene	240	1150000	ug/kg	180		4.7	U	7.6		140		220		4.1	U
Chrysene	166	11500000	ug/kg	450	J	8.3		20		350		600		4.1	U
Dibenzo(a,h)anthracene	33	11500	ug/kg	56		4.7	U	3	J	50		73		4.1	U
Fluoranthene	423	23900000	ug/kg	950	J	8.3		46		860		1500	J	7.2	
Fluorene	77.4	23900000	ug/kg	24		4.7	U	0.97	J	40		59		6.9	
Indeno(1,2,3-cd)pyrene	17	115000	ug/kg	350		4.4	J	12		270		480		4.1	U
Naphthalene	176	382000	ug/kg	12		4.7	U	5.4	U	19		20		2.1	J
Pentachlorophenol	504	102000	ug/kg	2.4	J	9.6	U	11	U	24	U	28	U	8.4	U
Phenanthrene	NL	NL	ug/kg	410		5.7		22		440		710		30	
Pyrene	195	17900000	ug/kg	540	J	6.3		28		480		840		6.2	

Notes:

Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
µg/kg = microgram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 19
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Sediment Samples

			Station:	SD-84		SD-85		SD-86		SD-87		SD-88		SD-90	
			Field Sample ID:	SEC-SD-84		SEC-SD-85		SEC-SD-86		SEC-SD-87		SEC-SD-88		SEC-SD-90	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/27/2018		6/26/2018	
			Lab Sample ID:	C0AK9		C0AL0		C0AL1		C0AL2		C0AL3		C0AL5	
SVOCs	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2-Methylnaphthalene	20.2	2390000	ug/kg	250	U	520	U	140	J	230	U	190	U	610	U
3-Nitroaniline	NL	NL	ug/kg	480	U	1000	U	570	U	440	U	380	U	1200	U
4-Methylphenol	670	63200000	ug/kg	480	U	1000	U	480	J	440	U	380	U	1200	U
Acenaphthene	6.7	35900000	ug/kg	250	U	520	U	350		140	J	190	U	610	U
Acenaphthylene	5.9	NL	ug/kg	250	U	520	U	3500		160	J	72	J	610	U
Anthracene	57.2	179000000	ug/kg	250	U	520	U	3900		180	J	80	J	610	U
Benzo(a)anthracene	108	113000	ug/kg	250	U	520	U	11000		580		240		610	U
Benzo(a)pyrene	150	11500	ug/kg	250	U	520	U	9600		580		210		610	U
Benzo(b)fluoranthene	NL	115000	ug/kg	250	U	520	U	14000		1100		320		610	U
Benzo(g,h,i)perylene	170	NL	ug/kg	250	U	520	U	4600		300		100	J	610	U
Benzo(k)fluoranthene	240	1150000	ug/kg	250	U	520	U	5100		280		97	J	610	U
Bis(2-ethylhexyl)phthalate	180	3880000	ug/kg	250	U	520	U	290	U	230	U	190	U	610	U
Carbazole	NL	NL	ug/kg	480	U	1000	U	460	J	440	UJ	380	U	1200	UJ
Chrysene	166	11500000	ug/kg	250	U	520	U	9900		630		220		610	U
Dibenzo(a,h)anthracene	33	11500	ug/kg	250	U	520	U	1400		85	J	190	U	610	U
Dibenzofuran	415	23900000	ug/kg	250	U	520	U	490		67	J	190	U	610	U
Fluoranthene	423	23900000	ug/kg	480	U	1000	U	26000		1500		530		1200	U
Fluorene	77.4	115000	ug/kg	250	U	520	U	1100		110	J	190	U	610	U
Indeno(1,2,3-cd)pyrene	17	382000	ug/kg	250	U	520	U	5300		340		120	J	610	U
Naphthalene	176	382000	ug/kg	250	U	520	U	150	J	230	U	190	U	610	U
Phenanthrene	NL	NL	ug/kg	250	U	520	U	13000		410		240		610	U
Pyrene	195	17900000	ug/kg	250	U	520	U	16000		1000		340		610	U
PAHs by SIM															
2-Methylnaphthalene	20.2	2390000	ug/kg	2.1	J	4.3	J	--		41		3.6	J	12	U
Acenaphthene	6.7	35900000	ug/kg	0.52	J	2.4	J	--		130		5.7		12	U
Acenaphthylene	5.9	NL	ug/kg	4.8	U	7.1	J	--		170		83		2.6	J
Anthracene	57.2	179000000	ug/kg	3.1	J	8.7	J	--		200		87		4.1	J
Benzo(a)anthracene	108	113000	ug/kg	12		33		--		600	J	240		21	
Benzo(a)pyrene	150	11500	ug/kg	10		32		--		610	J	210		8.3	J
Benzo(b)fluoranthene	NL	115000	ug/kg	18		59		--		910	J	280		18	
Benzo(g,h,i)perylene	170	NL	ug/kg	7		31		--		380	J	110		12	U
Benzo(k)fluoranthene	240	1150000	ug/kg	4.8	U	16		--		300		94		12	U
Chrysene	166	11500000	ug/kg	18		48		--		590	J	200		17	
Dibenzo(a,h)anthracene	33	11500	ug/kg	4.8	U	8.1	J	--		100		4.2		12	U
Fluoranthene	423	23900000	ug/kg	25		73		--		1200	J	480	J	160	
Fluorene	77.4	23900000	ug/kg	4.8	U	3.2	J	--		120		21		12	U
Indeno(1,2,3-cd)pyrene	17	115000	ug/kg	7.2		34		--		470	J	130		12	U
Naphthalene	176	382000	ug/kg	1.1	J	3.4	J	--		50		3.1	J	12	U
Pentachlorophenol	504	102000	ug/kg	9.8	U	21	U	--		4.8	J	0.9	J	24	U
Phenanthrene	NL	NL	ug/kg	16		41		--		370	J	210		20	
Pyrene	195	17900000	ug/kg	16		51		--		850	J	280		18	

Notes:

Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)
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Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No listed value
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Table 19
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 SVOCs and PAHs in Sediment Samples

			Station:	SD-91		SD-92		SD-93		SD-95		SD-96		SD-97		SD-98		SD-99	
			Field Sample ID:	SEC-SD-91		SEC-SD-92		SEC-SD-93		SEC-SD-95		SEC-SD-96		SEC-SD-97		SEC-SD-98		SEC-SD-99	
			Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	C0AL6		C0AL7		C0AL8		C0AM0		C0AM1		C0AM2		C0AS5		C0AS8	
SVOCs	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
2-Methylnaphthalene	20.2	2390000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
3-Nitroaniline	NL	NL	ug/kg	900	U	640	U	250	J	420	U	440	U	470	U	460	U	490	U
4-Methylphenol	670	63200000	ug/kg	900	U	640	U	1700		420	U	440	U	470	U	460	U	490	U
Acenaphthene	6.7	35900000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Acenaphthylene	5.9	NL	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Anthracene	57.2	179000000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Benzo(a)anthracene	108	113000	ug/kg	460	U	120	J	460	U	78	J	220	U	73	J	240	U	250	U
Benzo(a)pyrene	150	11500	ug/kg	460	U	330	U	460	U	66	J	220	U	240	U	240	U	250	U
Benzo(b)fluoranthene	NL	115000	ug/kg	460	U	160	J	240	J	120	J	110	J	190	J	240	U	250	U
Benzo(g,h,i)perylene	170	NL	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Benzo(k)fluoranthene	240	1150000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Bis(2-ethylhexyl)phthalate	180	3880000	ug/kg	460	U	330	U	240	J	220	U	220	U	240	U	2200		250	U
Carbazole	NL	NL	ug/kg	900	UJ	640	U	900	U	420	U	440	UJ	470	UJ	460	UJ	490	UJ
Chrysene	166	11500000	ug/kg	460	U	140	J	150	J	130	J	100	J	210	J	240	U	250	U
Dibenzo(a,h)anthracene	33	11500	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Dibenzofuran	415	23900000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Fluoranthene	423	23900000	ug/kg	900	U	240	J	210	J	190	J	120	J	370	J	77	J	490	U
Fluorene	77.4	115000	ug/kg	460	U	330	U	180	J	220	U	220	U	240	U	240	U	250	U
ndeno(1,2,3-cd)pyrene	17	382000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Naphthalene	176	382000	ug/kg	460	U	330	U	460	U	220	U	220	U	240	U	240	U	250	U
Phenanthrene	NL	NL	ug/kg	170	J	190	J	460	U	170	J	130	J	120	J	94	J	250	U
Pyrene	195	17900000	ug/kg	460	U	170	J	160	J	110	J	90	J	260		79	J	250	U
PAHs by SIM																			
2-Methylnaphthalene	20.2	2390000	ug/kg	23		31		28		37		26		24		17		4.9	U
Acenaphthene	6.7	35900000	ug/kg	9	U	3.5	J	4.5	J	5.6		4.4	U	4.7	U	5.5		4.9	U
Acenaphthylene	5.9	NL	ug/kg	6.8	J	39		37		24		7.5		7.9		4.6	U	4.9	U
Anthracene	57.2	179000000	ug/kg	10		45		37		26		10		15		14		0.59	J
Benzo(a)anthracene	108	113000	ug/kg	46		120		120		81		52		75		44		4.9	U
Benzo(a)pyrene	150	11500	ug/kg	38		98		130		70		56		60		38		4.9	U
Benzo(b)fluoranthene	NL	115000	ug/kg	70		140		180		100		100		190		52		4.9	U
Benzo(g,h,i)perylene	170	NL	ug/kg	16		49		75		36		41		33		11		4.9	U
Benzo(k)fluoranthene	240	1150000	ug/kg	16		45		54		31		26		49		14		4.9	U
Chrysene	166	11500000	ug/kg	110		130		140		120		110		240		63		4.9	U
Dibenzo(a,h)anthracene	33	11500	ug/kg	7.1	J	16		22		14		14		11		5.3		4.9	U
Fluoranthene	423	23900000	ug/kg	97		240		190		170		120		410		76		4.9	U
Fluorene	77.4	23900000	ug/kg	29		7.3		9	U	6.3		4.4	U	4.7	U	17		3	J
ndeno(1,2,3-cd)pyrene	17	115000	ug/kg	19		63		90		42		45		40		13		4.9	U
Naphthalene	176	382000	ug/kg	15		38		17		10		14		17		8		4.9	U
Pentachlorophenol	504	102000	ug/kg	18	U	13	U	2.1	J	8.6	U	8.8	U	1.1	J	1.2	J	9.9	U
Phenanthrene	NL	NL	ug/kg	150		170		91		150		130		120		83		4.9	U
Pyrene	195	17900000	ug/kg	65		130		130		93		85		250		56		2.2	J

Notes:

Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for carcinogens a hazard quotient of 10 for non carcinogens) (EPA, 2018)

µg/kg = microgram per kilogram

Red value indicates exceedance of EPA BTAG screening value

BTAG = Biological Technical Assistance Group

CLP = Contract Laboratory Program

J = Estimated quantity

NL = No listed value

RML = Removal Management Level

Q = Qualifier

U = Not detected

Table 20
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Sediment Samples

			Station:	SD-100		SD-101		SD-102		SD-103		SD-104		SD-105	
			Field Sample ID:	SEC-SD-100		SEC-SD-101		SEC-SD-102		SEC-SD-103		SEC-SD-104		SEC-SD-105	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/28/2018		6/28/2018	
			Lab Sample ID:	MC0AS9		MC0AT2		MC0AT3		MC0AT6		MC0AT7		MC0AT8	
	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	NL	774000	mg/kg	5020		5160		5830		3520		2950		902	
Arsenic	9.8	67.7	mg/kg	6.2		3.3		3.6		3.2		2.9		3	
Barium	NL	153000	mg/kg	99.2		47		56.3		33		58.4		18.9	J
Beryllium	NL	1560	mg/kg	0.98		1.7		0.65		1.5		0.63		1	
Cadmium	0.99	711	mg/kg	1.2		0.26	J	0.52	U	0.25	J	0.59	U	0.56	U
Calcium	NL	NL	mg/kg	3180		5280		1370		917		649		624	
Chromium	43.4	1170000	mg/kg	10.4		7.9		10.3		8.6		6.2		5.3	
Cobalt	50	234	mg/kg	20.5		26.2		11.2		9.8		8.9		2.8	J
Copper	31.6	31300	mg/kg	51.6		36.6		17.2		12		8.4		12.6	
Iron	20000	548000	mg/kg	28600		10500		19100		19500		13800		4720	
Lead	35.8	400	mg/kg	62.3		19.5		11.4		10.5		13.5		7.3	
Magnesium	NL	NL	mg/kg	882		1560		1110		769		489	J	200	J
Manganese	460	18300	mg/kg	688		504		307		187		249		59	
Nickel	22.7	15500	mg/kg	45		53.4		23.6		36.8		16.2		6.8	
Potassium	NL	NL	mg/kg	891		939		990		560	J	408	J	207	J
Selenium	2	3910	mg/kg	5.3	U	5.4	U	3.6	U	4.4	U	4.2	U	3.9	U
Silver	1	3910	mg/kg	1.5	U	1.6	U	1	U	1.2	U	1.2	U	1.1	U
Sodium	NL	NL	mg/kg	754	U	777	U	519	U	623	U	593	U	560	U
Thallium	NL	7.82	mg/kg	1.7	J	1.1	J	0.87	J	3.1	U	3	U	2.8	U
Vanadium	NL	3930	mg/kg	7.8		7	J	9.4		5.8	J	6.1		13.1	
Zinc	121	235000	mg/kg	594		109		55.3		88.6		41.6		17.9	

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for
mg/kg = milligram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No Listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 20
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Sediment Samples

			Station:	SD-106		SD-79		SD-80		SD-81		SD-82		SD-83	
			Field Sample ID:	SEC-SD-106		SEC-SD-79		SEC-SD-80		SEC-SD-81		SEC-SD-82		SEC-SD-83	
			Date:	6/28/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	MC0AW1		MC0AK4		MC0AK5		MC0AK6		MC0AK7		MC0AK8	
	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	NL	774000	mg/kg	3570		3900		4140		2700	J	1940	J	5170	
Arsenic	9.8	67.7	mg/kg	7.1		3.7		3.4		8.3		2.4		3.4	
Barium	NL	153000	mg/kg	55.6		51.6		39.7		66		39.9		49.7	
Beryllium	NL	1560	mg/kg	0.58	J	0.51	J	0.35	J	0.42	J	0.25	J	0.85	
Cadmium	0.99	711	mg/kg	0.25	J	0.2	J	0.66	U	0.34	J	0.24	J	0.15	J
Calcium	NL	NL	mg/kg	76300		1400		1190		1820		2580		839	
Chromium	43.4	1170000	mg/kg	10		6.2		5.8		5.7		3.9		13.9	
Cobalt	50	234	mg/kg	7.3		8.4		5.1	J	3.6	J	3	J	9.6	
Copper	31.6	31300	mg/kg	13.8		5.8		6		20.6		15.4		16.1	
Iron	20000	548000	mg/kg	12400		10600		11500		17600		4510		18000	
Lead	35.8	400	mg/kg	19.8		12.2		8.6		22.3		14.9		19.8	
Magnesium	NL	NL	mg/kg	7740		325	J	340	J	331	J	306	J	1520	
Manganese	460	18300	mg/kg	239		403		270		124		76.1		191	
Nickel	22.7	15500	mg/kg	14.1		8.3		5	J	10.2		9.8		22.4	
Potassium	NL	NL	mg/kg	739		419	J	511	J	509	J	315	J	1440	
Selenium	2	3910	mg/kg	4.2	U	5.3	U	4.6	U	6.2	U	5.2	U	3.9	U
Silver	1	3910	mg/kg	1.2	U	1.5	U	1.3	U	1.8	U	1.5	U	1.1	U
Sodium	NL	NL	mg/kg	601	U	761	U	663	U	885	U	744	U	558	U
Thallium	NL	7.82	mg/kg	3	U	3.8	U	3.3	U	4.4	U	3.7	U	2.8	U
Vanadium	NL	3930	mg/kg	7.9		9.1		8.9		4.3	J	4.4	J	15.5	
Zinc	121	235000	mg/kg	72.2		47.3		27.5		64.1		49		79.1	

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for
mg/kg = milligram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No Listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 20
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Sediment Samples

			Station:	SD-84		SD-85		SD-86		SD-87		SD-88		SD-90	
			Field Sample ID:	SEC-SD-84		SEC-SD-85		SEC-SD-86		SEC-SD-87		SEC-SD-88		SEC-SD-90	
			Date:	6/27/2018		6/27/2018		6/27/2018		6/28/2018		6/27/2018		6/26/2018	
			Lab Sample ID:	MC0AK9		MC0AL0		MC0AL1		MC0AL2		MC0AL3		MC0AL5	
	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Aluminum	NL	774000	mg/kg	4780		2960		4350		3200		5270		2180	J
Arsenic	9.8	67.7	mg/kg	7.2		7.1		7.5		5		4.8		1.8	J
Barium	NL	153000	mg/kg	84.8		85.6		93.6		39.8		49		32.8	J
Beryllium	NL	1560	mg/kg	0.69	J	0.53	J	1.1		0.5	J	0.58		1.9	
Cadmium	0.99	711	mg/kg	0.37	J	0.24	J	0.82		0.56	U	0.18	J	0.53	J
Calcium	NL	NL	mg/kg	5660		2180		5610		704		261	J	6520	
Chromium	43.4	1170000	mg/kg	11.7		7		15.8		6.7		10.8		3.3	
Cobalt	50	234	mg/kg	9.3		14.2		20.4		6.4		9.1		24.7	
Copper	31.6	31300	mg/kg	19.9		25.5		56.3		23.2		9.7		12.2	
Iron	20000	548000	mg/kg	21500		70500		33300		14800		20400		4120	
Lead	35.8	400	mg/kg	46		20.3		66.8		14.3		17.9		19.4	
Magnesium	NL	NL	mg/kg	663	J	411	J	938		973		348	J	1280	
Manganese	460	18300	mg/kg	391		71.7		1070		145		325		2970	
Nickel	22.7	15500	mg/kg	10.3		33.2		46		10.5		9.5		115	
Potassium	NL	NL	mg/kg	811		698	J	709	J	560		480	J	689	J
Selenium	2	3910	mg/kg	5	U	6	U	5.1	U	3.9	U	3.4	U	2.6	J
Silver	1	3910	mg/kg	1.4	U	1.7	U	1.4	U	1.1	U	0.97	U	0.5	J
Sodium	NL	NL	mg/kg	719	U	862	U	723	U	555	U	485	U	1150	U
Thallium	NL	7.82	mg/kg	1.1	J	4.3	U	2.6	J	2.8	U	1.1	J	6.2	
Vanadium	NL	3930	Removal	10.4		8.6	U	5.5	J	5.6		8.2		4.2	J
Zinc	121	235000	mg/kg	109		38.9		404		41.4		40		108	

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for
mg/kg = milligram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No Listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Table 20
Shaffer Equipment/Arbuckle Creek Area Site
Expanded Site Inspection
June 2018 Inorganics in Sediment Samples

			Station:	SD-91		SD-92		SD-93		SD-95		SD-96		SD-97		SD-98		SD-99	
			Field Sample ID:	SEC-SD-91		SEC-SD-92		SEC-SD-93		SEC-SD-95		SEC-SD-96		SEC-SD-97		SEC-SD-98		SEC-SD-99	
			Date:	6/26/2018		6/27/2018		6/27/2018		6/27/2018		6/26/2018		6/26/2018		6/26/2018		6/27/2018	
			Lab Sample ID:	MC0AL6		MC0AL7		MC0AL8		MC0AM0		MC0AM1		MC0AM2		MC0AS5		MC0AS8	
	BTAG	RML	Units:	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q				
Aluminum	NL	774000	mg/kg	2380	J	8420		5650		1850		5970	J	8020	J	2420	J	4930	
Arsenic	9.8	67.7	mg/kg	2.4		9.1		4.7		8.6		11		11.6		2.8		14.8	
Barium	NL	153000	mg/kg	26	J	78.8		125		26.5		75.1		109		32.2		36.8	
Beryllium	NL	1560	mg/kg	0.72	J	4.2		0.71	J	0.95		1.5		1.9		0.98		0.91	
Cadmium	0.99	711	mg/kg	1.1	U	2		0.84	J	0.17	J	0.36	J	0.68		0.29	J	0.38	J
Calcium	NL	NL	mg/kg	1960		2740		4130		699		3100		2120		2090		508	J
Chromium	43.4	1170000	mg/kg	4		13.6		18.7		6		12.3		15.2		5.2		36	
Cobalt	50	234	mg/kg	7.3	J	100		7.2	J	3	J	9.7		45.3		11.9		5	J
Copper	31.6	31300	mg/kg	9.3		40.4		33.1		16.7		35.2		44.8		57.2		5.9	
Iron	20000	548000	mg/kg	5250		11100		14000		6030		14800		23000		7860		104000	
Lead	35.8	400	mg/kg	7.6		17.1		74.2		7.3		59.7		112		84.8		34.2	
Magnesium	NL	NL	mg/kg	663	J	942		1030	J	720		1340		1370		576	J	242	J
Manganese	460	18300	mg/kg	126		14100		161		38		363		1770		258		233	
Nickel	22.7	15500	mg/kg	18.9		287		18.2		12		33.6		56.5		30.3		10.6	
Potassium	NL	NL	mg/kg	529	J	758	J	859	J	483	J	1270		1340		393	J	766	
Selenium	2	3910	mg/kg	7.7	U	10		8.7	U	4.2	U	4	U	4.3	U	4.8	U	3.9	U
Silver	1	3910	mg/kg	2.2	U	0.27	J	2.5	U	1.2	U	1.2	U	0.22	J	1.4	U	1.1	U
Sodium	NL	NL	mg/kg	1090	U	875	U	1250	U	244	J	576	U	612	U	691	U	555	U
Thallium	NL	7.82	mg/kg	5.5	U	1.3	J	6.2	U	3	U	0.92	J	4.1		3.5	U	1.2	J
Vanadium	NL	3930	mg/kg	4.6	J	6.8	J	10.8	J	11		10.7		13.4		6	J	33.6	
Zinc	121	235000	mg/kg	40.6		500		317		27.4		108		293		60		35.5	

Notes:
Results compared to EPA BTAG screening value for freshwater sediment (EPA, 2006) and to EPA RML for residential soil (1E-04 risk level for
mg/kg = milligram per kilogram
Red value indicates exceedance of EPA BTAG screening value
BTAG = Biological Technical Assistance Group
CLP = Contract Laboratory Program
J = Estimated quantity
NL = No Listed value
RML = Removal Management Level
Q = Qualifier
U = Not detected

Oak Hill

Minden

[redacted]

[redacted]

[redacted]

Arbuckle Creek

SS11
SS12
SEC-SS-R5-01
SS-152
SS-156
SS-155
SS-150
SS-154
SS-153
SS-256
SS33
SS14
SS17
SS15
SS13
SS16
SS21
SS43
SS20
SS36
SB07
SS35
SS40
SS34
SB05
SB08
SS37
SS32
SB03
SB02
SS31
SS30
SS28
SS27
SS42
SB09
SS26
SS39
SS29
SB01
SS18
SS25
SS44
SB10
SS23
SS24
SS22
SS41
SS19

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Soil Sample Location
- Background Soil Sample Location
- PCB concentration elevated with respect to background

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 3a
Source/Soil Sample Location Map
June 2017 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

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File: Y:\EPA_Region_III\Shaffer\MXD\ESI\Source_Samp_Loc_Map_A mxd, 10/9/2018 10:59 59 AM

Oak Hill

Minden

Arbuckle Creek

SEC-SS-T5-04
SEC-SS-T5-05
SEC-SD-T5-02
SEC-SD-T5-03
SEC-SD-T5-01
SEC-SD-T8-02
SEC-SD-T8-01
SEC-SS-T8-05
SEC-SS-T8-04
SEC-SD-T8-03
SEC-SD-TL-03
SEC-SS-R3-01
SEC-SS-R4-01
SEC-SS-TL-43-C
SEC-SS-T4-04
SEC-SS-T4-05
SEC-SD-T4-02
SEC-SD-TL-06
SEC-SD-T4-03
SEC-SD-T4-01
SEC-SS-T3-04
SEC-SD-T3-03
SEC-SD-T3-01
SEC-SD-T3-02
SEC-SS-T3-05
SEC-SD-T2-01
SEC-SD-T2-03
SEC-SS-T2-05
SEC-SS-T2-04
SEC-SD-T2-02
SEC-SD-T1-03
SEC-SD-T1-02
SEC-SS-T1-04
SEC-SD-T1-01
SEC-SS-BH-01
SEC-SS-TL-43-B
SEC-SS-TL-43
SEC-SS-TL-43-A
SEC-SS-T6-04
SEC-SD-T6-02
SEC-SS-SE-02
SEC-SS-R5-01
SEC-SS-SE-01
SS11
SS12
SS-152
SS-156
SS-155
SS-150
SS-154
SS-153
SS-256
SEC-SS-R2-01
SEC-SS-T7-05
SEC-SD-T7-02
SEC-SD-T7-03
SEC-SD-T7-01
SEC-SS-T7-04
SEC-SD-CL-01
SEC-SS-T6-05
SEC-SD-T6-01
SEC-SD-T6-03
SEC-SS-T1-05
SEC-SS-R1-01
SEC-SS-R1-02
SEC-SS-R1-06
SS-44
SEC-SS-R1-10
SEC-SS-R1-07
SEC-SS-R1-09
SEC-SS-R1-08
SEC-SS-R1-05
SEC-SS-R1-04
SEC-SS-R1-03

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Soil Sample Location
- Background Soil Sample Location
- PCB concentration elevated with respect to background
- PCB concentration elevated with respect to background and exceeds EPA RML for PCBs in residential soil of 24,000 µg/kg

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 3b
Source/Soil Sample Location Map
December 2017
Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

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File: Y:\EPA_Region_III\Shaffer\MXD\ESI\Source_Samp_Loc_Map_B mxd, 10/9/2018 11:00:15 AM

Oak Hill

Minden

Arbuckle Creek

SEC-SS-R5-01
SS11
SS12
SS-205
SS-206
SS-208
SS-211
SS-207
SS-209
SS-210
SS-152
SS-156
SS-155
SS-154
SS-153
SS-150
SS-256
SS-202
SS-122
SS-119
SS-123
SS-121
SS-120
SS-124
SS-117
SS-118
SS-116
SS-125
SS-115
SS-111
SS-111D
SS-110
SS-112
SS-113
SS-107
SS-106
SS-103
SS-109
SS-108
SS-102
SS-100
SS-101
SS-104
SS-105

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Soil Sample Location
- Background Soil Sample Location
- PCB concentration elevated with respect to background

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 3c
Source/Soil Sample Location Map
March 2018 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_II\Shaffer\MXD\ESI\Source_Samp_Loc_Map_C mxd, 10/9/2018 10:58:10 AM

Oak Hill

Minden

Arbuckle Creek

SS11
SS12
SEC-SS-R5-01
SS-152
SS-156
SS-155
SS-150
SS-154
SS-153
SS-256
SS-248/249
SS-216
SS-255
SS-213
SS-254
SS-222
SS-212
SS-227
SS-228
SS-229
SS-230
SS-231
SS-232
SS-233
SS-234
SS-225
SS-226
SS-235
SS-236
SS-239
SS-240
SS-241
SS-237
SS-238
SS-246
SS-253
SS-250
SS-217
SS-223
SS-247
SS-220
SS-251
SS-252
SS-218
SS-219
SS-224
SS-243
SS-242
SS-244
SS-245

-Samples SS239 and SS240 exceeds EPA RML for arsenic in residential soil of 35 mg/kg

-Sample SS-221 exceeds EPA residential soil lead level of 400 mg/kg

-The following samples exceed the EPA RML for thallium in residential soil of 0.78 mg/kg

SS-212	SS-235	SS-244	SS-213	SS-236
SS-245	SS-221	SS-237	SS-246	SS-225
SS-238	SS-250	SS-229	SS-239	SS-252
SS-232	SS-242	SS-253	SS-234	SS-243

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Soil Sample Location
- Background Soil Sample Location
- PCB concentration elevated with respect to background

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

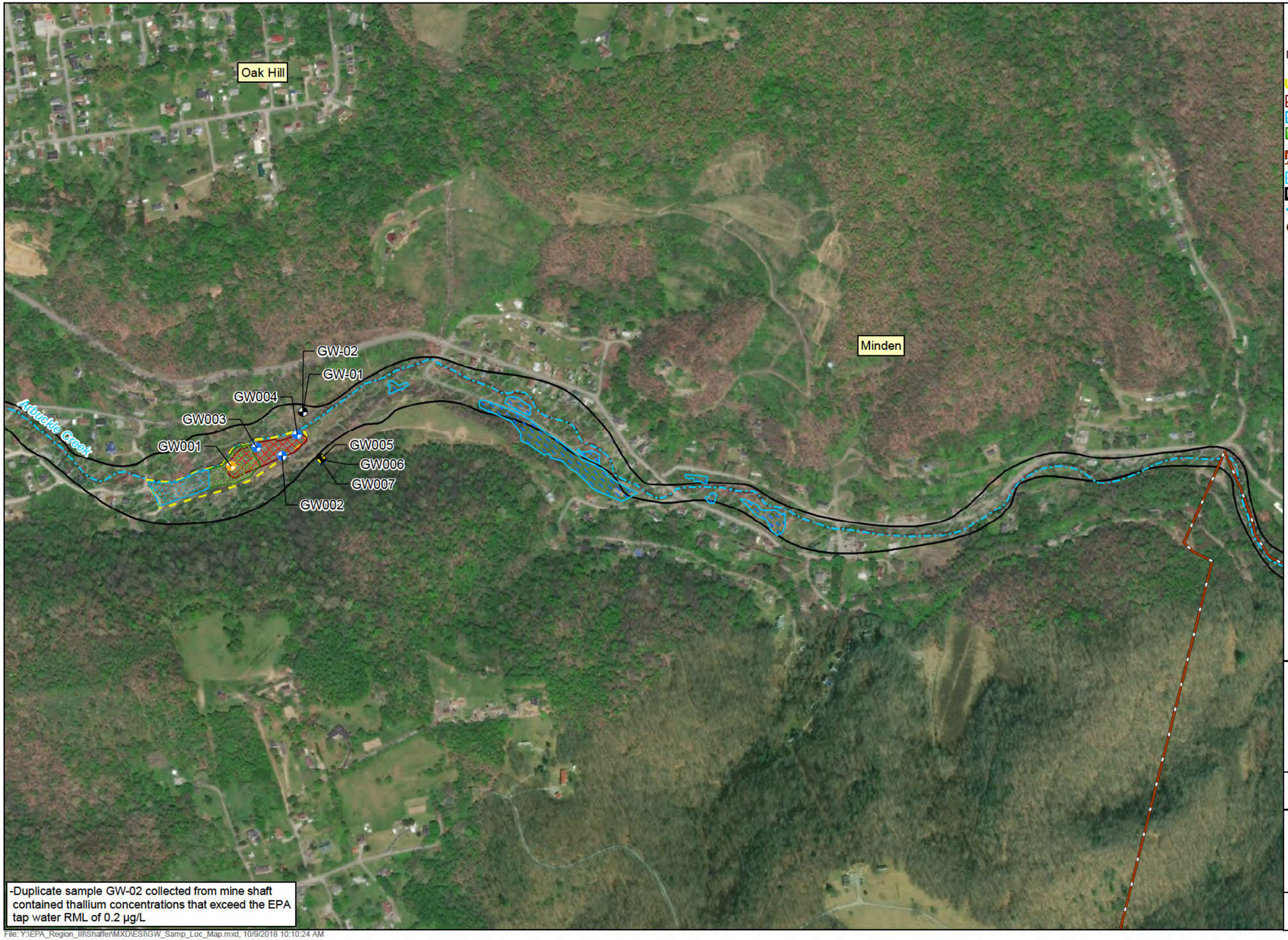
Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 3d
Source/Soil Sample Location Map
June 2018 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\Source_Samp_Loc_Map_D mxd, 10/9/2018 11:00 07 AM



Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek

Groundwater Sample Locations

- 2017 Monitoring Well Samples
- 2017 Mine Outfall Samples
- 2018 Mine Shaft Samples
- PCB concentration exceeds the EPA MCL of 0.5 µg/L and the EPA tap water RML of 0.78 µg/L

-Duplicate sample GW-02 collected from mine shaft contained thallium concentrations that exceed the EPA tap water RML of 0.2 µg/L

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 4
Groundwater
Sample Location Map

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\GW_Samp_Loc_Map.mxd, 10/9/2018 10:10:24 AM

Oak Hill

Minden

Arbuckle Creek

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Sediment Sample Location
- Background Sediment Sample Location
- Surface Water Sample Location
- Background Surface Water Sample Location

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 5
Surface Water and Sediment Sample Location Map

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

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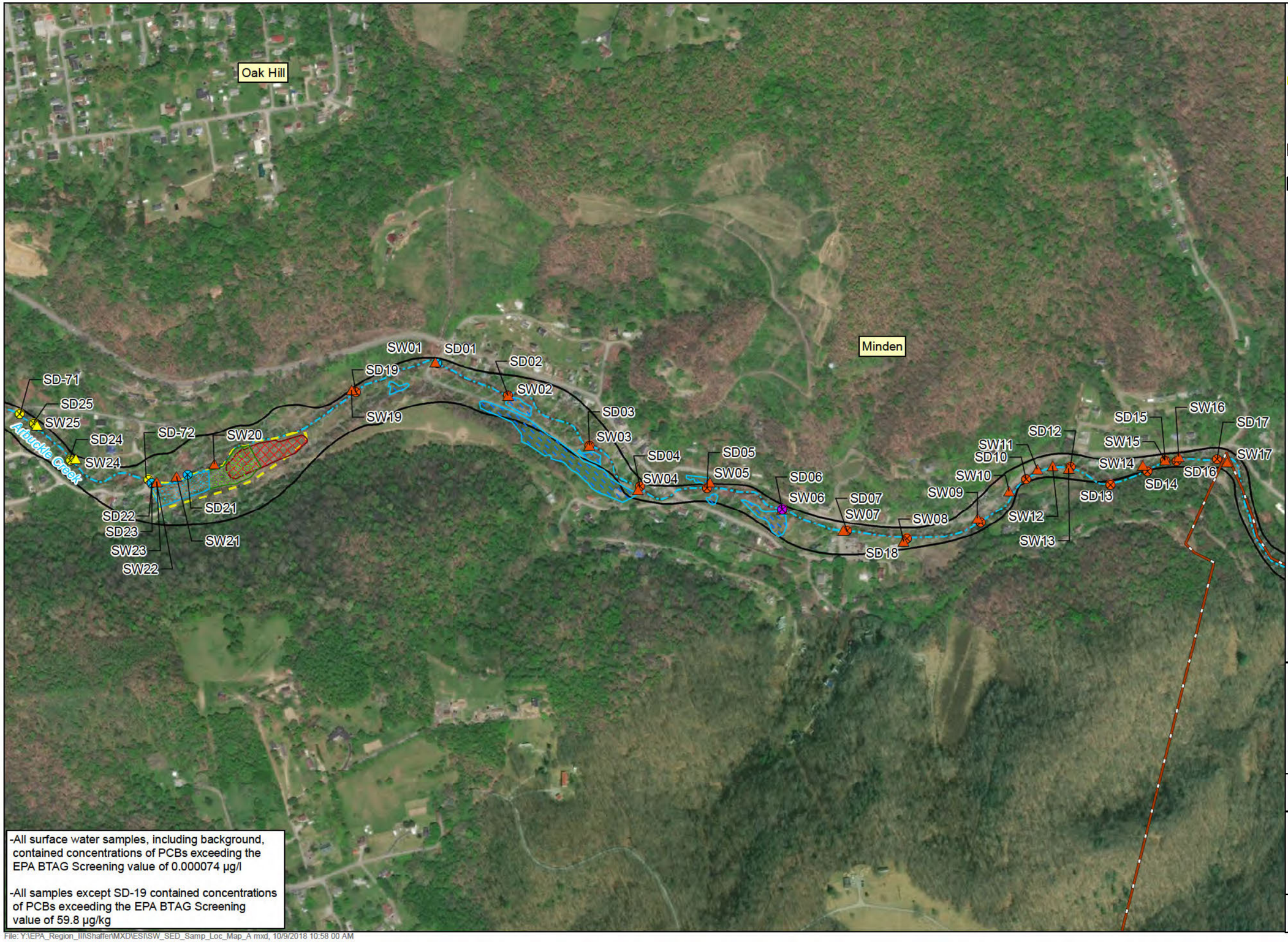


-All surface water samples, including background, contained concentrations of PCBs exceeding the EPA BTAG Screening value of 0.000074 µg/l

-All samples except SD-19 contained concentrations of PCBs exceeding the EPA BTAG Screening value of 59.8 µg/kg

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Sediment Sample Location
- Background Sediment Sample Location
- PCB concentration elevated with respect to background
- PCB concentration elevated with respect to background and exceeds EPA RML for PCBs in residential soil of 24,000 µg/kg
- Surface Water Sample Location
- Background Surface Water Sample Location
- PCB concentration elevated with respect to background

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 5a
Surface Water and Sediment Sample Location Map
June 2017 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\SW_SED_Samp_Loc_Map_A.mxd, 10/9/2018 10:58:00 AM

Oak Hill

Minden

SD-71

SD25

SD24

SD-72

Arbuckle Creek

SEC-SD-T8-02

SEC-SD-T8-01

SEC-SD-T8-03

SEC-SD-TL-03

SEC-SD-T6-01

SEC-SD-T6-02

SEC-SD-T6-03

SEC-SD-T5-01

SEC-SD-T5-02

SEC-SD-T5-03

SEC-SD-T3-01

SEC-SD-T3-02

SEC-SD-T3-03

SEC-SD-T7-02

SEC-SD-T7-03

SEC-SD-T7-01

SEC-SD-CL-01

SEC-SD-T4-03

SEC-SD-T4-01

SEC-SD-T4-02

SEC-SD-TL-06

SEC-SD-T1-01

SEC-SD-T1-03

SEC-SD-T1-02

SEC-SD-T2-03

SEC-SD-T2-02

SEC-SD-T2-01

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Sediment Sample Location
- Background Sediment Sample Location
- PCB concentration elevated with respect to background
- PCB concentrations elevated with respect to background and exceeds the EPA BTAG screening value for freshwater sediment of 59.8 µg/kg for PCBs

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 5b
Sediment Sample
Location Map
December 2017 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\SW_SED_Samp_Loc_Map_B mxd, 10/9/2018 10:51 51 AM

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Sediment Sample Location
- Background Sediment Sample Location
- PCB concentration elevated with respect to background
- PCB concentrations elevated with respect to background and exceeds the EPA BTAG screening value for freshwater sediment of 59.8 µg/kg for PCBs

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

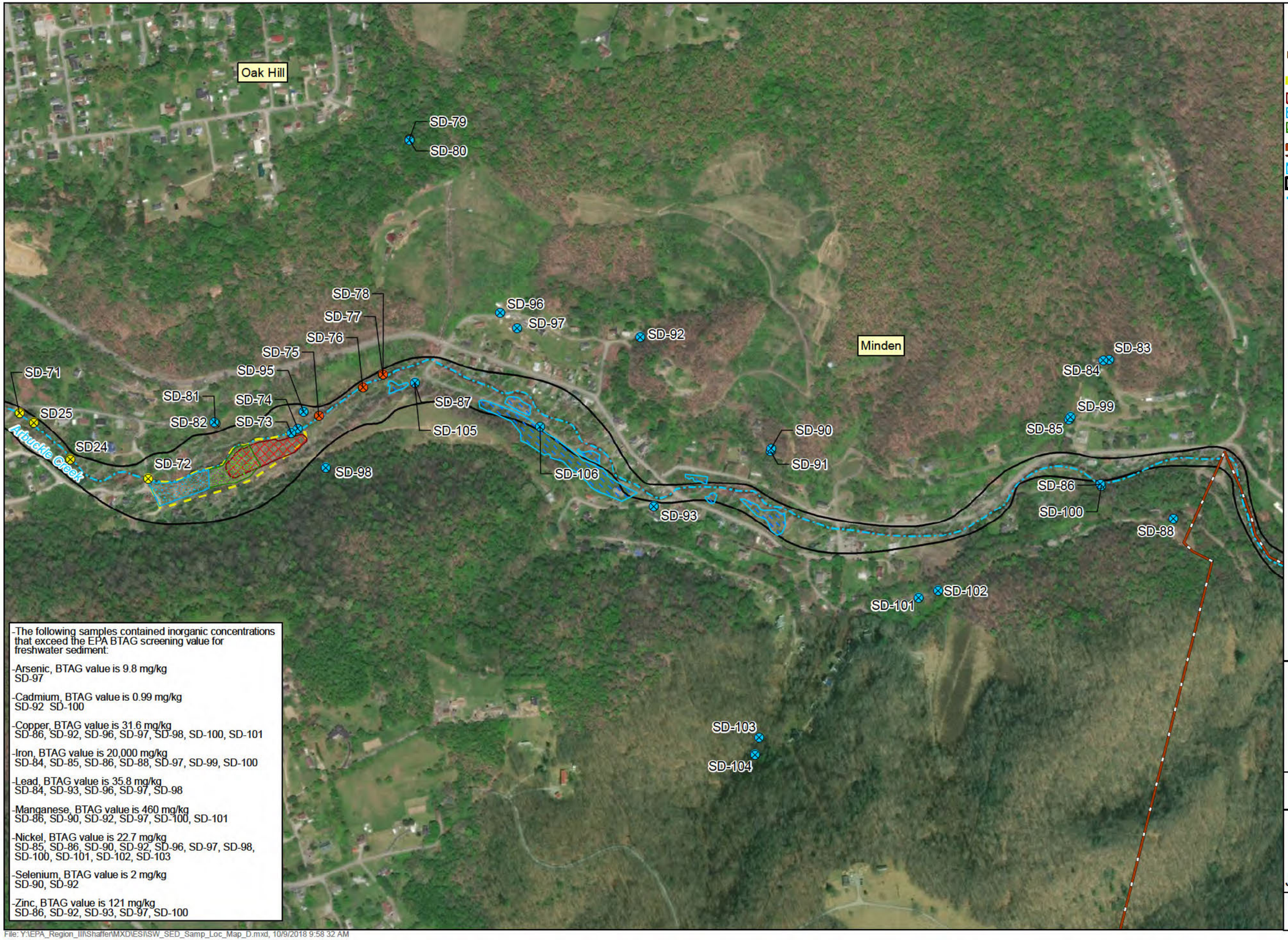
Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 5c
Sediment Sample Location Map
March 2018 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\SW_SED_Samp_Loc_Map_C.mxd, 10/9/2018 10:51:36 AM



- The following samples contained inorganic concentrations that exceed the EPA BTAG screening value for freshwater sediment:

-Arsenic, BTAG value is 9.8 mg/kg
SD-97

-Cadmium, BTAG value is 0.99 mg/kg
SD-92 SD-100

-Copper, BTAG value is 31.6 mg/kg
SD-86, SD-92, SD-96, SD-97, SD-98, SD-100, SD-101

-Iron, BTAG value is 20,000 mg/kg
SD-84, SD-85, SD-86, SD-88, SD-97, SD-99, SD-100

-Lead, BTAG value is 35.8 mg/kg
SD-84, SD-93, SD-96, SD-97, SD-98

-Manganese, BTAG value is 460 mg/kg
SD-86, SD-90, SD-92, SD-97, SD-100, SD-101

-Nickel, BTAG value is 22.7 mg/kg
SD-85, SD-86, SD-90, SD-92, SD-96, SD-97, SD-98, SD-100, SD-101, SD-102, SD-103

-Selenium, BTAG value is 2 mg/kg
SD-90, SD-92

-Zinc, BTAG value is 121 mg/kg
SD-86, SD-92, SD-93, SD-97, SD-100

File: Y:\EPA_Region_III\Shaffer\MXD\ESI\SW_SED_Samp_Loc_Map_D.mxd, 10/9/2018 9:58:32 AM

Legend

- Approximate Shaffer Equipment Company Boundary
- Capped Area Boundary
- Excavation (6 inch)
- Excavation (2 ft)
- New River Gorge National River Park Boundary
- Delineated Wetland Boundaries
- FEMA Flood Zone A
- Arbuckle Creek
- Sediment Sample Location
- Background Sediment Sample Location
- PCB concentrations elevated with respect to background and exceeds the EPA BTAG screening value for freshwater sediment of 59.8 µg/kg for PCBs

Background: ESRI, Mapping Service
The source of this map image is Esri, used by the EPA with Esri s permission

Coordinate System:
WGS84 UTM Zone 17N Feet

N

0 135 270 540
Feet

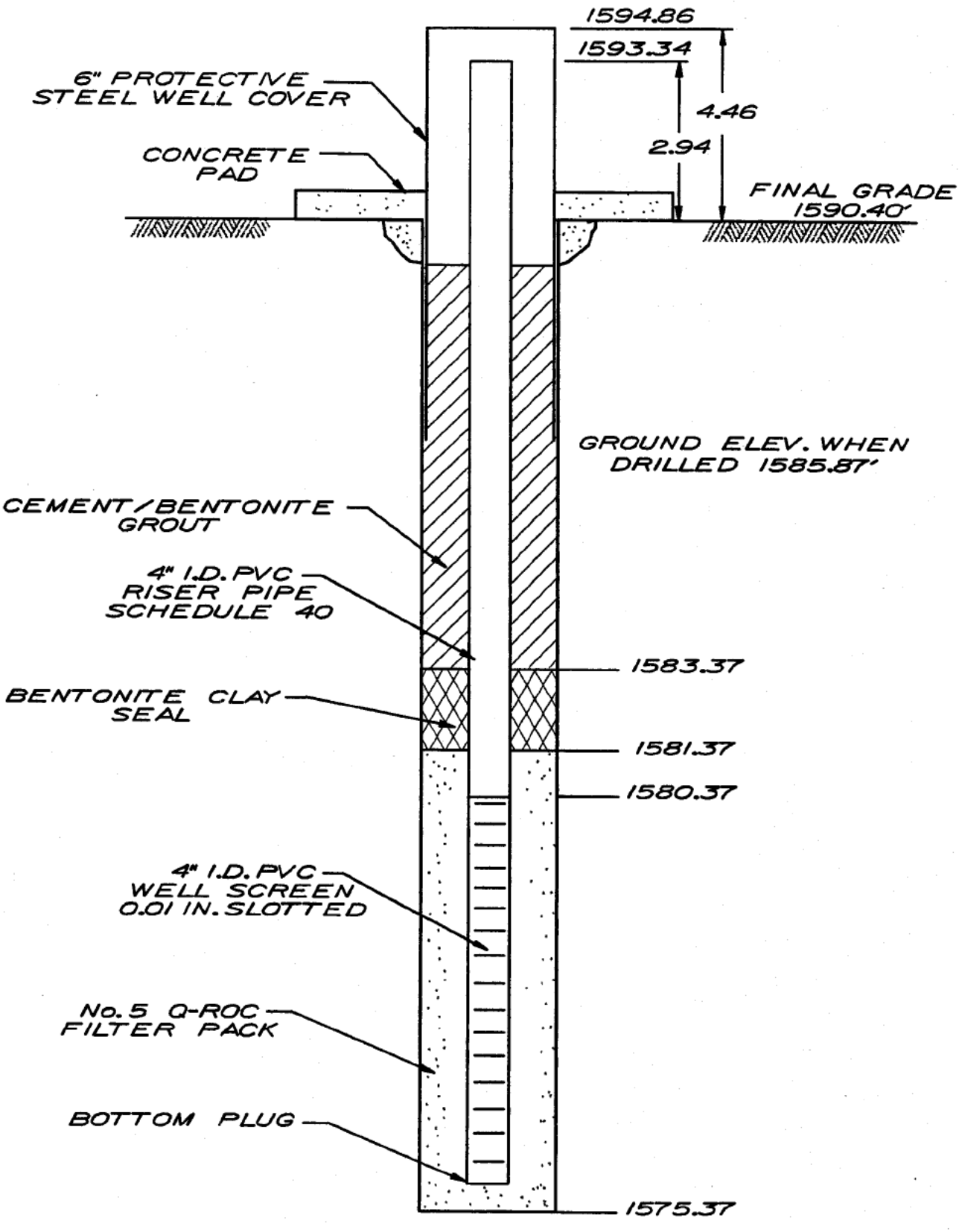
Shaffer Equipment/Arbuckle Creek Area
Minden, Fayette County, West Virginia

Figure 5d
Sediment Sample Location Map
June 2018 Sample Locations

TDD#: W503-17-12-001
Contract: EP-S3-15-02
Prepared: 10/9/2018

WESTON SOLUTIONS

JOB No. C01514



WELL MW-1

NOT TO SCALE

(b) (4)

INSTALLATION DETAILS SHAFFERS ELECTRIC COMPANY SITE FAYETTE COUNTY, WV	FIGURE NO.

(b) (4) [redacted]

(b) (4) [redacted]

MORGANTOWN & ST. ALBANS, WEST VIRGINIA

TEST BORING LOG

CLIENT (b) (4) [redacted] BORING NO. MW #1

PROJECT SHAFFER ELECTRIC JOB NO. C01514

LOCATION OF BORING AS STAKED IN FIELD

SOIL / ROCK DESCRIPTION	Strata Depth	Depth Scale	SAMPLE Blows/6"	No.	Type	Rec.
SURFACE	0.0		AUGER			
BROWN SILTY SAND w/ COBBLES						
BOTTOM OF TEST BORING @ 10.5 * SET 4" PVC WELL TO 10.5' * AUGER REFUSAL @ 10.5'						

Surf. Elev. 1585.87 Ft. Hammer Wt. — Lbs. Rock Core Dia. — Foreman ML

Date Started 11/16/01 Hammer Drop — In. Boring Method HSA Engineer

Date Completed 11/16/01

SAMPLER TYPE

SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
A - FLIGHT AUGER
RC - ROCK CORE

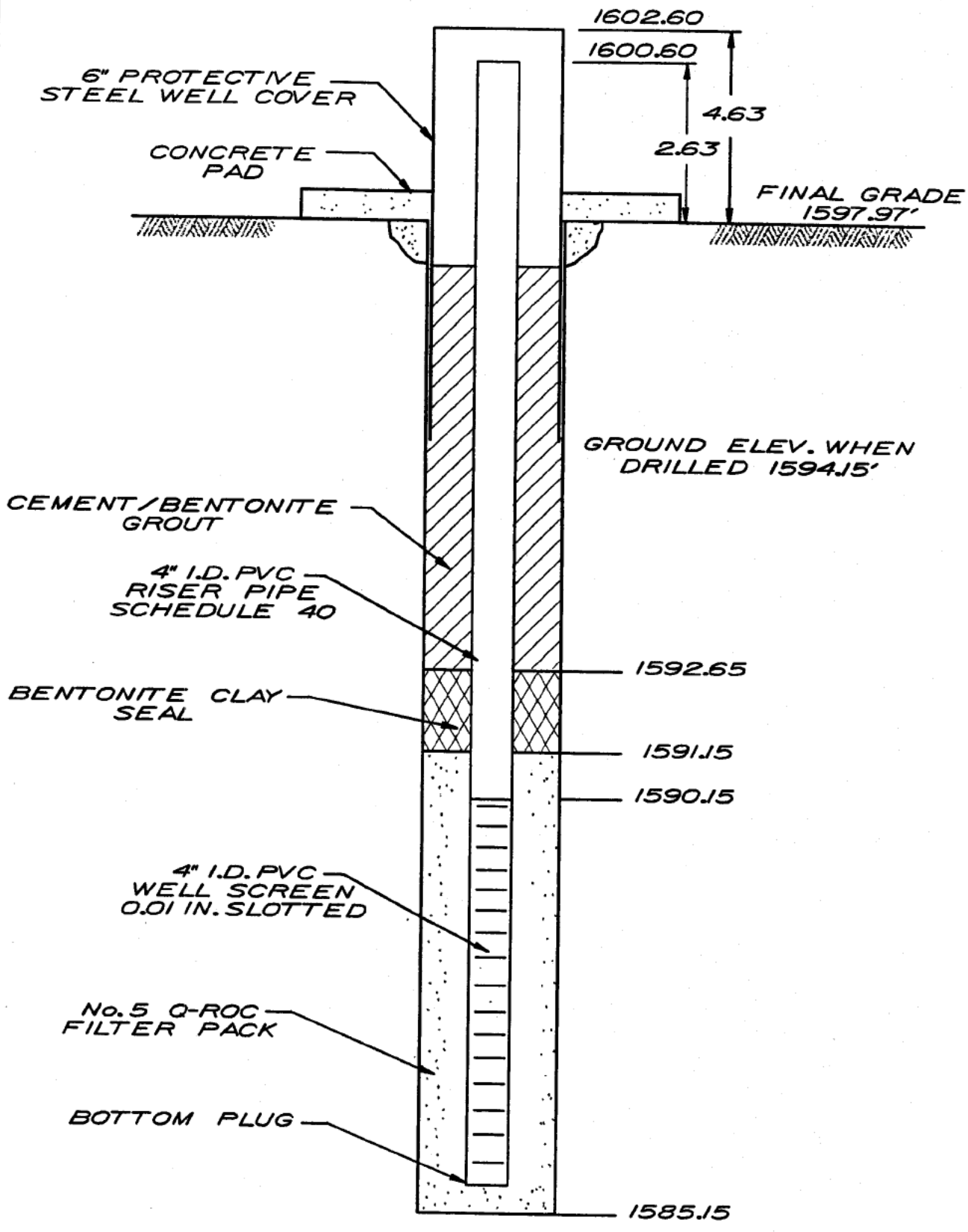
GROUNDWATER DEPTH

FIRST NOTED ____ FT.
AT COMPLETION ____ FT.
AFTER ____ HRS. ____ FT.
BACKFILLED ____ HRS.

BORING METHOD

HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

JOB No. C01514



WELL MW-2

NOT TO SCALE

(b) (4)

INSTALLATION DETAILS SHAFFERS ELECTRIC COMPANY SITE FAYETTE COUNTY, WV	FIGURE NO.

TEST BORING LOG

CLIENT (b) (4) [redacted]
PROJECT SHAFFER ELECTRIC
LOCATION OF BORING AS STAKED IN FIELD

BORING NO. MW #2
JOB NO. C01514

SOIL / ROCK DESCRIPTION	Strata Depth	Depth Scale	SAMPLE Blows/6"	No.	Type	Rec.
SURFACE	0.0					
BROWN SILTY SAND W/ COBBLES			AUGER			
BOTTOM OF TEST BORING @ 9.0' * SET 4" PVC WELL TO 9.0' * AUGER REFUSAL @ 9.0'						

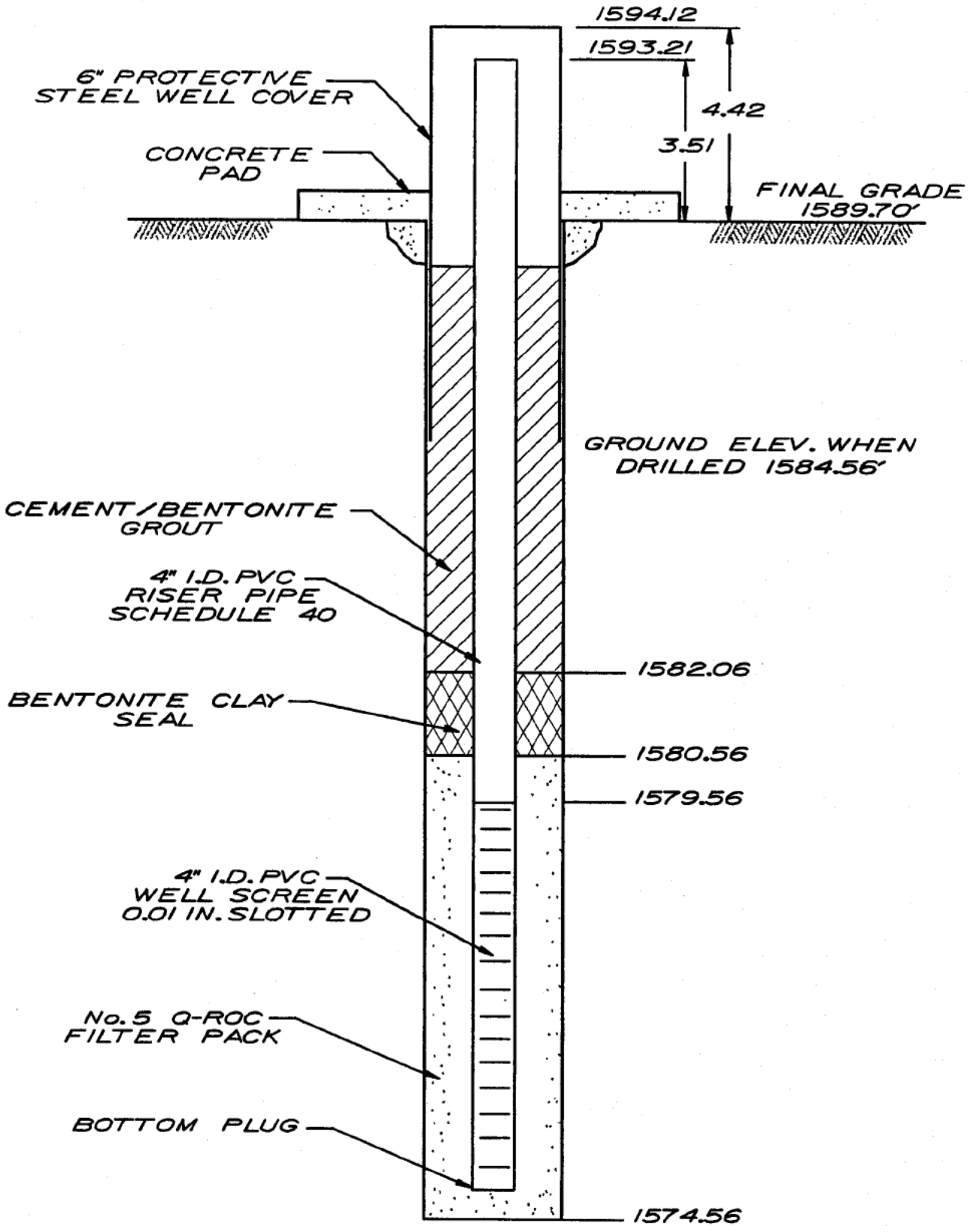
Surf. Elev. 1594.15 Ft. Hammer Wt. — Lbs. Rock Core Dia. — Foreman ML
Date Started 11/16/01 Hammer Drop — In. Boring Method HSA Engineer
Date Completed 11/16/01

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
A - FLIGHT AUGER
RC - ROCK CORE

GROUNDWATER DEPTH
FIRST NOTED _____ FT.
AT COMPLETION _____ FT.
AFTER _____ HRS. _____ FT.
BACKFILLED _____ HRS.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

JOB No. C01514



WELL MW-3

NOT TO SCALE

(b) (4)

INSTALLATION DETAILS SHAFFERS ELECTRIC COMPANY SITE FAYETTE COUNTY, WV	FIGURE NO.

(b) (4) [redacted]

(b) (4) [redacted]
MORGANTOWN & ST. ALBANS, WEST VIRGINIA

TEST BORING LOG

CLIENT (b) (4) [redacted]
PROJECT SHAFFER ELECTRIC
LOCATION OF BORING AS STAKED IN FIELD

BORING NO. MW #3
JOB NO. C01514

SOIL / ROCK DESCRIPTION	Strata Depth	Depth Scale	SAMPLE Blows/6"	No.	Type	Rec.
SURFACE	0.0		AUGER			
BROWN SILTY SAND w/ COBBLES						
BOTTOM OF TEST BORING @ 10.0' * SET 4" PVC WELL TO 10.0' * AUGER REFUSAL @ 10.0'						

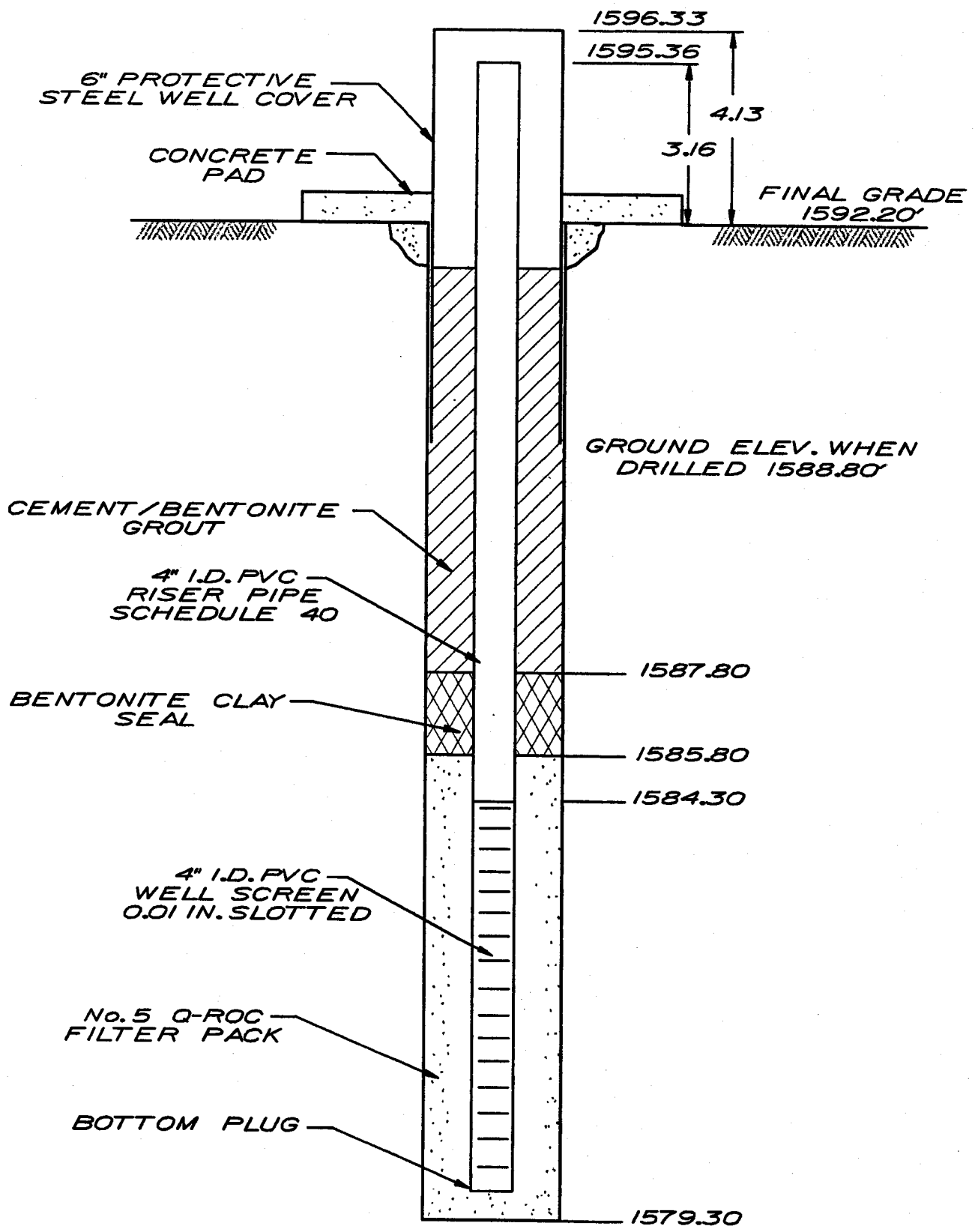
Surf. Elev. 1584.56 Ft. Hammer Wt. — Lbs. Rock Core Dia. —
Date Started 11/16/01 Hammer Drop — In. Boring Method HSA
Date Completed 11/16/01
Foreman ML
Engineer

SAMPLER TYPE
SS - DRIVEN SPLIT SPOON
ST - PRESSED SHELBY TUBE
A - FLIGHT AUGER
RC - ROCK CORE

GROUNDWATER DEPTH
FIRST NOTED ____ FT.
AT COMPLETION ____ FT.
AFTER ____ HRS. ____ FT.
BACKFILLED ____ HRS.

BORING METHOD
HSA - HOLLOW STEM AUGERS
CFA - CONTINUOUS FLIGHT AUGERS
DC - DRIVING CASING
MD - MUD DRILLING

JOB No. C01514



WELL MW-4

NOT TO SCALE

TRIAD	INSTALLATION DETAILS SHAFFERS ELECTRIC COMPANY SITE FAYETTE COUNTY, WV	FIGURE NO.

MORGANTOWN & ST. ALBANS, WEST VIRGINIA

TEST BORING LOG

CLIENT (b) (4) [redacted]
PROJECT SHAFFER ELECTRIC — BORING NO. MW #4
LOCATION OF BORING AS STAKED IN FIELD — JOB NO. C01514

SOIL / ROCK DESCRIPTION	Strata Depth	Depth Scale	SAMPLE Blows/6"	No.	Type	Rec.
SURFACE	0.0					
BROWN SILTY SAND W/ COBBLES			AUGER			
BOTTOM OF TEST BORING @ 9.5' * SET 4" PVC WELL TO 9.5' * AUGER REFUSAL @ 9.5'						

Surf. Elev. 1588.80 Ft. Hammer Wt. — Lbs. Rock Core Dia. — Foreman ML
Date Started 11/16/01 Hammer Drop — In. Boring Method HSA Engineer
Date Completed 11/16/01

SAMPLER TYPE
- S - DRIVEN SPLIT SPOON
- T - PRESSED SHELBY TUBE
- A - FLIGHT AUGER
- RC - ROCK CORE

GROUNDWATER DEPTH
- FIRST NOTED ____ FT.
- AT COMPLETION ____ FT.
- AFTER ____ HRS. ____ FT.
- BACKFILLED ____ HRS.

BORING METHOD
- HSA - HOLLOW STEM AUGERS
- CFA - CONTINUOUS FLIGHT AUGERS
- DC - DRIVING CASING
- MD - MUD DRILLING

Monitoring Well Construction Information

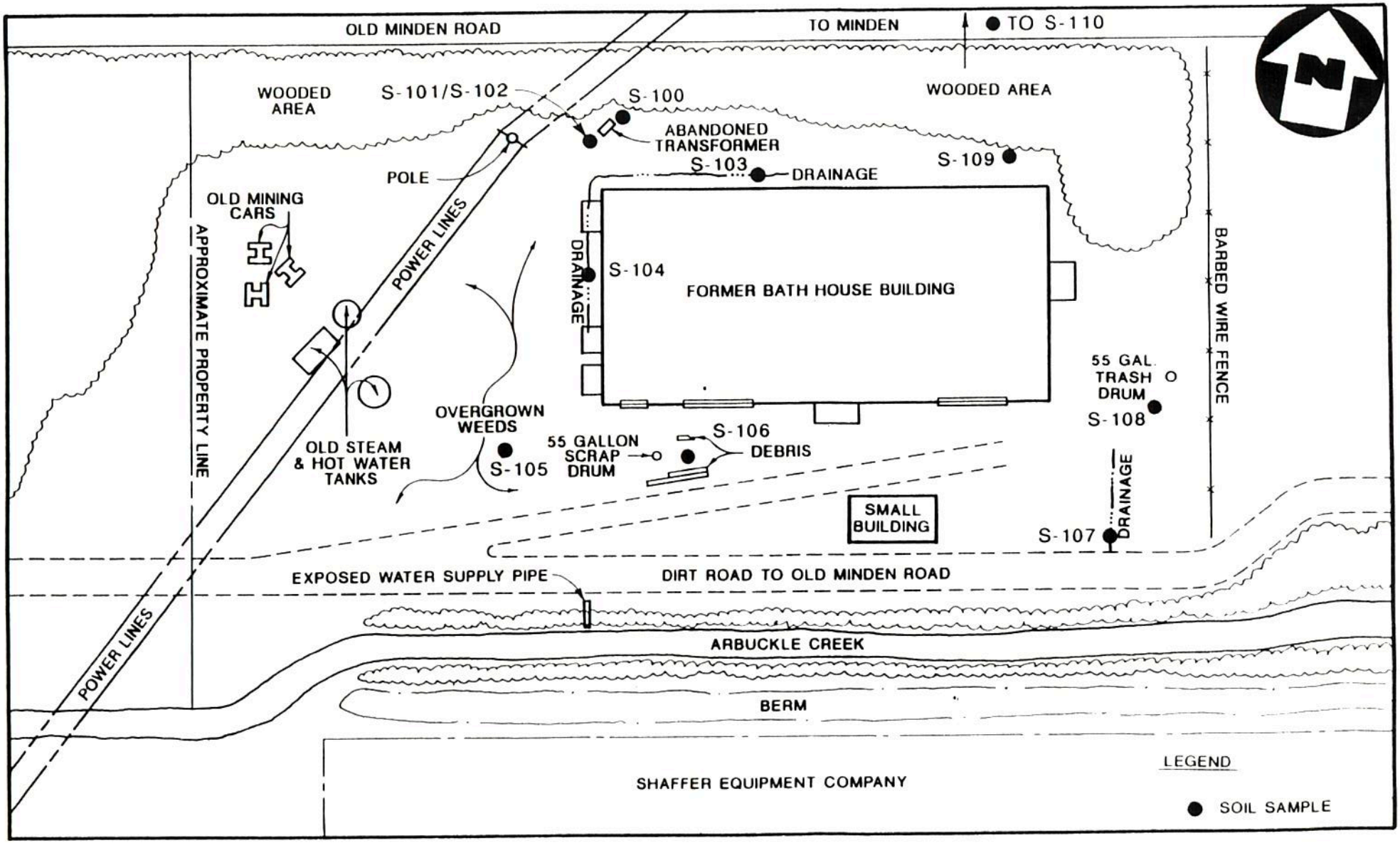
Shaffer Equipment Co.
Fayette County, West Virginia

Well ID	Final Grade Elevation (feet-msl[1])	TOC Elevation[2] (feet-msl)	Total Well Depth (feet btoc[3])	Total Well Depth (feet bgs[4])	Top of Screen (feet-msl)	Bottom of Screen (feet-msl)	Well diameter (inches)	Screen Length (feet)
GW001	1590.40	1593.34	17.97	15.03	1580.37	1575.37	4	5.00
GW002	1597.97	1600.60	15.45	12.82	1590.15	1585.15	4	5.00
GW003	1589.70	1593.21	18.65	15.14	1579.56	1574.56	4	5.00
GW004	1592.20	1595.36	16.06	12.90	1584.30	1579.3	4	5.00

Notes:
[1] msl = mean sea level
[2] Top-of-casing (TOC) elevation
[3] btoc = below top of casing
[4] bgs = below ground surface

APPENDIX C

DATA AND FIGUES – BRITT BATH HOUSE AREA



SAMPLE LOCATION MAP

BATH HOUSE - BRITT PROPERTY

(NO SCALE)

FIGURE 5.1

NUS CORPORATION

ORIGINAL

SITE NAME: BATH HOUSE/BRITT PROPERTY
TDD NUMBER: F3-9007-03
LAB NAMES: IEA(ORGANICS) SKINNER & SHERMAN (INORGANICS)

SAMPLING DATE(s): 07/12/90
CASE NUMBER: 14469

STATE/COUNTY CODE: 54/019
EPA NUMBER:

	SAMPLE NUMBER:	CDY78	CDY79	CDY80	CDY81	CDY82	CDY83
	SAMPLE ID:	S-100	S-101	S-102	S-103	S-104	S-105
	LOCATION:	ON-SITE, NO USE, ACSS, HVY VEG, NEAR TRANSFORMER	ON SITE, NO USE, HEVY VEG, NEAR TRANSFORMER	ON SITE, NO USE, ACSS, HVY VEG, DUP S-101	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, NO VEG, FINE DARK GREY
	PH:	6.8	6.8	5.7	6.9	6.7	4.6
	FIELD MEASUREMENTS:	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU
	PERCENT SOLIDS:	81.0%	79.0%	79.0%	91.0%	75.0%	94.0%
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.2	1.3	1.3	1.1	1.3	1.1

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY78	CDY79	CDY80	CDY81	CDY82	CDY83
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
5.00	methylene chloride	12.00 B	5.00 B	8.00 B	14.00 B	6.00 B	15.00 B
10.00	acetone	23.00 B			9.00 B	14.00B@	28.00 B
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	81.0	84.0	83.0	72.0	88.0	71.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY78	CDY79	CDY80	CDY81	CDY82	CDY83
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
50.00	benzoic acid						270.00 J
10.00	2-methylnaphthalene						210.00 J
10.00	N-nitrosodiphenylamine						140.00 J
50.00	pentachlorophenol						180.00 J
10.00	phenanthrene	280.00 J	730.00 J	460.00 J		230.00 J	640.00 J
10.00	anthracene						
10.00	di-n-butyl phthalate	340.00 B					
10.00	fluoranthene	740.00 J	1600.00	1100.00	350.00 J	500.00 J	260.00 J
10.00	pyrene	620.00 J	1600.00	810.00 J	210.00 J	400.00 J	350.00 J
10.00	benzo(a)anthracene	320.00 J	650.00 J	420.00 J		220.00 J	
10.00	chrysene	410.00 J	950.00	540.00 J		280.00 J	420.00 J
10.00	bis(2-ethylhexyl) phthalate						
10.00	benzo(b)fluoranthene	440.00 J	770.00 J	560.00 J		300.00 J	360.00 J
10.00	benzo(k)fluoranthene		750.00 J	490.00 J		260.00 J	370.00 J
10.00	benzo(a)pyrene	240.00 J	800.00 J	410.00 J		230.00 J	250.00 J
10.00	indeno(1,2,3-cd)pyrene		710.00 J				
10.00	benzo(g,h,i)perylene	190.00 J	370.00 J				
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	400.0	410.0	410.0	360.0	430.0	1700.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY78	CDY79	CDY80	CDY81	CDY82	CDY83
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
0.50	aroclor-1248						

Comments:

@= result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL

SITE NAME: BATH HOUSE/BRITT PROPERTY
TDD NUMBER: F3-9007-03
LAB NAMES: IEA(ORGANICS) SKINNER & SHERMAN (INORGANICS)

SAMPLING DATE(s): 07/12/90
CASE NUMBER:14469

STATE/COUNTY CODE: 54/019
EPA NUMBER:

	SAMPLE NUMBER:	MCDY78	MCDY79	MCDY80	MCDY81	MCDY82	MCDY83
	SAMPLE ID:	S-100	S-101	S-102	S-103	S-104	S-105
	LOCATION:	ON-SITE, NO USE,ACSS,HVY VEG, NEAR TRANSFORMER	ON SITE, NO USE, HEVY VEG, NEAR TRANSFORMER	ON SITE, NO USE, ACSS, HVY VEG, DUP S-101	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, NO VEG, FINE DARK GREY
	PH:	6.8	6.8	5.7	6.9	6.7	4.6
	FIELD MEASUREMENTS:	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU
	PERCENT SOLIDS:	81.4%	75.9%	75.2%	90.0%	72.2%	94.8%
TYPE OF DATA:	INORGANICS						
	DILUTION FACTOR: : GFAA	0.239	0.256	0.261	0.218	0.269	0.207
	: ICP	0.232	0.249	0.263	0.218	0.261	0.205
	: Hg	0.614	0.659	0.633	0.483	0.660	0.502
	: CN	0.062	0.067	0.067	0.056	0.069	0.054

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	MCDY78 mg/kg	MCDY79 mg/kg	MCDY80 mg/kg	MCDY81 mg/kg	MCDY82 mg/kg	MCDY83 mg/kg
29.00	aluminum	5380.00	5230.00	4850.00	5540.00	5830.00	2310.00
10.00	antimony						
2.00	arsenic	11.20	6.50	8.10	14.20	8.80	19.10
2.00	barium	233.00	92.30	75.00	75.20	202.00	71.30
1.00	beryllium	0.60 B	0.64 B	0.79 B	0.84 B	1.70	2.40
2.00	cadmium						
54.00	calcium	2050.00	2220.00	1880.00	3250.00	4360.00	1430.00
5.00	chromium	20.80	12.90	15.20	55.10	15.80	8.50
4.00	cobalt	9.70	7.50	6.20	7.50	127.00	16.30
3.00	copper	73.80	98.10	59.40	17.80	48.00	111.00
12.00	iron	28000.00	15100.00	16500.00	14900.00	46700.00	8940.00
16.00	lead (anal. by ICP)	238.00 J	264.00 J	107.00 J	289.00 J	399.00 J	42.70 K
37.00	magnesium	680.00	754.00	634.00	1780.00	1070.00	291.00
7.00	manganese	599.00	307.00	252.00	201.00	6510.00	157.00
0.20	mercury	0.27	0.18	0.21		0.26	0.11
5.00	nickel	17.00	11.30	8.20	11.50	232.00	29.70
780.00	potassium	977.00	903.00	927.00	1110.00	1110.00	528.00
3.00	selenium						1.10 L
37.00	sodium	115.00 B	102.00 B	93.60 B	152.00 B	141.00 B	143.00 B
3.00	vanadium	7.90	9.90	11.20	6.60	3.20	11.20
2.00	zinc	475.00 J	168.00 J	105.00 J	738.00 J	515.00 J	61.70 J

Comments:

@= result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL

SITE NAME: BATH HOUSE/BRITT PROPERTY
TDD NUMBER: F3-9007-03
LAB NAMES: IEA(ORGANICS) SKINNER & SHERMAN (INORGANICS)

SAMPLING DATE(s): 07/12/90
CASE NUMBER:14469

STATE/COUNTY CODE: 54/019
EPA NUMBER:

	SAMPLE NUMBER:	CDY84	CDY85	CDY86	CDY87	CDY88	CDY89
	SAMPLE ID:	S-106	S-107	S-108	S-109	S-110	TRIP BLANK
	LOCATION:	ON SITE, NO USE, ACCS, NO VEG, TRSH AND DEBRIS	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, HVY VEG, AT TRSH BRN BRL	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN DITCH	OFF SITE, BACKGROUND, NO USE, ACCS VEG	BLANK FOR SOLIDS VOA ONLY
	PH:	7.8	6.4	6.9	6.6	4.6	
	FIELD MEASUREMENTS:	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	N/A
	PERCENT SOLIDS:	95.0%	87.0%	83.0%	79.0%	90.0%	
TYPE OF DATA:	VOLATILES						
	DILUTION FACTOR:	1.1	1.2	1.2	1.3	1.1	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY84	CDY85	CDY86	CDY87	CDY88	CDY89
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/l
5.00	methylene chloride	22.00 B	5.00 B	4.00 B	4.00 B	6.00 B	
10.00	acetone	17.00 B	19.00 B	9.00 B	8.00 B		
TYPE OF DATA:	SEMIVOLATILES						
	DILUTION FACTOR:	69.0	76.0	80.0	84.0	72.0	0.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY84	CDY85	CDY86	CDY87	CDY88	CDY89
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	n//a
50.00	benzoic acid						
10.00	2-methylnaphthalene	250.00 J					
10.00	N-nitrosodiphenylamine						
50.00	pentachlorophenol						
10.00	phenanthrene	170.00 J	1600.00	300.00 J	650.00 J		
10.00	anthracene		350.00 J				
10.00	di-n-butyl phthalate						
10.00	fluoranthene		3200.00	710.00 J	1100.00		
10.00	pyrene		2400.00	580.00 J	780.00 J		
10.00	benzo(a)anthracene		1100.00	310.00 J	430.00 J		
10.00	chrysene		1200.00	440.00 J	570.00 J		
10.00	bis(2-ethylhexyl) phthalate	520.00 R					
10.00	benzo(b)fluoranthene		1100.00	460.00 J	510.00 J		
10.00	benzo(k)fluoranthene		1000.00	390.00 J	480.00 J		
10.00	benzo(a)pyrene		1000.00	330.00 J	400.00 J		
10.00	indeno(1,2,3-cd)pyrene		620.00 J				
10.00	benzo(g,h,i)perylene		320.00 J				
TYPE OF DATA:	PESTICIDES						
	DILUTION FACTOR:	340.0	370.0	390.0	410.0	360.0	0.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CDY84	CDY85	CDY86	CDY87	CDY88	CDY89
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	n/a
0.50	aroclor-1248		300.00	2600.00 C			

Comments:
@= result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL

SITE NAME: BATH HOUSE/BRITT PROPERTY
TDD NUMBER: F3-9007-03
LAB NAMES: IEA(ORGANICS) SKINNER & SHERMAN (INORGANICS)

SAMPLING DATE(s): 07/12/90
CASE NUMBER:14469

STATE/COUNTY CODE: 54/019
EPA NUMBER:

	SAMPLE NUMBER:	MCDY84	MCDY85	MCDY86	MCDY87	MCDY88
	SAMPLE ID:	S-106	S-107	S-108	S-109	S-110
	LOCATION:	ON SITE, NO USE, ACCS, NO VEG, TRSH AND DEBRIS	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN PATH	ON SITE, NO USE, ACCS, HVY VEG, AT TRSH BRN BRL	ON SITE, NO USE, ACCS, HVY VEG, IN DRAIN DITCH	OFF SITE, BACKGROUND, NO USE, ACCS VEG
	PH:	7.8	6.4	6.9	6.6	4.6
	FIELD MEASUREMENTS:	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU	0.1 PPM HNU
	PERCENT SOLIDS:	94.1%	87.6%	82.3%	78.3%	90.3%
TYPE OF DATA:	INORGANICS					
	DILUTION FACTOR: : GFAA	0.195	0.213	0.223	0.234	0.200
	: ICP	0.206	0.213	0.234	0.253	0.200
	: Hg	0.442	0.542	0.528	0.511	0.444
	: CN	0.052	0.056	0.062	0.064	0.056

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	MCDY84 mg/kg	MCDY85 mg/kg	MCDY86 mg/kg	MCDY87 mg/kg	MCDY88 mg/kg
29.00	aluminum	2980.00	4260.00	4910.00	5030.00	4950.00
10.00	antimony	2.20 B				
2.00	arsenic	21.40	6.60	6.60	9.70	2.60
2.00	barium	95.00	62.90	82.60	74.40	46.60
1.00	beryllium	0.80 B	0.55 B	0.60 B	0.65 B	0.96 B
2.00	cadmium	2.80				
54.00	calcium	158000.00	6510.00	4790.00	4800.00	258.00
5.00	chromium	14.60	14.00	12.90	12.10	8.50
4.00	cobalt	6.40	18.00	6.00	5.80	19.80
3.00	copper	40.40	15.80	51.30	20.70	8.40
12.00	iron	22400.00	16100.00	12100.00	15000.00	15700.00
16.00	lead (anal. by ICP)	37.00 K	43.00 K	84.80 J	66.30 K	23.10 K
37.00	magnesium	4580.00	1470.00	737.00	887.00	709.00
7.00	manganese	208.00	283.00	339.00	295.00	277.00
0.20	mercury	0.10		0.41	0.14	
5.00	nickel	14.50	9.30	8.10	9.50	15.70
780.00	potassium	1230.00	962.00	780.00	990.00	961.00
3.00	selenium	12.00 L				
37.00	sodium	131.00 B	132.00 B	118.00 B	129.00 B	58.10 B
3.00	vanadium	2.10	7.60	8.10	9.70	7.00
2.00	zinc	89.20 J	51.30 J	79.90 J	61.20 J	45.10 J

ORIGINAL

APPENDIX D

DATA AND FIGURES – ARBUCKLE CREEK

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC23	CBC24	CBC25	CBC26	CBC27	CBC28
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	APPLE TREE ACCESSABLE VEGETATED BLK, SANDY	0.5 MI DWNST ACCESSABLE NO VEG DK BRN SAND	HOUSE # 201 YARD VEGETATED DK BRN SILT	HOUSE # 201 STREAM BANK VEGETATED DK BRN SILT	HOUSE # 204 YARD VEGETATED DK BRN CLAY	HOUSE # 197 STREAM BANK VEGETATED DK BRN CLAY
	PH:	6.3	7.3	7.0	7.4	6.2	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	81.0%	91.0%	84.0%	84.0%	87.0%	81.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.2	1.1	1.2	1.2	1.1	1.2

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC23 ug/kg	CBC24 ug/kg	CBC25 ug/kg	CBC26 ug/kg	CBC27 ug/kg	CBC28 ug/kg
5.00	methylene chloride	15.00 B	16.00 B	23.00B@	11.00 B	6.00 B	9.00 B
10.00	acetone	15.00B@	10.00B@				
5.00	chloroform						
10.00	2-butanone			8.00B@	9.00B@	5.00 B	7.00 B
5.00	bromodichloromethane						
5.00	dibromochloromethane						
10.00	4-methyl-2-pentanone						
5.00	toluene						
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	410.0	36.0	39.0	39.0	38.0	41.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC23 ug/kg	CBC24 ug/kg	CBC25 ug/kg	CBC26 ug/kg	CBC27 ug/kg	CBC28 ug/kg
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol						
50.00	benzoic acid		53.00 J	120.00 J			75.00 J
10.00	1,2,4-trichlorobenzene						
10.00	naphthalene		250.00 J	85.00 J		51.00 J	160.00 J
10.00	4-chloroaniline						
10.00	2-methylnaphthalene		350.00 J	110.00 J	48.00 J	69.00 J	200.00 J
10.00	acenaphthylene		220.00 J	99.00 J			
10.00	acenaphthene		40.00 J				
10.00	dibenzofuran		140.00 J				65.00 J
10.00	diethyl phthalate						
10.00	fluorene		100.00 J				
10.00	phenanthrene	6700.00	1300.00	350.00 J	230.00 J	130.00 J	530.00
10.00	anthracene	850.00 J	1200.00	92.00 J			62.00 J
10.00	di-n-butyl phthalate		1400.00	48.00 B	58.00 B		
10.00	fluoranthene	14000.00	1800.00	670.00	330.00 J	160.00 J	520.00
10.00	pyrene	15000.00	1500.00	650.00	330.00 J	170.00 J	470.00
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene	6400.00	890.00	340.00 J	180.00 J	190.00 J	270.00 J
10.00	chrysene	8700.00	1200.00	600.00	300.00 J	360.00 J	410.00
10.00	bis(2-ethylhexyl) phthalate		130.00 B	130.00 B	57.00 B	90.00 B	250.00 R
10.00	benzo(b)fluoranthene	7700.00		500.00	230.00 J	200.00 J	340.00 J
10.00	benzo(k)fluoranthene	6200.00	1900.00	470.00	160.00 J	140.00 J	300.00 J
10.00	benzo(a)pyrene	6200.00	820.00	330.00 J	170.00 J	130.00 J	240.00 J
10.00	indeno(1,2,3-cd)pyrene	4300.00	510.00	310.00 J	130.00 J	88.00 J	180.00 J
10.00	dibenz(a,h)anthracene	1600.00 J		110.00 J		52.00 J	
10.00	benzo(g,h,i)perylene	5400.00	390.00	280.00 J	130.00 J	120.00 J	160.00 J
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	2000.0	700.0	950.0	190.0	180.0	990.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC23 ug/kg	CBC24 ug/kg	CBC25 ug/kg	CBC26 ug/kg	CBC27 ug/kg	CBC28 ug/kg
Comments:	**********	**********	**********	**********	**********	**********	**********

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic: IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER: 14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC23	CBC24	CBC25	CBC26	CBC27	CBC28
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	APPLE TREE ACCESSABLE VEGETATED BLK, SANDY	0.5 MI DWNST ACCESSABLE NO VEG DK BRN SAND	HOUSE # 201 YARD VEGETATED DK BRN SILT	HOUSE # 201 STREAM BANK VEGETATED DK BRN SILT	HOUSE # 204 YARD VEGETATED DK BRN CLAY	HOUSE # 197 STREAM BANK VEGETATED DK BRN CLAY
	PH:	6.3	7.3	7.0	7.4	6.2	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	81.0%	91.0%	84.0%	84.0%	87.0%	81.0%
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	2000.0	700.0	950.0	190.0	180.0	990.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC23 ug/kg	CBC24 ug/kg	CBC25 ug/kg	CBC26 ug/kg	CBC27 ug/kg	CBC28 ug/kg
0.05	gamma-BHC (lindane)						
0.10	4,4'-DDE				16.00 R		
0.10	4,4'-DDD						
0.10	4,4'-DDT						
1.00	aroclor-1260		600.00 J	1400.00	150.00 J		1400.00 C

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC29	CBC30	CBC31	CBC32	CBC33	CBC34
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	HOUSE # 197 YARD VEGETATED DK BRN SILT	HOUSE # 196 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 196 YARD VEGETATED BLK/BRN CLAY	HOUSE # 196 E. OF HOUSE VEGETATED BRN, SANDY	HOUSE # 163 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 163 YARD VEGETATED DK BRN SILT
	PH:	7.8	7.9	6.3	7.3	7.2	6.9
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	67.0%	76.0%	68.0%	84.0%	88.0%	79.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.5	1.3	1.5	1.2	1.1	1.3

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CBC29 ug/kg	CBC30 ug/kg	CBC31 ug/kg	CBC32 ug/kg	CBC33 ug/kg	CBC34 ug/kg
5.00	methylene chloride	9.00 B	10.00 B	13.00 B	21.00 B	18.00 B	3.00 B
10.00	acetone				39.00 B		
5.00	chloroform						
10.00	2-butanone			8.00 B		6.00 B	
5.00	bromodichloromethane						
5.00	dibromochloromethane						
10.00	4-methyl-2-pentanone						
5.00	toluene			2.00B@		2.00 B	
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	49.0	43.0	49.0	39.0	37.0	42.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CBC29 ug/kg	CBC30 ug/kg	CBC31 ug/kg	CBC32 ug/kg	CBC33 ug/kg	CBC34 ug/kg
10.00	1,4-dichlorobenzene	60.00 J					
10.00	4-methylphenol	55.00 J					
50.00	benzoic acid	79.00 J	94.00 J				64.00 J
10.00	1,2,4-trichlorobenzene	110.00 J	90.00 J		48.00 J		
10.00	naphthalene	320.00 J	350.00 J	470.00 J	140.00 J	42.00 J	660.00
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	460.00 J	410.00 J	370.00 J	160.00 J	48.00 J	230.00 J
10.00	acenaphthylene	89.00 J	92.00 J	60.00 J			110.00 J
10.00	acenaphthene			64.00 J			82.00 J
10.00	dibenzofuran	150.00 J	160.00 J	200.00 J	59.00 J		200.00 J
10.00	diethyl phthalate						
10.00	fluorene	74.00 J	90.00 J				160.00 J
10.00	phenanthrene	1200.00	1300.00	1500.00	430.00	250.00 J	1100.00
10.00	anthracene	140.00 J	160.00 J	140.00 J	46.00 J		350.00 J
10.00	di-n-butyl phthalate	56.00 B	49.00 B				
10.00	fluoranthene	1200.00	1400.00	930.00	400.00	250.00 J	1600.00
10.00	pyrene	1100.00	1200.00	730.00	380.00 J	190.00 J	1300.00
10.00	butylbenzyl phthalate		65.00 J				98.00 J
10.00	benzo(a)anthracene	600.00	670.00	410.00 J	220.00 J		790.00
10.00	chrysene	920.00	940.00	880.00	340.00 J	220.00 J	940.00
10.00	bis(2-ethylhexyl) phthalate	200.00 B	210.00 B	420.00 R	110.00 B	140.00 B	460.00
10.00	benzo(b)fluoranthene	720.00	750.00	1100.00	230.00 J	280.00 J	1300.00
10.00	benzo(k)fluoranthene	520.00	670.00		190.00 J		
10.00	benzo(a)pyrene	520.00	600.00	510.00	200.00 J	120.00 J	530.00
10.00	indeno(1,2,3-cd)pyrene	320.00 J	340.00 J	240.00 J	140.00 J	58.00 J	290.00 J
10.00	dibenz(a,h)anthracene	120.00 J	120.00 J				120.00 J
10.00	benzo(g,h,i)perylene	290.00 J	290.00 J	240.00 J	130.00 J	65.00 J	280.00 J
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	2400.0	2100.0	940.0	1900.0	180.0	200.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CBC29 ug/kg	CBC30 ug/kg	CBC31 ug/kg	CBC32 ug/kg	CBC33 ug/kg	CBC34 ug/kg
	Comments:	**********	**********	**********	**********	**********	**********

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:II Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC29	CBC30	CBC31	CBC32	CBC33	CBC34
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	HOUSE # 197 YARD VEGETATED DK BRN SILT	HOUSE # 196 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 196 YARD VEGETATED BLK/BRN CLAY	HOUSE # 196 E. OF HOUSE VEGETATED BRN, SANDY	HOUSE # 163 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 163 YARD VEGETATED DK BRN SILT
	PH:	7.8	7.9	6.3	7.3	7.2	6.9
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	67.0%	76.0%	68.0%	84.0%	88.0%	79.0%
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	2400.0	2100.0	940.0	1900.0	180.0	200.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC29	CBC30	CBC31	CBC32	CBC33	CBC34
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
0.05	gamma-BHC (lindane)						
0.10	4,4'-DDE						43.00
0.10	4,4'-DDD						11.00 J
0.10	4,4'-DDT						86.00
1.00	aroclor-1260	3600.00	5100.00 C	1300.00	2600.00 C	140.00 L	360.00

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic: IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER: 14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT25	MCCT26	MCCT27	MCCT28	MCCT29	MCCT30
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	APPLE TREE ACCESSABLE VEGETATED BLK, SANDY	0.5 MI DWNST ACCESSABLE NO VEG DK BRN SAND	HOUSE # 201 YARD VEGETATED DK BRN SILT	HOUSE # 201 STREAM BANK VEGETATED DK BRN SILT	HOUSE # 204 YARD VEGETATED DK BRN CLAY	HOUSE # 197 STREAM BANK VEGETATED DK BRN CLAY
	PH:	6.3	7.3	7.0	7.4	6.2	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	81.6%	88.9%	80.5%	80.8%	87.2%	78.9%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.245	0.225	0.248	0.247	0.218	0.241
	: ICP	0.245	0.225	0.248	0.247	0.218	0.241
	: Hg	0.613	0.559	0.620	0.618	0.558	0.610
	: CN	0.061	0.059	0.062	0.062	0.058	0.061

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER: / UNITS:	MCCT25 mg/kg	MCCT26 mg/kg	MCCT27 mg/kg	MCCT28 mg/kg	MCCT29 mg/kg	MCCT30 mg/kg
* 5.00	aluminum		6180.00	3890.00	6740.00	8800.00	7200.00	5580.00
* 10.00	antimony		30.80 L	3.80 B	2.50 B		15.80 B	4.40 B
* 2.00	arsenic		40.30	12.20	9.70	7.80	8.30	15.90
* 1.00	barium		346.00	92.30	175.00	140.00	96.50	126.00
* 1.00	beryllium		1.10 B	1.30 B	1.20 B	1.40 B	1.20 B	1.30 B
* 2.00	cadmium		5.40					
* 4.00	calcium		1560.00	3510.00	3000.00	1720.00	6670.00	3160.00
* 6.00	chromium		30.00	8.30 B	9.70 B	7.90 B	58.20	11.80
* 4.00	cobalt		16.10	9.40	10.70	11.90	15.70	11.20
* 3.00	copper		194.00	58.00	39.70	69.10	27.10	62.20
* 13.00	iron		45700.00	14100.00	14800.00	14000.00	35400.00	16200.00
* 1.00	lead (anal. by GFAA)		1170.00	86.70	206.00	111.00	79.30	131.00
* 11.00	magnesium		1310.00	608.00	712.00	645.00	1380.00	786.00
* 1.00	manganese		323.00	268.00	357.00	885.00	554.00	303.00
* 0.20	mercury		0.34	0.27	0.25	0.41		0.26
* 4.00	nickel		30.50	16.60	15.30	13.20	25.40	21.40
* 68.00	potassium		1300.00	864.00	1070.00	718.00	1220.00	1070.00
* 2.00	selenium		2.80	1.80	0.97	0.97	0.87	1.20
* 2.00	silver		0.71 B					
* 10.00	sodium		128.00	108.00 B	99.40 B	79.70 B	120.00	148.00
* 1.00	thallium		1.20	0.22	0.24			0.48
* 3.00	vanadium		14.00	12.90	15.20	14.40	15.90	12.30
* 2.00	zinc		3250.00	115.00	233.00	142.00	130.00	259.00
* 1.50	cyanide			0.22		0.19		0.32

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic: IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER: 14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	SAMPLE ID:	S-13	S-14	S-15	S-16	S-00	SD-1
	LOCATION:	HOUSE # 26 STREAM BANK VEGETATED LT. BRN SAND	HOUSE # 26 STREAM BANK VEGETATED LT BRN SAND	HOUSE # 200 YARD VEGETATED DK BRN SILT	MINDEN STORE STREAM BANK VEGETATED LT BRN SANDY	BLANK FOR SOLIDS	ARBUCKLE CR UPST / FRESH MATCHES SW-1 ORG MATTER
	PH:	7.5	7.7	7.4	8.0		7.5
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	83.0%	88.0%	70.0%	90.0%		75.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.2	1.1	1.4	1.1	1.0	1.3

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	ug/l	ug/kg
5.00	methylene chloride	8.00 B	6.00 B	25.00 B	4.00 B		5.00 B
10.00	acetone						19.00 B
5.00	chloroform						
10.00	2-butanone			8.00 B	2.00 B		2.00 B
5.00	bromodichloromethane						
5.00	dibromochloromethane						
10.00	4-methyl-2-pentanone						
5.00	toluene						
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	40.0	370.0	47.0	370.0	0.0	44.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	n/a	ug/kg
10.00	1,4-dichlorobenzene						160.00 J
10.00	4-methylphenol						
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene						
10.00	naphthalene	80.00 J		600.00			
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	71.00 J		530.00 J			
10.00	acenaphthylene			130.00 J			
10.00	acenaphthene			87.00 J			70.00 J
10.00	dibenzofuran			260.00 J			55.00 J
10.00	diethyl phthalate						
10.00	fluorene			78.00 J			100.00 J
10.00	phenanthrene	290.00 J	1300.00 J	1800.00	3300.00 J		1100.00 J
10.00	anthracene			1700.00	910.00 J		270.00 J
10.00	di-n-butyl phthalate						65.00 B
10.00	fluoranthene	340.00 J	1300.00 J	1300.00	15000.00		2000.00 J
10.00	pyrene	290.00 J	1000.00 J	980.00	14000.00		1200.00 J
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene	180.00 J	520.00 J	640.00	6700.00		550.00 J
10.00	chrysene	230.00 J	810.00 J	1300.00	6700.00		710.00 J
10.00	bis(2-ethylhexyl) phthalate	53.00 B		130.00 B			680.00
10.00	benzo(b)fluoranthene	320.00 J	1100.00 J	1500.00	13000.00		1100.00 J
10.00	benzo(k)fluoranthene						
10.00	benzo(a)pyrene	140.00 J	490.00 J	660.00	7000.00		380.00 J
10.00	indeno(1,2,3-cd)pyrene	83.00 J		220.00 J	4000.00		230.00 J
10.00	dibenz(a,h)anthracene			130.00 J	1400.00 J		
10.00	benzo(g,h,i)perylene	84.00 J		210.00 J	4400.00		190.00 J
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	960.0	910.0	460.0	890.0	0.0	210.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	n/a	ug/kg
	Comments:	**********	**********	**********	**********	**********	**********

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(S): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	SAMPLE ID:	S-13	S-14	S-15	S-16	S-00	SD-1
	LOCATION:	HOUSE # 26 STREAM BANK VEGETATED LT. BRN SAND	HOUSE # 26 STREAM BANK VEGETATED LT BRN SAND	HOUSE # 200 YARD VEGETATED DK BRN SILT	MINDEN STORE STREAM BANK VEGETATED LT BRN SANDY	BLANK FOR SOLIDS	ARBUCKLE CR UPST / FRESH MATCHES SW-1 ORG MATTER
	PH:	7.5	7.7	7.4	8.0		7.5
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	83.0%	88.0%	70.0%	90.0%		75.0%
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	960.0	910.0	460.0	890.0		210.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC35	CBC36	CBC37	CBC38	CBC39	CBC40
	UNITS:	ug/kg	ug/kg	ug/kg	ug/kg	n/a	ug/kg
0.05	gamma-BHC (lindane)						
0.10	4,4'-DDE						
0.10	4,4'-DDD						
0.10	4,4'-DDT						
1.00	aroclor-1260	2700.00 C	1900.00	340.00 J			

Comments: ********** @=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT31	MCCT32	MCCT33	MCCT34	MCCT35	MCCT36
	SAMPLE ID:	S-7	S-8	S-9	S-10	S-11	S-12
	LOCATION:	HOUSE # 197 YARD VEGETATED DK BRN SILT	HOUSE # 196 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 196 YARD VEGETATED BLK/BRN CLAY	HOUSE # 196 E.OF HOUSE VEGETATED BRN, SANDY	HOUSE # 163 STREAM BANK VEGETATED DK BRN CLAY	HOUSE # 163 YARD VEGETATED DK BRN SILT
	PH:	7.8	7.9	6.3	7.3	7.2	6.9
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	66.6%	77.2%	66.9%	84.7%	85.3%	79.6%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.295	0.260	0.287	0.236	0.234	0.250
	: ICP	0.295	0.260	0.287	0.236	0.234	0.250
	: Hg	0.738	0.650	0.750	0.580	0.585	0.615
	: CN	0.075	0.065	0.075	0.058	0.059	0.062

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER:	MCCT31	MCCT32	MCCT33	MCCT34	MCCT35	MCCT36
		UNITS:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
*	5.00	aluminum	6910.00	6600.00	10500.00	5590.00	4890.00	8230.00
*	10.00	antimony	6.00 B	4.60 B	5.50 B	2.40 B	6.80 B	3.90 B
*	2.00	arsenic	20.00	15.30	27.00	15.00	8.00	10.70
*	1.00	barium	135.00	122.00	224.00	89.40	256.00	154.00
*	1.00	beryllium	1.50 B	1.40 B	1.80 B	2.30 B	0.60 B	1.20 B
*	2.00	cadmium					2.40 B	
*	4.00	calcium	8200.00	8290.00	2870.00	2170.00	2070.00	3200.00
*	6.00	chromium	11.60 B	11.00 B	16.20	9.20 B	10.90 B	11.90 B
*	4.00	cobalt	13.60	15.00	17.30	11.20	6.20	12.20
*	3.00	copper	62.80	58.70	73.10	51.30	122.00	51.40
*	13.00	iron	19900.00	19400.00	25600.00	14700.00	13600.00	18800.00
*	1.00	lead (anal. by GFAA)	112.00	172.00	389.00	78.10	511.00	224.00
*	11.00	magnesium	1050.00	1270.00	1290.00	1060.00	639.00	888.00
*	1.00	manganese	490.00	410.00	474.00	279.00	172.00	420.00
*	0.20	mercury	0.38	0.35	0.67	0.25	0.18	0.36
*	4.00	nickel	22.00	24.50	26.30	22.20	9.10	17.40
*	68.00	potassium	1130.00	1260.00	1680.00	1130.00	741.00	1200.00
*	2.00	selenium	2.10	1.50	2.00	1.10	0.46	0.98
*	2.00	silver						
*	10.00	sodium	154.00	148.00	204.00	101.00 B	85.70 B	131.00
*	1.00	thallium	0.29	0.26	0.29		0.23	0.24
*	3.00	vanadium	15.50	14.40	23.00	12.00	9.60	16.50
*	2.00	zinc	165.00	204.00	391.00	95.50	508.00	271.00
*	1.50	cyanide					0.18	0.31

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic: IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER: 14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT37	MCCT38	MCCT39	MCCT40	MCCT41	MCCT42
	SAMPLE ID:	S-13	S-14	S-15	S-16	SD-1	SD-2
	LOCATION:	HOUSE # 26 STREAM BANK VEGETATED LT. BRN SAND	HOUSE # 26 STREAM BANK VEGETATED LT. BRN SAND	HOUSE # 200 YARD VEGETATED DK BRN SILT	MINDEN STORE STREAM BANK VEGETATED LT BRN SANDY	ARBUCKLE CR. UPST / FRESH MATCHES SW-1 ORG MATTER	SAME AS SD-1 DUPLCTE SD-1
	PH:	7.5	7.7	7.4	8.0	7.5	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	93.3%	89.5%	67.5%	91.2%	70.5%	66.9%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.214	0.222	0.296	0.209	0.284	0.300
	: ICP	0.214	0.215	0.296	0.209	0.284	0.300
	: Hg	0.534	0.538	0.713	0.525	0.702	0.750
	: CN	0.055	0.057	0.071	0.054	0.072	0.075

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER: / UNITS:	MCCT37 mg/kg	MCCT38 mg/kg	MCCT39 mg/kg	MCCT40 mg/kg	MCCT41 mg/kg	MCCT42 mg/kg
* 5.00	aluminum		4440.00	4650.00	8050.00	5480.00	4740.00	7170.00
* 10.00	antimony		4.80 B		6.60 B	4.60 B		
* 2.00	arsenic		8.40	8.90	32.30	5.00	3.00 J	8.80 J
* 1.00	barium		111.00	78.00	170.00	84.70	29.10 J	101.00 J
* 1.00	beryllium		1.00 B	1.40 B	1.70 B	1.10 B	1.10 B	1.40 B
* 2.00	cadmium							
* 4.00	calcium		1990.00	1930.00	5400.00	36900.00	3360.00 J	16200.00 J
* 6.00	chromium		19.30	11.80	13.30 B	210.00	49.40	39.90
* 4.00	cobalt		11.00	11.00	11.50	9.20	11.80	16.40
* 3.00	copper		31.50	38.10	54.10	28.70	15.90 J	64.70 J
* 13.00	iron		13900.00	11500.00	23700.00	13700.00	9130.00	14300.00
* 1.00	lead (anal. by GFAA)		65.70	78.20	154.00	94.40	28.40 J	74.70 J
* 11.00	magnesium		811.00	601.00	1430.00	3420.00	652.00 J	1520.00 J
* 1.00	manganese		194.00	204.00	386.00	354.00	176.00 J	364.00 J
* 0.20	mercury			0.12	0.59		0.14	
* 4.00	nickel		19.70	19.30	19.60	22.50	16.90	26.20
* 68.00	potassium		976.00	909.00	1620.00	1110.00	421.00	697.00
* 2.00	selenium		0.63	0.65	3.20	0.42		
* 2.00	silver							1.10 B
* 10.00	sodium		97.00 B	117.00	236.00	94.90 B	101.00 B	169.00
* 1.00	thallium			0.22	0.59			
* 3.00	vanadium		10.20	17.30	19.20	14.00	4.60	7.70
* 2.00	zinc		164.00	118.00	206.00	136.00	75.30 J	155.00 J
* 1.50	cyanide							

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

RC

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC41	CBC42	CBC43	CBC44	CBC45	CBC46
	SAMPLE ID:	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7
	LOCATION:	SAME AS SD-1	ARBUCKLE CR. DOWN/FRESH	ARBUCKLE CR. MIDST/FRESH	ARBUCKLE CR. MIDST/FRESH	ARBUCKLE CR DOWN/FRESH	DRN DITCH ONSITE/FRESH
		DUPLCTE SD-1	MATCHES SW-3 BRN/RED SAND	NO AQ SAMPLE BLK SILT ORG	NO AQ SAMPLE SILTY SAND	NO AQ SAMPLE RED SHALE SO	NO AQ SAMPLE CLAY STONY
	PH:	7.4	7.7	7.5	6.7	7.9	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	73.0%	80.0%	66.0%	89.0%	88.0%	46.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.4	1.2	1.6	1.1	1.1	2.2

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC41 ug/kg	CBC42 ug/kg	CBC43 ug/kg	CBC44 ug/kg	CBC45 ug/kg	CBC46 ug/kg
5.00	methylene chloride	5.00 B	3.00 B		8.00 B	10.00 B	18.00 B
10.00	acetone	45.00 B		32.00 B			
5.00	chloroform						
10.00	2-butanone	8.00 B					
5.00	bromodichloromethane						
5.00	dibromochloromethane						
10.00	4-methyl-2-pentanone						
5.00	toluene						
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	450.0	38.0	500.0	37.0	37.0	720.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC41 ug/kg	CBC42 ug/kg	CBC43 ug/kg	CBC44 ug/kg	CBC45 ug/kg	CBC46 ug/kg
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol				42.00 J		
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene						
10.00	naphthalene						
10.00	4-chloroaniline						1400.00 J
10.00	2-methylnaphthalene				68.00 J		
10.00	acenaphthylene						
10.00	acenaphthene				150.00 J		
10.00	dibenzofuran				87.00 J		
10.00	diethyl phthalate				39.00 B		
10.00	fluorene	1100.00 J			110.00 J		
10.00	phenanthrene	13000.00 J		810.00 J	770.00 J		1200.00 J
10.00	anthracene	2100.00 J			160.00 J		
10.00	di-n-butyl phthalate				45.00 B	130.00 B	
10.00	fluoranthene	16000.00 J	54.00 J	1300.00 J	860.00 J	44.00 J	1700.00 J
10.00	pyrene	12000.00 J	48.00 J	970.00 J	730.00 J	44.00 J	1500.00 J
10.00	butylbenzyl phthalate					1800.00	
10.00	benzo(a)anthracene	3800.00 J			190.00 J		850.00 J
10.00	chrysene	5400.00 J		660.00 J	190.00 J		1000.00 J
10.00	bis(2-ethylhexyl) phthalate	1400.00 B	140.00 B	5800.00	140.00 B	1200.00	4000.00 R
10.00	benzo(b)fluoranthene	3500.00 J		1100.00 J	86.00 J		960.00 J
10.00	benzo(k)fluoranthene	2500.00 J			110.00 J		930.00 J
10.00	benzo(a)pyrene				94.00 J		880.00 J
10.00	indeno(1,2,3-cd)pyrene						800.00 J
10.00	dibenz(a,h)anthracene	590.00 J					
10.00	benzo(g,h,i)perylene						
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	220.0	190.0	480.0	180.0	730.0	1400.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC41 ug/kg	CBC42 ug/kg	CBC43 ug/kg	CBC44 ug/kg	CBC45 ug/kg	CBC46 ug/kg
Comments:	**********	**********	**********	**********	**********	**********	**********

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC41	CBC42	CBC43	CBC44	CBC45	CBC46
	SAMPLE ID:	SD-2	SD-3	SD-4	SD-5	SD-6	SD-7
	LOCATION:	SAME AS SD-1	ARBUCKLE CR. DOWN/FRESH MATCHES SW-3	ARBUCKLE CR. MIDST/FRESH NO AQ SAMPLE	ARBUCKLE CR. MIDST/FRESH NO AQ SAMPLE	ARBUCKLE CR DOWN/FRESH NO AQ SAMPLE	DRN DITCH ONSITE/FRESH NO AQ SAMPLE
		DUPLCTE SD-1	BRN/RED SAND	BLK SILT ORG	SILTY SAND	RED SHALE SO	CLAY STONY
	PH:	7.4	7.7	7.5	6.7	7.9	7.4
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	73.0%	80.0%	66.0%	89.0%	88.0%	46.0%
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	220.0	190.0	480.0	180.0	730.0	1400.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC41 ug/kg	CBC42 ug/kg	CBC43 ug/kg	CBC44 ug/kg	CBC45 ug/kg	CBC46 ug/kg
0.05	gamma-BHC (lindane)						
0.10	4,4'-DDE						
0.10	4,4'-DDD						
0.10	4,4'-DDT						
1.00	aroclor-1260		60.00 J	640.00	320.00		1300.00 J

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic: El Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER: 14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT43	MCCT44	MCCT45	MCCT46	MCCT47	MCCT48
	SAMPLE ID:	SD-3	SD-4	SD-5	SD-6	SD-7	SD-8
	LOCATION:	ARBUCKLE CR. DOWN/FRESH MATCHES SW-3 BRN/RED SAND	ARBUCKLE CR. MIDST/FRESH NO AQ SAMPLE BLK SILT ORG	ARBUCKLE CR. MIDST/FRESH NO AQ SAMPLE SILTY SAND	ARBUCKLE CR. DOWN/FRESH NO AQ SAMPLE RED SHALE SO	DRN DITCH ONSITE/FRESH NO AQ SAMPLE CLAY, STONY	DRN DITCH ONSITE/FRESH NO AQ SAMPLE MED BRN, ORG
	PH:	7.7	7.5	6.7	7.9	7.4	7.1
	FIELD MEASUREMENTS:	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG	NO HNU > BKG
	PERCENT SOLIDS:	81.1%	59.2%	86.3%	88.2%	44.3%	40.5%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.247	0.338	0.236	0.227	0.451	0.484
	: ICP	0.247	0.339	0.226	0.227	0.451	0.484
	: Hg	0.587	0.845	0.565	0.565	1.120	1.220
	: CN	0.060	0.085	0.055	0.055	0.110	0.120

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER:	MCCT43	MCCT44	MCCT45	MCCT46	MCCT47	MCCT48
		UNITS:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
*	5.00	aluminum	4310.00	11800.00	5370.00	5170.00	13400.00	8900.00
*	10.00	antimony	14.10 B		24.10	8.60 B		17.40 B
*	2.00	arsenic	11.50 J	3.70 J	8.20 J	3.60 J	8.60	10.00
*	1.00	barium	41.50 J	78.90 J	63.00 J	61.80 J	420.00	98.70
*	1.00	beryllium	0.60 B	3.20 B	0.89 B	0.65 B	3.40 B	4.40 B
*	2.00	cadmium						
*	4.00	calcium	834.00 J	5140.00 J	3540.00 J	41100.00 J	29000.00	1810.00
*	6.00	chromium	14.50	9.70 B	17.40	18.40	18.90 B	10.20 B
*	4.00	cobalt	20.40	23.30	24.10 J	7.00 J	40.80 J	112.00 J
*	3.00	copper	14.30 J	46.70 J	35.50	13.80	269.00	97.80
*	13.00	iron	31400.00	17400.00	41700.00	18000.00	23500.00	38600.00
*	1.00	lead (anal. by GFAA)	41.30 J	58.50 J	32.60 J	15.00 J	128.00	38.60
*	11.00	magnesium	908.00 J	1150.00 J	1510.00 J	3970.00 J	2830.00	1270.00
*	1.00	manganese	408.00 J	399.00 J	227.00 J	308.00 J	881.00	1860.00
*	0.20	mercury					1.20	
*	4.00	nickel	24.50	37.30	36.20 J	12.00 J	111.00 J	178.00 J
*	68.00	potassium	737.00	670.00	1030.00 J	1160.00 J	1290.00 J	1100.00 J
*	2.00	selenium				0.45 J	1.40 J	1.90 J
*	2.00	silver		3.90 B	0.60 B	0.77 B	11.50 B	
*	10.00	sodium	221.00	267.00	188.00	186.00	201.00 B	95.60 B
*	1.00	thallium			0.23	0.22	0.45	0.47
*	3.00	vanadium	10.40	7.80	7.50 J	11.90 J	16.30 J	12.40 J
*	2.00	zinc	62.20 J	217.00 J	119.00 J	44.90 J	616.00 J	436.00 J
*	1.50	cyanide						

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:II Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC47	CBC48	CBC49	CBC50	CBC51	CBC52
	SAMPLE ID:	SD-8	PW-1	SW-1	SW-2	SW-3	PW-2
	LOCATION:	DRN. DITCH	ASPD ROCKLIK	ARBUCKLE CR	SAME AS SW-1	ARBUCKLE CR	ASPD ROCKLIK
		ONSITE/FRESH	POTABLE	UPST/FRESH		DOWNST/FRESH	POTABLE
		NO AQ SAMPLE	PRETREATMENT	MATCHES SD-1		MATCHES SD-3	POSTTREATMNT
		MED BRN, ORG	CLEAR/NO ODR	CLR/SEWG ODR	DUPLICT SW-1	TURBD/SWG OD	CLR/NO ODOR
	PH:	7.1	7.3	7.8	7.9	7.7	6.9
	FIELD MEASUREMENTS:	NO HNU > BKG	532 UMHOS/CM	1043UMHOS/CM	1029UMHOS/CM	612 UMHOS/CM	542 UMHOS/CM
	PERCENT SOLIDS:	46.0%					
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	2.2	1.0	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC47 ug/kg	CBC48 ug/l	CBC49 ug/l	CBC50 ug/l	CBC51 ug/l	CBC52 ug/l
5.00	methylene chloride	15.00 B	1.00 B				1.00 B
10.00	acetone	110.00 B				3.00 B	2.00 B
5.00	chloroform						3.00 J
10.00	2-butanone	24.00 B					
5.00	bromodichloromethane						3.00 J
5.00	dibromochloromethane						2.00 J
10.00	4-methyl-2-pentanone						2.00 B
5.00	toluene						
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	72.0	1.0	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC47 ug/kg	CBC48 ug/l	CBC49 ug/l	CBC50 ug/l	CBC51 ug/l	CBC52 ug/l
10.00	1,4-dichlorobenzene						
10.00	4-methylphenol	150.00 J					
50.00	benzoic acid						
10.00	1,2,4-trichlorobenzene	230.00 J					
10.00	naphthalene	330.00 J					
10.00	4-chloroaniline						
10.00	2-methylnaphthalene	340.00 J					
10.00	acenaphthylene	1100.00					
10.00	acenaphthene	160.00 J					
10.00	dibenzofuran	410.00 J					
10.00	diethyl phthalate						
10.00	fluorene	690.00 J					
10.00	phenanthrene	3800.00 J					
10.00	anthracene	1500.00					
10.00	di-n-butyl phthalate	91.00 B					
10.00	fluoranthene	6100.00 J					
10.00	pyrene	5400.00 J					
10.00	butylbenzyl phthalate	85.00 B					
10.00	benzo(a)anthracene	3500.00 J					
10.00	chrysene	3800.00 J					
10.00	bis(2-ethylhexyl) phthalate	160.00 B			2.00 B		
10.00	benzo(b)fluoranthene	3500.00 J					
10.00	benzo(k)fluoranthene	3500.00					
10.00	benzo(a)pyrene	2900.00					
10.00	indeno(1,2,3-cd)pyrene	1300.00					
10.00	dibenz(a,h)anthracene	120.00 J					
10.00	benzo(g,h,i)perylene	960.00					
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	3500.0	1.0	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC47 ug/kg	CBC48 ug/l	CBC49 ug/l	CBC50 ug/l	CBC51 ug/l	CBC52 ug/l
	Comments:	**********	**********	**********	**********	**********	**********

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC47	CBC48	CBC49	CBC50	CBC51	CBC52
	SAMPLE ID:	SD-8	PW-1	SW-1	SW-2	SW-3	PW-2
	LOCATION:	DRN. DITCH ONSITE/FRESH NO AQ SAMPLE MED BRN. ORG	ASPD ROCKLIK POTABLE PRETREATMENT CLEAR/NO ODR	ARBUCKLE CR UPST/FRESH MATCHES SD-1 CLR/SEWG ODR	SAME AS SW-1 DUPLICT SW-1	ARBUCKLE CR DOWNST/FRESH MATCHES SD-3 TURBD/SWG OD	ASPD ROCKLIK POTABLE POSTTREATMNT CLR/NO ODOR
	PH:	7.1	7.3	7.8	7.9	7.7	6.9
	FIELD MEASUREMENTS:	NO HNU > BKG	532 UMHOS/CM	1043UMHOS/CM	1029UMHOS/CM	612 UMHOS/CM	542 UMHOS/CM
	PERCENT SOLIDS:	46.0%					
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	3500.0	1.0	1.0	1.0	1.0	1.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC47 ug/kg	CBC48 ug/l	CBC49 ug/l	CBC50 ug/l	CBC51 ug/l	CBC52 ug/l
0.05	gamma-BHC (lindane)			0.07 R	0.06 R		
0.10	4,4'-DDE						
0.10	4,4'-DDD						
0.10	4,4'-DDT						
1.00	aroclor-1260	9000.00 C					

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT49	MCCT50	MCCT51	MCCT52	MCCT53	MCCT54
	SAMPLE ID:	PW-1	SW-1	SW-2	SW-3	PW-2	PW-3
	LOCATION:	ASPD ROCKLIK POTABLE PRETREATMENT CLEAR/NO ODR	ARBUCKLE CR. UPST/FRESH MATCHES SD-1 CLR/SEWG ODR	SAME AS SW-1 DUPLICT SW-1	ARBUCKLE CR. DOWNST/FRESH MATCHES SD-3 TURBD/SWG OD	ASPD ROCKLIK POTABLE POSTTREATMNT CLR/NO ODR	WVAWC MON #1 POTABLE PRETREATMENT CLR/NO ODR
	PH:	7.3	7.8	7.9	7.7	6.9	6.1
	FIELD MEASUREMENTS:	532 UMHOS/CM	1043UMHOS/CM	1029UMHOS/CM	612 UMHOS/CM	542 UMHOS/CM	650 UMHOS/CM
	PERCENT SOLIDS:						
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	1.000	1.000	1.000	1.000	1.000	1.000
	: ICP	1.000	1.000	1.000	1.000	1.000	1.000
	: Hg	1.000	1.000	1.000	1.000	1.000	1.000
	: CN	1.000	1.000	1.000	1.000	1.000	1.000

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER:	MCCT49	MCCT50	MCCT51	MCCT52	MCCT53	MCCT54
		UNITS:	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
* 5.00	aluminum		21.10 B	141.00	161.00	163.00	20.90 B	29.20 B
* 10.00	antimony		11.00 B			10.70 B	11.90 B	18.80 B
* 2.00	arsenic							
* 1.00	barium		105.00	29.00	28.30	26.50	101.00	72.10
* 1.00	beryllium		4.20 B	4.00 B	4.00 B	4.40 B	4.00 B	4.50 B
* 2.00	cadmium							
* 4.00	calcium		33100.00	33400.00	33300.00	34900.00	33000.00	46300.00
* 6.00	chromium							
* 4.00	cobalt							
* 3.00	copper			10.50 B	9.50 B	4.40 B	14.30 B	
* 13.00	iron		775.00	553.00	662.00	1180.00	45.50 B	2100.00
* 1.00	lead (anal. by GFAA)			1.30	1.60	1.20		
* 11.00	magnesium		11600.00	12400.00	12300.00	16700.00	11500.00	17700.00
* 1.00	manganese		116.00	251.00	252.00	178.00		305.00
* 0.20	mercury							
* 4.00	nickel					6.40 B		
* 68.00	potassium		2340.00	10500.00	10300.00	6010.00	2320.00	2740.00
* 2.00	selenium							
* 2.00	silver							
* 10.00	sodium		78700.00	176000.00	175000.00	79900.00	79100.00	83800.00
* 1.00	thallium							
* 3.00	vanadium							4.00
* 2.00	zinc		16.80 B	28.50 B	28.80 B	25.60 B	9.00 B	12.20 B
* 1.50	cyanide			61.50	69.50	25.50		

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

ORIGINAL (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC53	CBC54	CBC55	CBC56	CBC57
	SAMPLE ID:	PW-3	PW-4	PW-6	SW-00	S-17
	LOCATION:	WVAWC MON #1 POTABLE PRETREATMENT CLR/NO ODR	WVAWC EFLUNT POTABLE PLNT EFFLUNT CLR/NO ODOR	WVAWC WIP#4 POTABLE PRETREATMENT CLDY/NO ODOR	BLANK	OFF-SITE BKG ACCESSABLE VEGETATION LT TAN SAND
	PH:	6.1	7.8	7.1	7.3	4.4
	FIELD MEASUREMENTS:	650 UMHOS/CM	795 UMHOS/CM	812 UMHOS/CM	11 UMHOS/CM	NO HNU > BKG
	PERCENT SOLIDS:					94.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	1.1

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC53 ug/l	CBC54 ug/l	CBC55 ug/l	CBC56 ug/l	CBC57 ug/kg
5.00	methylene chloride	1.00 B				4.00 B
10.00	acetone		4.00 B			
5.00	chloroform		4.00 J			
10.00	2-butanone					
5.00	bromodichloromethane		4.00 J			
5.00	dibromochloromethane		4.00 J			
10.00	4-methyl-2-pentanone					
5.00	toluene					
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	35.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC53 ug/l	CBC54 ug/l	CBC55 ug/l	CBC56 ug/l	CBC57 ug/kg
10.00	1,4-dichlorobenzene					
10.00	4-methylphenol					
50.00	benzoic acid					
10.00	1,2,4-trichlorobenzene					
10.00	naphthalene					42.00 J
10.00	4-chloroaniline					
10.00	2-methylnaphthalene					84.00 J
10.00	acenaphthylene					
10.00	acenaphthene					
10.00	dibenzofuran					
10.00	diethyl phthalate					
10.00	fluorene					
10.00	phenanthrene					240.00 J
10.00	anthracene					
10.00	di-n-butyl phthalate					
10.00	fluoranthene					150.00 J
10.00	pyrene					120.00 J
10.00	butylbenzyl phthalate					
10.00	benzo(a)anthracene					
10.00	chrysene					160.00 J
10.00	bis(2-ethylhexyl) phthalate					
10.00	benzo(b)fluoranthene					150.00 J
10.00	benzo(k)fluoranthene					
10.00	benzo(a)pyrene					
10.00	indeno(1,2,3-cd)pyrene					38.00 J
10.00	dibenz(a,h)anthracene					
10.00	benzo(g,h,i)perylene					45.00 J
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	850.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CBC53 ug/l	CBC54 ug/l	CBC55 ug/l	CBC56 ug/l	CBC57 ug/kg
	Comments:	**********	**********	**********	**********	**********

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:II Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	MCCT55	MCCT56	MCCT57	MCCT58
	SAMPLE ID:	PW-4	PW-6	SW-00	S-17
	LOCATION:	WVAWC EFLUNT POTABLE PLNT EFFLUNT CLR/NO ODOR	WVAWC WIPL#4 POTABLE PRETREATMENT CLDY/NO ODOR	BLANK	OFF-SITE BKG ACCESSABLE VEGETATION LT.TAN SAND
	PH:	7.8	7.1	7.3	4.4
	FIELD MEASUREMENTS:	795 UMHOS/CM	812 UMHOS/CM	11 UMHOS/CM	NO HNU > BKG
	PERCENT SOLIDS:				94.0%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	1.000	1.000	1.000	0.220
	: ICP	1.000	1.000	1.000	0.220
	: Hg	1.000	1.000	1.000	0.550
	: CN	1.000	1.000	1.000	0.055

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER: UNITS:	MCCT55 ug/l	MCCT56 ug/l	MCCT57 ug/l	MCCT58 mg/kg
*	5.00	aluminum	21.30 B	64.00 B		4420.00
*	10.00	antimony		19.40 B		6.60 B
*	2.00	arsenic		3.00		12.10
*	1.00	barium	58.70	111.00		55.80
*	1.00	beryllium	4.40 B	4.70 B	4.20	0.70 B
*	2.00	cadmium				
*	4.00	calcium	29400.00	22300.00	120.00	269.00
*	6.00	chromium				9.10 B
*	4.00	cobalt		4.30		8.90 J
*	3.00	copper		3.60 B		25.70
*	13.00	iron		20800.00	40.60	17000.00
*	1.00	lead (anal. by GFAA)		1.40		52.00
*	11.00	magnesium	13500.00	7930.00		916.00
*	1.00	manganese	1.30	127.00		236.00
*	0.20	mercury				0.19
*	4.00	nickel				13.40 J
*	68.00	potassium	2870.00	2750.00		1110.00 J
*	2.00	selenium				1.10 J
*	2.00	silver				
*	10.00	sodium	169000.00	180000.00	102.00	64.80 B
*	1.00	thallium				0.22
*	3.00	vanadium				11.60 J
*	2.00	zinc	8.60 B	14.30 B	7.50	29.30 J
*	1.50	cyanide		9.50		

ORIGIN (Red)

SITE NAME: Arbuckle Creek Area
TDD NUMBER: F3-9007-01
LAB NAMES: Organic:IT Cerritos ; Inorganic: ITPA

SAMPLING DATE(s): July 10, 1990
CASE NUMBER:14462

STATE/COUNTY CODE: 54/19
EPA NUMBER: WV-418

	SAMPLE NUMBER:	CBC53	CBC54	CBC55	CBC56	CBC57
	SAMPLE ID:	PW-3	PW-4	PW-6	SW-00	S-17
	LOCATION:	WVAWC MON #1 POTABLE PRETREATMENT CLR/NO ODR	WVAWC EFLUNT POTABLE PLNT EFFLUNT CLR/NO ODOR	WVAWC WIP#4 POTABLE PRETREATMENT CLDY/NO ODOR	BLANK	OFF-SITE BKG ACCESSABLE VEGETATION LT TAN SAND
	PH:	6.1	7.8	7.1	7.3	4.4
	FIELD MEASUREMENTS:	650 UMHOS/CM	795 UMHOS/CM	812 UMHOS/CM	11 UMHOS/CM	NO HNU > BKG
	PERCENT SOLIDS:					94.0%
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1.0	850.0

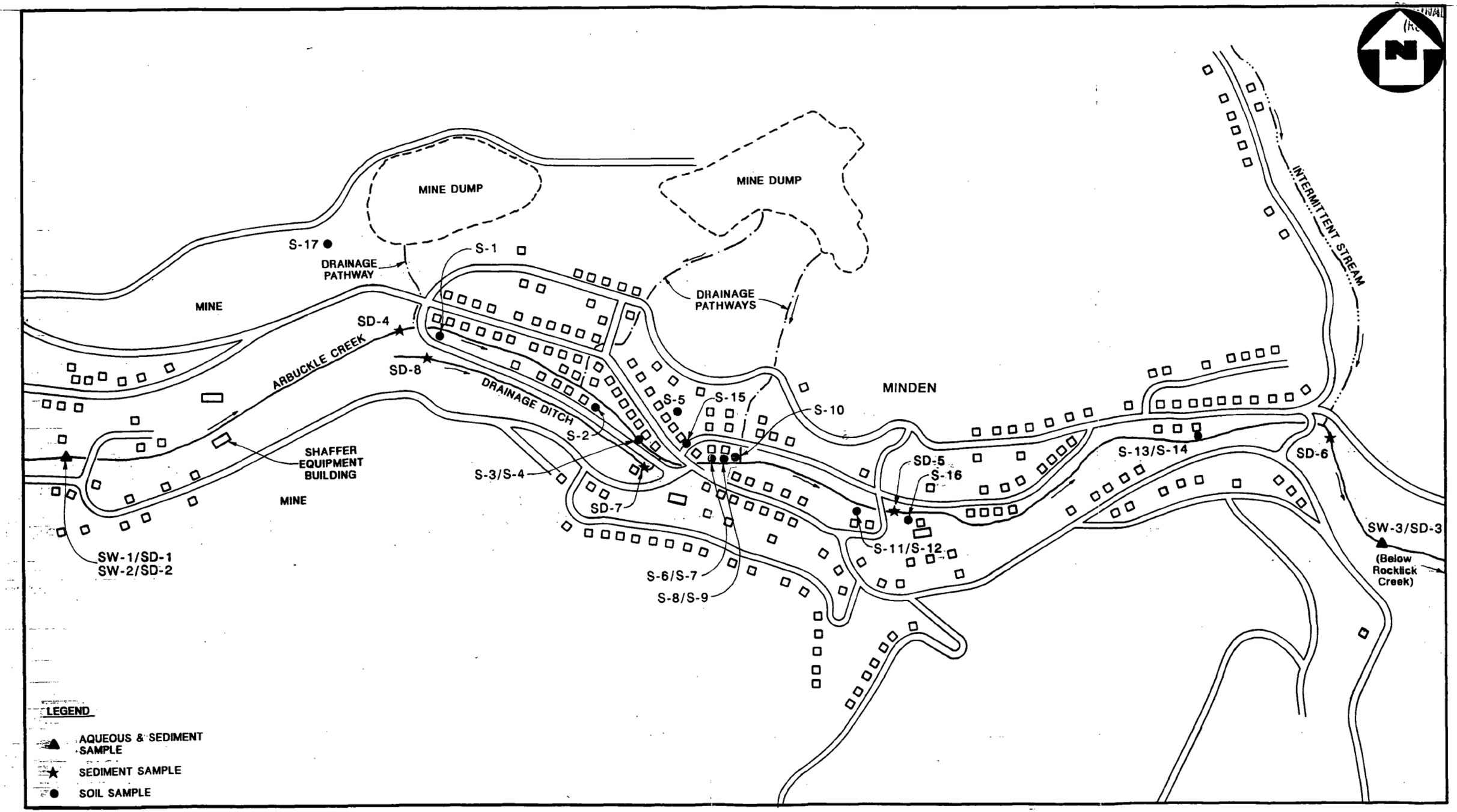
DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER:	CBC53	CBC54	CBC55	CBC56	CBC57
	UNITS:	ug/l	ug/l	ug/l	ug/l	ug/kg
0.05	gamma-BHC (lindane)					
0.10	4,4'-DDE					
0.10	4,4'-DDD					
0.10	4,4'-DDT					
1.00	aroclor-1260					

Comments: **********

@=result reported from re-analysis C= result confirmed by GC/MS

AC

ORIGINAL (red)



SAMPLE LOCATION MAP
ARBUCKLE CREEK AREA STUDY, MINDEN, WV
(NO SCALE)

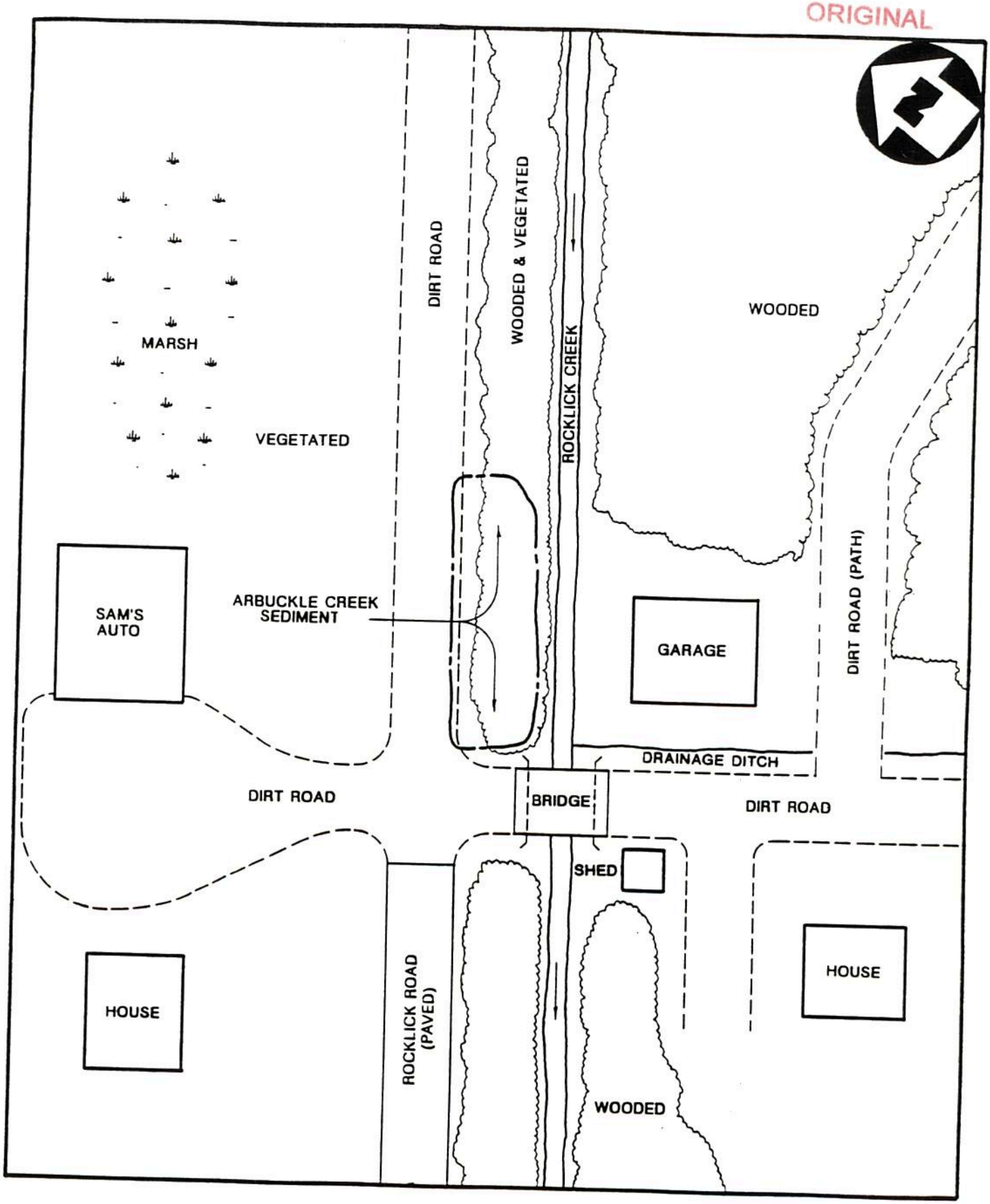
FIGURE 5.1

NUS CORPORATION

APPENDIX E

DATA AND FIGURES – ROCKLICK ROAD

ORIGINAL



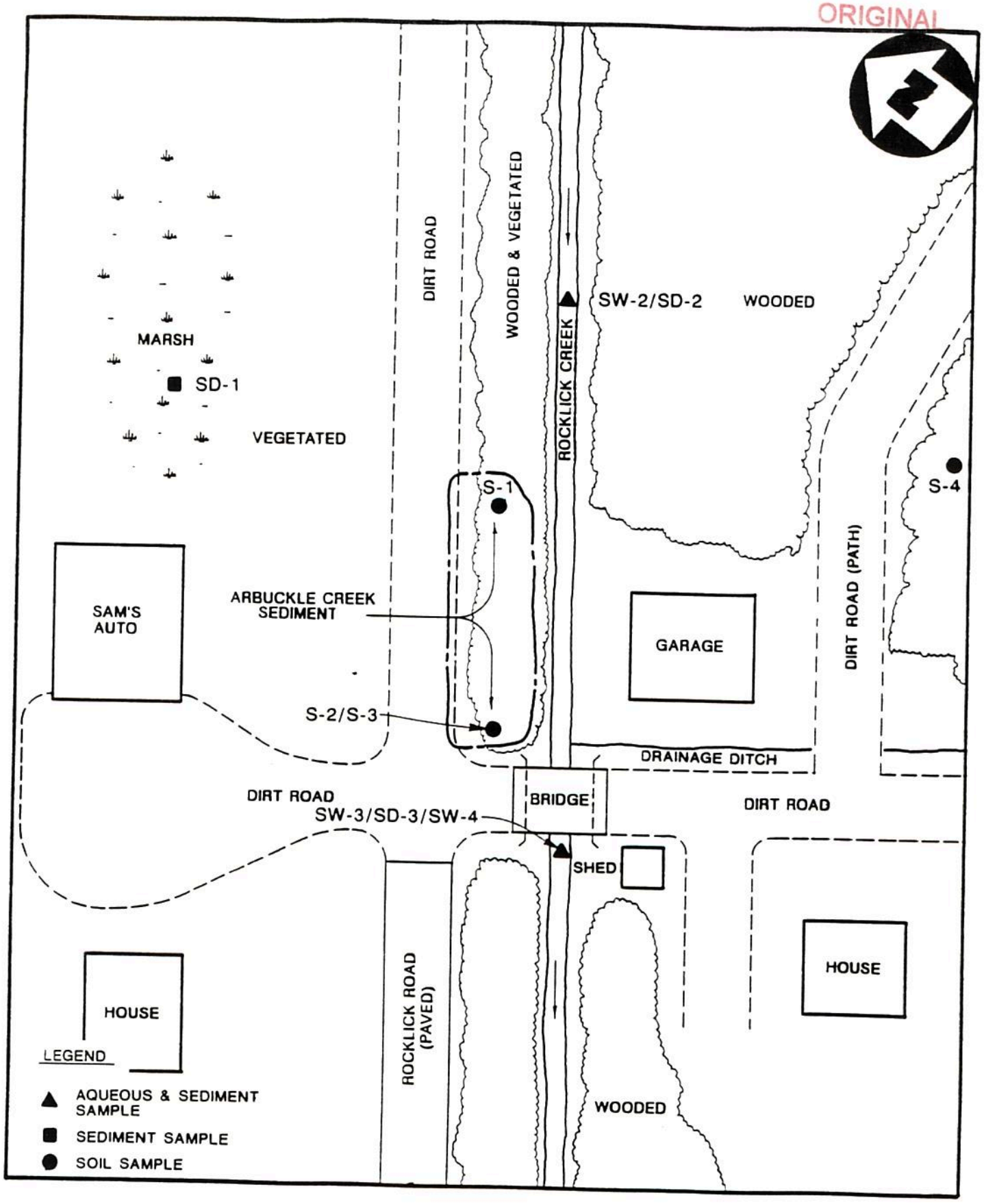
SITE SKETCH
ROCKLICK ROAD

(NO SCALE)

FIGURE 2.2

NUS CORPORATION

ORIGINAL



SAMPLE LOCATION MAP
ROCKLICK ROAD
(NO SCALE)

FIGURE 5.1

NUS CORPORATION

SITE NAME: ROCKLICK ROAD
TDD NUMBER: F3-9007-06
LAB NAMES: LANGSTON(ORGANIC); NET ALLIED(INORGANIC)

SELECTED SAMPLE ORDER
SAMPLING DATE(s): JULY 9, 1990
CASE NUMBER:14461
STATE/COUNTY CODE: 54/019
EPA NUMBER: WV-423

	SAMPLE NUMBER:	CCR15	CCR13	CCR14	CDY53	CDY54	CDY55
	SAMPLE ID:	SW-2	SW-3	SW-4	SD-1	SD-2	SD-3
	LOCATION:	ROCKLICK CRK UPSTREAM ALL REC CLEAR	ROCKLICK CRK DOWNSTREAM ALL REC CLEAR	SAME AS SW-3 DUP SW-3	MARSHY AREA ON-SITE NO AQ. SAMPL DRK BRN SAND	ROCKLICK CRK UPSTREAM MATCHES SW-2 BLACK SANDY	ROCKLICK CRK DOWNSTREAM MATCHES SW-3 BROWN SANDY
	PH:				5.2	7.7	7.3
	FIELD MEASUREMENTS:						
	PERCENT SOLIDS:				18.0%	67.0%	69.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	5.6	1.5	1.4

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CCR15	CCR13	CCR14	CDY53	CDY54	CDY55
	UNITS:	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg
5.00	methylene chloride				63.00 B	29.00 B	18.00 B
10.00	acetone				150.00 B	38.00 B	29.00 B
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	360.0	95.0	94.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CCR15	CCR13	CCR14	CDY53	CDY54	CDY55
	UNITS:	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg
10.00	phenanthrene					510.00 J	
10.00	fluoranthene						620.00 J
10.00	pyrene						119.00 J
10.00	chrysene						500.00 J
10.00	bis(2-ethylhexyl) phthalate				2600.00 B		1600.00 B
10.00	benzo(b)fluoranthene						660.00 J
10.00	benzo(a)pyrene						
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.0	1500.0	390.0	400.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER:	CCR15	CCR13	CCR14	CDY53	CDY54	CDY55
	UNITS:	ug/l	ug/l	ug/l	ug/kg	ug/kg	ug/kg
	Comments:	**********	**********	**********	**********	**********	**********

ORIGINAL

SITE NAME: ROCKLICK ROAD
TDD NUMBER: F3-9007 06
LAB NAMES: LANGSTON(ORGANIC); NET ALLIED(INORGANIC)

SELECTED SAMPLE ORDER
SAMPLING DATE(S): JULY 9, 1990 STATE/COUNTY CODE: 54/019
CASE NUMBER:14461 EPA NUMBER: WV-423

	SAMPLE NUMBER:	CDY56	CDY57	CDY58	CDY59	CDY47	CDY46
	SAMPLE ID:	S-1	S-2	S-3	S-4	AQUEOUS	SOLID
	LOCATION:	ON-SITE ROAD,ACCESS NO VEG. BROWN SILTY	ON-SITE ROAD, ACCESS NO VEG. BROWN SILTY	SAME AS S-2 DUP S-2	OFF-SITE BKG FOREST ACCS. HEAVY VEG. DRK BRN SILT	BLANK	TRIP BLANK VOA ONLY
	PH:	8.1	8.0	8.2	5.6		
	FIELD MEASUREMENTS:						
	PERCENT SOLIDS:	91.0%	91.0%	92.0%	75.0%		
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.1	1.1	1.1	1.3	1.0	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CDY56 ug/kg	CDY57 ug/kg	CDY58 ug/kg	CDY59 ug/kg	CDY47 ug/l	CDY46 ug/l
5.00	methylene chloride	14.00 B	16.00 B	16.00 B	17.00 B		
10.00	acetone	11.00 B	13.00 B	11.00 B	11.00 B		
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	71.0	72.0	71.0	88.0	1.0	0.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CDY56 ug/kg	CDY57 ug/kg	CDY58 ug/kg	CDY59 ug/kg	CDY47 ug/l	CDY46 N/A
10.00	phenanthrene	560.00 J	410.00 J	360.00 J			
10.00	fluoranthene	430.00 J	370.00 J				
10.00	pyrene	500.00 J	440.00 J	380.00 J			
10.00	chrysene						
10.00	bis(2-ethylhexyl) phthalate						
10.00	benzo(b)fluoranthene						
10.00	benzo(a)pyrene	470.00 J					
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	310.0	350.0	350.0	420.0	1.0	0.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CDY56 ug/kg	CDY57 ug/kg	CDY58 ug/kg	CDY59 ug/kg	CDY47 ug/l	CDY46 N/A
	Comments: **********	**********	**********	**********	**********	**********	**********

ORIGINAL

SITE NAME: ROCKLICK ROAD
TDD NUMBER: F3-9007-06
LAB NAMES: LANGSTON(ORGANIC); NET ALLIED(INORGANIC)

SELECTED SAMPLE ORDER
SAMPLING DATE(s): JULY 9, 1990 STATE/COUNTY CODE: 54/019
CASE NUMBER:14461 EPA NUMBER: WV-423

	SAMPLE NUMBER:	MCDX52	MCDX50	MCDX51	MCDX53	MCDX54	MCDX55
	SAMPLE ID:	SW-2	SW-3	SW-4	SD 1	SD-2	SD-3
	LOCATION:	ROCKLICK CRK UPSTREAM ALL REC. CLEAR	ROCKLICK CRK DOWNSTREAM ALL REC. CLEAR	SAME AS SW-3 DUP SW-3	MARSHY AREA ON SITE NO AQ. SAMPL DRK BRN SAND	ROCKLICK CRK UPSTREAM MATCHES SW-2 BLACK SANDY	ROCKLICK CRK DOWNSTREAM MATCHES SW-3 BROWN SANDY
	PH:				5.2	7.7	7.3
	FIELD MEASUREMENTS:						
	PERCENT SOLIDS:				19.6%	57.6%	73.5%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	1.000	1.000	1.000	0.200	0.344	0.272
	: ICP	1.000	1.000	1.000	0.200	0.347	0.272
	: Hg	1.000	1.000	1.000	2.551	0.868	0.680
	: CN	1.000	1.000	1.000	0.259	0.223	0.201

DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER:	MCDX52	MCDX50	MCDX51	MCDX53	MCDX54	MCDX55
		UNITS:	ug/l	ug/l	ug/l	mg/kg	mg/kg	mg/kg
20.00	aluminum		121.00 B	114.00 B	93.20 B	9180.00	4840.00	3530.00
8.00	arsenic					12.50	6.30	5.10
20.00	barium		45.40	51.50	51.00	229.00	81.90	225.00
1.00	beryllium					1.50 J	2.50 J	1.30 J
1487.00	calcium		37400.00	39000.00	39200.00	3550.00	1670.00	10500.00
3.00	chromium					15.90 J	10.70 J	7.00 J
9.00	cobalt					10.00	13.70	4.40
3.00	copper			4.90 B		48.20 J	23.40 J	16.60 J
46.00	iron		281.00 B	704.00	599.00	18900.00	16700.00	12000.00
3.00	lead (anal. by GFAA)					70.20 K	20.60 K	17.40 L
459.00	magnesium		19900.00	20200.00	20300.00	1550.00	1360.00	1910.00
3.00	manganese		89.20	137.00	137.00	291.00	162.00	254.00
9.00	nickel					39.80	25.10	8.50
3304.00	potassium					1560.00	1350.00	1130.00
3.00	selenium					5.10 L		
2485.00	sodium		4820.00	5110.00	4940.00			
8.00	vanadium					17.90	12.50	7.10
6.00	zinc		12.80 B	15.40 B	11.70 B	396.00 J	70.00 J	76.70 J

Comments: **********

ORIGINAL

SITE NAME: ROCKLICK ROAD
TDD NUMBER: F3-9007-06
LAB NAMES: LANGSTON(ORGANIC); NET ALLIED(INORGANIC)

SELECTED SAMPLE ORDER
SAMPLING DATE(s): JULY 9, 1990 STATE/COUNTY CODE: 54/019
CASE NUMBER:14461 EPA NUMBER: WV-423

	SAMPLE NUMBER:	MCDX56	MCDX57	MCDX58	MCDX59	MCDX60
	SAMPLE ID:	S-1	S-2	S-3	S-4	AQUEOUS
	LOCATION:	ON-SITE ROAD,ACCESS NO VEG. BROWN SILTY	ON-SITE ROAD,ACCESS NO VEG. BROWN SILTY	SAME AS S-2 DUP. S-2	OFF-SITE BKG FOREST ACCS. HEAVY VEG. DRK BRN SILT	BLANK
	PH:	8.1	8.0	8.2	5.6	
	FIELD MEASUREMENTS:					
	PERCENT SOLIDS:	73.0%	89.9%	90.7%	72.1%	
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.271	0.216	0.221	0.277	1.000
	: ICP	0.274	0.220	0.221	0.275	1.000
	: Hg	0.685	0.484	0.525	0.693	1.000
	: CN	0.314	0.251	0.251	0.271	1.000

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	MCDX56 mg/kg	MCDX57 mg/kg	MCDX58 mg/kg	MCDX59 mg/kg	MCDX60 ug/l
20.00	aluminum	8870.00	7350.00	7800.00	6690.00	44.20
8.00	arsenic	13.80	11.40	9.30	4.20	
20.00	barium	139.00	112.00	103.00	76.00	
1.00	beryllium	1.90 J				
1487.00	calcium	7940.00	11400.00	8930.00	882.00	
3.00	chromium	21.20 J	17.10 J	128.00 J	12.10 J	
9.00	cobalt	11.00	9.60	7.70	25.00	
3.00	copper	29.90 J	23.90 J	23.30 J	19.80	
46.00	iron	24300.00	22000.00	15400.00	26200.00	56.90
3.00	lead (anal. by GFAA)	31.70 K	26.00 K	24.50 K	23.90 K	
459.00	magnesium	2720.00	2950.00	2660.00	1940.00	
3.00	manganese	547.00	475.00	324.00	2280.00	
9.00	nickel	28.30	23.40	18.30	47.00	
3304.00	potassium	2910.00	2190.00	2340.00	1600.00	
3.00	selenium					
2485.00	sodium					
8.00	vanadium	17.70	15.60	14.60	13.70	
6.00	zinc	279.00 J	217.00 J	233.00 J	83.00 J	9.90

ORIGINAL

APPENDIX F

DATA AND FIGUES – N R & P SUPPLY HOUSE

ORIGINAL (Red)

GENERAL ELECTRIC CO.
LIQUID INSULATION LABORATORY
4900 KINGSTON ST.
DENVER, CO 80239
(303) 329-2323 or 329-2324

G.E. CHARLESTON SERVICE SHOP
306 MacCorkle Ave. S.E.
Charleston, WV 25314
ATTN: [redacted]

JOB #: 30327

PO #: 017-161123-2

04/05/89

The results of PCB (Polychlorinated Biphenyl) analysis of your sample(s) is as follows:

Sample ID Description	Arochlor Type	Result in PPM (mg/kg)
BERWIND LAND CO #1		NONE DET.
BERWIND LAND CO #2		NONE DET.
BERWIND LAND CO #3		NONE DET.

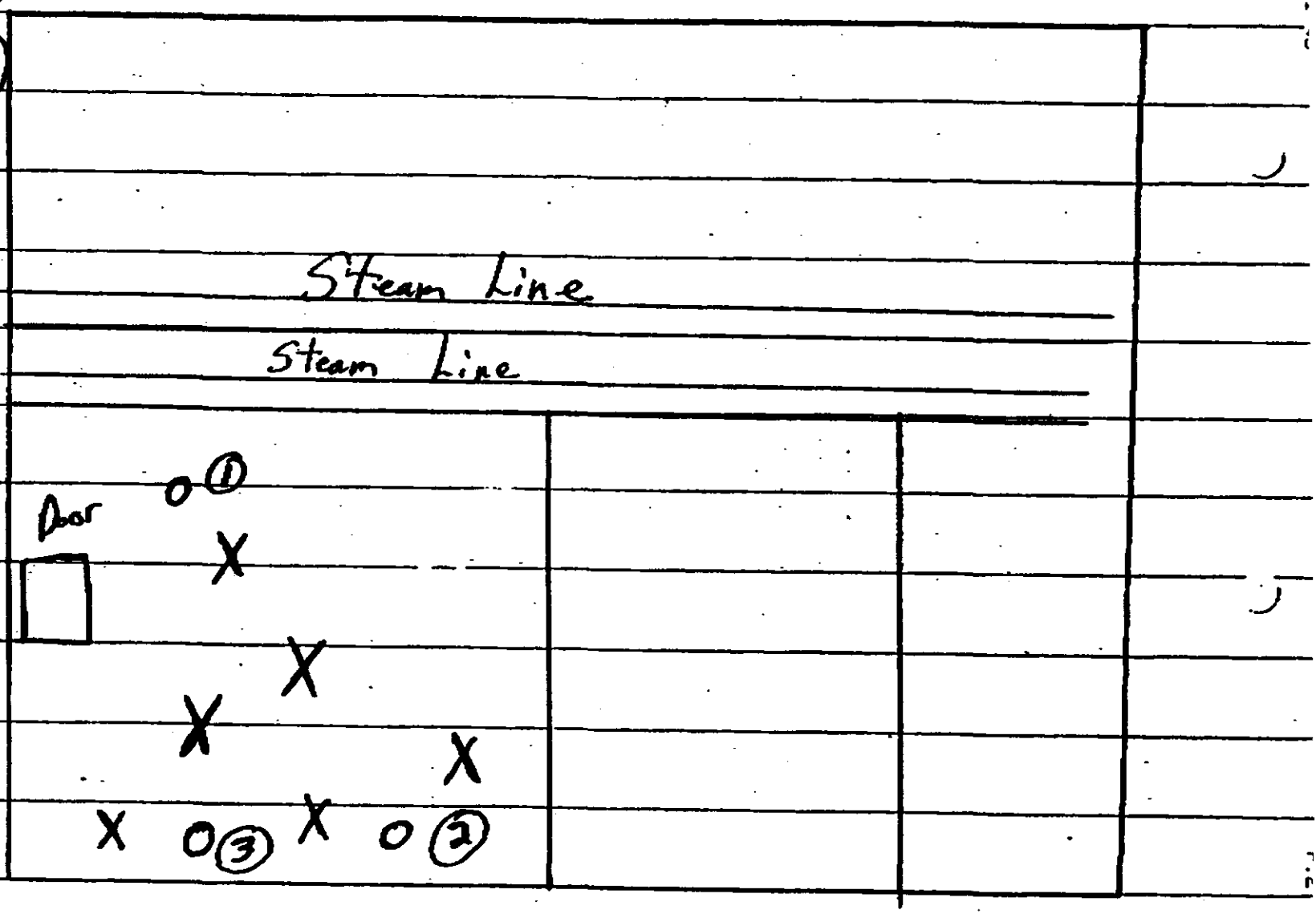
3 Samples

[redacted] Tested by

RECEIVED
APR 10 1989
GENERAL ELECTIC

X = Transformers (ORIGINAL Wired)

O = Samples (See Test Sheet)



Minden PCB's

ORIGINAL (Red)

GENERAL ELECTRIC CO.
LIQUID INSULATION LABORATORY
4900 KINGSTON ST.
DENVER, CO 80239
(303) 329-2323 or 329-2324

G.E. CHARLESTON SERVICE SHOP
306 MacCorkle Ave. S.E.
Charleston, WV 25314
ATTN: [redacted]

JOB #: 30269

PO #: 017-16123-1

03/22/89

The results of PCB (Polychlorinated Biphenyl) analysis of your sample(s) is as follows:

Sample ID Description	Arocnlor Type	Result in PPM (mg/kg)
SAMPLE #1 FRONT LEFT CORNER		NONE DET.
SAMPLE #2 FRONT RIGHT CORNER		NONE DET.
SAMPLE #3 REAR RIGHT CORNER		NONE DET.
SAMPLE #4 REAR LEFT CORNER		NONE DET.

4 Samples

Tested by [redacted]

RECEIVED
MAR 27 1989
GENERAL ELECTRIC

SITE NAME: NR & P STORE HOUSE
TDD NUMBER: F3-9007-02
LAB NAMES: ORGANIC-NET, INORGANIC-CENTRY

SAMPLING DATE(s): 7/12/90
CASE NUMBER: 14464

STATE/COUNTY CODE: WV019
EPA NUMBER: N/A

	SAMPLE NUMBER:	CCR49	CCR50	CCR51	CCR52	CCR53	CCR55
	SAMPLE ID:	SD-1	SD-2	SD-3	SD-4	SD-5	S-1
	LOCATION:	ON SITE ACC. NO USES NO VEG. BR.SILT CLAY	ON SITE ACC. NO USES NO VEG. BR. GRAVEL	ON SITE ACC. NO USES NO VEG. DK. BR. CLAY	OFF SITE ACC. NO USES NO VEG. BR. GRAVEL	OFF SITE ACC. NO USES NO VEG. LT.BR.GRAVEL	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.
	PH:	6.1	7.2	7.5	7.2	7.5	7.5
	FIELD MEASUREMENTS:	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS
	PERCENT SOLIDS:	52.0%	82.0%	75.0%	76.0%	79.0%	98.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.9	1.1	1.3	1.3	1.3	1.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CCR49 ug/kg	CCR50 ug/kg	CCR51 ug/kg	CCR52 ug/kg	CCR53 ug/kg	CCR55 ug/kg
5.00	methylene chloride	31.00 B	13.00 B	56.00 B	14.00 B	12.00 B	140.00 R
10.00	acetone	88.00 R					
5.00	toluene						
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	130.0	81.0	89.0	88.0	84.0	68.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CCR49 ug/kg	CCR50 ug/kg	CCR51 ug/kg	CCR52 ug/kg	CCR53 ug/kg	CCR55 ug/kg
10.00	naphthalene						62.00J
10.00	2-methylnaphthalene						180.00 J
10.00	dibenzofuran						51.00 J
50.00	pentachlorophenol		250.00 J				
10.00	phenanthrene	240.00 J		220.00 J			560.00 J
10.00	anthracene						44.00 J
10.00	di-n-butyl phthalate		180.00 B				110.00 B
10.00	fluoranthene			130.00 J			580.00 J
10.00	pyrene			110.00 J			580.00 J
10.00	butylbenzyl phthalate						100.00 B
10.00	benzo(a)anthracene						250.00 J
10.00	chrysene	180.00 J		210.00 J			660.00 J
10.00	bis(2-ethylhexyl) phthalate	730.00 B	990.00 B		91.00 B	120.00 B	290.00 B
10.00	di-n-octyl phthalate						20.00 B
10.00	benzo(b)fluoranthene						530.00 J
10.00	benzo(k)fluoranthene	150.00 J		110.00 J			
10.00	benzo(a)pyrene						200.00 J
10.00	indeno(1,2,3-cd)pyrene						94.00 J
10.00	benzo(g,h,i)perylene						130.00 J
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	610.0	390.0	430.0	420.0	400.0	330.0

DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: / UNITS:	CCR49 ug/kg	CCR50 ug/kg	CCR51 ug/kg	CCR52 ug/kg	CCR53 ug/kg	CCR55 ug/kg

Comments: **********

@= result reported from re-analysis

ORIGINAL (typed)

SITE NAME: NR & P STORE HOUSE
TDD NUMBER: F3-9007-02
LAB NAMES: ORGANIC-NET, INORGANIC-CENTRY

SAMPLING DATE(s): 7/12/90
CASE NUMBER: 14464

STATE/COUNTY CODE: WV019
EPA NUMBER: N/A

	SAMPLE NUMBER:	CCR56	CCR57	CCR58	CCR59	CCR60	CCR61
	SAMPLE ID:	S-2	S-3	S-4	S-5	S-6	S-7
	LOCATION:	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.	ON SITE ACC. NO USES VEG. DK.BR. ORG.	ON SITE ACC. NO USES VEG. DK.BR. ORG.	ON SITE ACC. NO USES VEG. DK.BR.ORG.	OFF SITE BKG ACC. NO USES VEG. DK. BR. ORG.
	PH:	7.3	7.7	6.9	6.7	6.7	5.7
	FIELD MEASUREMENTS:	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS
	PERCENT SOLIDS:	98.0%	96.0%	76.0%	61.0%	61.0%	91.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.0	1.0	1.3	1.7	1.7	1.1
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CCR56 ug/kg	CCR57 ug/kg	CCR58 ug/kg	CCR59 ug/kg	CCR60 ug/kg	CCR61 ug/kg
5.00	methylene chloride	56.00 R	18.00@B	12.00 B	13.00 B	21.00 B	330.00 J
10.00	acetone						
5.00	toluene						21.00 J
TYPE OF DATA: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	68.0	69.0	87.0	78.0	110.0	110.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CCR56 ug/kg	CCR57 ug/kg	CCR58 ug/kg	CCR59 ug/kg	CCR60 ug/kg	CCR61 ug/kg
10.00	naphthalene				90.00J		
10.00	*2-methylnaphthalene*	*180.00 J*	*110.00 J*	*88.00 J*	*230.00 J*	*160.00J@*	
10.00	dibenzofuran				79.00 J		
50.00	pentachlorophenol						
10.00	phenanthrene	670.00 J	850.00	200.00 J	750.00 J	410.00J@	200.00 J
10.00	anthracene		110.00 J				190.00 J
10.00	di-n-butyl phthalate		130.00 B	160.00 B	120.00 B	@	
10.00	fluoranthene	710.00	1200.00	160.00 J	640.00 J	270.00 J	
10.00	pyrene	710.00	1100.00	160.00 J	610.00 J	320.00 J	
10.00	butylbenzyl phthalate						
10.00	benzo(a)anthracene	290.00 J	460.00 J	160.00 J	290.00 J	140.00 J	
10.00	chrysene	670.00 J	870.00	220.00 J	730.00 J	370.00J@	210.00 J
10.00	bis(2-ethylhexyl) phthalate	270.00 B	240.00 B	300.00 B	440.00 B	310.00 B	
10.00	di-n-octyl phthalate						
10.00	benzo(b)fluoranthene	260.00 J	490.00 J	190.00 J	490.00 J	170.00 J	
10.00	benzo(k)fluoranthene		J	260.00 J	190.00 J	170.00J@	
10.00	benzo(a)pyrene	230.00 J	400.00 J		220.00 J		
10.00	indeno(1,2,3-cd)pyrene	100.00 J	160.00 J				
10.00	benzo(g,h,i)perylene	120.00 J	170.00 J				
TYPE OF DATA: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	330.0	330.0	420.0	370.0	520.0	350.0
DET. LIMIT CRQL (@=IDL)	SAMPLE NUMBER: UNITS:	CCR56 ug/kg	CCR57 ug/kg	CCR58 ug/kg	CCR59 ug/kg	CCR60 ug/kg	CCR61 ug/kg

Comments: **********

@= result reported from re-analysis

ORIGINAL (Red)

SITE NAME: NR & P STORE HOUSE
TDD NUMBER: F3-9007-02
LAB NAMES: ORGANIC-NET, INORGANIC-CENTRY

SAMPLING DATE(s): 7/12/90
CASE NUMBER:14464

STATE/COUNTY CODE: WV019
EPA NUMBER: N/A

	SAMPLE NUMBER:	CCR62
	SAMPLE ID:	S-0 TRIP BLK
	LOCATION:	BLANK
		FOR SOLIDS
		VOA
	PH:	
	FIELD MEASUREMENTS:	N/A
	PERCENT SOLIDS:	
TYPE OF DATA: ******	VOLATILES	**********
	DILUTION FACTOR:	1.0

DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	CCR62 ug/l
5.00	methylene chloride		4.00 J
10.00	acetone		
5.00	toluene		
TYPE OF DATA: ******	SEMIVOLATILES		**********
	DILUTION FACTOR:		0.0
DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	CCR62 n/a
10.00	naphthalene		
10.00	2-methylnaphthalene		
10.00	dibenzofuran		
50.00	pentachlorophenol		
10.00	phenanthrene		
10.00	anthracene		
10.00	di-n-butyl phthalate		
10.00	fluoranthene		
10.00	pyrene		
10.00	butylbenzyl phthalate		
10.00	benzo(a)anthracene		
10.00	chrysene		
10.00	bis(2-ethylhexyl) phthalate		
10.00	di-n-octyl phthalate		
10.00	benzo(b)fluoranthene		
10.00	benzo(k)fluoranthene		
10.00	benzo(a)pyrene		
10.00	indeno(1,2,3-cd)pyrene		
10.00	benzo(g,h,i)perylene		
TYPE OF DATA: ******	PESTICIDES		**********
	DILUTION FACTOR:		0.0
DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	CCR62 n/a

ORIGINAL (Red)

SITE NAME: NR & P STORE HOUSE
TDD NUMBER: F3-9007-02
LAB NAMES: ORGANIC-NET, INORGANIC-CENTRY

SAMPLING DATE(s): 7/12/90
CASE NUMBER: 14464

STATE/COUNTY CODE: WV019
EPA NUMBER: N/A

	SAMPLE NUMBER:	MCCH19	MCCH20	MCCH21	MCCH22	MCCH23	MCCH25
	SAMPLE ID:	SD-1	SD-2	SD-3	SD-4	SD-5	S-1
	LOCATION:	ON SITE ACC. NO USES NO VEG. BR.SILT CLAY	ON SITE ACC. NO USES NO VEG. BR. GRAVEL	ON SITE ACC. NO USES NO VEG. DK.BR. CLAY	OFF SITE ACC. NO USES NO VEG. BR. GRAVEL	OFF SITE ACC. NO USES NO VEG. LT.BR.GRAVEL	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.
	PH:	6.1	7.2	7.5	7.2	7.5	7.5
	FIELD MEASUREMENTS:	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS
	PERCENT SOLIDS:	52.4%	82.1%	72.0%	81.1%	81.7%	98.2%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.382	0.244	0.278	0.247	0.245	0.204
	: ICP	0.382	0.244	0.278	0.247	0.245	0.204
	: Hg	0.954	0.610	0.694	0.616	0.612	0.509
	: CN	0.090	0.061	0.070	0.062	0.061	0.051

DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	MCCH19 mg/kg	MCCH20 mg/kg	MCCH21 mg/kg	MCCH22 mg/kg	MCCH23 mg/kg	MCCH25 mg/kg
12.00	aluminum		7800.00	6340.00	8500.00	2600.00	2900.00	11800.00
11.00	antimony							2.90
5.00	arsenic		11.10	6.20	13.60	4.10	3.60	19.20
3.00	barium		84.00	65.00	123.00	32.60	39.20	189.00
3.00	beryllium		1.50	0.73	0.83	0.99	0.73	1.80
2.00	cadmium							0.81
20.00	calcium		1380.00	2010.00	5060.00	413.00	641.00	2930.00
3.00	chromium		9.50	7.80	14.70	9.60	8.30	20.40
3.00	cobalt		11.50	6.10	5.30	4.90	2.90	25.50
3.00	copper		31.70 J	13.20 J	35.80 J	8.60 J	14.90 J	46.40 J
25.00	iron		19500.00	15400.00	21600.00	24700.00	23200.00	29800.00
2.00	lead (anal. by GFAA)		44.00	14.10	38.30	31.40 J	35.70	108.00
24.00	magnesium		1590.00 J	1350.00 J	2260.00 J	402.00 J	599.00 J	3020.00 J
3.00	manganese		434.00	284.00	363.00	368.00	301.00	1240.00
0.20	mercury							0.20
4.00	nickel		19.50 J	10.70 J	13.90 J	29.80 J	22.50 J	54.20 J
58.00	potassium		1740.00	1550.00	2170.00	524.00	620.00	2640.00
2.00	selenium		1.10 B		0.56 B			
3.00	silver							
66.00	sodium		167.00	166.00	228.00	51.00	56.10	224.00
3.00	vanadium		9.90	7.80	14.20	5.40	7.30	19.60
3.00	zinc		54.60 J	36.10 J	70.00 J	93.70 J	93.30 J	217.00 J

Comments: **********

@= result reported from re-analysis

ORIGINAL (Red)

SITE NAME: NR & P STORE HOUSE
TDD NUMBER: F3-9007-02
LAB NAMES: ORGANIC-NET, INORGANIC CENTRY

SAMPLING DATE(s): 7/12/90
CASE NUMBER: 14464

STATE/COUNTY CODE: WV019
EPA NUMBER: N/A

	SAMPLE NUMBER:	MCCH26	MCCH27	MCCH28	MCCH29	MCCH30	MCCH31
	SAMPLE ID:	S-2	S-3	S-4	S-5	S-6	S-7
	LOCATION:	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.	ON SITE ACC. NO USES SOME VEG. BR.FINE SED.	ON SITE ACC. NO USES VEG. DK.BR. ORG.	ON SITE ACC. NO USES VEG. DK.BR. ORG.	ON SITE ACC. NO USES VEG. DK.BR.ORG.	OFF SITE BKG ACC. NO USES VEG. DK. BR. ORG.
	PH:	7.3	7.7	6.9	6.7	6.7	5.7
	FIELD MEASUREMENTS:	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS	HNU NO RDNGS
	PERCENT SOLIDS:	94.4%	96.7%	80.2%	83.7%	50.9%	92.3%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.212	0.207	0.249	0.239	0.393	0.217
	: ICP	0.212	0.207	0.249	0.239	0.393	0.217
	: Hg	0.530	0.517	0.423	0.600	0.982	0.600
	: CN	0.053	0.052	0.062	0.060	0.098	0.054

DET. LIMIT CRQL (@=IDL)		SAMPLE NUMBER: UNITS:	MCCH26 mg/kg	MCCH27 mg/kg	MCCH28 mg/kg	MCCH29 mg/kg	MCCH30 mg/kg	MCCH31 mg/kg
12.00	aluminum		12800.00	8680.00	9020.00	12200.00	14800.00	5840.00
11.00	antimony				5.70			2.60
5.00	arsenic		16.30	18.30	13.70	17.20	16.90	9.80
3.00	barium		200.00	162.00	292.00	201.00	217.00	83.90
3.00	beryllium		2.10	1.40	1.50	1.90	3.90	1.30
2.00	cadmium		0.42	0.62	1.50	1.20		
20.00	calcium		5760.00	3260.00	3360.00	16100.00	14400.00	932.00
3.00	chromium		21.20	16.30	18.00	21.50	18.90	10.80
3.00	cobalt		26.10	16.10	11.00	23.70	71.50	8.20
3.00	copper		48.10 J	45.50 J	789.00 J	48.30 J	49.50 J	28.80 J
25.00	iron		30800.00	23600.00	27600.00	30600.00	25300.00	23300.00
2.00	lead (anal. by GFAA)		108.00	134.00	898.00	177.00	90.40	56.80
24.00	magnesium		3410.00 J	2450.00 J	3880.00 J	3400.00 J	5260.00 J	2770.00 J
3.00	manganese		1190.00	754.00	424.00	991.00	3040.00	414.00
0.20	mercury		0.11	0.12	0.19			0.14
4.00	nickel		56.80 J	33.70 J	34.20 J	55.90 J	137.00 J	17.10 J
58.00	potassium		2850.00	2020.00	1820.00	2630.00	3300.00	1200.00
2.00	selenium							
3.00	silver				0.75			
66.00	sodium		248.00	183.00	71.60	191.00	1060.00	65.00
3.00	vanadium		20.30	15.10	14.20	20.10	18.10	27.30
3.00	zinc		215.00 J	263.00 J	1130.00 J	361.00 J	314.00 J	62.40 J

Comments: **********

@= result reported from re-analysis

ORIGINAL (Red)

Table 1, Surface Soil Laboratory Analytical Summary

NR & P Supply House

Minden, Fayette County, West Virginia

COPC	Units	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	Industrial Soil RBC *
Aluminum	mg/kg	11,800.00	12,800.00	8,680.00	9,020.00	12,200.00	14,800.00	5,840.00	NA
Antimony	mg/kg	2.90	ND	ND	5.70	ND	ND	2.60	410
Arsenic	mg/kg	**19.20**	**16.30**	**18.30**	**13.70**	**17.20**	**16.90**	9.80	**13** [1]
Barium	mg/kg	189.00	200.00	162.00	292.00	201.00	217.00	83.90	200,000
Beryllium	mg/kg	1.80	2.10	1.40	1.50	1.90	3.90	1.30	2,000
Cadmium	mg/kg	0.81	0.42	0.62	1.50	1.20	ND	N	1,000
Calcium	mg/kg	2,930.00	5,760.00	3,260.00	3,360.00	16,100.00	14,400.00	932.00	NA
Chromium	mg/kg	20.40	21.20	16.30	18.00	21.50	18.90	10.80	1,500,000
Cobalt	mg/kg	25.50	26.10	16.10	11.00	23.70	71.50	8.20	NA
Copper	mg/kg	46.4 J	48.10	45.50 J	789.00 J	48.30 J	49.50 J	28.80 J	41,000
Iron	mg/kg	29,800.00	30800.00 J	23,600.00	27,600.00	30,600.00	25,300.00	23,300.00	310,000
Lead	mg/kg	108.00	108.00	134.00	898.00	177.00	90.40	56.80	1,000
Magnesium	mg/kg	3020.00 J	3410.00 J	2450.00 J	3880.00 J	3400.00 J	5260.00 J	2770.00 J	NA
Manganese	mg/kg	1,240.00	1,190.00	754.00	424.00	991.00	3,040.00	414.00	20,000
Mercury	mg/kg	0.20	0.11	0.12	0.19	ND	ND	0.14	0.44 [2]
Nickel	mg/kg	54.20 J	56.80 J	33.70	34.20 J	55.90 J	137.00 J	17.10 J	20,000
Potassium	mg/kg	2,640.00	2,850.00	2,020.00	1,820.00	2,630.00	3,300.00	1,200.00	NA
Silver	mg/kg	ND	ND	ND	0.75	ND	ND	ND	5,100
Sodium	mg/kg	224.00	248.00	183.00	71.60	191.00	1,060.00	65.00	NA
Vanadium	mg/kg	19.60	20.30	15.10	14.20	20.10	18.10	27.30	1,000
Zinc	mg/kg	217.00 J	215.00	263.00	1130.00 J	361.00 J	314.00 J	62.40 J	310,000
Naphthalene	ug/kg	62.00 J	ND	ND	ND	90.00 J	ND	ND	20,000,000
2-Methylnaphthalene	ug/kg	180.00 J	180.00 J	110.00 J	88.00 J	230.00 J	160.00 J	ND	4,100,000
Dibenzofuran	ug/kg	51.00 J	ND	ND	ND	79.00 J	ND	ND	NA
Phenanthrene	ug/kg	560.00 J	670.00 J	850	200.00 J	750.00 J	410.00 J	200.00 J	310,000,000 [3]
Anthracene	ug/kg	44.00 J	ND	110.00 J	ND	ND	ND	190.00 J	310,000,000
Di-n-butyl phthalate	ug/kg	110.00 B	ND	130.00 B	160.00 B	120.00 B	ND	ND	NA
Fluoranthene	ug/kg	580.00 J	710	1200	160.00 J	640.00 J	270.00 J	ND	41,000,000
Pyrene	ug/kg	580.00 J	710	1100	160.00 j	610.00 J	320.00 J	ND	31,000,000
Butylbenzyl phthalate	ug/kg	100.00 B	ND	ND	ND	ND	ND	ND	NA
Benzo (a) anthracene	ug/kg	250.00 J	290.00 J	460.00 J	160.00 J	290.00 J	140.00 J	ND	3,900

ORIGINAL

Table 1, Surface Soil Laboratory Analytical Summary (continued)
NR & P Supply House
Minden, Fayette County, West Virginia

COPC	Units	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	Industrial Soil RBC *
Chrysene	ug/kg	660.00 J	670.00 J	870	220.00 J	730.00 J	370.00 J	210.00 J	390,000
Bis (2-ethylhexyl) phthalate	ug/kg	290.00 B	270.00 B	240.00 B	300.00 B	440.00 B	310.00 B	ND	NA
Di-n-octyl phthalate	ug/kg	20.00 B	ND	ND	ND	ND	ND	ND	NA
Benzo(b) fluoranthene	ug/kg	530.00 J	260.00 J	490.00 J	190.00 J	490.00 J	170.00 J	ND	3,900
Benzo (k) fluoranthene	ug/kg	ND	ND	ND	260.00 J	190.00 J	170.00 J	ND	39,000
Benzo (a) pyrene	ug/kg	200.00 J	230.00 J	**400.00 J**	ND	220.00 J	ND	ND	**390**
Indeno (1,2,3-cd) pyrene	ug/kg	94.00 J	100.00 J	160.00 J	ND	ND	ND	ND	NA
Benzo (g,h,i) perylene	ug/kg	130.00 J	120.00 J	170.00 J	ND	ND	ND	ND	31,000,000 [4]
Methylene chloride	ug/kg	140.00 R	56.00 R	18.00 B	12.00 B	13.00 B	21.00 B	330.00 J	NA
Toluene	ug/kg	ND	ND	ND	ND	ND	ND	21.00 J	82,000,000

NOTES:

All samples were analyzed for base-neutral acids (BNAs), pesticides, PCBs, total metals, and cyanide; however, this summary table contains only compounds that were detected in at least one sample.

* USEPA Region III Risk Based Concentrations, April 2006.

[1] Natural background for Arsenic in soils in West Virginia range from 5.9 mg/kg to 13 mg/kg.

[2] Natural background for Mercury in soils in West Virginia range from 0.02 mg/kg to 0.44 mg/kg.

[3] No RBC benchmark is available for phenanthrene; therefore, anthracene was used as a surrogate.

[4] No RBC benchmark is available for benzo (g,h,i) perylene; therefore, pyrene was used as a surrogate.

J Analyte present. Reported value may not be accurate or precise.

B Not detected substantially above the level reported in laboratory or field blanks.

R Unreliable result. Analyte may or may not be present in the sample.

ND Not detected at concentrations above the CRQL.

CRQL Contract Required Quanitation Limit.

NA Benchmark not available

ORIGINAL

ORIGINAL

Table 2, Surface Water Sediment Laboratory Analytical Summary

NR & P Supply House

Minden, Fayette County, West Virginia

COPC	Units	SD-1	SD-2	SD-3	SD-4	SD-5	benchmark *
Aluminum	mg/kg	7,800.00	6,340.00	8,500.00	2,600.00	2,900.00	NA
Arsenic	mg/kg	**11.10**	6.20	**13.60**	4.10	3.60	**8.20**
Barium	mg/kg	84.00	65.00	123.00	32.60	39.20	NA
Beryllium	mg/kg	1.50	0.73	0.83	0.99	0.73	NA
Calcium	mg/kg	1,380.00	2,010.00	5,060.00	413.00	641.00	NA [1]
Chromium	mg/kg	9.50	7.80	14.70	9.60	8.30	81.00
Cobalt	mg/kg	11.50	6.10	5.30	4.90	2.90	NA
Copper	mg/kg	31.7 J	13.2 J	35.8 J	8.6 J	14.9 J	34.00
Iron	mg/kg	19,500.00	15,400.00	21,600.00	24,700.00	23,200.00	NA
Lead	mg/kg	44.00	14.10	38.30	31.40	35.70	47.00
Magnesium	mg/kg	1590.00 J	1350.00 J	2260.00 J	402.00 J	599.00 J	NA [1]
Manganese	mg/kg	434.00	284.00	363.00	368.00	301.00	NA
Nickel	mg/kg	19.50 J	10.70 J	13.90 J	**29.80 J**	**22.50 J**	**21.00**
Potassium	mg/kg	1,740.00	1,550.00	2,170.00	524.00	620.00	NA
Selenium	mg/kg	1.10 B	ND	0.56 B	ND	ND	NA
Sodium	mg/kg	167.00	166.00	228.00	51.00	56.10	NA
Vanadium	mg/kg	9.90	7.80	14.20	5.40	7.30	NA
Zinc	mg/kg	54.6 J	36.1 J	70.00 J	93.7 J	93.30 J	150.00
Pentachlorophenol	ug/kg	ND	250.00 J	ND	ND	ND	NA
Phenanthrene	ug/kg	**240.00 J**	ND	220.00 J	ND	ND	**240.00**
Di-n-butyl phthalate	ug/kg	ND	180.00 B	ND	ND	ND	NA
Fluoranthene	ug/kg	ND	ND	130.00 J	ND	ND	600.00
Pyrene	ug/kg	ND	ND	110.00 J	ND	ND	660.00
Chrysene	ug/kg	180.00 J	ND	210.00 J	ND	ND	NA
Bix (2-ethylhexyl) phthalate	ug/kg	730.00 B	990.00 B	ND	91.00 B	120.00 B	NA
Benzo (k) fluoranthene	ug/kg	150.00 J	ND	110.00 J	ND	ND	NA
Methylene chloride	ug/kg	31.00 B	13.00 B	56.00 B	14.00 B	12.00 B	NA
Acetone	ug/kg	88.00 R	ND	ND	ND	ND	NA

NOTES:

All samples were analyzed for base-neutral acids (BNAs), pesticides, PCBs, total metals, and cyanide; however, this summary table contains only compounds that were detected in at least one sample.

ND Not detected at concentrations above the CRQL.

NA Benchmark not available

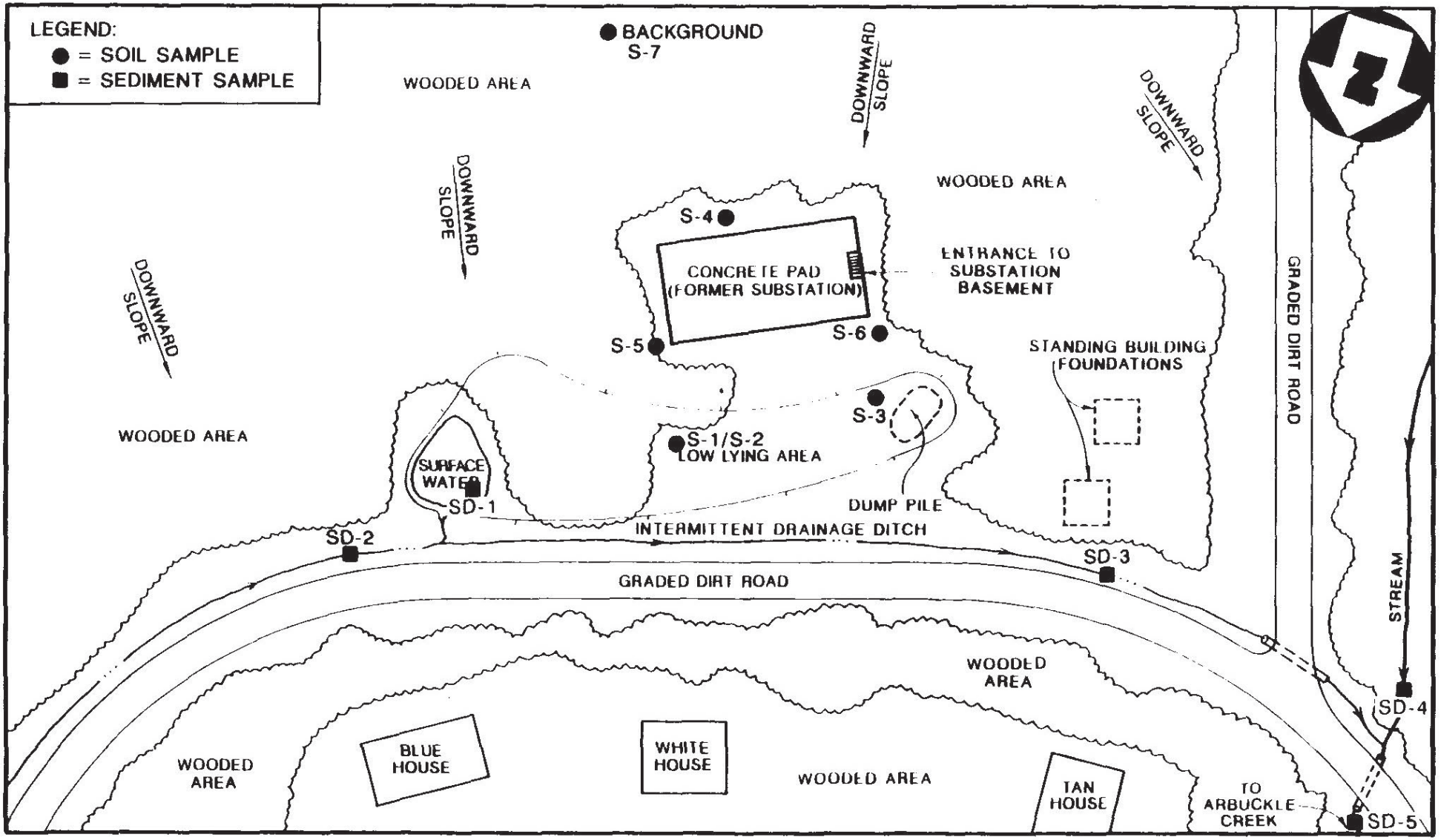
[1] Essential Nutrient. Eliminated from consideration as COC.

J Analyte present. Reported value may not be accurate or precise.

B Not detected substantially above the level reported in laboratory or field blanks.

R Unreliable result. Analyte may or may not be present in the sample.

* USEPA ECO Update, Ecotox Thresholds, 1996, Sediment Effects Range - Low (Long et al, 1995)



SAMPLE LOCATION MAP

N.R. & P. SUPPLY HOUSE

(NO SCALE)

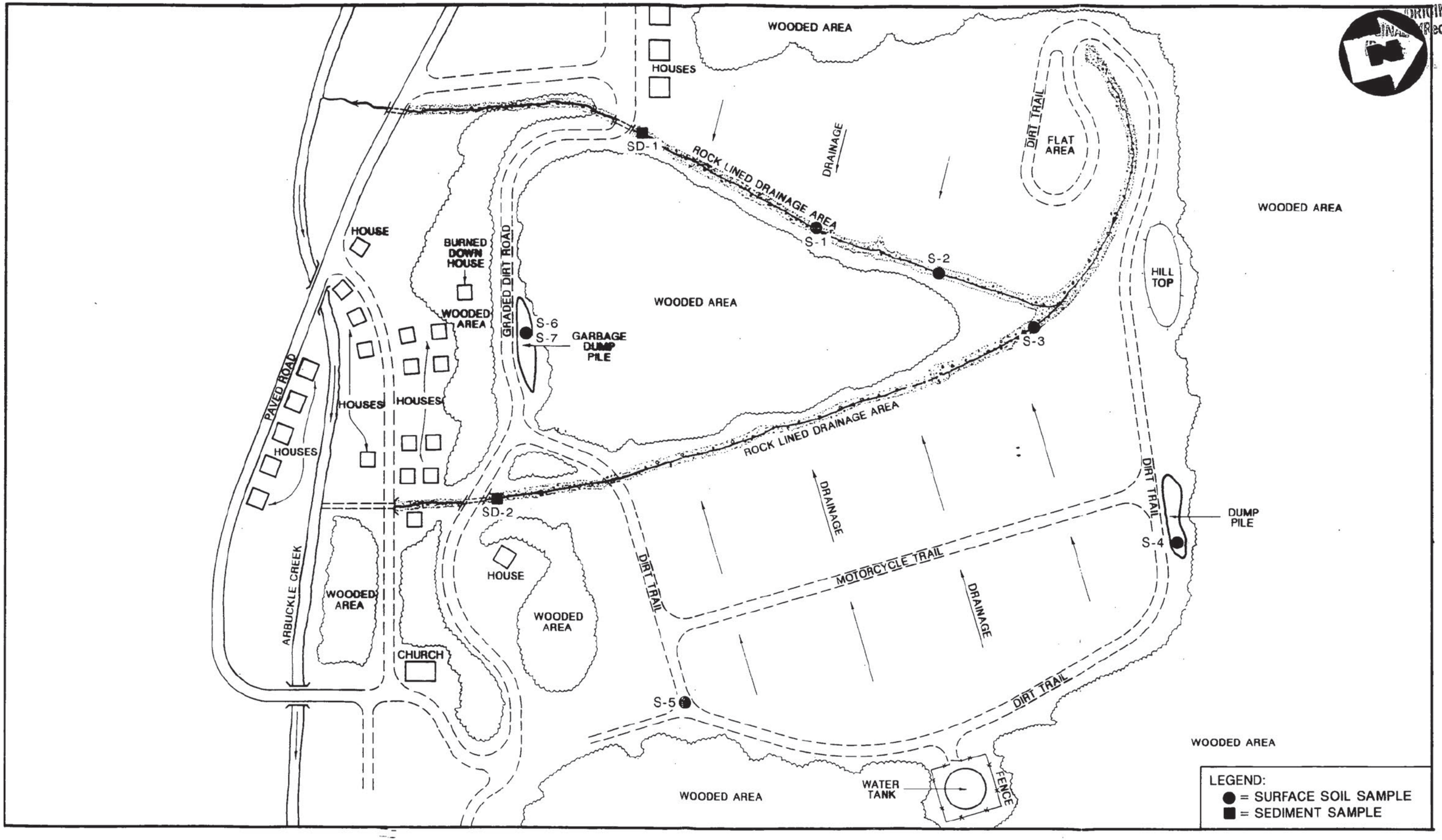
FIGURE 5.1

NUS CORPORATION

APPENDIX G

DATA AND FIGURES – BERWIND GREEN HILL MINE DUMP AREA

ORIGINAL
(Red)



SAMPLE LOCATION MAP

BERWIND - GREEN HILL/RECLAIMED MINE DUMP

(NO SCALE)

FIGURE 5.1

NUS CORPORATION

SITE NAME: BERWIND GREENHILL/RECL MINE
TDD NUMBER: F3-9007-05
LAB NAMES: ORG-CLAYTON INORG CEIMIC

SAMPLING DATE(s): 07/09/90
CASE NUMBER:14463

STATE/COUNTY CODE: WV019
EPA NUMBER: NA

	SAMPLE NUMBER:	CES70	CES71	CES72	CES73	CES74	CES75
	SAMPLE ID:	S-1	S-2	S-3	S-4	S-5	S-6
	LOCATION:	ON SITE ACC NO USES VEG	ON-SITE ACC NO USES VEG	ON SITE ACC NO USES VEG	ON SITE ACC NO USES VEG.	ON-SITE ACC NO USES VEG	ON SITE ACC NO USES VEG
		lt BR. CLAY	lt.Br.sandy	lt Br sndslt	LT.BR. CLAY	LT BR SANDY	LT BR SANDY
	PH:	6.3	6.2	6.0	6.3	6.3	5.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	HNU NO RDNGS	HNU NO RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	79.0%	97.0%	90.0%	86.0%	95.0%	89.0%
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	1.3	1.0	1.1	1.2	1.1	1.1

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CES70 ug/kg	CES71 ug/kg	CES72 ug/kg	CES73 ug/kg	CES74 ug/kg	CES75 ug/kg
5.00	methylene chloride	3.00 B	2.00 B	5.00 B	6.00 B	6.00 B	6.00 B
10.00	acetone	15.00 B	16.00 B	27.00 B	21.00 B	24.00 B	25.00 B
5.00	carbon disulfide						
5.00	chloroform	1.00 B	0.60 B	0.60 B	0.60 B		
10.00	2-butanone	5.00 B	4.00 B	7.00 B	6.00 B	6.00 B	5.00 B
10.00	2-hexanone					1.00 B	
5.00	toluene						
5.00	styrene			2.00 B	0.60 B	1.00 B	0.80 B
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	84.0	68.0	73.0	77.0	69.0	74.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CES70 ug/kg	CES71 ug/kg	CES72 ug/kg	CES73 ug/kg	CES74 ug/kg	CES75 ug/kg
50.00	benzoic acid	130.00 J					
10.00	naphthalene			100.00 J		74.00 J	
10.00	2-methylnaphthalene			150.00 J		160.00 J	
10.00	dibenzofuran						
50.00	pentachlorophenol			4400.00 B			
10.00	phenanthrene	120.00 J		200.00 J		160.00 J	
10.00	fluoranthene						
10.00	pyrene						
10.00	chrysene					75.00 J	
10.00	bis(2-ethylhexyl) phthalate			3400.00 B	130.00 B	92.00 B	110.00 B
10.00	benzo(b)fluoranthene						
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR:	410.0	330.0	360.0	370.0	340.0	360.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: UNITS:	CES70 ug/kg	CES71 ug/kg	CES72 ug/kg	CES73 ug/kg	CES74 ug/kg	CES75 ug/kg
Comments:	**********	**********	**********	**********	**********	**********	**********

RL

ORIGINAL (Red)

SITE NAME: BERWIND GREENHILL/RECL MINE
TDD NUMBER: F3-9007-05
LAB NAMES: ORG-CLAYTON INORG-CEIMIC

SAMPLING DATE(s): 07/09/90
CASE NUMBER: 14463

STATE/COUNTY CODE: WV019
EPA NUMBER: NA

	SAMPLE NUMBER:	MCET25	MCET26	MCET27	MCET70	MCET71	MCET72
	SAMPLE ID:	S-7	SD-1	SD-2	S-1	S-2	S-3
	LOCATION:	ON SITE ACC NO USES dup S-6	ON SITE ACC NO USES VEG LT BR SANDY	ON SITE ACC NO USES VEG LT BR SANDY	ON SITE ACC NO USES VEG lt BR. CLAY	ON-SITE ACC NO USES VEG lt.Br.sandy	ON SITE ACC NO USES VEG SANDY
	PH:	4.9	6.2	6.3	6.3	6.2	6.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	90.6%	69.4%	83.4%	79.1%	97.4%	90.8%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.181	0.246	0.187	0.239	0.205	0.168
	: ICP	0.178	0.283	0.201	0.214	0.167	0.150
	: Hg	0.446	0.708	0.500	0.535	0.510	0.490
	: CN	0.053	0.066	0.057	0.060	0.054	0.054

DET. LIMIT CRQL (*=IDL)		SAMPLE NUMBER:	MCET25	MCET26	MCET27	MCET70	MCET71	MCET72
		UNITS:	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
37.00	aluminum		4300.00	5290.00	2610.00	8290.00	4790.00	4660.00
39.00	antimony		9.40 B	14.70 B		11.10 B	8.50 B	10.00 B
1.00	arsenic		2.30	9.20	4.60	7.30	6.10	3.50
3.00	barium		27.60	43.50	41.30	75.20	52.80	55.90
1.00	beryllium		0.71 B	1.40 B	1.20 B	1.10 B	0.83 B	0.90 B
3.00	cadmium		0.71 B	1.10 B	0.81 B	2.10 B	1.80 B	1.50 B
13.00	calcium		137.00	690.00	3540.00	1920.20	16300.00	1460.00
6.00	chromium		3.90 B	8.20 B	8.90 B	13.50 B	11.20 B	9.10 B
5.00	cobalt		7.50 B	22.90	7.90 B	20.10	9.30 B	10.60
3.00	copper		6.20	22.00	11.10	17.60	14.40	14.70
5.00	iron		9390.00	11700.00	8100.00	26900.00	21200.00	14200.00
1.00	lead (anal. by GFAA)		10.30	9.70	6.60	12.50	10.60	7.40
26.00	magnesium		305.00	816.00	596.00	1100.00	1590.00	860.00
2.00	manganese		139.00	1530.00	151.00	772.00	236.00	224.00
11.00	nickel		10.70 B	23.20 B	12.10 B	23.40 B	13.20 B	17.40 B
310.00	potassium		596.00 B	913.00 B	540.00 B	1290.00	1060.00	1040.00
1.00	selenium			0.81 L	0.52 L	0.37 L		
54.00	sodium		318.00 J	421.00 J	250.00 J	708.00 J	459.00 J	321.00 J
7.00	vanadium		8.50 B	12.10 B	8.90 B	18.60	11.90	10.00
3.00	zinc		34.70	49.70	22.20	55.90	36.10	37.00
10.00	cyanide		0.61 B	0.85 B	0.65 B	0.84 B		

Comments: **********

ORIGIN (Red)

SITE NAME: BERWIND GREENHILL/RECL MINE
TDD NUMBER: F3-9007-05
LAB NAMES: ORG-CLAYTON INORG CEIMIC

SAMPLING DATE(s): 07/09/90
CASE NUMBER: 14463

STATE/COUNTY CODE: WV019
EPA NUMBER: NA

	SAMPLE NUMBER:	CES76	CES77	CES78	CES79
	SAMPLE ID:	S-7	SD-1	SD-2	trip blank
	LOCATION:	ON SITE ACC NO USES dup S-6	ON SITE ACC NO USES VEG LT BR SANDY	ON SITE ACC NO USES VEG LT BR SANDY	VOA only
	PH:	4.9	6.2	6.3	
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS	
	PERCENT SOLIDS:	89.0%	61.0%	80.0%	
TYPE OF DATA: ******	VOLATILES	**********	**********	**********	**********
	DILUTION FACTOR:	1.1	1.6	1.3	1.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CES76 ug/kg	CES77 ug/kg	CES78 ug/kg	CES79 ug/l
5.00	methylene chloride	6.00 B	7.00 B	4.00 B	1.00 J
10.00	acetone	18.00 B	9.00 B	5.00 B	3.00 J
5.00	carbon disulfide	0.70 J			
5.00	chloroform		0.90 B	0.70 B	
10.00	2-butanone	4.00 B	3.00 B	1.00 B	
10.00	2-hexanone				
5.00	toluene			0.70 J	
5.00	styrene				
TYPE OF DATa: ******	SEMIVOLATILES	**********	**********	**********	**********
	DILUTION FACTOR:	74.0	110.0	83.0	0.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CES76 ug/kg	CES77 ug/kg	CES78 ug/kg	CES79 n/a
50.00	benzoic acid				
10.00	naphthalene		480.00 J		
10.00	2-methylnaphthalene		660.00 J	110.00 J	
10.00	dibenzofuran		130.00 J		
50.00	pentachlorophenol				
10.00	phenanthrene		1000.00 J	130.00 J	
10.00	fluoranthene		130.00 J		
10.00	pyrene		120.00 J		
10.00	chrysene		270.00 J		
10.00	bis(2-ethylhexyl) phthalate				
10.00	benzo(b)fluoranthene		120.00 J		
TYPE OF DATa: ******	PESTICIDES	**********	**********	**********	**********
	DILUTION FACTOR:	360.0	520.0	400.0	0.0

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	CES76 ug/kg	CES77 ug/kg	CES78 ug/kg	CES79 n/a
Comments: **********					

RC

ORIGINAL (Red)

SITE NAME: BERWIND GREENHILL/RECL MINE
TDD NUMBER: F3-9007-05
LAB NAMES: ORG-CLAYTON INORG-CEIMIC

SAMPLING DATE(s): 07/09/90
CASE NUMBER: 14463

STATE/COUNTY CODE: WV019
EPA NUMBER: NA

	SAMPLE NUMBER:	MCET73	MCET74	MCET75
	SAMPLE ID:	S-4	S-5	S-6
	LOCATION:	ON SITE ACC NO USES VEG. LT.BR. CLAY	ON-SITE ACC NO USES VEG LT BR SANDY	ON SITE ACC NO USES VEG LT BR SANDY
	PH:	5.0	6.3	5.0
	FIELD MEASUREMENTS:	NO HNU RDNGS	NO HNU RDNGS	NO HNU RDNGS
	PERCENT SOLIDS:	66.8%	96.4%	89.5%
TYPE OF DATA: ******	INORGANICS	**********	**********	**********
	DILUTION FACTOR: : GFAA	0.245	0.176	0.188
	: ICP	0.206	0.196	0.207
	: Hg	0.550	0.560	0.550
	: CN	0.730	0.051	0.054

DET. LIMIT CRQL (*=IDL)	SAMPLE NUMBER: / UNITS:	MCET73 mg/kg	MCET74 mg/kg	MCET75 mg/kg
37.00	aluminum	7900.00	4580.00	5720.00
39.00	antimony	11.20 B	10.00 B	
1.00	arsenic	9.00	6.40	3.10
3.00	barium	68.60	58.50	23.20
1.00	beryllium	1.00 B	1.20 B	1.20 B
3.00	cadmium	1.70 B	1.80 B	1.40 B
13.00	calcium	4430.00	2480.00	96.00
6.00	chromium	12.80 B	12.90 B	3.90 B
5.00	cobalt	9.70 B	10.40 B	12.00 B
3.00	copper	9.70	13.10	7.90
5.00	iron	17300.00	18800.00	12400.00
1.00	lead (anal. by GFAA)	12.70	11.30	8.80
26.00	magnesium	611.00	1150.00	408.00
2.00	manganese	453.00	290.00	133.00
11.00	nickel	9.10 B	15.50 B	14.30 B
310.00	potassium	1390.00	757.00	790.00
1.00	selenium		0.89 L	
54.00	sodium	336.00 J	344.00 J	217.00 J
7.00	vanadium	16.30	8.80 B	9.50 B
3.00	zinc	22.70	41.30	33.50
10.00	cyanide			

RC

ORIGINAL (Red)

APPENDIX H

MOBILE LABORATORY QAPP

FIELD ANALYSIS OF POLYCHLORINATED BIPHENYLS (PCBs) BY GC/ECD IN SOIL/SEDIMENT SAMPLES INTHE ERT MOBILE LABORATORY

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*These sections affected by Revision 1.0

SUPERCEDES: SOP #1709; Revision 1.0; 07/20/11; U.S. EPA Contract EP-W-09-031

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FIELD ANALYSIS OF POLYCHLORINATED BIPHENYLS (PCBs) BY GC/ECD IN SOIL/SEDIMENT SAMPLES INTHE ERT MOBILE LABORATORY

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1.0 OBJECTIVE

The purpose of this Standard Operating Procedure (SOP) is to screen soil and sediment samples in the field for the presence of polychlorinated biphenyls (PCBs), also known as Aroclors, using a gas chromatograph (GC) with a narrow-bore fused silica column and an electron capture detector (ECD) in the ERT mobile laboratory. This SOP is based on a field screening method prepared by the Environmental Protection Agency (EPA) Region 1 (USEPA 2002). The data generated using this SOP meets the Screening Data objective for a quick, preliminary assessment of site contamination and provides compound identification and quantification (USEPA 1990). A list of the Aroclors that may be analyzed by this method and their corresponding reporting limits (RLs) on a wet weight basis are presented in Table 1.

2.0 METHOD SUMMARY

Approximately 1.0 gram (g) of a soil/sediment sample is extracted with a water/methanol/hexane mixture in a 4-milliliter (mL) vial. An aliquot of the hexane layer of the extract is removed and analyzed on a GC/ECD. Second column confirmation is not required for this field screening method. Field screening data may be definitively confirmed by the analysis of additional samples using methods and quality control (QC) criteria associated with definitive data.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

3.1 Sample Storage

Soil/sediment samples should be collected in wide-mouth glass containers with Teflon-lined caps. From the time of collection until after analysis, extracts and unused samples must be protected from the light and refrigerated at less than or equal to (≤) 6 degrees Celsius (ºC) for the periods specified by the SERAS Task Leader (TL) and/or the Work Assignment Manager (WAM) for the project.

Samples and sample extracts **must** be stored separately from standards in an atmosphere free of all potential contaminants.

3.2 Holding Time

Since this is a field screening method, extraction of soil/sediment samples will be completed as expeditiously as possible to meet the project's goals; however, extraction must be completed within 14 days from the date of collection. Extracts should be stored in the refrigerator and must be analyzed within 40 days of extraction.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of Occupational Safety and Health (OSHA) regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets should be made available to all personnel involved in these analyses. Always wear safety glasses or a shield for eye protection, protective clothing, and observe proper mixing when working with these reagents. Some method analytes have been

tentatively classified as known or suspected human or mammalian carcinogens. Pure standard materials and stock standard solutions of these compounds should be handled with suitable protection to skin, eyes, etc.

Method interferences may be caused by contaminants in solvents, reagents, glassware and other sample processing hardware that lead to discrete artifacts and/or elevated baselines in the chromatograms. All of these materials must routinely be demonstrated to be free from interferences under the conditions of the analysis by running method blanks. Matrix interferences may be caused by contaminants that co-elute with the target compounds. The extent of matrix interferences will vary considerably from source to source. An acid cleanup may be used to eliminate this interference. Contamination by carryover can occur whenever high-level and then low-level samples are analyzed. To reduce carryover, an injection of either the method blank or clean solvent (hexane) should be analyzed immediately following an unusually concentrated sample to assure the syringe is clean and assess any potential carryover.

5.0 EQUIPMENT/APPARATUS

The following equipment/apparatus is required:

- Spoon and/or spatula, stainless steel or Teflon
- Disposable glass Pasteur pipettes
- Drying Oven
- Vials and Caps, 2-mL for GC auto sampler
- Vials, 4-mL
- Gas Chromatograph, an analytical system complete with GC and all required accessories including syringes, auto sampler, analytical columns, gases, dual electron capture detectors and data system. A data system is required for measuring peak areas or peak heights and recording retention times.
- ZB-XLB fused silica capillary column, 30 meters (m) x 0.32 millimeter (mm) inner diameter (ID), 0.50 micron (µm) film thickness or equivalent
- Syringes, various µL volumes, for spiking and preparation of standards
- Class “S” weights for balance calibration
- Analytical balance, capable of accurately weighing ± 0.01 g.
- Volumetric flasks, Class A, various volumes ranging from 5- to 500-mL
- Vortex mixer

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- Nitrile gloves
- Safety glasses
- Centrifuge

6.0 REAGENTS

- Hexane, pesticide residue analysis grade or equivalent
- Methanol, pesticide residue analysis grade or equivalent
- Reagent water, free of all interfering contaminants
- Sulfuric Acid (H_2SO_4), concentrated
- Sodium sulfate, anhydrous
- PCB Stock Aroclor 1016/1260 Calibration Standard, 1000 µg/mL each in hexane, commercially available
- PCB Intermediate Aroclor 1016/1260 Calibration Standard, 100 µg/mL – Dilute 1 mL of the stock PCB 1016/1260 calibration standard to 10 mL hexane.
- PCB Working Aroclor 1016/1260 Calibration Standards – Prepare a minimum of five concentration levels in hexane as documented in the following table. Add 20 µL of the working internal standard solution to 1 mL of each of the working standards prior to analysis. This results in an internal standard concentration of 100µg/L. This curve will be used to establish the linearity of the instrument prior to analysis of any samples.

Concentration of Calibration Standard, µg/mL	100 µg/mL Intermediate Calibration Standard, µL	Final Volume in Hexane, mL
0.25	25	10
0.50	50	10
1.00	100	10
2.00	200	10
5.00	500	10

NOTE: Preparation for any of the other Aroclor calibration standards will follow this standard preparation scheme.

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- Working PCB Aroclor 1016/1260 Initial Calibration Verification (ICV) Standard, 1.0 µg/mL – Dilute 10 µL of the stock second source Aroclor 1016/1260 standard to 10 mL of hexane.
- 4,4'-Dibromooctaaafluorobiphenyl, 1000 µg/mL in methylene chloride
- 3,3',4,4'-Tetrabromobiphenyl, 100 µg/mL in isooctane
- Working Internal Standard Solution, 5.0 µg/mL – Add 1.0 mL of 3,3',4,4'-tetrabromobiphenyl and 100 µL of 4,4'-dibromooctaaafluorobiphenyl to 18.9 mL of hexane for a total volume of 250 mL.
- Stock PCB Aroclor Fingerprint Standards, 1000 µg/mL in hexane, commercially available, for Aroclor 1016, 1221, 1232, 1242, 1248, 1254, 1260 and 1268
- Intermediate PCB Aroclor Fingerprint Standards, 200 µg/mL – Dilute 1 mL of a stock Aroclor fingerprint standard to 10 mL in hexane.
- Working PCB Aroclor Fingerprint Standards, 1.0 µg/mL – Dilute 100 µL of an intermediate Aroclor Fingerprint Standard and 50 µL of the 20 µg/mL of the working surrogate PCB standard to 10 mL.
- Working PCB Aroclor 1221 Fingerprint Standard, 2.0 µg/mL – Dilute 100 µL of an intermediate Aroclor Fingerprint Standard and 50 µL of the 20 µg/mL of the working surrogate PCB standard to 10 mL.

  NOTE: Fingerprint standards may be used past their 12-month expiration date for pattern recognition only. If an Aroclor other than 1016/1260 is present, a new standard will be prepared for quantitation.

- Daily Ar 1016+1260 PCB Aroclor Working Calibration Standard, 1.0 µg/mL and depending on the project the Aroclor(s) of interest - Prepare a daily check standard to establish the response factor (RF). Refer to the preparation of the working PCBs Aroclor standards above.

7.0 PROCEDURES

7.1 Sample Preparation and Extraction

1. Calibrate the balance with Class "S" weights prior to weighing samples on daily basis when the balance is in use. The balance must be calibrated with a weight that is similar to the weight used to extract the samples.

2. Transfer the sample container into the fume hood and open the sample container. Mix sample thoroughly in container. Avoiding twigs and small pebbles weigh approximately 1 gram of sample into a 4-mL vial. Record the weight to the nearest 0.01 gram.

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3. If received from the field sampling personnel, weigh an additional 1-g portion of the sample chosen for a Field Duplicate Sample at the rate of one per day.

4. Weigh a 1-g portion to the nearest 0.01 g of a Performance Evaluation (PE) Sample at a rate of one per batch or per day.

5. Add the following volumes of the solvents below to the method blank, PE sample and all field samples using a syringe, a pipettor or dispenser.

   200 µL of Reagent Water
   800 µL of Methanol
   1000 µL of Hexane

6. Agitate the sample for one minute using a Vortex mixer and centrifuge all extracts.

7. Transfer 0.5 ml of the top hexane layer into a 2-mL injection vial for analysis. Add 10 µL of the 5 µg/mL working internal standard solution to each extract.

7.2 Percent Solids

The sample aliquots for total solids (TS) are weighed in conjunction with the samples for the extractions. The method blank, the PE sample and the LCS/LCSD samples are assumed to be 100 percent (%) total solids.

Preheat an oven to 103-105°C. Weigh and record an empty aluminum sample dish to the nearest 0.01g. Place at least 10 g of the soil/sediment into the aluminum dish and record the weight. Place the dishes in the oven, record the initial temperature and dry the samples overnight. In the morning, turn off the oven and allow the dishes to cool before weighing. Calculate the %TS using the following equation:

$$\%\text{Total Solids} = \frac{\text{Weight of Dried Sample With Dish (g)} - \text{Dish Weight (g)}}{\text{Weight of Wet Sample With Dish (g)} - \text{Dish Weight (g)}} \times 100$$

7.3 Sulfuric Acid Clean-Up

Sulfuric acid cleanup is optional. Acid cleanup will be used whenever elevated baselines or overly complex chromatograms prevent accurate quantification of PCBs. The decision to perform acid cleanup is left to the discretion of the field chemist.

Transfer the 1-mL hexane extract from Section 7.1.9 to 4-mL screw top vial and add 1 mL of sulfuric acid. Cap the vial tightly and vortex for 1 minute. A vortex must be visible in the vial.

Allow the phases to separate for at least 1 minute. Transfer the top (hexane) layer into the injection vial. If there is a separation problem, a centrifuge can be used to separate the layers.

7.4 GC/ECD Conditions

The GC/ECD conditions used for PCBs analysis are listed below.

Injector Temperature	250 °C
Oven Temperature Program	120 °C hold for 1 minute, 9 °C/minute to 285 °C, 10 minutes at 285 °C
Detector Temperature	300 °C
Carrier Gas	Helium
Make-up Gas	Argon/Methane
Column Flow rate	ZB-XLB, 3.0 milliliters/minute (mL/min)
Amount Injected	1 µL
Data System	Agilent Chem Station

The instrument conditions listed above are guidelines to be used for standard and sample analysis on the GC/ECD system. Any suitable conditions may be used as long as the QC criteria and peak separation are achieved.

7.5 Standard and Sample Analysis

1. Prepare calibration standards as in Section 6.0 for the initial determination of the RL. Inject 1 µL of each of the five concentrations of the working Aroclor 1016+1260 calibration mix. Choose five peaks (peaks must be >25% of full scale) to calculate the response factors (RFs). The average RFs and percent relative standard deviation (%RSD) must be calculated for each Aroclor peak on the column used for quantitation using the equation below. Inject 1 µL of the 1.0 µg/mL working PCB Aroclor 1016/1260 ICV Standard right after the initial curve.

$$RF = \frac{(A_X)(C_{IS})}{(A_{IS})(C_X)}$$

where:

A_x = Peak Area or Peak Height of each target analyte
A_{IS} = Peak Area or Peak Height of each internal standard assigned to target analyte
C_{IS} = Concentration of each internal standard (µg/mL)
C_x = Concentration of each target analyte (µg/mL)

$$RRF_{avg} = \frac{RF_{1...} + RF_5}{5}$$

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$$SD = \sqrt{\frac{\sum_{i=1}^{n} \left(\overline{X} - x\right)^2}{N - 1}}$$

$$\%RSD = \frac{SD}{RRF_{average}} \; x \; 100$$

The % RSD (average of all 5 peaks) for each Aroclor must be ≤20.0%.

NOTE: The initial calibration curve must run every six months at a minimum or more if needed.

2. Inject 1 µg/mL each of the remaining Aroclors (Ar), Ar 1016, Ar 1232, Ar 1242, Ar 1248, Ar 1254, Ar 1260, and Ar 1268 and 2 ppm of Ar 1221 for the fingerprints.

   NOTE: The fingerprints are used for qualitative pattern matching only. The fingerprints need not be run with each calibration curve as long as the date of the fingerprints does not exceed one year.

3. Using 1 gram of sodium sulfate, extract one method blank, seven limit of detection (LOD) replicates at a concentration of 0.5 µg/mL using the primary source of Aroclor standard and one limit of quantitation (LOQ) at 0.5 µg/mL using the second Aroclor standard.

4. An initial demonstration of proficiency in PCB analysis must be demonstrated by each analyst initially and each time significant changes are made in the procedure or in instrumentation. Using 1 g of sodium sulfate, prepare and extract four replicates at a concentration of 1.0 µg/mL using the secondary source Aroclor standard.

5. Inject the 1 µg/mL Ar 1016+1260 mix and the Aroclor of concern for the project to establish the RF using the equation in step 1.

6. Inject the method blank, PE sample, field duplicate sample and the environmental samples.

7. Inject the End of Sequence Check Standards (Ar 1016+1260 mix and the Aroclor of concern) every 24 hours or at the end of the batch using the following equation to calculate the percent difference.

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$$\textbf{Percent Difference } (\%D) = \frac{RF_{INT} - RF_{CALC}}{RF_{INT}} \; x \; 100$$

where:

RF_{INT} = Initial Average Response Factor
RF_{CALC} = Calculated response Factor

7.6 Evaluation of Chromatograms

All standard and sample chromatograms must be evaluated to determine if re-injection and/or dilution are necessary. The identification of PCBs is based on pattern recognition, which can only be verified from an on-scale chromatogram. Second column confirmation is not required for this field screening method.

7.6.1 Standard and Sample Chromatograms

The following requirements apply to all data presented for the PCB.

1. The PCB chromatogram must display the multi-component analytes present in each standard or sample greater than (>) 25% and less than (<) 100% full scale.

2. If an extract is diluted, chromatograms must display multi-component PCBs between 10% and 100% of full scale.

3. If a chromatogram is re-plotted electronically to meet requirements, the scaling factor used must be displayed on the chromatogram. The time scale must match the daily calibration check.

4. If a chromatogram indicates carryover from a previous injection, subsequent sample extract(s) must be re-analyzed.

5. The internal standard must fall within the RT window. If the RT window has shifted in the thousandth place (>0.030 but <0.040), professional judgment may be used to determine the acceptability of the data.

6. The method blank and QC samples must undergo the same clean-up steps as the samples.

7.6.2 Dilutions

If the result of the original sample concentration exceeds the linear calibration range, then the sample must be diluted accordingly to bring it within the calibration curve.

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8.0 CALCULATIONS

8.1 Reporting Limit

$$RL\ (\mu g/kg) dry\ weight = \frac{(C_{STD})(V_T)(DF)}{(W)(S)}$$

where:

C_{STD}	=	Concentration of the lowest standard in the calibration range (µg/mL)
V_T	=	Volume of the extract (mL)
DF	=	Dilution factor
W	=	Weight of soil or sediment extracted (kg)
S	=	Decimal Percent Solids

8.2 Sample Concentration

$$Concentration\ (\mu g/kg) = \frac{(A_X)(I_S)(V_T)(DF)}{(A_{IS})(RRF_{avg})(W)(S)}$$

where:

A_x	=	Peak Area or Peak Height of each target analyte
I_s	=	Concentration of each internal standard in the extract (µg/mL)
V_T	=	Volume of the concentrated extract (mL)
DF	=	Dilution Factor
A_{IS}	=	Peak Area or Peak Height of each internal standard
RF	=	Response Factor
W	=	Weight of soil/sediment (kg)
S	=	Decimal percent solid

8.3 Dixon's Criterion

Dixon's criterion at the 95% confidence level is used to identify statistical outliers in a data set. This test should be applied sparingly and never more than once to a single data set. For weathered samples, all peaks are included in the quantitation even if any of the peaks fail Dixon's criterion.

To determine if a peak may be omitted from the average of the peaks used for quantitation, arrange the results in ascending order (X_1, X_2,……X_n). If X_n is to be tested as an outlier, use the following equation:

$$\frac{X_n - X_{n-1}}{X_n - X_1}$$

Reject X_n as an outlier if the ration is greater than Dixon's Criterion for n (see Table 3, Appendix A).

If X_1 is to be treated as an outlier, use the following equation:

$$\frac{X_2 - X_1}{X_n - X_1}$$

Reject X_1 as an outlier if the ratio is greater than Dixon's Criterion for n (see Table 3, Appendix A).

9.0 QUALITY ASSURANCE/QUALITY CONTROL

1. A 1.0 µg/mL Ar 1016+1260 one-point calibration check and a 1.0 µg/mL one-point calibration check containing the Aroclor of interest for the project will be used to determine the RF. The first Ar 1016+1260 one-point calibration check analyzed at the beginning of the first sequence should be within 15% of the initial calibration.

2. A method blank is extracted and analyzed with the frequency of one per day. The method blank results must be less than the RL.

3. An external quality control sample (PE sample) is analyzed once per day. The concentration(s) must be within the manufacturer's acceptance range. If the Aroclor of interest is known prior to mobilization, the PE sample will contain that Aroclor. However, if the Aroclor of interest is not known prior to mobilization; Aroclor 1260 will be used initially until the Aroclor is identified by analyzing the environmental samples. If it is determined that more than one Aroclor is present in the samples, then PE samples containing the Aroclors of interest will be alternated on a daily basis.

   Note: If the PE sample of interest is not available in the mobile lab, the PE sample containing Aroclor 1260 will be used.

4. An end of sequence calibration standard is run every 24 hours or at the end of batch. The %D must be within ±30%.

5. The internal standard recoveries must be within 50 to 150%.

6. The lowest calibration standard (250 µg/kg) for all Aroclors except Ar 1221 (500 µg/kg) analyzed during the initial calibration determines the RLs based on the initial weight of the sample, the final volume of extract obtained from the extraction and the %TS.

7. Prior to running a method or any time there is a change in instrument type, personnel or test method or any time a method or analyst has not performed a method in a 12-month period, an analyst must demonstrate acceptable performance for this method. The initial demonstration of capability (DOC) consists of four aliquots of a QC standard (second source) that are prepared and analyzed according to the method over one or a period of days. The concentration must be prepared at 1-4 times the RL. Using Excel, the analyst must provide a table containing the following: results of the four replicates, Mean Concentration, Mean Recovery, Standard Deviation and %RSD.

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On-going DOC on an annual basis maybe satisfied by the analyst successfully passing a performance testing (PT) sample or another initial DOC. Results of tabulated QC samples (i.e., control chart data) that are analyst-specific accompanied by precision and accuracy criteria agreed upon by the Analytical Support Leader and the QA/QC Officer may also be used.

8. If the concentration of any sample extract exceeds the initial calibration range, that sample extract must be diluted and re-analyzed. If there are no peaks detected above 25% of the full scale in the dilution analysis, a lower dilution of the sample extract must be analyzed.

9. The LOD must be determined for each target analyte on every instrument that will be used for the analysis and reporting of samples. The LOD must be determined each time there is a change in the method that affects how the test is performed or when there is a change in instrumentation. The LOD must be verified annually for each matrix, method and analyte. The LOD will be run using a minimum of seven replicates of a sample prepared from the calibration source at 1-4 times the RL for multiple analyte tests. All seven aliquots must be subjected to the entire analytical procedure. Calculate the mean, mean recovery, variance and standard deviation of the replicate measurements. The LOD is calculated by multiplying the standard deviation times the Students t-Value of 3.143. If more than 7 replicates are used, the Students t-Value must be adjusted accordingly.

   The LOQ must be confirmed by the successful analysis of a secondary source QC sample containing the target analyte (Aroclor 1016+1260 mix) in each matrix at 1-2 times the claimed LOD (typically the low standard). The recoveries must fall within the recoveries established for the LCS. The LOQ must be subjected to the entire analytical procedure. The LOD/LOQ must be determined at the same time. Alternatively a control chart with recoveries established from previous LOQ samples may be used.

10. A nonconformance memo will be generated any time an employee notices a deficiency suspected of being a nonconformance. This nonconformance memo will be forwarded to the QA/QC Officer for verification of corrective action.

11. If any changes are made to this SOP in the field, the analyst must fill out a Work Assignment Field Change Form and have it signed by the ERT WAM and the SERAS TL.

10.0 DATA VALIDATION

The data is reviewed using the Quality Assurance/Quality Control considerations listed in Section 9.0 by the analyst prior to submittal to the client to ensure that the instrument has been operated in accordance with this SOP and manufacturer's recommendations and that all QA/QC checks have been performed. The screening data objective requires that the calibration and detection limits be evaluated. All field analytical reports must be reviewed in accordance with the Administrative Procedure (AP) #22, *Peer Review of SERAS Deliverables*.

All samples must be analyzed as part of a valid analytical sequence, i.e., an acceptable initial calibration, and continuing calibration check at the required frequency.

All the QC requirements described in Section 9.0 must be met at all times. Any deviations or anomalous conditions must be documented in the case narrative and on a nonconformance memo.

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11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, refer to U.S. EPA, Occupational Safety and Health Administration (OSHA) and corporate health and safety practices. More specifically, refer to SERAS SOP #3013, SERAS *Chemical Hygiene Plan* and SERAS SOP #1501, *Hazardous Waste Management.*

12.0 REFERENCES

U.S. Environmental Protection Agency. 1990. Quality Assurance/Quality Control Guidance for Removal Activities, OSWER Directive 9360.4-01.

U.S. Environmental Protection Agency. 2002. Standard Operating Procedure for Polychlorinated Biphenyls (PCBs) Field Testing for Soil and Sediment Samples, EIA-FLDPCB2.SOP, Region 1, Office of Environmental Measurement and Evaluation.

13.0 APPENDICES

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TABLE 1. Target Compound List and Typical Reporting Limits for Soil/Sediment

Analyte	RL (µg/kg)
Aroclor 1016	250
Aroclor 1221	500
Aroclor 1232	250
Aroclor 1242	250
Aroclor 1248	250
Aroclor 1254	250
Aroclor 1260	250
Aroclor 1268	250

RL denotes Reporting Limits
Reported on a wet weight basis

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TABLE 2. Target Compound List and Internal Standards

4,4'-Dibromooctafluorobiphenyl (IS)
Aroclor 1016
Aroclor 1221

3,3'4,4'-Tetrabromobiphenyl (IS)
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1268

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TABLE 3. Dixon's Criterion for n

Number of results, n	Dixon's Criterion
3	0.941
4	0.765
5	0.642
6	0.560
7	0.507

FIGURE 1. Multi Component PCB Analytical Sequence

Time	Injection #	Material Injected
	1-6	Initial Calibration (5-point) + ICV - Ar 1016+1260 mix (Every six months or sooner)
	7-14	PCB Fingerprints (Every Year)
0 hr.	1	1 ppm Ar 1016+1260 Standard
	2	1 ppm Aroclor Standard (Project Specific)
	3	Method Blank
	4	PE Sample
	5	1st Sample
24 hr.	n	1 ppm Aroclor Standard (End of Sequence) 1 ppm Aroclor Std. (End of Sequence) (Project Specific)
0 hr.	n+1	1 ppm Ar 1016+1260 Standard 1 ppm Aroclor Standard (Based on the Project) Method Blank PE Sample 1st Sample
24 hr.		1 ppm Ar 1016+1260 Standard (End of Sequence) 1 ppm Aroclor Std. (End of Sequence) (Project Specific)
	etc	
	last	1 ppm Ar 1016+1260 Standard (End of Sequence) 1 ppm Aroclor Std. (End of Sequence) (Project Specific)

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APPENDIX I

FIELD STANDARD OPERATING PROCEDURES

TETRA TECH	STANDARD OPERATING PROCEDURE (GUIDANCE)	Number CT-04	Page 1 of 7
		Effective Date 11/20/2016	Revision 5
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	
Subject SAMPLE NOMENCLATURE		Approv [redacted]	

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1.0 PURPOSE

This document specifies a consistent sample nomenclature system that facilitates subsequent data management in a cost-effective manner. The sample nomenclature system has been devised such that the following objectives can be attained:

- Sorting of data by matrix
- Sorting of data by depth
- Maintenance of consistency (field, laboratory, and database sample numbers)
- Accommodation of all project-specific requirements
- Accommodation of laboratory sample number length constraints (maximum of 20 characters)

2.0 SCOPE AND APPLICABILITY

The methods described in this document are designed to be used consistently for all projects requiring electronic data. Other contract- or project-specific sample nomenclature requirements may also be applicable. If project-specific requirements dictate the use of a different system of nomenclature than what is described in this guidance, the objectives identified above must be borne in mind when developing the alternate nomenclature. Consultation with the NUS Operating Unit database group is advisable in those cases. The database group will help ensure that sample nomenclature is compatible with the affected databases.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Program Manager - The Program Managers (or their designees) are responsible for informing contract-specific Project Managers (PMs) of the existence and requirements of this document. Program Manager qualifications are described in the current NUS Operating Unit Quality Assurance Program Manual available on the intranet Quality Assurance link.

Project Manager - Project Managers (PMs) determine the applicability of this document based on: (1) program-specific requirements and (2) project size and objectives. PMs (or their designees) ensure that sample nomenclature requirements are thoroughly specified in the relevant project planning document (e.g., sampling and analysis plan) and are consistent with this document, if relevant. PMs ensure that the Field Operations Leader (FOL) is familiar with the sample nomenclature system. Program Managers appoint PMs based on their experience and past performance and qualifications as described in the current NUS Operating Unit Quality Assurance Program Manual, which is available on the intranet Quality Assurance link.

Field Operations Leader - The FOL ensures that all field technicians or sampling personnel are thoroughly familiar with this document and the project-specific sample nomenclature system and that they implement the nomenclature system in accordance with this document.

General personnel qualifications for sample nomenclature activities in the field include the following:

- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.

- Familiarity with appropriate procedures for field documentation, sample handling, packaging, and shipping.

5.0 PROCEDURES

5.1 INTRODUCTION

The sample identification (ID) system may consist of as few as eight but not more than 20 distinct alpha-numeric characters. The sample ID will be provided to the laboratory on the sample labels and chain-of-custody forms. The basic sample ID provided to the laboratory has three segments and shall be as follows, where "A" indicates "alpha," and "N" indicates "numeric":

A or N 3 or 4 Characters	**AAA 2 or 3 Characters**	**A or N 3 to 6 Characters**
Site Identifier	Sample Type	Sample Location

Additional segments may be added as needed. For example:

(1) Soil and sediment sample ID

A or N 3 or 4 Characters	**AAA 2 or 3 Characters**	**A or N 3 to 6 Characters**	**NNNN 4 Characters**
Site identifier	Sample type	Sample location	Sample depth

(2) Aqueous (groundwater or surface water) sample ID

A or N 3 or 4 Characters	**AAA 2 or 3 Characters**	**A or N 3 to 6 Characters**	**NN 2 Characters**	**A 1 Character**
Site identifier	Sample type	Sample location	Round number	Filtered sample only

Note 1: Sampling dates may be used in place of round numbers.

Note 2: The “-F” may be omitted from the sample ID if there is another way to definitively indicate on chain of custody forms and in the NUS Operating Unit database which portion of a samples is designated for total species analysis (unfiltered samples) and which is designated for dissolved species analysis (filtered samples).

(3) Biota sample ID

A or N 3 or 4 Characters	**AAA 2 or 3 Characters**	**A or N 3 to 6 Characters**	**AA 2 Characters**	**NNN 3 Characters**
Site identifier	Sample type	Sample location	Species identifier	Sample group number

5.2 SAMPLE IDENTIFICATION FIELD REQUIREMENTS

The various fields in the sample ID include but are not limited to the following:

- Site identifier
- Sample type
- Sample location
- Sample depth
- Sampling round number
- Filtered
- Species identifier
- Sample group number

The site identifier must be a three- or four-character field (numeric characters, alpha characters, or a mixture of alpha and numeric characters may be used). A site number is necessary because many facilities/sites have multiple individual sites, Solid Waste Management Units (SWMUs), Operable Units (OUs), etc. Several examples are presented in Section 5.3.

The sample type must be a two- or three-character alpha field. Suggested codes are provided in Section 5.3.

The sample location must be at least a three-character field but may have up to six characters (alpha, numeric, or a mixture). The six characters may be useful in identifying a monitoring well to be sampled or describing a grid location.

The sample depth field is used to note the depth below ground surface (bgs) in units of feet at which a soil sample is collected; and the depth in units of inches bgs at which a sediment sample was collected. The first two numbers of the four-number code specify the top interval, and the third and fourth specify the bottom interval in feet bgs of the sample. If the sample depth is equal to or greater than 100, then only the top interval would be represented and the sampling depth would be truncated to three characters. The depths will be noted in whole numbers only; further detail, if needed, will be recorded on the sample log sheet or boring log, in the logbook, etc.

A two-digit round number will be used to track the number of aqueous samples collected from a particular aqueous sample location. The first sample collected from a location will be assigned the round identifier 01, the second 02, etc. This applies to both existing and proposed monitoring wells and surface water locations.

Aqueous samples that are field filtered (dissolved analysis) will be identified with an "-F" in the last field segment. No entry in this segment signifies an unfiltered (total) sample.

Note: If samples are filtered in the field, the results will be segregated in the NUS Operating Unit database according to whether they represent the unfiltered sample or filtered sample. The chain of custody form must be marked to indicate which portion of a sample is filtered. This may be accomplished by appending “-F” to the end of the sample number or by otherwise indicating on the chain of custody form which sample portion is filtered (for dissolved species analysis) as opposed to unfiltered (for total species analysis).

The species identifier must be a two-character alpha field. Several suggested codes are provided in Section 5.3.

The three-digit sample group number will be used to track the number of biota sample groups (a particular group size may be determined by sample technique, media type, the number of individuals caught, weight issues, time, etc.) by species and location. The first sample group of a particular species collected from a

given location will be assigned the sample group number 001, and the second sample group of the same species collected from the same location will be assigned the sample group number 002.

5.3 EXAMPLE SAMPLE FIELD DESIGNATIONS

Examples of each of the fields are as follows:

Site identifier - Examples of site numbers/designations are as follows:

A01 - Area of Concern (AOC) 1
125 - SWMU 125
000 - Base- or facility-wide sample (e.g., upgradient well)
BBG - Base background

The examples cited are only suggestions. Each PM (or designee) must designate appropriate (and consistent) site designations for their individual project.

Sample type - Examples of sample types are as follows:

AH - Ash Sample
AS - Air Sample
BM - Building Material Sample
BSB - Biota Sample Full Body
BSF - Biota Sample Fillet
CP - Composite Sample
CS - Chip Sample
DS - Drum Sample
DU - Dust Sample
FP - Free Product
IDW - Investigation-Derived Waste Sample
LT - Leachate Sample
MW - Monitoring Well Groundwater Sample
OF - Outfall Sample
RW - Residential Well Sample
SB - Soil Boring Sample
SD - Sediment Sample
SC - Scrape Sample
SG - Soil Gas Sample
SL - Sludge Sample
SP - Seep Sample
SS - Surface Soil Sample
ST - Storm Sewer Water Sample
SW - Surface Water Sample
TP - Test Pit Sample
TW - Temporary Well Sample
WC - Well Construction Material Sample
WP - Wipe Sample
WS - Waste/Solid Sample
WW - Wastewater Sample

Sample location - Examples of the location field are as follows:

001 - Monitoring Well 1
N32E92 - Grid location 32 North and 92 East
D096 - Investigation-derived waste drum number 96

Species identifier - Examples of species identifier are as follows:

BC - Blue Crab
GB - Blue Gill
CO - Corn
SB - Soybean

5.4 EXAMPLES OF SAMPLE NOMENCLATURE

A first round monitoring well groundwater sample collected from existing monitoring well 001 at SWMU 16 for a filtered sample would be designated as 016MW00101-F (or without the "-F" if otherwise indicated as to which portion of sample is filtered and which is unfiltered)..

The second round monitoring well groundwater sample collected from existing monitoring well C20P2 at Site 23 for an unfiltered sample would be designated as 023MWC20P202.

The second surface water sample collected from point 01 at SWMU 130 for an unfiltered sample would be designated as 130SW00102.

A surface soil sample collected from grid location 32 North and 92 East at Site 32 at the 0- to 2-foot interval would be designated as 032SSN32E920002.

A subsurface soil sample from soil boring 03 at SWMU 32 at an interval of 4 to 5 feet bgs would be designated as 032SB0030405.

A sediment sample collected at SWMU 19 from 0 to 6 inches at location 14 would be designated as 019SD0140006. The sample data sheet would reflect the precise depth at which this sample was collected.

During biota sampling for full-body analysis, the first time a minnow trap was checked at grid location A25 of SWMU 1415, three small blue gills were captured, collected, and designated with the sample ID of 1415BSBA25BG001. The second time blue gill were collected at the same location (grid location A25 at SWMU 1415), the sample ID would be 1415BSBA25BG002.

Note: No dash (-) or spacing is used between the segments with the exception of the filtered segment. The "F" used for a filtered aqueous sample is preceded by a dash (-F).

Note: It may be more useful for project staff to use feet bgs instead of inches bgs to indicate sediment sampling depths. Whichever units of measure are used for sampling of any matrix, the units must be clearly documented to ensure there is no confusion. Consistency with previous sample nomenclature also will reduce any chance of confusion.

5.5 FIELD QA/QC SAMPLE NOMENCLATURE

Field Quality Assurance (QA)/Quality Control (QC) samples are designated using a different coding system. The QC code will consist of a three- to four-segment alpha-numeric code that identifies the sample QC type, the date the sample was collected, and the number of this type of QC sample collected on that date.

AA	NNNNNN	NN	-F
QC type	Date	Sequence number (per day)	Filtered (aqueous only, if needed)

Note: The "-F" may be omitted from the sample ID if there is another way to definitively indicate on chain of custody forms which portion of a samples is designated for total species analysis (unfiltered samples) and which is designated for dissolved species analysis (filtered samples).

The QC types are identified as:

TB = Trip Blank
RB = Rinsate Blank (Equipment Blank)
FD = Field Duplicate
AB = Ambient Conditions Blank
WB = Source Water Blank

The sampling time recorded on the chain-of-custody form, labels, and tags for duplicate samples will be 0000 so that the samples are "blind" to the laboratory. Notes detailing the sample number, time, date, and type will be recorded on the routine sample log sheets and will document the location of the duplicate sample (sample log sheets are not provided to the laboratory). Documentation for all other QC types (TB, RB, AB, and WB) will be recorded on the QC Sample Log Sheet (see SOP SA-6.3, Field Documentation).

5.6 EXAMPLES OF FIELD QA/QC SAMPLE NOMENCLATURE

The first duplicate of the day for a filtered groundwater sample collected on June 3, 2016, would be designated as FD06031601-F (or without the "-F" if otherwise indicated on the chain of custody form as to which portion of sample is filtered and which is unfiltered).

The third duplicate of the day taken of a subsurface soil sample collected on November 17, 2016, would be designated as FD11171603.

The first trip blank associated with samples collected on October 12, 2016, would be designated as TB10121601.

The only rinsate blank collected on November 17, 2016, would be designated as RB11171601.

6.0 DEVIATIONS

Deviations from instructions specified in this document are allowed but sufficiently accurate and precise descriptions of sample nomenclature must be described in the site-specific planning documents to prevent confusion over sample identification.

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		Effective Date 09/30/016	Revision 3
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	
Subject SITE RECONNAISSANCE		Approved [redacted]	

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1.0 PURPOSE

This guidance describes the collection of general and specific technical information to support project scoping, scheduling, implementing project activities, and writing reports for an environmental investigation.

2.0 SCOPE AND APPLICABILITY

The guidance provided in this document applies to the performance of a site reconnaissance for initial site characterization. It is not a guide for Phase I investigations or for Environmental Baseline Survey activities.

The steps required to develop and carry out a site reconnaissance are presented here. These steps include a list of equipment and items which may be needed, areas of special interest during field observations, and methods by which the field observation team can ensure that necessary and appropriate observations have been made.

3.0 GLOSSARY

Site reconnaissance. An onsite inspection program used to identify site-specific conditions that control scheduling, manpower, and affect costs. A site reconnaissance usually consists of visual observations and, often, the use of field monitoring instruments to identify potential health and safety threats and potential sampling locations for site evaluation during subsequent field investigations.

4.0 RESPONSIBILITIES AND QUALIFICATIONS

Personnel at various levels of qualification may implement this procedure at the direction of the Field operations Leader (FOL). Refer to the HEALTH AND SAFETY section for applicable health and safety requirements.

Project Manager – The Project Manager is responsible for:

- Supervising the retrieval and examination of available, applicable information regarding the site.
- Obtaining appropriate program approvals and ensuring the preparation of a site Health and Safety Plan (HASP) or equivalent for the site reconnaissance.
- Coordinating the field activities with the client and regulatory agencies, as applicable.
- Ensuring that personnel supporting a site reconnaissance are qualified to do so safely in accordance with applicable health and safety requirements.

Field Operations Leader – The FOL is responsible for:

- Ensuring that site surveys are carried out in sufficient detail to satisfy project requirements. To accomplish this, the FOL must assign the proper personnel and equipment to characterize the site adequately, in accordance with the requirements defined in this procedure and best engineering and scientific practices. Examples of other disciplines which may be involved include (but are not limited to): Geology/Hydrogeology, Health and Safety personnel, Ecological Specialists, and Engineering.
- Supervising equipment preparation, including necessary calibrations

- Field data collection and documentation in accordance with the methods described in referenced standard operation procedures.
- Implementing the appropriate health and safety measures; providing site-specific training concerning operation and measures to control anticipated hazards including:
- Serving as a liaison with facility and subcontractor personnel.
- Ensuring compliance with the HASP or equivalent.
- Coordinating site activities so they may be performed in an effective, efficient, and safe manner consistent with the HASP.
- Implementing the buddy system on-site.
- Controlling site entry of unauthorized personnel.
- Ensuring availability of safety equipment and other supplies.
- Providing logistical support for:
    - Potable water for decontamination operations
    - Areas for equipment lay down and storage
    - Communication – Points of Contact
    - Utility clearance support, where applicable
    - Hours of operation

Field Personnel – These personnel are primarily responsible for observing and recording, either through written documentation or photographic evidence, the site reconnaissance. Field personnel will take direction from the FOL. Consult SOP SA-6.3 for requirement specific to photography and the recording of other types of images.

5.0 HEALTH AND SAFETY

The principal elements of the Tetra Tech NUS Operating Unit Health and Safety Program are founded on the requirement that our managers and employees:

- Recognize a personal responsibility for their own health and safety and for actions that affect the health and safety of fellow employees.

- They integrate safety and health into all aspects of their work, with the well-being of themselves and their follow employees as their primary concern.

- That each employee take an active role in the Health and Safety Program by providing input and constructive criticism for the overall improvement of the program.

Accordingly, Tetra Tech and Subcontractor Employees are responsible for:

- Understanding and following directions provided in the project-specific HASP and other project plans and as provided under the direction of the Site Safety Officer (SSO) and/or the FOL. Opportunities will be given to ask questions regarding the information provided in these documents during site-specific training, tail gate and safety meeting sessions. If questions arise outside of these sessions the questions should be raised immediately to the FOL, SSO or Project Manager.

- Reporting unsafe conditions or incidents to the SSO and/or FOL.

- Satisfactorily completing/meeting necessary training and medical surveillance requirements.

- Completing the Medical Data Sheet(s) and providing this information to the SSO. In cases presenting an increased hazard to certain site personnel (such as allergies to bee stings, etc.) site personnel must

carry their doctor-recommended antidote kits and must instruct personnel they work with on the proper use of these devices.

- Attending site-specific training and periodic safety meetings.

6.0 PROCEDURES

6.1 Equipment Items/Needed

Below is a list of items that may be useful when conducting a site reconnaissance. All, or a portion of these items may be required, depending upon the objective of the site reconnaissance.

- Field documents – Work Plan, Sampling and Analysis Plan, and HASP (or equivalent), including an Activity Hazard Analysis (AHAs). It is important that as much detailed history of the site be gathered and made known to all personnel conducting a reconnaissance prior to the start of onsite activities.
- Health and Safety equipment; information; and forms required as required by the SSO.
- Maps (United States [US] Geological Survey [USGS]) quadrangle, geologic maps, street and highway maps, and client facility maps].
- Historical Aerial photography is available from various commercial vendors; client historical files; USGS; US Environmental Protection Agency (USEPA), and National Archives to name a few.
- As-built and/or development drawings
- Geologic tools (e.g., compass, tape measure, hand level, camera)
- Physical and chemical monitoring equipment, if applicable (photoionization detector, immunoassay test kits, radiation survey instruments, etc.)
- Regional publications [USGS reports, water well surveys, US Department of Agriculture (USDA) soil conservation surveys, etc.].
- Site-specific publications by previous investigators (USEPA aerial photographic analyses, remedial investigation reports, data on waste disposal practices, boring logs, etc.).
- Marking items (ink markers, surveyor's flagging, spray paint, pin flags, wooden stakes). Handheld Global Positioning System (GPS) units are recommended to mark or locate specific items; terrain markers/features, debris piles, etc. to allow them to be relocated in the future. When using a handheld GPS unit use the correct coordinate system and always record in a known feature (i.e. monitoring well) when starting and when closing the day's activities.
- Field notebooks/Logbooks.

Note: Obtain area maps and a local telephone book with yellow pages. These tools are useful for identifying contact information for utility companies, and for identifying site trailer locations, living accommodations, etc.) If more expedient to do so, use electronic devices such as a cell phone or computer to conduct an Internet search to obtain this information.

Sufficient time will be required to obtain some of the aforementioned material. In general, most publications can be obtained in time to be used in the site reconnaissance if ordered approximately 2 weeks before the actual site visit takes place.

6.2 Observations

A site reconnaissance usually requires one to two days; however, additional time may be needed depending upon the objective, site size, etc. The following observations, when applicable, should be documented either on a site map, field notebook, or photographed.

- General Site Access/Emergency Access. It should be noted whether site roads provide access to all proposed work locations, or if it will be necessary to prepare access roads with either a backhoe, dozer, chain saws, etc., to get drill rigs, excavators, or other work vehicles to specific locations. If temporary driveways must be constructed from existing public roads, regulatory permits may be required. Military facilities may have specific security requirements which require detailed clearance procedures. Remember when working near or within roadways, emergency access routes must remain open.

- Emergency Assembly/Extraction Location(s). Areas where reconnaissance activities are conducted are often abandoned and local emergency services may not be familiar with the location or correct directions to the area the location. Provide maps, and GPS coordinates to local emergency response personnel. If necessary, post directional signs for first responders. These signs will assure first responders that they are taking the correct path to the area and could prevent confusion.

- Location of the Command Post or Site Trailer and Sanitary Facilities. The ideal location for the site trailer and sanitary facilities is a level area, within an uncontaminated zone, and centralized to provide easy access to work areas on the site. However, certain utility companies may require that the site trailer be placed within a specified radius (usually 100 feet), of the nearest utility pole. Contact the necessary utility companies and inquire about the requirements regarding service before conducting the site reconnaissance. Information that may be required by the utility companies is: type of electric service needed (inquire with trailer vendor for this information); and utility pole number of interest (pole numbers are usually stamped on a brass plate on the pole).

- Potable Water Sources. Local fire departments may allow access to fire hydrants. Private water delivery companies may also be available in the area.

- Locations of suspected Contamination. Drums, tanks, sludge areas, areas of stressed vegetation, fill areas, and leachate seeps may indicate where sources of contamination exist. Filler pipes protruding from the ground surface may indicate the presence of underground storage tanks. Areas where the original ground surface has been reworked may be contaminated fill areas that have since been buried and covered with natural material. Previous environmental investigations may also identify source areas.

- Overland Drainage Routes and Patterns/Topography Maps. Show drainage routes and flow patterns on topographic maps, aerial photographs, and other documents.

- Location of Decontamination Areas and Storage/Disposal Areas for Equipment and Wastes Generated. On complex projects, it may be desirable to segregate these areas by field activity.

- Locations of Surface Water Bodies. The locations of surface water bodies, both man-made and natural, and their relation to topographic highs may give an indication of the groundwater flow direction in the area (groundwater flow typically follows topography with the topographic highs serving as groundwater recharge areas, and the surface waters at topographic lows serve as groundwater discharge areas). Visible signs of contamination, the existence of aquatic life, flow rates, and approximate levels should

also be observed and noted. Check if the surface water bodies could potentially be impacted by field activities. If so, appropriate sedimentation and erosion controls will be required.

- Existing Wells. Existing monitoring wells, or domestic wells within the site and off site, should be noted on a map, and access checked to see if the wells can be used for data collection.

- Outcrops. Outcrops can be useful in providing hydrogeological data (lithologic description, strike and dip information, fracture and joint system analysis, identification of moist zones, etc.). Outcrops may occur naturally or be a part of a man-made feature such as a road-cut.

- Lineaments. A lineament is a straight lengthy feature on the earth's surface which is expressed topographically as a line of depression. Stream beds, vegetation patterns or soil characteristics may be aligned or controlled by this feature. Lineaments are due in some cases to the presence of intense jointing or faults beneath the ground surface. Groundwater in the bedrock may follow lineaments. Lineaments should be noted on site maps and described in the field notebooks.

- Bench or Property Markers. Benchmarks or property markers should be marked with paint or surveyor's flagging if encountered during a site reconnaissance. Surveyors may need to use these markers as a reference point when surveying. Benchmarks are typically a brass plate secured in concrete in the ground with numbering on the top. Property markers can range from a stake driven into the ground to a rock protruding from the ground surface. Facility contacts may also be aware of local benchmarks used during the course of other environmental or public work projects.

- Metal Cultural Effects. Overhead power lines, railroad tracks, junk automobiles, fences, etc. will greatly affect certain geophysical surveys. These features should be noted while conducting a site reconnaissance.

7.0 RECORDS

The data collected during a site reconnaissance may have to be compiled into a trip report when returning from the field. This trip report can then be distributed to the project team. A site reconnaissance checklist is located in Attachment A which can be copied and used while conducting the site reconnaissance.

ATTACHMENT A

SITE RECONNAISSANCE CHECKLIST

SITE SKETCH

Include the following as appropriate:

- Site name
- Site location
- Site boundaries
- Entrance locations
- Access roads and security requirements
- Consider future investigations and how traffic patterns and heavy equipment would be routed into and out of the facility/area.
- Disposal locations
- Unexplained ground depressions
- Storage areas
- Office areas
- Well locations
- Treatment facility locations
- Surface drainage/discharge points, outcrops, general topography descriptions
- Potential or known locations of cultural sites that could interfere with site work.
- Location of utilities – Surface features (overhead lines); surface features (manhole covers; drainage grates; meter boxes, etc.)
- Survey demarcations – Benchmarks vertical and horizontal controls

CHEMICAL STORAGE FACILITIES DESCRIPTION

- Storage tanks - numbers, volumes, condition of tanks and containment structures, contents, etc.
- Consider also piping and utility runs
- Drums - number, types, conditions, labeling; Temporary containers, etc.
- Lagoons and surface pits - number, size, use of liner, contents, etc.
- Location of monitoring wells, where applicable

TREATMENT SYSTEMS

Note the presence of any treatment systems. These can be difficult to evaluate visually. One should appraise general appearance, maintenance and visual integrity; ask operators for any monitoring records; note presence of odors; and visually characterize any effluents or residues. Describe type of wastes and volumes treated.

- Incinerators
- Flocculation/filtration
- Chemical/physical treatment
- Biological treatment
- Volume reduction
- Waste recycling
- Compositing
- Other

ATTACHMENT A
SITE RECONNAISSANCE CHECKLIST
PAGE TWO

DISPOSAL FACILITIES

Note the presence and use of any of the following operations. Include a description of the size, use of liners, soil type, and the presence of leachate. Provide a description of management practices. Interview site workers if possible. Describe waste types.

- Landfills
- Land forms
- Open dump
- Surface impoundment
- Underground injection
- Incineration

Also, records for disposal of concentrated/containerized waste should be reviewed.

HAZARDOUS SUBSTANCE CHARACTERISTICS

Ask facility contacts for manifests, inventories, or monitoring reports. Note markings on containers.

- Chemical identities
- Quantities
- Hazard characteristics (toxic, explosive, flammable, etc.)
- Container markings
- Monitoring data, other analytical data
- Physical state (liquid, solid, gas, sludge)

CHEMICAL PROCESS INFORMATION

- Manufacturing processes and chemicals
- Off-specification or by-product disposal processes
- Housekeeping practices
- Locations of plant operations

ATTACHMENT A
SITE RECONNAISSANCE CHECKLIST
PAGE THREE

HYDROGEOLOGIC ASSESSMENT

Look for situations that promote hazardous substance migration (i.e., porous soils, fractured bedrock formations, shallow water table and karst features).

- Soil type
- Surface water features
- Surface drainage patterns
- Outcrop studies
- Water wells (use, water depth, and construction details)
- Erosion potential
- Flooding potential
- Climatology

IDENTIFICATION OF SENSITIVE RECEPTORS

- Number and locations of private homes
- Public buildings including tenant usage
- Areas of dead or dying vegetation or animals
- Presence of sensitive ecosystems (wetlands, tidal marshes, etc.)
- Other public use areas (roads, parks, etc.)
- Natural areas with suitable receptor habitat

IDENTIFICATION OF RESOURCE SOURCES AND EMERGENCY AID LOCATIONS

- Identify support resources including
  - o Industrial supply locations (Home Depot; Grainger; Walmart, etc.)
  - o Emergency support services
    - – Drive the route to the closest identified hospital/emergency care facility
    - – Contact and meet with identified emergency support personnel.

CONTACT PERSONNEL/INTERVIEW NOTES

- – Collect names and phone numbers of personnel you meet that may have relevant information concerning the site.
- – Based on historical notes, possible disposal practices; spills/releases generate lines of inquiries that may be pertinent to future investigation activities.

HIGH/IMMINENT HAZARDS

During the site reconnaissance identify high hazard operations or features within the facility that may present field personnel with high hazard conditions – Sink holes; dilapidated buildings; buried explosives; unmarked/unidentified containers

[redacted]

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1.0 PURPOSE

The purpose of this procedure is to provide reference information regarding the proper methods for evaluating the physical condition and project utility of existing monitoring wells and determining water levels.

2.0 SCOPE

The procedures described herein are applicable to all existing monitoring wells and, for the most part, are independent of construction materials and methods.

3.0 GLOSSARY

Hydraulic Head - The height to which water will rise in a well.

Water Table - A surface in an unconfined aquifer where groundwater pressure is equal to atmospheric pressure (i.e., the pressure head is zero).

4.0 RESPONSIBILITIES

Site Geologist/Hydrogeologist - Has overall responsibility for the evaluation of existing wells, obtaining water level measurements and developing groundwater contour maps. The site geologist/hydrogeologist (in concurrence with the Project Manager) shall specify the reference point from which water levels are measured (usually a specific point on the upper edge of the inner well casing), the number and location of data points which shall be used for constructing a contour map, and how many complete sets of water levels are required to adequately define groundwater flow directions (e.g., if there are seasonal variations).

Field Personnel - Must have a basic familiarity with the equipment and procedures involved in obtaining water levels and must be aware of any project-specific requirements or objectives.

5.0 PROCEDURES

Accurate, valid and useful groundwater monitoring requires that four important conditions be met:

- Proper characterization of site hydrogeology.
- Proper design of the groundwater monitoring program, including adequate numbers of wells installed at appropriate locations and depths.
- Satisfactory methods of groundwater sampling and analysis to meet the project data quality objectives (DQOs).
- The assurance that specific monitoring well samples are representative of water quality conditions in the monitored interval.

To insure that these conditions are met, adequate descriptions of subsurface geology, well construction methods and well testing results must be available. The following steps will help to insure that the required data are available to permit an evaluation of the utility of existing monitoring wells for collecting additional samples.

5.1 Preliminary Evaluation

A necessary first step in evaluating existing monitoring well data is the study and review of the original work plan for monitoring well installation (if available). This helps to familiarize the site geologist/hydrogeologist with site-specific condition, and will promote an understanding of the original purpose of the monitoring wells.

The next step of the evaluation should involve a review of all available information concerning borehole drilling and well construction. This will allow interpretation of groundwater flow conditions and area geology, and will help to establish consistency between hydraulic properties of the well and physical features of the well or formation. The physical features which should be identified and detailed, if available, include:

- The well identification number, permit number and location by referenced coordinates, the distance from prominent site features, or the location of the well on a map.
- The installation dates, drilling methods, well development methods, past sampling dates, and drilling contractors.
- The depth to bedrock -- where rock cores were not taken, auger refusal, drive casing refusal, or penetration test results (blow counts for split-barrel sampling) may be used to estimate bedrock interface.
- The soil profile and stratigraphy.
- The borehole depth and diameter.
- The elevation of the top of the protective casing, the top of the well riser, and the ground surface.
- The total depth of the well.
- The type of well materials, screen type, slot size, and length, and the elevation/depths of the screen, interval, and/or monitored interval.
- The elevation/depths of the tops and bottom of the filter pack and well seals and the type and size.

5.2 Field Inspection

During the onsite inspection of existing monitoring wells, note the following features and others as appropriate:

- The condition of the protective casing, cap and lock.
- The condition of the cement seal surrounding the protective casing.
- The presence of depressions or standing water around the casing.
- The presence of and condition of dedicated sampling equipment.
- The presence of a survey mark on the inner well casing.

If the protective casing, cap and lock have been damaged or the cement collar appears deteriorated, or if there are any depressions around the well casing capable of holding water, surface water may have infiltrated into the well. This may invalidate previous sampling results unless the time when leakage started can be precisely determined.

The routine physical inspection must be followed by a more detailed investigation to identify other potential routes of contamination or sampling equipment malfunction. Any of these occurrences may invalidate previously-collected water quality data. If the monitoring well is to be used in the future, considerations shown in the steps described above should be rectified to rehabilitate the well.

After disconnecting any wires, cables or electrical sources, remove the lock and open the cap. Check for the presence of organic vapors with a photoionization detector (PID) or flame-ionization detector (FID) to determine the appropriate worker safety level. The following information should be noted (at a minimum):

- Cap function.
- Physical characteristics and composition of the inner casing or riser, including inner diameter and annular space.
- Presence of grout between the riser and outer protective casing and the existence of drain holes in the protective casing.
- Presence of a riser cap, method of attachment to casing, and venting of the riser.
- Presence of dedicated sampling equipment; if possible, remove such equipment and inspect size, materials of construction and condition.

The final step of the field inspection is to confirm previous hydraulic or physical property data and to obtain data not previously available. This includes the determination of static water levels, total well depth and potential well obstructions. This may be accomplished using a weighted tape measure which can also be used to check for sediment (the weight will advance slowly if sediment is present, and the presence of sediment on the weight upon removal should be noted). If sediment is present and/or the well has not been sampled in 12 or more months, it should be redeveloped before sampling.

Lastly, as a final step, the location, condition and expected water quality of the wells should be reviewed in light of their usefulness for the intended purpose of the investigation.

See Attachment A, Monitoring Well Inspection Sheet.

5.3 Water Level (Hydraulic Head) Measurements

5.3.1 General

Groundwater level measurements can be made in monitoring wells, private or public water wells, piezometers, open boreholes, or test pits (after stabilization). Groundwater measurements should generally not be made in boreholes with drilling rods or auger flights present. If groundwater sampling activities are to occur, groundwater level measurements shall take place prior to well purging or sampling.

Measure all groundwater levels to the nearest 0.01 foot, and record the levels in the site geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment B), along with the date and time of the reading.

If not already known, measure the total depth of the well and record this depth. Weather changes that occur over the period of time during which water levels are being taken, such as precipitation and barometric pressure changes, should be noted.

In measuring groundwater levels, ensure that there is a clearly-established reference point of known elevation, which is normally identified by a mark on the upper edge of the inner well casing. To be useful,

the reference point should be tied in with an established USGS benchmark or other properly surveyed elevation datum. An arbitrary datum could be used for an isolated group of wells, if necessary.

Cascading water within a borehole or steel well casings can cause false readings with some types of sounding devices (chalked line, electrical). Oil layers may also cause problems in determining the true water level in a well. Special devices (interface probes) are available for measuring the thickness of oil layers and true depth to groundwater, if required.

Water level measurements should be taken regularly, as required by the site geologist/hydrogeologist. Monitoring wells or open-cased boreholes that are subject to tidal fluctuations should be measured in conjunction with a tidal chart (or preferably in conjunction with readings of a tide staff or tide level recorder installed in the adjacent water body); the frequency of such measurements should be established by the site hydrogeologist. All water level measurements at a site used to develop a groundwater contour map should be made in the shortest practical time to minimize affects due to weather changes.

5.3.2 Water Level Measuring Techniques

There are several methods for determining standing or changing water levels in boreholes and monitoring wells. Certain methods have particular advantages and disadvantages depending upon well conditions. A general description of these methods is presented, along with a listing of various advantages and disadvantages of each technique. An effective technique shall be selected for the particular site conditions by the site geologist/hydrogeologist.

In most instances, preparation of accurate potentiometric surface maps require that static water level measurements be obtained to a precision of 0.01 feet. To obtain such measurements in individual accessible wells, electrical water level indicator methods have been found to be best, and thus should be utilized. Other, less precise methods, such as the popper or bell sound, or bailer line methods, should be avoided. When a large number of (or continuous) readings are required, time-consuming individual readings are not usually feasible. In such cases, it is best to use a pressure transducer.

5.3.3 Methods

Water levels may be measured by several different techniques, but the same steps should be followed in each case. The proper sequence is as follows:

1. Check operation of recording equipment above ground. Prior to opening the well, don personal protective equipment, as required. Never remove an air-tight lock (such as a J-plug) with your face over the well. Pressure changes within the well may explosively force the cap off once loosened.

2. Record all information specified below in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet (Attachment B):

    - Well number.
    - Water level (to the nearest 0.01 foot). Water levels shall be taken from the surveyed reference mark on the top edge of the inner well casing. If the J-plug was on the well very tightly, it may take several minutes for the water level to stabilize.
    - Time and day of the measurement.
    - Thickness of free product if present.

Water level measuring devices with permanently marked intervals shall be used. The devices shall be free of kinks or folds which will affect the ability of the equipment to hang straight in the well pipe.

5.3.4 Water Level Measuring Devices

Electric Water Level Indicators

These are the most commonly used devices and consist of a spool of small-diameter cable and a weighted probe attached to the end. When the probe comes in contact with the water, an electrical circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contact.

There are a number of commercial electric sounders available, none of which is entirely reliable under all conditions likely to occur in a contaminated monitoring well. In conditions where there is oil on the water, groundwater with high specific conductance, water cascading into the well, steel well casing, or a turbulent water surface in the well, measuring with an electric sounder may be difficult.

For accurate readings, lower the probe slowly into the well adjacent to the survey mark on the inner well casing. The electric tape is read (to the nearest 0.01 ft.) at the measuring point and recorded where contact with the water surface was indicated.

Popper or Bell Sounder

A bell- or cup-shaped weight that is hollow on the bottom is attached to a measuring tape and lowered into the well. A "plopping" or "popping" sound is made when the weight strikes the surface of the water. An accurate reading can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight strikes the water. This method is not sufficiently accurate to obtain water levels to 0.01 feet, and thus is more appropriate for obtaining only approximate water levels quickly.

Pressure Transducer

Pressure transducers can be lowered into a well or borehole to measure the pressure of water and therefore the water elevation above the transducer. The transducer is wired into a recorder at the surface to record changes in water level with time. The recorder digitizes the information and can provide a printout or transfer the information to a computer for evaluation (using a well drawdown/recovery model). The pressure transducer should be initially calibrated with another water level measurement technique to ensure accuracy. This technique is very useful for hydraulic conductivity testing in highly permeable material where repeated, accurate water level measurements are required in a very short period of time. A sensitive transducer element is required to measure water levels to 0.01 foot accuracy.

Borehole Geophysics

Approximate water levels can be determined during geophysical logging of the borehole (although this is not the primary purpose for geophysical logging and such logging is not cost effective if used only for this purpose). Several logging techniques will indicate water level. Commonly-used logs which will indicate saturated/unsaturated conditions include the spontaneous potential (SP) log and the neutron log.

5.3.5 Data Recording

Record water level measurements, time, data, and weather conditions in the geologist/hydrogeologist's field notebook or on the Groundwater Level Measurement Sheet. All water level measurements should be measured from a known reference point (see Section 5.3.1). The reference point is generally a marked point on the upper edge of the inner well casing that has been surveyed for an elevation. The exact reference point should be marked with permanent ink on the casing since the top of the casing may not be entirely level. It is important to note changes in weather conditions because changes in the barometric pressure may affect the water level within a well.

5.3.6 Specific Quality Control Procedures for Water Level Measuring Devices

All groundwater level measurement devices must be cleaned before and after each use to prevent cross contamination of wells. Manufacturer's instructions for cleaning the device should be strictly followed. Some devices used to measure groundwater levels may need to be calibrated. These devices should be calibrated to 0.01 foot accuracy and any adjustments/corrections should be recorded in the field logbook/notebook. After the corrections/adjustments are made to the measuring device and entered in the field logbook/notebook, the corrected readings should be entered onto the Groundwater Level Measurement Sheet (Attachment B). Elevations will be entered on the sheet when they become available.

5.4 Equipment Decontamination

Equipment used for water level measurements provide a mechanism for potentially cross contaminating wells. Therefore, all portions of a device which project down the well casing must be decontaminated prior to advancing to the next well. Decontamination procedures vary based on the project objectives but must be defined prior to conducting any field activities including the collection of water level data. Consult the project planning documents and SA-7.1 Decontamination of Field Equipment.

5.5 Health and Safety Considerations

Groundwater contaminated by volatile organic compounds may release toxic vapors into the air space inside the well pipe. The release of this air when the well is initially opened is a health/safety hazard which must be considered. Under certain conditions, air-tight well caps may explosively fly off the well when the pressure is relieved. Never stand directly over a well when uncapping it.

Perform and initial monitoring of the well headspace and breathing zone concentrations using a PID or FID to determine required levels of protection.

6.0 RECORDS

Record all field procedures, tests and observations in the site logbook or designated field notebook. Entries in the log/notebook should include the individuals participating in the field effort, and the date and time. The use of annotated sketches may help to supplement the evaluation.

ATTACHMENT A
MONITORING WELL INSPECTION SHEET **(EXAMPLE)**

Monitoring Well Inspection Sheet

Project Name: _____ Date: _____

Location: _____ Time: _____

Tidally Influenced: Y / N Personnel: _____

Field Measurements				
Well ID	PID Reading PPM	Depth to Water *	Total Depth *	Flush Mt./ Stick-up

Well Construction Details (Taken from construction logs)		
Total Depth *	Ground Elev.	Top/Btm Screen *

Check List:

Riser Pipe Material:
Riser Notched for Surveyors:
Well ID Tag In-place:
Well security:
Photo taken:

Condition of Well:

Protective Case:
Riser:
Well Pad:
Other:

Presence/Evidence of:

Standing Water Around Well:
Existing Sampling Equipment:
Sediment build-up in Well Btm:

Comments:

** = Measurements are from the top of the inner case to the nearest 0.01'*

ATTACHMENT B
GROUNDWATER LEVEL MEASUREMENT SHEET (EXAMPLE)

Tetra Tech

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: _____ **Project No.:** _____
Location: _____ **Personnel:** _____
Weather Conditions: _____ **Measuring Device:** _____
Tidally Influenced: Yes ___ No ___ **Remarks:** _____

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Comments

* All measurements to the nearest 0.01 foot, from surveyed mark (unless noted)

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1 STANDARD SIZES OF CORE BARRELS AND CASING 15

1.0 PURPOSE

This guidance describes the methods and equipment necessary to safely perform soil and rock boring and identify the equipment, sequence of events, and appropriate methods necessary to obtain soil, both surface and subsurface, and rock samples during field sampling activities.

2.0 SCOPE

This guidance describes most of the accepted and standard drilling techniques, their benefits, and drawbacks. In doing so, the guidance applies to all Tetra Tech NUS Operating Unit staff when performing these types of drilling. Project Managers should consult Senior Geologists on staff to determine project objectives and the best type of drilling to be employed to meet those objectives.

3.0 GLOSSARY

Lithology - 1) the study of rocks; 2) the character of a rock formation; *also*: a rock formation having a particular set of characteristics.

Hydrogeology – A branch of geology that deals with the occurrence, distribution, and effects of groundwater.

Bedrock – The solid rock underlying unconsolidated surface materials (as soil)

Overburden – Unconsolidated material overlying bedrock

4.0 RESPONSIBILITIES

Project Manager (PM) – Responsible for overall project direction and execution in coordination with the client and project team. Responsible for identifying key staff needs and resulting makeup of the project support staff.

Project Geologist (PG) - In consultation with the Project Manager, the Project Geologist is responsible for developing drilling requirements for a site and specifying drilling techniques that will likely be most successful given the study objectives and the known or suspected geologic conditions at the site. The PG also provides guidance during drilling activities and plays a role in determining the disposal methods for products generated during drilling, such as drill cuttings, drilling fluids and well development water, as well as any specialized supplies or logistical support required for the drilling operations.

Field Operations Leader (FOL) - The FOL is responsible for overall coordination and execution of the field program in accordance with project planning documents and for communication from the field to the project manager and other key staff. May be the Site Geologist, or other senior technical staff.

Site Geologist - The Site Geologist is responsible for ensuring that standard and approved drilling procedures are followed while drilling is occurring onsite. The Site Geologist will generate a detailed boring log for each test/borehole drilled in accordance to SOP GH-1.5.

The person assigned to this position is responsible for oversight (monitoring and inspecting) the drilling operations. These responsibilities may be filled by other geotechnical personnel, such as soils and foundation engineers, civil engineers, etc.

Determination of the exact location for borings is the responsibility of the Site Geologist. There are times when the exact drilling location is determined in the field for a variety of reasons such as utility avoidance, trees, or physical barriers resulting in small changes in location. However, if the proposed drilling location needs to be moved a significant distance that could compromise the ability to achieve project objectives,

the project manager must be contacted. The final location for drilling must be properly documented in the field note book. The general area in which the borings are to be located will be shown on a site map included in the Work Plan and/or Sampling and Analysis Plan.

Drilling Subcontractor - Operates under the supervision of the FOL and/or the Site Geologist. Subcontractors are responsible for obtaining all drilling permits and clearances, and supplying all services (including labor), equipment and material required to perform the drilling, testing, and well installation in accordance with their scopes of work. The Drilling Subcontractor is also responsible for maintenance and quality control of required equipment.

The Drilling Subcontractor shall be licensed in the State/Territory where the drilling is to occur and will be required to meet certain performance requirements to perform such duties pending state requirements.

The Drilling Subcontractor is responsible for providing equipment (drill rig and drilling components – auger flights, drill rods, etc.) that are in safe operating condition. Tetra Tech field staff on site will inspect the drill rig and components in an effort to ensure no one is injured due to faulty equipment, and the equipment to be employed is clean and free from potential contamination.

The Drilling Subcontractor is responsible for providing fully capable staff knowledgeable in the operation of the equipment to safely support the drilling operation in accordance with project-specific drilling specifications, Tetra Tech direction, and State/local requirements. Generally, the staff will be comprised of a Licensed Driller and one to two Driller Helper(s) per drill rig.

The Drilling Subcontractor works closely with the Site Geologist and/or the FOL during all drilling and well construction activities to document the process and ensure borings and/or well installations proceed according to prescribed specifications.

The Drilling Subcontractor is responsible for following safety and decontamination procedures specified in the project drilling specification. Upon completion of the work, the Drilling Subcontractor is responsible for demobilizing all equipment, cleaning up any materials deposited on site during drilling operations, and properly backfilling any open borings.

5.0 PROCEDURES

5.1 General

The purpose of drilling boreholes is to support subsurface investigations which may include but not be limited to the following:

- Groundwater and soil remediation
- Site characterization of soil and groundwater; nature and extent of contamination, groundwater flow characteristics, etc.
- Geotechnical and civil engineering characterization
- Geothermal applications

Equipment Inspection – Drilling equipment, drill rigs and support equipment shall be inspected by the Site Geologist or other “Competent Person” to ensure the rig shall meet the operational rigors, but also to ensure no one gets injured using faulty or substandard equipment. The equipment inspections should be done before the work begins and after major maintenance which required retooling or replacement of parts.

These inspections are documented in accordance with the project specific health and safety plan (HASP) or equivalent. The Drilling Subcontractor will be required to perform a Daily Walk around to ensure all systems are functioning as intended. These Daily Walk arounds shall be documented in the Site Log Book.

The Drilling Subcontractor will be responsible for testing emergency stop devices daily.

Utility Clearances

The Drilling Subcontractor is typically responsible for initiating the State One-Call service for utility avoidance in accordance with State law. However, in some states, the prime contractor i.e., Tetra Tech, could alternatively make the One-Call arrangements. This law can vary from state to state therefore prior to the making the call to the One-Call service, the responsible party needs to be identified during the contracting process. In additional to the required One-Call service, a private utility locating contractor can be used to insure that privately owned buried utilities are avoided during the drilling operations. See SOP HS-1.0 for further guidance regarding utility avoidance procedures.

Decontamination

Geotechnical drilling commonly requires water rinse for the split barrel samplers and drilling tools, or simple cleaning using a wire brush to get excess soil off the tools primarily to make working with the tools trouble free.

Where subsurface contamination may exist, the drilling and sampling equipment will be cleaned prior to arrival on site, and between samples and borings using appropriate decontamination procedures as outlined in project documents or as specified in SOP SA-7.1 for environmental drilling work.

Documentation

All borings generally must be logged by the Site Geologist to document lithologic conditions as the borings are advanced (see SOPs SA-6.3 and GH-1.5). Situations not requiring logging include but are not limited to:

- Installation of multiple well points within a small area, or
- A "second attempt" boring adjacent to a logged boring that could not be continued through resistant material.

When in doubt regarding the need for logging consult the PM or Site Geologist.

5.2 Drilling Methods

The selected drilling methods described below are commonly used in environmental and geotechnical drilling and apply to drilling in subsurface materials, including, but not limited to, sand, gravel, clay, silt, cobbles, boulders, bedrock, and fill. Drilling methods should be selected after studying the site geology and terrain, the waste management requirements for the site, and reviewing the purpose of drilling and the overall subsurface investigation program objectives proposed for the site. The full range of different drilling methods applicable to the proposed program should be identified with final selection based on relative cost, availability, time constraints, and how well each method meets the sampling and testing requirements of the individual drilling program. Maximum depth capabilities vary based on the drilling method, size of the drill rig, borehole diameter needed, and the nature of the subsurface material.

5.2.1 Continuous-Flight Hollow-Stem Auger Drilling

This method of drilling consists of rotating augers with a hollow stem into the ground by attaching five foot long flights as the drilling proceeds downward, creating a continuous drill string that is opened to the bottom. The lead auger has a cutting bit that can be replaced or removed for repair as the cutting teeth wear down. Common inside diameters (inches) are 3¼, 4½, 6⅝, 8¼, and 10¼ with nominal outside diameters of 7, 8, 10, 12, and 15 inches, respectively. Cuttings are brought to the surface by the rotating action of the augers. A center or pilot bit is typically attached to a drill or sampling rod string, and is used inside the hollow stem auger drill string while the augers are advanced downward to minimize residual soils entering the inside of the augers. The sampling rods are withdrawn from the augers when a soil (or groundwater) sample is to be collected, or the boring is to be converted to a well. The same rods are used to collect a sample, by removing the center bit and attaching the sampling tool, which is then lowered into the augers and advanced into the undisturbed material beyond the lead auger. Sampling tools include but are not limited to split barrel samplers and thin walled tubes (i.e., Shelby tubes). Well installations are done in accordance with SOP GH-2.8. This drilling method is relatively quick and inexpensive and hollow stem auger drill rigs are readily available and common. Characteristics of this type of drilling include:

- Undisturbed samples can be obtained using drill rods and a cable winch without pulling the augers out of the hole.
- Generally no drilling fluids are required.
- A well can be installed inside the hollow stem auger string and backfilled as the augers are withdrawn.
- Hollow stem auger drilling can only be done in unconsolidated materials.
- The inside diameter (ID) of hollow stem augers used for well installation should be at least 2 inches greater than the well casing. However, it is recommended that the ID of the augers be 4 inches greater than the well casing to ensure proper placement of the well and annular backfill materials.
- The maximum effective depth for drilling is approximately 150 feet, depending on site conditions, the size of augers used, and drill rig capability. In many cases it is difficult to reach a depth greater than approximately 80 feet with this method.

When drilling through clean sand formations below the water table, the sand may flow upward into the hollow stem when the center bit is removed for soil sampling or well installation. Water may be added to the auger string in an attempt to mitigate the sand flowing up into the augers. This method is effective for water table well installation i.e. minimal depth of 5 to 8 feet below the saturated zone, however when the desired total depth is well below the water table, water may not be dense enough to prevent the sand from flowing upward, therefore drilling mud may be added to the drill string to prevent running sands. This is an undesirable procedure and should be avoided if possible. If the condition of "running" or "flowing" sands is persistent at a site, an alternative method of drilling is recommended. Direct push technology (DPT), rotosonic or mud rotary drilling methods are effective under these conditions.

Hollow-stem auger drilling is an effective method of drilling for standard penetration testing, soil sample collection for chemical analysis, and for installation of wells with a diameter ranging from 2 to 6-inches. Direct push technology is the preferred method of drilling for soil sampling and smaller well installation of less than 2-inch diameter. HSA drill rigs can also be retro-fitted for air hammer rotary (limited) or rock coring.

The use of HSA presents a number of safety challenges that the FOL and/or the Site Geologist must contend with and these will be addressed in the project health and safety plan (HASP). If on-site personnel

should identify any hazards not addressed in the HASP, the FOL will contact the Project Manager and the site health and safety officer to remedy the deficiency.

5.2.2 Continuous-Flight Solid-Stem Auger Drilling

This drilling method is similar to hollow-stem auger drilling and is not commonly used. It is generally recommended that this method be avoided when procuring a drilling subcontractor. Practical application of this method is severely restricted compared to use of hollow-stem augers. Split-barrel (split-spoon) sampling cannot be performed without pulling the augers out, which may allow the hole to collapse. Also, augers would have to be withdrawn before installing a monitoring well, which again, may allow the hole to collapse. Furthermore, geologic logging by examining the soils brought to the surface is unreliable, and depth to water may be difficult to determine while drilling. This type of drilling is sometimes used to install protective bollards around a well.

5.2.3 Air and Fluid Rotary Drilling

Direct rotary drilling includes air-rotary and fluid-rotary drilling. For air or fluid-rotary drilling, the rotary drill may be advanced to the desired depth by any power-operated drilling machine having sufficient torque and ram range to rotate and force the bit to the desired depth. Prior to well installation or soil sampling, any settled drill cuttings and geologic formation water in the borehole should be flushed and removed to obtain the desired installation depth. The total depth of the hole should be measured with a weighted tape measure just after the drill string is removed and just prior to well installation, i.e., lowering the well materials or casing into the hole.

Air Rotary

In air-rotary drilling the drill rig simultaneously turns and exerts a downward pressure on the drilling rods and bit while circulating compressed air down the inside of the drill rods, around the bit, and out the annulus of the borehole. Air circulation serves to both cool the bit and remove the cuttings from the borehole. There are three types of bits commonly used for air rotary drilling. The most aggressive technique is to use a down-the-hole (DTH) drill, air-actuated hammer (air hammer), which is basically a mini jackhammer attached to the bottom of a drill string and hammers and pulverizes the rock with downward force, rotary motion, and compressed air applied to the hammer tool. The other type of bits are drag and roller type which are slower and use the rotary action to grind up the rock. Roller bits are also commonly used to install casings in the overburden prior to bedrock drilling.

Characteristics of this method include:

- The drilling rate is high for the air rotary technique, and large rigs with 20 foot drill rods can achieve up to 400 feet a day in sedimentary rock.
- The cost per foot of drilling is relatively low.
- Air-rotary rigs are common in most areas. HSA and DPT rigs can be retro fitted to do DTH air rotary drilling with the proper fittings and adequately sized air compressor.
- No drilling fluid is required (except when water is injected to keep down dust).
- Bits are available in diameters ranging from 4 to 24-inches to accommodate a wide range of project needs.
- Geologic formations must be logged from the cuttings that are blown to the surface and thus the depths of materials logged are approximate.

- Air blown into the formation during drilling may "bind" the formation and impede well development and natural groundwater flow.

- Temporary or permanent surface casing is needed in the overburden when conducting bedrock drilling with this method.

- Large amounts of dust are generated, potentially exposing personnel to contaminants in the soil or bedrock; crystalline silica; or respirable and total dusts. The use of cyclones with properly installed air hoses are an effective means to minimize air born particles and containerize the drill cuttings and fluid mixture.

- Noise – Due to the compression and release of air (clearing the borehole) noise levels associated with this type of drilling are generally excessive and hearing protection is required for the drill operators and the Site Geologist.

- Pressurized systems – Air and hydraulic – The air and hydraulic lines operate at extreme pressure. Ensure all lines are:

    - Mechanical (threaded) or have pins and whip checks to prevent thrashing should a pressurized line become disconnected.

    - Checked for leaking. Look for staining and use a material such as cardboard to determine whether a high pressure hydraulic line is leaking. DO NOT USE YOUR GLOVED HAND because, at high pressure, the fluid can be injected through your glove and skin into your body.

    - Examined thoroughly for structural defects – Replace as necessary.

Fluid Rotary

Fluid-Rotary drilling operates in a similar manner to air-rotary drilling except that a drilling fluid ("mud") or clean water is used in place of air to cool the drill bit and remove cuttings. There is a variety of fluids that can be used with this drilling method, including bentonite slurry and synthetic slurries. If a drilling fluid other than water/cuttings is used, it must be a natural clay (i.e., bentonite) and National Science Foundation (NSF) certified. Mud rotary is an effective drilling method for split spoon sampling, well installation, and downhole geophysical logging.

Characteristics of the fluid-rotary drilling method include:

- Commonly used in unconsolidated formations known for running sands.

- High drilling rates and inexpensive relative to sonic drilling.

- Split-barrel (split-spoon) samples can be obtained without removing drill rods if the appropriate size drill rods and bits (i.e., fish-tail or drag bit) are used.

- Temporary surface casing should be installed to 5 to 20 feet, depending on the makeup and depth of surface materials, to minimize drill fluid losses.

- Drill rigs are readily available.

- Drilling fluids temporarily reduce permeability of the geologic formation adjacent to the boring to some degree, and require appropriate well development in accordance with SOP GH-2.8.

- No information on depth to water is obtainable while drilling. Though water producing zones can be detected based on mud thickness observations.

- There can be some question about the effects of the drilling fluids on subsequent water samples obtained. For this reason as well, appropriate well development is required in accordance with SOP GH-2.8.

- In very porous materials (i.e., rubble fill, boulders, and coarse gravel) drilling fluids may be continuously lost into the formation. This requires either constant replenishment of the drilling fluid, or the use of casing through this formation.

- Drill rigs must be equipped with properly sized circulation pumps to insure flow through the bore hole to clean out the cuttings.

In all cases record volumes and types of additives onsite on the chemical inventory list; ensure they are properly labeled per GHS 2012, and SDSs are onsite and available to all personnel.

5.2.4 Rotosonic Drilling

5.2.4.1 Rotosonic Methodology

The Rotosonic drilling method employs a high frequency, 50 to 150 Hz, vibrational energy that is transferred to the drill string and down to the cutting shoe. The frequency is adjusted so the drill string resonance frequency is obtained and causes the material along the drill pipe to liquefy, allowing the pipe to move when low speed rotational motion coupled with downward pressure is applied. This produces a uniform borehole while providing a continuous, undisturbed core sample of unconsolidated formations. When coring into sedimentary bedrock, many of the primary rock features are destroyed, such as fracturing, moisture content, and hardness. The fine grain rock types, such as clay and mudstones are liquefied and become unconsolidated. Rotosonic drilling advances a 4-inch diameter core barrel for sampling and can advance up to a 12-inch diameter outer casing for the construction of standard and telescoped monitoring wells. During drilling, the core barrel is advanced ahead of the outer casing in increments of 5 to 10-feet, depending on rig type and setup.

The outer casing can be advanced at the same time as the inner drill string and core barrel, or advanced down over the inner drill rods and core barrel, or after the core barrel has moved ahead to collect the undisturbed sample and has been pulled out of the borehole. The outer casing can be advanced dry in a few cases, though most commonly is advanced with water depending upon the formations being drilled, the depth and diameter of the hole, or requirements of the project.

The boreholes for larger wells 6 to 8 inch installation require multiple runs i.e., reaming the hole to get to the desired borehole diameter. For example, to install a 6-inch well the drilling would start with 4 by 6-inch drill pipe combination (this is the core barrel and drill pipe diameters), then reaming with an 8-inch drill pipe over the 6-inch pipe. The 6-inch pipe would be withdrawn after the 8-inch drill pipe reaches the desired depth. A 10- or 12-inch pipe could be over drilled around the 8-inch pipe. When the 10 or 12-inch pipe reaches the desired depth the 8-inch pipe would be withdrawn. Then the well would be installed into the largest pipe. This process generates large quantities of water. If isolation of upper water bearing zones is not a concern, mud rotary drilling can be a good alternative to this method in unconsolidated materials.

Characteristics of this method include:

- Sampling and well installation are faster compared to HSA drilling methods.
- Continuous sampling, with larger sample volume as compared to split-spoon sampling.
- The ability to drill through difficult formations such as cobbles or boulders, hard till and bedrock (to some extent).
- The ability to mitigate heaving sand issues.
- Well installations are quick and controlled by elimination of potential bridging of annular materials during well installation, because of to the ability to vibrate the outer casing during removal and seat the sand or filter pack.
- The cost of Rotosonic drilling as compared to other methods is generally higher. Rotosonic drilling commonly requires the use of large quantities of water to advance the drill string and produces investigation derived waste (IDW) comprising a large amount of liquid mixed with solids.
- Rotosonic drill rigs are available in several sizes. The large rigs are mounted on trucks and commonly use 10- to 20-feet long tools, with 10-foot long sample core barrel. Track mount rigs are available in different sizes also.

5.2.5 Casing Advancement Drilling

This drilling method consist of a down-hole air hammer system that is designed to advance casing during drilling. There are many systems used for this drilling method, Odex, Stratex, and Tubex are some examples of the system trade names available for this type of drilling. It uses a swing-out eccentric percussion bit to ream the hole beyond the bottom of the casing. The percussion bit is a multi-piece bit consisting of a concentric pilot bit behind which is an eccentric second bit that swings out to enlarge the borehole diameter. Immediately above the eccentric bit is a drive sub that engages a special internal shouldered drive shoe on the bottom of the casing. The casing is thus pulled down by the drill stem as the hole is advanced. Cuttings blow up through the drive sub and casing annulus to a swivel connecting them to a sample collector or onto the ground. Upon reaching a desired depth the eccentric bit can be retrieved leaving the casing in place for sampling, well installations, or additional drilling beyond the casing. When the bore-hole is complete, the casing is retrieved to be used again. This method can also be used for permanent casing installation. The temporary casing is typically machine threaded and design to be reused. The permanent casing is typical casing pipe, welded sections, as the borehole is advance to the desired depth.

Important characteristics are:

- No use of drilling mud.
- Medium penetration rate.
- Mitigation of caving in very loose unconsolidated materials such as mine spoils with a high risk of caving.
- Can be used in unconsolidated and consolidated formations utilizing a DTH hammer.

- Alternative method when HSA and air rotary drilling have problems with unstable materials such as mine spoils with cobbles and gravels.

- Temporary casing extraction can be difficult

5.2.6 Jet Drilling (Washing)

Jet drilling, which should be used only for piezometer or vadose zone sampler installation, consists of pumping water or drilling mud downward through a small diameter (1/2- to 2-inch) standard pipe (steel or polyvinyl chloride). The pipe may be fitted with a chisel bit or a special jetting screen. Formation materials dislodged by the bit and jetting action of the water are brought to the surface through the annulus around the pipe. As the pipe is jetted deeper, additional lengths of pipe may be added at the surface. This method is rarely used today because DPT rigs have become stronger and more versatile in their capabilities. The limitation of this method far exceed the advantages making this method outdated.

5.2.7 Direct Push Technology (DPT) Drilling

Direct Push Technology is one of the most common drilling method used for projects that require soil sampling and small diameter well installation. The rigs are mounted on several type of vehicles, trailer, track, 4-wheel truck, and covered panel trucks. All-terrain vehicles (ATVs) can be supported with utility type off road vehicles because of the compact type tooling. Minimal IDW is generated, and decontamination waste also is limited because of the compact size of the tooling. Refer to Tetra Tech SOP SA-2.5 for DPT guidance.

5.2.8 Rock Coring Drilling

The rock coring drilling method is used to obtain an undisturbed rock core sample for detailed rock description for hydrogeologic or geotechnical purposes. The core drilling is done by rotating and applying downward pressure to drill rods and drill bit. The drill bit is a circular, hollow, diamond-studded bit attached to the outer core barrel in a double-tube core system. Water is circulated down through the drill rods and annular space between the core barrel tubes to cool the bit and remove the cuttings. The bit cuts a core out of the rock which rises into an inner barrel mounted inside the outer barrel.

Rock core borings are made through surface casing or hollow stem augers. The surface casing is seated into the rock formation to prevent seepage from the overburden into the hole to be cored. Alternatively, hollow stem augers are advanced until split spoon refusal or auger refusal is encountered.

There are two ways to do rock core drilling: conventional and wireline. The main difference is how the core sample is recovered after the inner core barrel is full.

In conventional drilling, the entire drill string is pulled out of the bore hole for each drilling cycle or run. This means that all the drill rods must be removed from the hole and the drill rods must be taken apart and rejoined for each core sample.

In wireline core drilling, a piece of equipment called an overshot is sent down the outer drill tube to release and retrieve the core barrel. The overshot and core barrel are then brought up to the surface using a wireline hoist, allowing the outer tube and core bit to remain in the hole. The rock core is then withdrawn from the core barrel, then the emptied core barrel is lowered down and locked into place using the wireline hoist. Additional rods are then attached to the drill string to advance the hole deeper to continue coring. The wireline method is more common as it is more efficient and safe.

When coring rock, including shale and claystone, the speed of the drill and the drilling pressure, amount and pressure of water, and length of run can be varied to provide maximum recovery from the rock being

drilled. When soft or broken rock is encountered, the length of core runs should be reduced to 5 feet or less to avoid core loss and minimize core disturbance. The most common core barrel diameters are listed in Attachment A.

Characteristics of core drilling include:

- Undisturbed rock cores can be recovered for examination and/or testing.
- In formations in which the cored hole will remain open without casing, water from the rock fractures may be recovered from the well without the installation of a well screen and gravel pack.
- Geologic formation logging is extremely accurate.
- Drill rigs can be relatively small and mobile.
- Water is needed for drilling.
- Coring is much slower than air rotary drilling (and more expensive).
- Depth to water cannot accurately be determined if water is used for drilling.
- The size of the borehole is limited.
- This drilling method is useful if accurate determinations of rock lithology are desired or if open wells are to be installed into bedrock. To install larger diameter wells in core holes, the hole must be reamed out to the proper size after coring, using other methods suitable for drilling bedrock.

5.2.9 Rock Core Handling, Preparation and Documentation

After rock coring has been completed and the rock core is recovered, the rock core shall be carefully removed from the core barrel and placed into a core box (previously labeled with the depth of the top and bottom of the core run the Drilling Subcontractor will communicate these depths), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). Each core shall be handled, prepared, described, classified, and logged in accordance with SOP GH-1.5

See Health and Safety concerns for Air and Fluid rotary drilling procedures as these address the predominant hazards.

5.2.10 Drilling & Support Vehicles

In addition to selecting the drilling method(s) required to accomplish the objectives of the field program, the type of vehicle carrying the drill rig and/or support equipment and its suitability for the site terrain, will often be an additional factor to consider in planning the drilling program. Most large Drilling Subcontractors will have a wide variety of vehicle and drill types suited for most drilling assignments in their particular region, while smaller drilling subcontractors will usually have a fleet of much more limited diversity. The weight, size, and means of travel (tires, tracks, etc.) of the drill rig must be selected to be compatible with the site terrain to assure adequate mobility between borehole locations. Such considerations also apply to necessary support vehicles used to transport water and/or drilling materials to the drill rigs at the borehole locations. When the drill rigs or support vehicles do not have adequate mobility to easily traverse the site, provisions must be made for assisting equipment, such as bulldozers, winches, timber planking, etc., to maintain adequate progress during the drilling program.

Some of the typical vehicles which are usually available for drill rigs and support equipment are:

- Skid-mounted drilling equipment containing a rotary drill or engine-driven cathead (to lift hammers and drill string), a pump, and a dismounted tripod. The skid is pushed, dragged, or winched (using the cathead drum) between boring locations. This type of drilling equipment is rarely used today because of the associated hazards and the availability of DPT drilling options.

- Drilling equipment mounted on an ATV or utility terrain vehicle (UTV), Jeep, stake body or other light truck (4 to 6 wheels), upon which are mounted the drill and/or a cathead, a pump, and a tripod or small drilling derrick. On some rigs, the drill and/or a cathead are driven by a power take-off from the truck, instead of by a separate engine. This type of drilling equipment is rarely used today because of the associated hazards and the availability of DPT drilling options.

- Track-mounted drilling equipment for traversing soft ground. Sometimes a continuous-track ATC is also modified for this purpose. Some types of tracked drill rigs are called "bombardier" or "weasel" rigs. Most of today's ATV rigs are mounted on track type vehicles because of the light weight and versatility, some of the larger rigs are mounted on rubber tired ATV vehicles.

- Heavy truck-mounted drilling equipment is mounted on tandem or dual tandem trucks to transport the drill, derrick, winches, and pumps or compressors. Large auger, hydraulic rotary, and reverse circulation rotary drilling equipment are usually mounted on such heavy duty trucks. For soft-ground sites, the drilling equipment is sometimes mounted on vehicles having low ground pressure, very wide diameter tires and capable of floating; these vehicles are called "swamp buggy" rigs.

- Marine drilling equipment is mounted on various floating equipment for drilling borings in lakes, estuaries and other bodies of water. The floating equipment varies, and is often manufactured or customized by the drilling subcontractor to suit specific drilling requirements. Typically, the range of flotation vehicles include:

    - Barge-mounted drill rigs.
    - Jack-up platforms - drilling equipment mounted on a floating platform having retractable legs to support the unit on the sea or lake bed when the platform is jacked up out of the water.

- Flatbed support vehicle with a crane (referred to as a "tender"). This truck provides support to large air or mud rotary operations to handle additional drill rods beyond the drill rigs on-board capacity, Also used to transport well installation supplies such as, cement, concrete, rise and screen materials.

In addition to the mobility for the drilling equipment, similar considerations must be given for equipment to support the drilling operations. Such vehicles or floating equipment are needed to transport drill water, drilling supplies and equipment, samples, drilling personnel, etc. to and/or from various boring locations.

5.2.11 Equipment Sizes

Each of the drilling methods described in this procedure has its size limitations (bore hole diameter and depth), therefore prior to any selection of a drilling method the project objectives need to be clearly identified so that the type of drilling method selected will meet those expectations. In planning subsurface exploration programs, care must be taken in specifying the various drilling components, so that they meet the project objectives. The potential Drilling Subcontractors may have experience drilling in the project area, and can provide helpful information when selecting equipment for a project.

5.2.12 Drilling Progress

To estimate the anticipated rates of drilling progress for a site, the following must be considered:

- The speed of the drilling method employed.
- Applicable site conditions (e.g., terrain, mobility between borings, difficult drilling conditions in unstable soils with boulders, cobbles, gravels, rubble fill, mine spoils, or broken rock, etc.).
- Project-imposed restrictions (e.g., drilling while wearing personal protective equipment, decontamination of drilling equipment, etc.).
- Sample collection interval.
- Borehole diameter.
- Waste management requirements.
- Type of rig ATV vs truck mounted.

Because of the high variability in the drilling rates due to the wide range of conditions, it is not practical to estimate a "typical" footage progress rate for each method. However, some methods are inherently faster than others, as previously described in the method descriptions. After a drilling method has been determined and the project conditions have been identified, contact a licensed Drilling Subcontractor who would be a potential subcontractor and has worked in the project area and discuss the expected daily drilling progress for the intended drilling method.

5.3 Prevention of Cross-Contamination

Preventing cross–contamination employs a number of methods, including:

- A diligent and thorough decontamination of drilling equipment before use.
- Beginning the investigation in the least contaminated area. By using this method, areas of higher concentrations are not carried to lower concentrations.
- Material testing (optional) – Collecting and analyzing samples of your sand, bentonite, and other boring/well construction materials to ensure they are clean and there are no indication of contaminants present. Check labelling of supplies and should come in identified packaging with manufacturing details and contacts.
- During boring and/or well installation the use of telescoping casings (properly grouted in place) to isolate the desired vertical interval or aquifer is also employed.

5.4 Drilling-Related Materials

The effects of monitoring well construction materials on specific chemical analytical parameters are described and/or referenced in SOP GH-2.8. However, there are several materials used during drilling, particularly drilling fluids and lubricants, which must be used with care to avoid compromising the representativeness of soil and ground water samples.

The use of synthetic or organic polymer slurries is not permitted at any location where soil samples for chemical analysis are to be collected. These slurry materials could be used for installation of long-term monitoring wells, but the early time data in time series collection of ground water data may then be suspect. If synthetic or organic polymer muds are proposed for use at a given site, a complete written justification including methods and procedures for their use must be provided by the site geologist and approved by the Project Manager. The specific slurry composition and the concentration of suspected contaminants for each site must be known.

Hollow stem auger drilling operations; maintaining clean tools along with potable water is an adequate lubricant for auger flight and sampling drilling rod connections. Vegetable based greases, such as Crisco grease, is a common lubricant used to lubricant threads for tools used with DTH air hammer and rock coring. The Site Geologist shall document the type of grease used in the site logbook. Petroleum based greases are not permitted for environmental projects, however they are acceptable for geotechnical and non-environmental type drilling projects

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FIGURE 1

STANDARD SIZES OF CORE BARRELS AND CASING

Coring Bit Size	Nominal*		Set Size*	
	O.D.	I.D.	O.D.	I.D.
RWT	1 5/32	3/4	1.160	0.735
EWT	1 1/2	29/32	1.470	0.905
EX, EXL, EWG, EWM	1 1/2	13/16	1.470	0.845
AWT	1 7/8	1 9/32	1.875	1.281
AX, AXL, AWG, AWM	1 7/8	1 3/16	1.875	1.185
BWT	2 3/8	1 3/4	2.345	1.750
BX, BXL, BWG, BWM	2 3/8	1 5/8	2.345	1.655
NWT	3	2 5/16	2.965	2.313
NX, NXL, NWG, NWM	3	2 1/8	2.965	2.155
HWT	3 29/32	3 3/16	3.889	3.187
HWG	3 29/32	3	3.889	3.000
2 3/4 x 3 7/8	3 7/8	2 3/4	3.840	2.690
4 x 5 1/2	5 1/2	4	5.435	3.970
6 x 7 3/4	7 3/4	6	7.655	5.970
AX Wire line ___|___/	1 7/8	1	1.875	1.000
BX Wire line ___|___/	2 3/8	1 7/16	2.345	1.437
NX Wire line ___|___/	3	1 15/16	2.965	1.937

* All dimensions are in inches; to convert to millimeters, multiply by 25.4.
___|___/ Wire line dimensions and designations may vary according to manufacturer.

FIGURE 1
STANDARD SIZES OF CORE BARRELS AND CASING
PAGE TWO

Size Designations			Casing Coupling					Approximate Core Diameter	
Casing; Casing coupling; Casing bits; Core barrel bits	Rod; rod couplings	Casing O.D., Inches	O.D., Inches	I.D., Inches	Casing bit O.D., Inches	Core barrel bit O.D., Inches*	Drill rod O.D., Inches	Normal, Inches	Thinwall, Inches
RX	RW	1.437	1.437	1.188	1.485	1.160	1.094	---	0.735
EX	E	1.812	1.812	1.500	1.875	1.470	1.313	0.845	0.905
AX	A	2.250	2.250	1.906	2.345	1.875	1.625	1.185	1.281
BX	B	2.875	2.875	2.375	2.965	2.345	1.906	1.655	1.750
NX	N	3.500	3.500	3.000	3.615	2.965	2.375	2.155	2.313
HX	HW	4.500	4.500	3.938	4.625	3.890	3.500	3.000	3.187
RW	RW	1.437	Flush Joint	No Coupling	1.485	1.160	1.094	---	0.735
EW	EW	1.812			1.875	1.470	1.375	0.845	0.905
AW	AW	2.250			2.345	1.875	1.750	1.185	1.281
BW	BW	2.875			2.965	2.345	2.125	1.655	1.750
NW	NW	3.500			3.615	2.965	2.625	2.155	2.313
HW	HW	4.500			4.625	3.890	3.500	3.000	3.187
PW	---	5.500			5.650	---	---	---	---
SW	---	6.625			6.790	---	---	---	---
UW	---	7.625			7.800	---	---	---	---
ZW	---	8.625			8.810	---	---	---	---
---	AX __|__\	---	---	---	---	1.875	1.750	1.000	---
---	BX __|__\	---	---	---	---	2.345	2.250	1.437	---
---	NX __|__\	---	---	---	---	2.965	2.813	1.937	---

* All dimensions are in inches; to convert to millimeters, multiply by 25.4.

___|___/ Wire line dimensions and designations may vary according to manufacturer.

NOMINAL DIMENSIONS FOR DRILL CASINGS AND ACCESSORIES. (DIAMOND CORE DRILL MANUFACTURERS ASSOCIATION). 288-D-2889

ATTACHMENT A

DRILLING EQUIPMENT SIZES

Drilling Component	Designation or Hole Size (Inches)	O.D. (Inches)	I.D. (Inches)	Coupling I.D. (Inches)
Hollow-stem augers (Ref. 7)	6 1/4	5	2 1/4	
	6 3/4	5 3/4	2 3/4	---
	7 1/4	6 1/4	3 1/4	---
	13 1/4	12	6	---
Thin Wall Tube Samplers (Ref. 7)	---	2	1 7/8	---
	---	2 1/2	2 3/8	---
	---	3	2 7/8	---
	---	3 1/2	3 3/8	---
	---	4 1/2	4 3/8	---
	---	5	4 3/4	---
Drill Rods (Ref. 7)	RW	1 3/32	23/32	13/32
	EW	1 3/8	15/16	7/16
	AW	1 3/4	1 1/4	5/8
	BW	2 1/8	1 3/4	3/4
	NW	2 5/8	2 1/4	1 3/8
	HW	3 1/2	3 1/16	2 3/8
	E	1 5/16	7/8	7/16
	A	1 5/8	1 1/8	9/16
	B	1 7/8	1 1/4	5/8
	N	2 3/8	2	1
				Wall Thickness (Inches)
Driven External Coupled Extra Strong Steel* Casing (Ref. 8)	2 1/2	2.875	2.323	0.276
	3	3.5	2.9	0.300
	3 1/2	4.0	3.364	0.318
	4	4.5	3.826	0.337
	5	5.63	4.813	0.375
	6	6.625	5.761	0.432
	8	8.625	7.625	0.500
	10	10.750	9.750	0.500
	12	12.750	11.750	0.500

* Add twice the casing wall thickness to casing O.D. to obtain the approximate O.D. of the external pipe couplings.

ATTACHMENT A
DRILLING EQUIPMENT SIZES
PAGE TWO

Drilling Component	Designation or Hole Size (Inches)	O.D. (Inches)	I.D. (Inches)	Coupling I.D. (Inches)
Flush Coupled Casing (Ref. 7)	RX	1 7/16	1 3/16	1 3/16
	EX	1 13/16	1 5/8	1 1/2
	AX	2 1/4	2	1 29/32
	BX	2 7/8	2 9/16	2 3/8
	NX	3 1/2	3 3/16	3
	HX	4 1/2	4 1/8	3 15/16
Flush Joint Casing (Ref. 7)	RW	1 7/16	1 3/16	
	EW	1 13/16	1 1/2	
	AW	2 1/4	1 29/32	
	BW	2 7/8	2 3/8	
	NW	3 1/2	3	
	HW	4 1/2	4	
	PW	5 1/2	5	
	SW	6 5/8	6	
	UW	7 5/8	7	
	ZW	8 5/8	8	
Diamond Core Barrels (Ref. 7)	EWM	1 1/2	7/8**	
	AWM	1 7/8	1 1/8**	
	BWM	2 3/8	1 5/8**	
	NWM	3	2 1/8	
	HWG	3 7/8	3	
	2 3/4 x 3 7/8	3 7/8	2 11/16	
	4 x 5 1/2	5 1/2	3 15/16	
	6 x 7 3/4	7 3/4	5 15/16	
	AQ (wireline)	1 57/64	1 1/16**	
	BQ (wireline)	2 23/64	1 7/16**	
	NQ (wireline)	2 63/64	1 7/8	
	HQ (wireline)	3 25/32	2 1/2	

** Because of the fragile nature of the core and the difficulty to identify rock details, use of small-diameter core (1 3/8") is not recommended.

TETRA TECH	STANDARD OPERATING PROCEDURES	Number GH-1.5	Page 1 of 20
		Effective Date 01/2012	Revision 2
		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject BOREHOLE AND SAMPLE LOGGING		Approved [redacted]	

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1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

FIGURE 1

BORING LOG (EXAMPLE)

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING NUMBER: _____

PROJECT NUMBER: _____ DATE: _____

DRILLING COMPANY: _____ GEOLOGIST: _____

DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Drilling Area Background (ppm): ☐

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

FIGURE 1 (CONTINUED)

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size					
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than) Inches and Basing Fractions on Estimated Weights			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than) Inches and Basing Fractions on Estimated Weights				GROUP SYMBOL	TYPICAL NAMES
					Identification Procedures on Fraction Smaller than No. Sieve Size					
						DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
GRAVELS (More than Half of Coarse Fraction is LARGER than No. Sieve Size)	CLEAN GRAVELS (Little or No Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.	SILTS AND CLAYS Liquid Limit Less than 50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.		Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	GRAVELS WITH FINES (More than 12% Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.		Slight to Medium	Slow	Slight	OL	Organic silts and organic silty clays of low plasticity.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.	SILTS AND CLAYS Liquid Limit Greater than 50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
SANDS (More than Half of Coarse Fraction is SMALLER than No. Sieve Size)	CLEAN SANDS (Little or No Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.		High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.		Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
	SANDS WITH FINES (More than 12% Fines)	Non-plastic fines (for identification procedures, see MOL)	SM	Silty sands, poorly graded sand-silt mixtures.	HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.						

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE- BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE- BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Terms	Scratcher or Knife Blade	Hammer Blade	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V.Br.)	0.0"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	0"-1"
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1"-3"
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3"-9"

LEGEND :

SOIL SAMPLES - TYPES

S-1" Split Barrel Sample

ST-3" O.D. Undisturbed Sample

O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

X-NX (Conventional) Core (2.1-1/4" O.D.)

C-NQ (Wireline) Core (1.89" O.D.)

Z - Other Core Sizes, Specify in Remarks

WATER LEVELS

Water Level at Date & Time

Initial Level at Date & Depth

Stabilized Level at Date & Depth

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).
This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.3. Those designations are:

Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4

Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

FIGURE 3

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite ($CaCO_3$). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

FIGURE 4

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).

- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.

- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.

- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the works "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL.) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD

(After Deere, 1964)

$$RQD\ \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.

- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."

- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."

- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."

- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.

- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.

- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.

- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.

- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.

- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.

- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.

- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.

- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow

Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine-grained
Tr - Trace		

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.

- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.

- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.

- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.

- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

FIGURE 5
COMPLETED BORING LOG (EXAMPLE)

BOREHOLE LOG

Page 1 of 1

PROJECT NAME: NSB - SITE
PROJECT NUMBER: 9594
DRILLING COMPANY: SOILTEST CO.
DRILLING RIG: CME - 55
BORING NUMBER: SB/MW 1
DATE: 3/8/96
GEOLOGIST: [redacted]
DRILLER: R. ROCK

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0.0	7/6	1.5/2.0		M DENSE	BRN	SILTY SAND - SOME	SM	MOIST SL. ORG.	5	0	0	0
@ 0800	2.0	9/10				TO BLK	ROCK FR.: TR BRICKS		ODOR				
							(FILL)		FILL TO 4'±				
	4.0			4.0									
S-2 @		5/7	2.0/2.0		M DENSE	BRN	SILTY SAND - TR FINE	SM	MOIST - W ODOR	10	0	-	-
0810	6.0	9/8					GRAVEL		NAT. MATL. TOOK SAMPLE				
	•			7'▽ ±					SB01-0406 FOR ANALYSIS				
	8.0			8.0									
S-3 @		6/8	1.9/2.0		DENSE	TAN BRN	FINE TO COARSE SAND	SW	WET	0	0	0	0
0820	10.0	17/16					TR. F. GRAVEL		HIT WATER @ 7'±				
	12.0			12.0									
S-4 @		7/6	1.6/2.0		STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	.5	-	-
0830	14.0	5/8											
	15.0			15.0					AUGER REF @ 15'				
				16	M HARD	BRN	SILTSTONE	VBR	WEATHERED				
									LO & JNTS @ 15.5				
9/5	①		4.0/5.0						WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
				19'					LOSING SOME				
	20.0				HARD	GRAY	SANDSTONE - SOME	BR	DRILL H20 @ 17'±				
							SILTSTONE		SET TEMP 6" CAS TO 15.5				
4.9/5.0	②		5.0/5.0						SET 2" Φ PVC SCREEN 16-25	0	0	0	0
									SAND 14-25				
	25.0			25					PELLETS 12-14				

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

• 1-20Z
1-80Z

Drilling Area Background (ppm): 0

Remarks: CME-55 R16, 4¼" ID HSA - 9" OD ±
2" SPLIT SPOONS - 140 LB HAMMER - 30" DROP
NX CORE IN BEDROCK RUN ① = 25 min, RUN ② = 15 min

Converted to Well: Yes ✓ No _____ Well I.D. #: MW-1

- Enter color of the material in the appropriate column.

- Describe material using the USCS. Limit this column for sample description only. The predominant material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:

  - Trace: 0 - 10 percent
  - Some: 11 - 30 percent
  - And/Or: 31 - 50 percent

- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.

- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.

- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:

  - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.

  - Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.

  - Particle shape - flat, elongated, or flat and elongated.

  - Maximum particle size or dimension.

  - Water level observations.

  - Reaction with HCl - none, weak, or strong.

- Additional comments:

  - Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.

  - Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.

  - Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.

  - At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

  - Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.

- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.

- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.

- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.

- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.

- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.

- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.

- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:

  - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70E angle from horizontal, high angle.
  - Indicate calcareous zones, description of any cavities or vugs.
  - Indicate any loss or gain of drill water.
  - Indicate drop of drill tools or change in color of drill water.

- Remarks at the bottom of Boring Log shall include:

  - Type and size of core obtained.
  - Depth casing was set.
  - Type of rig used.

- As a final check the boring log shall include the following:

  - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.

  - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole

logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.

- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.

- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.

- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.

- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

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		Applicability Tetra Tech, Inc.	
		Prepared Earth Sciences Department	
Subject GROUNDWATER MONITORING WELL INSTALLATION		Approved [redacted]	

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1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development.

2.0 SCOPE

This procedure is applicable to the construction of monitoring wells. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many regulatory agencies have specific regulations pertaining to monitoring well construction and permitting. These requirements must be determined during the project planning phases of the investigation, and any required permits must be obtained before field work begins. Innovative monitoring well installation techniques, which typically are not used, will be discussed only generally in this procedure.

3.0 GLOSSARY

Monitoring Well - A well which is screened, cased, and sealed which is capable of providing a groundwater level and groundwater sample representative of the zone being monitored. Some monitoring wells may be constructed as open boreholes.

Piezometer - A pipe or tube inserted into the water bearing zone, typically open to water flow at the bottom and to the atmosphere at the top, and used to measure water level elevations. Piezometers may range in size from 1/2-inch-diameter plastic tubes to well points or monitoring wells.

Potentiometric Surface - The surface representative of the level to which water will rise in a well cased to the screened aquifer.

Well Point (Drive Point) - A screened or perforated tube (Typically 1-1/4 or 2 inches in diameter) with a solid, conical, hardened point at one end, which is attached to a riser pipe and driven into the ground with a sledge hammer, drop weight, or mechanical vibrator. Well points may be used for groundwater injection and recovery, as piezometers (i.e., to measure water levels) or to provide groundwater samples for water quality data.

4.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

5.0 PROCEDURES

5.1 Equipment/Items Needed

Below is a list of items that may be needed when installing a monitoring well or piezometer:

- Health and safety equipment (hard hats, safety glasses, etc.) as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installation tools (sledge hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 Well Design

The objectives and intended use for each monitoring well must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity).

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow directions and potential well locations can be determined by an experienced hydrogeologist through the review of geologic data and the site terrain. In addition, data from production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the depths at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contaminant plume, since groundwater samples collected in wells that are screened over the full thickness of the water-bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of contamination in the water-bearing zone. The well diameter desired depends upon the hydraulic characteristics of the water-bearing zone, sampling requirements, drilling method and cost.

The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- The vertical location of the contaminant source in relation to the water-bearing zone.
- The depth, thickness and uniformity of the water-bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (5 feet or less) are usually required where flow lines are not horizontal, (i.e., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs.

Standard monitoring well diameters are 2, 4, 6, or 8 inches. Drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch-diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open-hole bedrock monitoring wells are used. With smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced; however, the sampling devices that can be used are limited.

In specifying well diameter, sampling requirements must be considered (up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples), particularly if the monitored formation is known to be a low-yielding formation. The unit volume of water contained within a monitoring well is dependent on the well diameter as follows:

Casing Inside Diameter (Inch)	Standing Water Length to Obtain 1 Gallon Water (Feet)
2	6.13
4	1.53
6	0.68

If a well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

Pumping tests for determining aquifer characteristics may require larger diameter wells (for installation of high capacity pumps); however, in small-diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "Schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength". Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well screen and riser materials depends on the method of drilling, the type of subsurface materials the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive presentation on this topic). The two most commonly used materials are PVC and stainless steel. Properties of these two materials are compared in Attachment B. Stainless steel is a good choice where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, ease of manipulation, and widespread acceptance. The crushing strength of PVC may limit the depth of installation, but the use of Schedule 80 materials may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps required for sampling or testing. Due to this problem, the minimum well pipe size recommended for Schedule 80 wells is 4-inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe may corrode and release metal ions or chemically react with organic constituents, but this is considered a minor issue. Galvanized steel is not recommended where samples may be collected for metals analyses, as zinc and cadmium levels in groundwater samples may become elevated from leaching of the zinc coating.

Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints. Welded-joint steel casing is also acceptable. Glued PVC may release organic contaminants into the well, and therefore, should not be used if the well is to be sampled for organic constituents.

When the water-bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary, and the annular borehole space around the screened interval is artificially packed with an appropriately sized sand, selected based on formation grain size. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The site geologist shall specify the combination of screen slot size and sand pack which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. For example, as a standard procedure, a Morie No. 1 or No. 10 to No. 20 U.S. Standard Sieve size filter pack is typically appropriate for a 0.020-inch slot screen; however, a No. 20 to No. 40 U.S. Standard Sieve size filter pack is typically appropriate for a 0.010-inch slot screen.

5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a medium-to coarse-grained poorly graded, silica sand and should relate to the grain size of the aquifer sediments. The quantity of sand placed in the annular space is dependent upon the length of the screened interval, but should always extend at least 1 foot above the top of the screen. At least 1 to 3 feet of bentonite pellets or equivalent shall be placed above the sand pack. Cement-bentonite grout (or equivalent) is then placed to extent from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally (i.e., no artificial sand pack installed). In this case, the natural formation material is allowed to collapse around the well screen after the well is installed. This method has been used where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets, extending to the surface. The grout effectively seals the remaining borehole annulus and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom upward, to prevent bridging, and to provide a better seal. In shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of one or two assemblages of material, (e.g., cement and/or bentonite). A cement-bentonite grout, which is the most common type of grout used in monitoring well completions, normally is a mixture of cement, bentonite, and water at a ratio of one 90-pound bag of Portland Type I cement, plus 3 to 5 pounds of granular or flake-type bentonite, and 6-7 gallons of water. A neat cement consists of one ninety-pound bag of Portland Type I cement and 6-7 gallons of water. A bentonite slurry (bentonite and water mixed to a thick but pumpable mixture) is sometimes used instead of grout for deep well installations where placement of bentonite pellets is difficult. Bentonite chips are also occasionally used for annular backfill in place of grout.

In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets/chips or sand. A short (1- to 2-foot) section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is typically placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

A protective casing which is level with the ground surface (flush-mounted) is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter, manhole-type protective collar is set into the wet cement around the well with the top set level with or slightly above the pavement. An appropriately-sized id is placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 Monitoring Well Installation

Pertinent data regarding monitoring well installation shall be recorded on log sheets as depicted and discussed in SOP SA-6.3. Attachments to this referenced SOP illustrate terms and physical construction of various types of monitoring wells.

5.3.1 Monitoring Wells in Unconsolidated Sediments

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is slowly poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur. Centralizers may be used at the geologist's discretion, one above and one below the screen, to assure enough annular space for sand pack placement.

After the sand pack is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent), can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack. Pellets should be added slowly and their fall monitored closely to ensure that bridging does not occur.

The cement-bentonite grout is then mixed and tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

5.3.2 Confining Layer Monitoring Wells

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between aquifers. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 5 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting a large-diameter casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the

confining layer for installation of the monitoring well as detailed for overburden monitoring wells. Sufficient time (determined by the field geologist), must be allowed for setting of the grout prior to drilling through the confined layer.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 –10 feet into bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued into bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. If a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be removed when the final well installation is completed.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen section is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be manually driven to depths exceeding 10 feet.

Direct push sampling/monitoring point installation methods, using a direct push rig or drilling rig, are described in SOP SA-2.5.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only small-diameter tubes extending to the surface. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross-contamination from sampling equipment. Four manufacturers of these samplers include Timco Manufacturing Company, Inc., of Prairie du Sac, Wisconsin, BARCAD Systems, Inc., of Concord, Massachusetts, Westbay Instruments Ltd. of Vancouver, British Columbia, Canada and the University of Waterloo at Waterloo, Ontario, Canada.. Each manufacturer offers various construction materials.

5.4 Well Development Methods

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity, turbidity, and temperature taken during development may yield information (stabilized values) regarding whether sufficient development has been performed. The selection of the well development method shall be made by the field geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

5.4.1 Overpumping and Backwashing

Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the

formation. This back and forth movement of water through the well screen and gravel pack serves to remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods, including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

5.4.2 Surging with a Surge Plunger

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is aggressively moved up and down within the well to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

5.4.3 Compressed Air

Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus introducing air into the formation and reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping of the well is subsequently done using the air lift method.

5.4.4 High Velocity Jetting

In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 RECORDS

A critical part of monitoring well installation is recording of all significant details and events in the site logbook or field notebook. The geologist must record the exact depths of significant hydrogeological features, screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (see Attachments to SOP SA-6.3) shall be completed, ensuring the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information shall include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. Documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded, depending on whether the well is completed in overburden (single- or double-cased), as a cased well in bedrock, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The geologist shall calculate the annular space volume and have an idea of the quantity of material needed to fill the annular space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in or bridging of the backfill materials. Any problems with rig operation or down-time shall be recorded and may affect the driller's final fee.

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ATTACHMENT A

RELATIVE COMPATIBILITY OF RIGID WELL CASING MATERIAL (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/ High Solids Content	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

1 Teflon[7]
2 Stainless Steel 316
3. Stainless Steel 304
4 PVC 1
5 Lo-Carbon Steel
6 Galvanized Steel
7 Carbon Steel

* Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material								
	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton[7]*	Silicone	Neoprene	Teflon[7]*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/ High Solids Content	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials:

1 Teflon[7]
2 Polypropylene (PP)
3. PVC Flexible/PE Linear
4 Viton[7]
5 PE Conventional
6 Plexiglas/Lucite (PMM)
7 Silicone/Neoprene

* Trademark of DuPont

Source: Barcelona et al., 1983

ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength are not critical.
Weight	Relatively heavier.	Light-weight; floats in water.
Cost	Relatively expensive.	Relatively inexpensive.
Corrosivity	Deteriorates more rapidly in corrosive water.	Non-corrosive -- may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons.
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work with in the field.
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled.	Never use glue fittings -- pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized.	May sorb or release organic substances.

* See also Attachment A.

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		Effective Date 07/15/2016	Revision 4
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Health & Safety	
Subject UTILITY LOCATING AND EXCAVATION CLEARANCE		[redacted]	

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1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this Standard Operating Procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. This SOP must be reviewed by any employee potentially involved with underground or overhead utility locating and avoidance activities.

2.0 SCOPE AND APPLICABILITY

This procedure applies to field activities where there is potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence and avoidance of contact with utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the initiation of any such activities on a specific project. This SOP is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the methods presented may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Excavation - An operation for the purpose of movement or removal of earth, rock, or the materials in the ground, including but not limited to; digging, blasting, auguring, backfilling, test boring, drilling, pile driving, directional drilling, grading, plowing-in, hammering, pulling-in, jacking-in, trenching, tunneling, structural demolition, milling, scraping, tree and root removal (grubbing), fence or sign post installation. Tetra Tech requires that the designated One-Call agency for the applicable jurisdiction be contacted any time an intrusive activity is planned.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphical representation of subsurface conditions.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

One-Call – The “One Call” or “Call Before You Dig” System is a communications system established to prevent damage to underground facilities. It provides one national telephone number “811” to call before performing intrusive ground work. Each state in the country has its own regulations and 811 call center. More information is available on http://call811.com/

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less representative of deep geologic features.

4.0 RESPONSIBILITIES

Project Manager (PM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Safety Officer (SSO) – Responsible to provide technical assistance and verifying full compliance with this SOP. The SSO is also responsible for reporting any deficiencies to the PM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy and this SOP.

Site Personnel – Responsible for performing their work activities in accordance with this SOP and the site-specific Health and Safety Plan (HASP).

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown and even that an incorrect location has been established on client properties. This procedure must be followed prior to beginning any subsurface probing or excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. Conduct a comprehensive review of available property maps, blue lines, or as-built drawings/diagrams prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities.

2., Conduct a visual site inspection to compare the site plan information to actual field conditions. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information

regarding utility locations shall be added to project maps upon completion of this exercise and returned to the PM.

3. If the planned work is to be conducted on private property the FOL must identify and contact appropriate facility personnel before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified. The One-Call service must be notified prior to commencing fieldwork per their requirements. Most States require, by law, 48- to 72-hour advance notice prior to beginning any excavation. The One-Call service typically assigns a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again.

5. The One-Call service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, the One-Call system may still be required to provide location services on military installations.

5. Identify utilities and plainly mark their locations using pin flags, spray paint, or other accepted means. The locations of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code as described in American Public Works Association Uniform Color Code scheme (Figure 1):

FIGURE 1

AMERICAN PUBLIC WORKS ASSOCIATION UNIFORM COLOR CODE

COLOR	SERVICE
Red	Electrical, Cables, Conduit
Orange	Telephone, Communications, Cable TV
Yellow	Gas, Oil, Steam, Petroleum or Gaseous Materials
Green	Sewers, Drains
Blue	Potable Water Systems
Purple	Reclaimed Water, Irrigation, Slurry Lines
Pink	Temporary Survey Markings
White	Proposed Excavation

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., investigate the work area prior to beginning the excavation. In these situations, utilities must be identified using safe and effective methods such as passive and intrusive surveys, or the use of non-conductive hand tools. Also, in situations where such hand tools are used, they should always be used in conjunction with suitable detection equipment, such as the items described in Section 6.0 of this SOP.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, probe the soil using a device such as a tile probe which is made of non-conductive

material (such as fiberglass). If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. Ensure that utilities uncovered or undermined during excavation are structurally supported to prevent potential damage. Tetra Tech shall not make any repairs or modifications to existing utility lines without prior permission of the PM, utility owner, property owner, and Corporate HSM. Repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

Figure 2 provides the required minimum clearances for working in proximity to overhead power lines.

FIGURE 2

MINIMUM CLEARANCE DISTANCE

Nominal Voltage	Minimum Clearance
0 -50 kilovolt (kV)	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

A variety of supplemental utility locating approaches are available and can be applied when additional assurance is needed. The selection of the appropriate method(s) to employ is site-specific and should be tailored to the anticipated conditions, site and project constraints, and personnel capabilities.

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the Tetra Tech SOPs included in the References (Section 8.0).

Electromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. Electrons in the utility line are induced to move and this movement generates an electromagnetic (EM) signal, which can be detected with a radiofrequency receiver. Electrical current carrying conductors have a 60 Hertz (Hz) signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as electrical grounds may also have a 60 Hz signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is a Geonics EM-61 metal detector.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of incurring signal interference. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (USTs), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphical representation of subsurface conditions. In general, reflectivity increases with the density of the object reflecting the signal. Utilities, tunnels, USTs, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature, and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1-foot x 1-foot area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

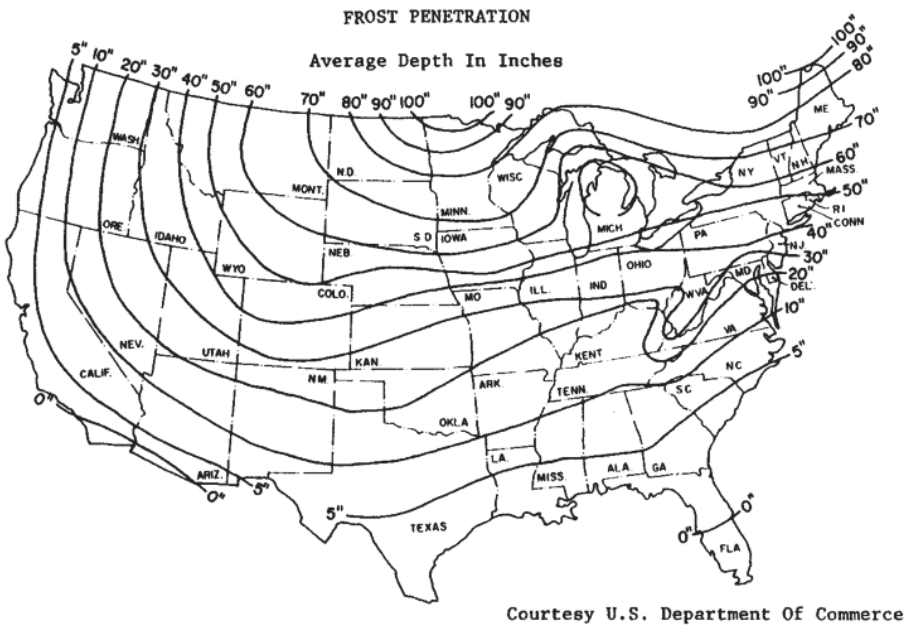
Hand Excavation

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings and excavations may be cleared via the use of non-conductive hand tools. This should always be done in conjunction with the use of detection equipment. This would be required for all locations where there is a potential to impact buried utilities.

The minimum hand-excavation depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Figure 3 presents frost line depths for the regions of the contiguous United States. At a minimum, hand excavation depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs).

FIGURE 3

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

For hand excavation, the hole created must be reamed large enough to be at least the diameter of the drill rig auger or bit prior to drilling.

For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand excavation. It is important to note that a post-hole digger must not be used in this type of hand excavation activity.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, non-conductive tile probes may be used. A tile probe is a "T"-handled rod of varying lengths that can be pushed into the soil to determine if any obstructions exist at that location. Tile probes constructed of fiberglass or other nonconductive material are readily-available from numerous vendors. Tile probes must be performed to the same depth requirements as previously specified. As with other types of hand excavating activities, the use of a non-conductive tile probe should always be in conjunction with suitable utility locating detection equipment.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service by dialing 811. If possible, arrange for an appointment to show the One-Call representative the surface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Implement supplemental utility detection techniques as necessary and appropriate to conform utility locations or the absence thereof.

5. Complete the Utility Clearance Form (Figure 4). This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form.

6. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

FIGURE 4

UTILITY CLEARANCE FORM (EXAMPLE)

Client:			Project Name:			
Project No.:			Completed By:			
Location Name:			Work Date:			
Excavation Method/Overhead Equipment:						
1.	Underground Utilities			Circle One		
	a	Review of existing maps?		Y	N	N/A
	b	Interview local personnel?		Y	N	N/A
	c	Site visit and inspection?		Y	N	N/A
	d	Excavation areas marked in the field?		Y	N	N/A
	e	Utilities located in the field?		Y	N	N/A
	f	Located utilities marked/added to site maps?		Y	N	N/A
	g	Client contact notified?		Y	N	N/A
		Name:	Telephone:	Date:		
	h	State One-Call agency called?		Y	N	N/A
		By:	Ticket #:	Date:		
	i	Geophysical survey performed?		Y	N	N/A
		By:	Method:	Date:		
	j	Hand excavation performed (w/ concurrent use of utility detection vice)? device		Y	N	N/A
		By:	Total depth (feet):	Date:		
	k	Trench/excavation probed?		Y	N	N/A
		By:	Depth/frequency:	Date:		
2	Overhead Utilities			N/A	N	N/A
	a	Determination of nominal voltage		Y	N	N/A
	b	Marked on site maps		Y	N	N/A
	c	Necessary to lockout/insulate/re-route		Y	N	N/A
	d	Document procedures used to lockout/insulate/re-route		Y	N	N/A
	e	Minimum acceptable clearance		Y	N	N/A
	f	Are Guy Wires present? If so, describe below:		Y	N	N/A
	g	Name of Utility:				
	H	Emergency contact:	Telephone:			
3. Notes:						
Approval:				Date:		
Field Operations Leader Date				Date:		

C: PM/Project File
Program File

8.0 REFERENCES

Tetra Tech SOP GH-3.1 - Resistivity and Electromagnetic Induction

Tetra Tech SOP GH-3.2 - Magnetic and Metal Detection Surveys

Tetra Tech SOP GH-3.4 - Ground-Penetrating Radar Surveys
Tetra Tech, Inc. Health and Safety Manual SWP 5-35 Underground Utilities
Tetra Tech, Inc. Health and Safety Manual FORM 5-35 Ground Disturbance Permit (Excavations/Utility Locate)

Tetra Tech, Inc. Health and Safety Manual FORM – Overhead Utilities

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process to be used for purging groundwater monitoring wells prior to sampling, for collecting groundwater samples, and for measuring groundwater quality parameters.

2.0 SCOPE AND APPLICABILITY

This document provides information on proper sampling equipment, onsite water quality testing, safety measures to ensure the safety of the field technician(s), and techniques for groundwater sampling. All personnel are encouraged to review the information contained herein to facilitate planning of the field sampling effort. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

WARNING:

- Sample containers can be contaminated during storage if nearby volatile substances infiltrate the surrounding air and migrate into the containers. This can occur even when containers are capped. Therefore, containers that have been stored onsite for longer than 6 months should not be used.

Note: Whereas most air-borne contamination is likely to be associated with organic substances, inorganic substances such as hydrochloric acid (muriatic acid) can emit inorganic vapors that infiltrate sample containers.

3.0 GLOSSARY

Conductivity – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions and their total concentration, mobility, valence, and relative concentrations and on temperature. Conductivity is highly dependent on temperature and should be reported at a particular temperature, e.g., 20.2 milliSiemens per centimeter (mS/cm) at 14 degrees Celsius (°C).

Dissolved Oxygen (DO) – DO concentrations in natural water (including groundwater and surface water) and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

Groundwater Sample – A quantity of water removed from the ground, usually via a monitoring well that may or may not be lined with a well casing, and typically in a manner that is designed to represent the in-situ quality of one or more parameters of interest regarding the water in the ground.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode immersed in water, as referenced against a reference electrode. Also commonly referred to as redox potential or Eh. A reference electrode commonly used in the field is the silver/silver chloride electrode, which has a voltage offset of about 210 millivolts (mV) from the standard hydrogen electrode (SHE). To convert field ORP measurements to equivalent SHE values, approximately 210 mV must be added to the ORP values obtained using the silver/silver chloride electrode. The actual offset depends on the concentration of the potassium chloride (KCl) solution in the field reference electrode and the temperature. Offsets typically range from 199 (saturated KCl) to 205 (3.5 Molar KCl) to 222 mV (1 Molar KCl) at 25°C and are greater at lower temperatures.

pH – A unitless number equal to the negative logarithm (base 10) of the hydrogen ion activity, expressed in moles per liter. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is related to the hydrogen ion

concentration. This is an inverse relationship, meaning that the pH decrease with increasing hydrogen ion concentration.

pH Paper - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

Salinity – The measurement of dissolved salts in a given mass of solution. Note: most field meters determine salinity automatically from conductivity and temperature. The value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent). The parts per thousand symbol ($^0/_{00}$) is not the same as the percent symbol (%).

Specific Conductance – Specific conductance is the electrical conductivity across an electrical cell of specified geometry in an electrolyte solution. The electrical current is carried by charged atoms or molecules in the solution (i.e., ions). Standard measurements are commonly made at, or normalized to, a standard temperature of 25°C. Temperature normalizations commonly are automated by the specific conductance meters used to make these measurements. Temperature compensation, however, adjusts only for changes in instrument response caused by temperature changes. The temperature compensation does not correct for changes in conductance that result from changes in ion mobility. Hence the reason most measurements are made at the standard temperature of 25°C.

Turbidity – Turbidity in water is caused by suspended matter such as clay, silt, and fine organic and inorganic matter. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of groundwater samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager identifies sampling locations.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP) or equivalent. This includes but is not be limited to performing air quality monitoring during sampling, boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the Field Operations Leader (FOL) on other safety-related matters regarding sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Project Hydrogeologist – This individual is responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), equipment to be used, and providing detailed input in this regard to the project planning documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of site sampling personnel.

Field Operations Leader (FOL) – This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self-acquisition or through the management of a field team of samplers.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- OSHA 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Specific safety and health precautions are identified throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard surfaces.
- Slips, trips, and falls.
- Cuts and lacerations.
- Traffic hazards associated with sampling in parking areas and roadways and along highways and railways.

Methods of avoiding these hazards are provided below.

Knee injuries – Many monitoring wells are installed as flush mounts. Personnel are required to kneel to open these wells and to take groundwater level measurements, etc. This could result in knee injuries from kneeling on stones/foreign objects and general damage due to stress on the joints. To combat this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample wells. To minimize these hazards:

- Pre-survey well locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations – To prevent cuts and lacerations associated with groundwater sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.
- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut -- do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken glass or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel**. Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.

- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.

- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

6.1 General

For information derived from a groundwater sample to be useful and accurate, the sample must be representative of the particular zone being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis to keep any changes in water quality parameters to a minimum.

> ***CAUTION***
> A closed well may generate and accumulate gases due to biological degradation, evolution of volatile chemicals from groundwater into the air, or other chemical actions. These gases may also be artificially generated, such as in the case of air sparging or extraction wells, which may take several days to depressurize. See Section 6.6.2 for safety measures to be employed to protect sampling personnel.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air or nitrogen, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water sample due to external influences of the sampling technique(s). In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. Concentration gradients resulting from mixing and dispersion processes, layers of variable geologic permeability, and the presence of separate-phase product (e.g., floating hydrocarbons) may cause stratification. Excessive pumping or improper sampling methods can dilute or increase contaminant concentrations in the collected sample compared to what is representative of the integrated water column as it naturally occurs at that point, resulting in the collection of a non-representative sample.

To safeguard against collecting non-representative samples, the following approach shall be followed prior to sample acquisition:

> ***CAUTION***
> Mechanical agitation of well water may cause off-gas generation of volatile contaminants, creating an inhalation exposure to the sampler(s). Where avoiding an inhalation exposure is not possible and mechanical agitation is possible, pump into closed-top containers to control potential air emissions.

1. If possible, position yourself (and the sampling equipment) upwind of the well head.

2. Purge the monitoring well to be sampled prior to obtaining any samples from it. Evacuation of three to five well volumes is recommended prior to sampling, unless low-flow purging and sampling methods are utilized as described in Section 6.7 (Consult the site-specific SAP for exact purging parameters). In a high-yielding groundwater formation and where there is no stagnant water in the well above the

screened section, extensive evacuation prior to sample withdrawal is not as critical as it is in a low-yielding well or in wells containing stagnant water.

3. For wells with low yields that are purged dry during sampling, evacuate the well and allow it to recover to 75 percent of full capacity prior to sample acquisition. If the recovery rate is fairly rapid [generally 300 milliliters (mL) per minute or greater], attempt to continue evacuation until the number of well volumes specified in the SAP is achieved. If this cannot be accomplished, allow recovery to 75 percent of capacity and begin sampling.

> ***CAUTION***
> For moderate to high-yielding monitoring wells, an evacuation rate that does not cause excessive turbulence in the well should be selected. There is no absolute safeguard against contaminating the sample with stagnant water; hence, special techniques are required for purging to minimize the potential for sample contamination (see below).

4. For moderate to high-yielding monitoring wells, use one of the following purge techniques:

   - Place a submersible pump or the intake line of a surface pump or bailer just below the water surface when removing the stagnant water.
   - While purging and as the water level decreases, lower the pump or intake line as the water level drops in the well. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. After this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.
   - Unless otherwise directed, place the intake line of the sampling pump (or the submersible pump itself) near the center of the screened section, and pump approximately one casing volume of water from the well at a low purge rate equal to the well's recovery rate (low-flow sampling).

6.2 Sampling, Monitoring, and Evacuation Equipment

Sample containers shall conform to the guidelines in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

- Sample packaging and shipping equipment – Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler materials, ice, labels, and chain-of-custody documents.
- Field tools and instrumentation
  - Multi-parameter water quality meter with an in-line sample chamber capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity, and salinity, or individual meters (as applicable).
  - pH Paper.
  - Camera and film (if appropriate). Approval prior to use may be required (see SOP SA-6.3).
  - Appropriate keys (for locked wells).

- Water level indicator and/or oil-water interface probe if separate-phase product is expected.

- Pumps

  - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with drop lines and air-lift apparatus (compressor and tubing) where applicable.

  - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.

- Other sampling equipment – Bailers, graduated cylinder, stopwatch, and inert line with tripod-pulley assembly (if necessary).

- Pails – Plastic, graduated.

- Clean paper or cotton towels for cleaning equipment.

- Buckets with lids for collecting purge water.

- Decontamination solutions – Deionized water, potable water, phosphate-free laboratory-grade detergent, and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

6.3 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to know the volume of standing water in the well pipe (including well screen where applicable). This volume can be easily calculated by the following method. Calculations shall be entered in the site logbook or field notebook or on a sample log sheet form or equivalent electronic form(s) (see SOP SA-6.3):

1. Obtain all available information on well construction (location, casing, screen, etc.).

2. Determine well or inner casing diameter.

3. Measure and record static water level (depth below ground level or top of casing reference point).

4. Determine depth of well by sounding using a clean, decontaminated, weighted tape measure or water level indicator.

5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).

6. Calculate one static well volume in gallons $V = (0.163)(T)(r^2)$

   where: V = Static volume of well in gallons.
   T = Linear feet of water in the well.
   r = Inside radius of well casing in inches.
   0.163 = Conversion factor (compensates for conversion of casing radius from inches to feet; cubic feet to gallons; and pi (π)).

7. Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

Measuring devices may become contaminated when gathering the above information if they are submerged in contaminated water. Decontamination of the tape or water level indicator must be conducted between measurements in different wells as follows:

1. Saturate a paper towel or clean cotton towel with deionized water.

2. As the measuring device is extracted, wipe the tape, changing the cleaning surface frequently.

3. After it is extracted, rinse the probe or tape using a spray bottle of deionized water over a bucket or similar collection container.

Based on the contaminant (oily, etc.), it may be necessary to use a soap and water wash and rinse to remove contaminants. Isopropanol can be used on the probe/tape. However, it is recommended that the use of solvents on the tape be minimized because they could degrade the protective covering or possibly remove the scale designations. If isopropanol (or some other solvent) is used, assure that the manufacturer/supplier Safety Data Sheet (SDS) is obtained, kept onsite at a readily available location with other SDSs, and reviewed by personnel prior to the first usage of the solvent. Also, add the substance to the site-specific Hazardous Chemical Inventory list (see Section 5 of the Tetra Tech Health and Safety Manual (available on the Health and Safety link of the My Tetra Tech intranet site, Tetra Tech Hazard Communication Program, and OSHA Standard 29 Code of Federal Regulations [CFR] 1910.1200).

6.4 Evacuation of Static Water – Purging

6.4.1 General

The amount to be purged from each well will be determined prior to sample collection. This amount will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of the aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately, the well can be pumped until parameters such as temperature, specific conductance, pH, and turbidity (as applicable) have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook or field notebook or on standardized data sheets or an equivalent electronic form(s).

6.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. All of these techniques involve equipment that is portable and readily available.

Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of tubing equipped with a base plate and ball check-valve at the bottom. Bailers are typically comprised of stainless steel and plastic. They come in a variety of sizes, but the two most often used are 2 inches and 4 inches in diameter. An inert non-absorbent line such as polyethylene rope is used to lower and then raise the bailer to retrieve the sample. As the bailer is lowered into the water column, the ball is

pushed up allowing the tube to be filled. When the bailer is pulled upward, the ball seats in the base plate preventing water from escaping.

Advantages of bailers include the following:

- There are few limitations on size and materials used.
- No external power source is needed.
- Bailers are inexpensive and can be dedicated and hung in a well to reduce the chances of cross-contamination.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Splashing the bailer into the water or transfer of sample may cause aeration.
- The use of a bailer does not permit constant in-line monitoring of groundwater parameters.
- Use of bailers is physically demanding, especially in warm temperatures at personal protection equipment (PPE) levels above Level D.

Safety concerns using a bailer include the following:

- Muscle stress and strain, especially when using 4-inch bailers and when pulling from excessively deep wells.
- Entanglement, possible hand/finger injuries, and rope burns during a sudden release of the bailer back down the well.
- Direct contact with contaminants of concern and sample preservatives when discharging the bailer contents because there is not a high level of control during a direct pour, and splashing and indirect contact with contaminants/preservatives could occur.

Control measures for these hazards are provided in Section 6.6.2.

Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze flexible tubing to create suction. This tubing can be dedicated to a well to prevent cross-contamination from well to well. Suction pumps are all portable, inexpensive, and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause loss of dissolved gases and volatile organics. Another limitation of these pumps is that they require a secondary energy source to drive them. Electrically driven pumps may require portable generators as energy sources. Air diaphragm pumps require air compressors and/or compressed gas cylinders to drive

them. The advantage of the peristaltic pump is that it can operate from either a built in power source or a portable battery source. Safety measures associated with these pumps are provided below.

Air-Lift and Gas-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a Venturi to force groundwater up a sampling tube. These pumps are also relatively inexpensive. Air- or gas-lift samplers are more suitable for well development than for sampling because the samples may be aerated as a result of pump action. Aeration can cause pH changes and subsequent trace metal precipitation or loss of volatile organics.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. Operation principles vary, and displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include the following:

- They may have low delivery rates.
- Many models are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding of the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time consuming.

Compressed Gases

Safety concerns using compressed gases as an energy source in these pumps are numerous. The nitrogen gas or compressed air is provided in a compressed gas cylinder at a pressure of approximately 2,000 pounds per square inch (psi). If damaged, these cylinders can become dangerous projectiles. Additionally, a sudden release of a cylinder's contents can involve considerable force that could cause significant damage to the eyes and/or skin. Protective measures include the following:

- Always wear safety impact glasses when handling compressed gases.
- Always administer compressed gases through an appropriate pressure-reducing regulator.
- When clearing the cylinder connection port, open the cylinder valve only enough to clear foreign debris. During this process, always position the cylinder valve so that it faces away from you and others.
- If the cylinder is designed to accept a valve protection cap, always keep that protection cap in place, except when the cylinder is connected for use.

- When using the cylinder, lay the cylinder on its side to avoid the potential of it falling and knocking the valve off (and becoming a missile).

- DO NOT use the compressed nitrogen or air to clean clothing or to spray off the skin. Small cuts in the protective layer of the skin may permit the gas to enter into the bloodstream, presenting the potential danger of an embolism.

See the project-specific HASP (or equivalent) for additional direction concerning cylinder safe handling procedures pertaining to the safe handling, transportation, and storage of compressed gas cylinders.

Electrical Shock

Even in situations where portable batteries are used, the potential for electrical shock exists. This potential risk is increased in groundwater sampling activities because of the presence of groundwater near the batteries. This potential is also increased in (prohibited) situations where jury-rigging of electrical connections is performed. Other potential hazards occur when field samplers open the hood of a running car to access the battery as a power source. To control these hazards:

- If you are unfamiliar with electrical devices, do not experiment, get help, and get the proper equipment necessary to power your device.

- Use the proper portable power inverters for cigarette lighter connections to minimize the need to access the battery under the hood of your vehicle.

- Use of electrical generators may pose a number of hazards including noise, those associated with fueling, and indirect sample influence.

To minimize or eliminate electrical generator hazards:

- Inspect the generator before use. Ensure that the generator and any extension cords are rated for the intended operation and have a Ground Fault Circuit Interrupter (GFCI) in line to control potential electrical shock.

- Fuel the generator before purging and sampling to avoid loss of power during sampling.

- Fuel engines only when they are turned OFF and have cooled sufficiently to prevent a fire hazard.

- Place the generator and any fuel source at least 50 feet from the well to be sampled to avoid indirect influence to the sample from fuel vapors or emission gases.

Lifting Hazards

This hazard may be experienced when moving containers of purge water, equipment, cylinders, etc. To control these potential hazards:

- Do not fill purge buckets to more than 80 percent of their capacity.

- Obtain a gas cylinder of sufficient size to complete the designated task but not too large to handle. K-size cylinders weigh approximately 135 pounds and are difficult to handle. M-size cylinders weigh approximately 50 pounds and are easier to handle and move.

- When necessary, get help lifting and moving gas cylinders and other heavy objects. Minimize twisting and turning while lifting. If it is necessary to move these cylinders or generators over significant distance, use mechanical means (carts, etc.).

- Use proper lifting techniques as described in Section 4.4 of the Tetra Tech Health and Safety Manual.

6.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific conductance
- Temperature
- DO
- ORP
- Turbidity
- Salinity

This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous waste site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, or colloidal material or other suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Because instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use. Most meters used to measure field parameters require calibration on a daily basis. Refer to SOP SA-6.3 for an example equipment calibration log.

6.5.1 Measurement of pH

6.5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken and recorded on the groundwater sample log sheet (Attachment B) or equivalent electronic form.

Two methods are given for pH measurement: the pH meter and pH indicator paper. Indicator paper is used when only an approximation of the pH is required or when pH meter readings need to be verified, and the pH meter is used when a more accurate measurement is needed. The response of a pH meter can be affected by high levels of colloidal or suspended solids, but the effect is generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, or colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

6.5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific, or narrower range, pH range paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion activity (which is usually similar to concentration) across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

6.5.1.3 Equipment

The following equipment is to be used for obtaining pH measurements:

- A stand-alone portable pH meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Combination electrode with polymer body to fit the above meter. Alternately, a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.
- Buffer solutions, as specified by the manufacturer. If the buffer solutions are considered hazardous per 29 CFR 1910.1200 (Hazard Communication) or the volumes used are greater than consumer commodity levels, the SSO shall obtain SDSs from the manufacturer for the specific buffer solutions (see Section 4 of the Tetra Tech Health and Safety Manual regarding the Hazard Communication Program).
- pH indicator paper to cover the pH range 2 through 12.
- Manufacturer's operation manual. All personnel must be familiar with the equipment operation to ensure that the integrity of samples is preserved and that the equipment is operated safely.

6.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

The following procedure shall be used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

1. Inspect the instrument and batteries prior to initiation of the field effort.
2. Check that the buffer solutions are used for field calibration prior to their expiration dates. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
3. If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).

4. Calibrate the meter and electrode(s) on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on a water quality meter calibration log sheet (Attachment C) or equivalent electronic form.

5. Immerse the electrode(s) in the sample. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. The failure of the measurements to stabilize must be clearly noted in the logbook or equivalent electronic form.

6. Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH standard unit. Also record the sample temperature (unless otherwise specified in the SAP, record temperatures to the nearest whole degree Fahrenheit or 0.5 degree Celsius).

7. Rinse the electrode(s) with deionized water.

8. Store the electrode(s) in an accordance with manufacturer’s instructions when not in use.

Any visual observation of conditions that may interfere with pH measurement, such as oily materials or turbidity, shall be noted and avoided as much as possible.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, or 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown, then the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is determined. To measure the pH with pH paper:

1. Collect a small portion of sample into a clean container.

2. Dip the pH paper into this small portion of sample.

3. Compare the color of the paper to the color chart that is provided with the pH paper and read the corresponding pH from the chart.

4. Record the pH value from the chart on the sample log sheet.

5. Discard the used pH paper as trash.

6. Discard the small volume of sample that was used for the pH measurement with the other investigative-derived waste.

6.5.2 Measurement of Specific Conductance

6.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

Specific conductance at 25°C is used as a standard of comparison for different water sources as conductivity changes with temperature. It is important to obtain a specific conductance measurement soon after taking a sample because temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect specific conductance. Most conductivity meters in use today display specific conductance in units of mS/cm, which is the conductivity normalized to a temperature of 25°C. These are the required units to be recorded on the groundwater sample log field form or equivalent electronic form. If a sample cannot be cooled or warmed (as appropriate) to 25°C, this should be noted in the field documentation

6.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, and the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases, and salts such as hydrochloric acid, sodium carbonate, and sodium chloride, respectively, are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on the ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell, which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

6.5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

- Stand-alone portable conductivity meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available that may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirements of the sampling program.

6.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are as follows (calibration shall be conducted according to manufacturer's instructions):

1. Check batteries and calibrate instrument before going into the field.

2. Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used for calibration.

3. Rinse the cell with one or more portions of the sample to be tested or with deionized water and shake excess water from the cell.

4. Immerse the electrode in the sample and measure the conductivity.

5. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.

6. Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for troubleshooting assistance.

6.5.3 Measurement of Temperature

6.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field because collected water samples may rapidly equilibrate with the temperature of their surroundings.

6.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury-filled, dial-type thermometers or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22). In addition, various meters such as specific conductance or DO meters that have temperature measurement capabilities may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

6.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample, use the following procedure:

1. Immerse the thermometer in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples that will undergo subsequent chemical analysis.

2. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

If a temperature meter or probe is used:

1. Calibrate the instrument according to manufacturer's recommendations prior to use.

2. Immerse the meter/probe in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the meter/probe shall not be inserted into samples that will undergo subsequent chemical analysis.

3. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

6.5.4 Measurement of Dissolved Oxygen

6.5.4.1 General

DO levels in natural water and wastewater depend on the physical, chemical, and biochemical activities in the water body. In addition, the growth of many aquatic organisms and the rate of corrosivity are dependent on DO concentrations. Thus, analysis for DO is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ because concentrations may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of DO meters. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters using a membrane electrode are suitable for highly polluted waters because the probe is completely submersible and is not susceptible to interference caused by color, turbidity, or colloidal material or suspended matter.

6.5.4.2 Principles of Equipment Operation

DO probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode. This rate is proportional to the oxygen concentration in the water being measured.

Because the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, leaving the surface of the solution undisturbed.

DO probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases such as chlorine or with gases such as hydrogen sulfide that are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field logbook and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer. This compensation can counteract some of the temperature effects, but not all of them.

6.5.4.3 Equipment

The following equipment is needed to measure DO concentrations:

- A stand-alone portable DO meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Sufficient cable to allow the probe to contact the sample.

- Manufacturer's operation manual.

6.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

DO probes differ as to instructions for use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure DO concentrations:

1. Check the DO meter batteries before going to the field.
2. Condition the probe in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
3. Calibrate the instrument in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
5. Rinse the probe with deionized water.
6. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells may be moved up and down to achieve the required mixing.
7. Record the DO content and temperature of the sample in a field logbook or on a sample log sheet or equivalent electronic form.
8. Rinse the probe with deionized water.
9. Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable because sample handling is not involved. This however may not always be practical.

Special care shall be taken during sample collection to avoid turbulence that can lead to increased oxygen solubilization and positive test interferences.

6.5.5 Measurement of Oxidation-Reduction Potential

6.5.5.1 General

ORP provides a measure of the tendency of organic or inorganic chemicals to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of reduced to oxidized species in the sample.

6.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between

the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as DO, may be correlated with ORP to provide knowledge of the quality of the solution, water, or wastewater.

6.5.5.3 Equipment

The following equipment is needed for measuring the ORP of a solution:

- A combination meter with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring ORP:

1. Check the equipment using the manufacturer's recommended reference solution and check its batteries before going to the field.
2. Thoroughly rinse the electrode with deionized water.
3. If the probe does not respond properly to the recommended reference solution, verify the sensitivity of the electrodes by noting the change in millivolts when the pH of a test solution is altered. The ORP will increase when the pH of a test solution decreases, and the ORP will decrease when the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note that the ORP drops sharply when the caustic is added (i.e., pH increases) thus indicating that the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions or the probe should be replaced.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.

6.5.6 Measurement of Salinity

6.5.6.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Most field meters determine salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent).

6.5.6.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (such as are found in Standard Methods for the Examination of Water and Wastewater).

Depending on the meter, the results are displayed in either ppt or percent. The salinity measurements are carried out in reference to the conductivity of standard seawater (corrected to salinity = 35 ppt).

6.5.6.3 Equipment

The following equipment is needed for salinity measurements:

- A multi-parameter water quality meter capable of measuring conductivity and temperature and converting them to salinity (e.g., Horiba U-22 or YSI 600 series).
- Calibration solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.6.4 Measurement Techniques for Salinity

The steps involved in taking salinity measurements are as follows (standardization shall be conducted according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the meter before going into the field.
3. Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
4. Rinse the cell with the sample to be tested. This is typically accomplished as the probe is placed in line during the collection of the purge water up to the time of sample acquisition.
5. Immerse the multi-probe in the sample and measure the salinity. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
6. Rinse the probes with deionized water.

6.5.7 Measurement of Turbidity

6.5.7.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter such as clay, silt, or other finely divided organic and inorganic matter and microscopic organisms including plankton.

It is important to obtain a turbidity reading immediately after taking a sample because irreversible changes in turbidity may occur if the sample is stored too long.

6.5.7.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method, which is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard

reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidimeter. Therefore, nephelometric turbidity units (NTUs) based on the formazin preparation will approximate units derived from the candle turbidimeter, but will not be identical to them.

6.5.7.3 Equipment

The following equipment is needed for turbidity measurements:

- A turbidity meter (preferably a stand-alone meter such as a LaMotte 2020) that calibrates easily using test cells with standards such as 0.0, 1.0, and 10 NTUs, or a combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22). The range of calibration standards should bracket the measured sample turbidities.
- Calibration solution and sample tubes, as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.7.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements utilizing an electrode (e) or light meter (l) are listed below (standardization shall be done according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the instrument before going into the field.
3. Calibrate on a daily basis according to the manufacturer's instructions, and record all pertinent information on a turbidity meter calibration log sheet (Attachment C) or equivalent electronic form.
4. When using the YSI 600 and/or Horiba U-22, rinse the electrode with one or more portions of the sample to be tested or with deionized water.
5. When using the Lamotte 2020, fill the light meter’s glass test cell with approximately 5 mL of sample, screw on the cap, wipe off glass to remove all residue that could intercept the instrument’s light beam, place the test cell in the light meter, aligning the arrow on the cap of the test cell to the arrow on the meter, and close the lid.
6. Immerse the electrode in the sample and measure the turbidity.
7. The reading must be taken immediately because suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
8. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
9. Rinse the electrode or test cell with deionized water.

6.6 Sampling

6.6.1 Sampling Plan

The sampling approach consisting of the following shall be developed as part of the project planning documents approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence, volumes, and types of samples. If the relative degree of contamination between wells is insignificant, a sampling sequence that facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells. In situations where the well is not well-characterized and the nature or extent of airborne contamination is unknown, it is recommended that head space analysis using a photoionization detector (PID) or flame ionization detector (FID) is performed to rate the wells, sampling from least contaminated to most contaminated. Refer to the project-specific HASP (or equivalent) for appropriate information and direction on air monitoring requirements.
- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirements for split samples, access problems, location of keys, etc.
- The FOL shall ensure that the sampling method(s) to be employed is accurately represented in the HASP (or equivalent), indicating the types of sampling to be employed and the hazards. If the methods are not accurately represented, the FOL should rectify this with the HASP (or equivalent) author.
- The FOL shall ensure that sampling teams understand the sampling approach that they are to follow. Where sampling teams are made up of personnel from multiple locations, personal sampling experiences may vary. Therefore, the FOL shall review project-specific requirements, SOPs, and protocol to be followed. The FOL will conduct periodic surveys to ensure that these methods are being completed per his/her direction.

6.6.2 Sampling Methods as Related to Low-Flow Sampling

The collection of a groundwater sample consists of the following steps:

1. Ensure the safety of the sample location. Take a few minutes to evaluate the area for physical hazards (trip hazards, uneven ground, overhanging branches, etc.) and natural hazards (snakes, bees, spiders, etc.) that may exist in the area or that may have constructed nests in the well head. Snakes often like

to sun themselves on concrete well pads. Follow provisions in the project-specific HASP (or equivalent) and/or Tetra Tech Health and Safety Manual for addressing natural hazards.

2. As indicated earlier, some monitoring wells have the potential to contain pressurized headspace (e.g., through the generation of gases form contaminated groundwater, due to biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities) or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. This presents a hazard to people opening these wells. The Field Sampling Technician shall employ the following practices to minimize these hazards:

   - Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety impact eye protection.

   - DO NOT place your face or any other part of your body over the well when opening because this may place you in a strike zone.

   - Open the well cover at arms' length, then step away and allow the well to off gas and stabilize.

   Follow directions provided in the project-specific HASP (or equivalent), Work Plan, and/or SAP pertaining to the use of volatile chemical detection equipment (PID or FID) within the breathing zone of the sampler during sampling to determine the need to retreat from the work area and/or for the use of respiratory protection (as specified in the HASP or equivalent).

3. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet or equivalent electronic form; then calculate the fluid volume in the well pipe (as previously described in this SOP). It is imperative that downhole equipment be adequately decontaminated between wells to prevent cross-contamination. Just as sampling occurs from the least contaminated to the most contaminated, it is also recommended that groundwater level measurements be taken in this manner.

4. Calculate volume of well water to be removed as described in Section 6.3.

5. Select the appropriate purging equipment (see Attachment A) or as designated within the governing Work Plan/SAP. If an electric submersible pump with packer is chosen, go to Step 10.

6. Lower the purging equipment or intake into the well to a short distance below the water level or mid-screen as indicated in project-specific documentation and begin water removal. Remember that some contaminants are "bottom dwellers," and in these cases, project-specific direction may specify placing the intake just above (1 to 2 feet) the well bottom. Secure the pump intake at the well and secure the effluent at the collection container and begin pumping. The pumping rate will be determined based on the decrease in the water level (see Section 6.7) or as directed in your project-specific documents or this SOP. Purge water is generally collected in a 5-gallon bucket or similar open- or closed-top container. To minimize the potential for spills and back injuries, do not fill 5-gallon buckets beyond approximately 80 percent of their capacity. Dispose of purge water as indicated in the planning document(s). Where necessary, slow the pumping rate or lower the pump intake as required to maintain submergence.

7. Estimate the approximate rate of discharge frequently and record it on the Low Flow Purge Data Sheet (see Attachment D). Estimate flow rate by noting the amount of discharge in a bucket or graduated cylinder per unit time using a watch with a second hand or a stopwatch.

8. Observe the peristaltic pump tubing intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.

9. Purge a minimum of three to five well casing volumes before sampling (or as directed by the site-specific SAP). In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recover to 75 percent of initial water level before sampling. Do not overfill purge containers because this increases the potential for spills and lifting injuries.

10. If sampling using a submersible pump, lower the pump intake to mid-screen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.

11. For pump and packer assemblies only: Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.

12. If the recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this occurrence in the site logbook or equivalent electronic form. When this occurs, contact the analytical laboratory to alert them that a reduced sample volume(s) will be submitted for analysis.

13. Fill sample containers and preserve and label them as described in SOP SA-6.1. Many sample bottles will contain preservative when they are shipped to the field. In those cases, do not add preservative.

14. Replace the well cap and lock it as appropriate. Make sure the well is readily identifiable as the source of the sample.

15. Process sample containers as described in SOP SA-6.1.

16. Decontaminate equipment as described in SOP SA-7.1.

6.7 Low-Flow Purging and Sampling

6.7.1 Scope and Application

Low-flow purging and sampling techniques may be required for groundwater sampling activities. The purpose of low-flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at or near natural flow conditions. This minimum-stress procedure emphasizes negligible water level drawdown and low pumping rates to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 1 inch or more and a saturated screen length, or open interval, of 10 feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semivolatile organic compounds [VOCs and SVOCs], pesticides, polychlorinated biphenyls [PCBs], metals, and other inorganic ions [cyanide, chloride, sulfate, etc.]). This low-flow procedure is not designed for collection of non-aqueous phase liquid samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

This procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 10 NTUs and to achieve a water level drawdown of less

than 0.3 foot during purging and sampling. If these goals cannot be achieved, sample collection can take place provided that the remaining criteria in this procedure are met.

6.7.2 Equipment

The following equipment is required (as applicable) for low-flow purging and sampling:

- Adjustable rate submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom-filling bailers to be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing – Teflon, Teflon-lined polyethylene, polyethylene, polyvinyl chloride (PVC), Tygon, or stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device with 0.01-foot accuracy (electronic devices are preferred for tracking water level drawdown during all pumping operations).
- Interface probe.
- Flow measurement supplies.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional indicators - ORP, salinity, and DO. A flow-through cell (also referred to as an in-line sample chamber) is required.
- Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s) and other forms (see Attachments B through D) or equivalent electronic form(s).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event (if available).
- Field Sampling Plan.
- PID or FID instrument for measuring volatile organic vapors per the HASP (or equivalent).

6.7.3 Purging and Sampling Procedure

1. Open the monitoring well as stated earlier and step away. Prepare sampling equipment while allowing 3 to 5 minutes to allow the water level to reach equilibrium. In situations where VOCs are the primary contaminants of concern, air monitoring of the samplers' breathing zone areas may be required by the HASP or equivalent (typically with a PID or FID).

2 Measure the water level immediately prior to placing the pump in the well and record the water level on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well.

3. Lower the measuring device further into the well to collect the total depth measurement. Again wait 3 to 5 minutes to allow the well to equilibrate to the initial water level prior to placing the pump or pump intake in the well.

4. Record the total well depth on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well.

5. Lower the pump or tubing slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible, keep the pump intake at least 2 feet above the bottom of the well to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is 3 feet or less of standing water in the well.

6. Start with the initial pump rate set at approximately 0.1 liter per minute. Use a graduated cylinder and stopwatch to measure the pumping rate. Adjust the pumping rate as necessary to prevent drawdown from exceeding 0.3 foot during purging. If no drawdown is noted, the pump rate may be increased (to a maximum of 0.4 liter per minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. If groundwater is drawn down below the top of the well screen, purging shall cease or the well shall be pumped to dryness and then allowed to recover before purging continues. Well recovery to 75 percent is necessary prior to sampling. Slow-recovering wells should be identified and purged at the beginning of the workday to maximize field work efficiency. If possible, samples should be collected from these wells within the same workday and no later than 24 hours after the end of purging.

7. Measure the water level in the well every 5 to 10 minutes using the water level meter. Record the well water level on the Low Flow Purge Data Form (Attachment D) or equivalent electronic form.

8. Record on the Low Flow Purge Data Form every 5 to 10 minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, DO, and salinity or as specified by the approved site-specific planning document) measured by the water quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled/deionized water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form or equivalent electronic form.

9. Estimate the flow rate by noting the amount of discharge in a graduated cylinder per unit time using a watch with a second hand. Remeasure the flow rate any time the pump rate is adjusted and periodically during purging. This will determine if a reduction in rate has occurred due to possible battery depletion.

10. During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections and tighten, repair, or replace them as necessary to achieve a tight connection.

11. Wait until stabilization is achieved, or a minimum of two saturated screen volumes have been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits, then begin sampling:

    - pH ±0.2 standard units
    - Specific conductance ±10%
    - Temperature ±10%
    - Turbidity less than 10 NTUs
    - DO ±10%

12. If the above conditions have not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. Record the final well stabilization parameters from the Low-Flow Purge Data Form onto the Groundwater Sample Log Form or equivalent electronic form.

NOTE: VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

13. If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples:

    - Collect samples for non-VOC analyses first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample for VOCs, and record the new flow rate.

    - Reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel) or clamp, which should reduce the flow rate by constricting the end of the tubing. Proceed with sample collection.

    - Insert a narrow-diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, then collect the sample from the narrow diameter tubing.

    - Prepare samples for shipping as per SOP SA-6.1.

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ATTACHMENT A

PURGING EQUIPMENT SELECTION

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet	X	X	X	X	X			
	Water Level >25 feet	X			X				
2-Inch	Water level <25 feet	X	X	X	X	X	X		
	Water Level >25 feet	X			X		X		
4-Inch	Water level <25 feet	X	X	X	X	X	X	X	X
	Water Level >25 feet	X			X		X	X	X
6-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X
8-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X

ATTACHMENT A
Purging and Sampling Equipment Selection (Updated July 2016)

Manufacturer	Model Name/ Number	Principle of Operation	I/E[1]	Maximum Outer Diameter (OD)/ Length (L)[2]	Construction Materials[3] (with Lines and Tubing)	Lift Range (Feet)	Delivery Rates or Volumes[4]	Main Source(s) of Information[5]	Comments
Commonly Used Purging/Sampling Equipment									
GeoTech Environmental Equipment, Inc.	Geopump (Series I or II)	Portable; peristaltic vacuum (suction) or pressure - reversible pump	E	3.5" x 8" x 8"	Not applicable (NA)	0 - 27	0 - 1,000 mL/min	Mfg./Pine	Variable speed; operate with 12 volt (V) direct current (DC) or 120V alternating current (AC) power source.
Grundfos Pumps Corporation	Redi-Flo2	Portable; submersible pump	I	1.8" OD x 11" L	SS; PTFE (i.e., Teflon®)	0 - 250	100 mL/min to 9 gpm	Pine/PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling.
QED Environmental Systems	Sample Pro	Portable; bladder pump (positive displacement)	I	1.75" OD x 12" L	SS: PTFE or PE disposable bladder	0 - 250	0 - 800 mL/min	Mfg.	First pump developed specifically to bring the advantages of low-flow sampling to sites with non-dedicated pumps.
QED Environmental Systems	Well Wizard	Dedicated; bladder pump (positive displacement)	I	1.66" OD x 41" L	SS; PTFE bladder, HDPE, PP	0 - 1,000	0 - 2,000 mL/min	Pine/PNNL	Ideal for deep well applications and long-term monitoring. Available in a variety of sizes and materials.
Less Commonly Used Purging/Sampling Equipment									
Bennett Sample Pumps, Inc.	Bennett 1800-8	Portable; piston pump (positive displacement)	I	1.8" OD x 23.625" L	SS: PTFE, PP, Nylon	0 - 1,000	100 mL/min to 2.6 gpm	Mfg./PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling. Discharge rates are difficult to control.
Cole-Parmer Inst. Co.	Masterflex 7571-00	Portable; peristaltic vacuum (suction) or pressure - reversible pump	E	16" x 10.25" x 11"	NA	0 - 27	0.06 - 680 mL/min	Mfg./Pine	Peristaltic pumps are not recommended for sampling volatile organic compounds (VOCs).
Fultz Pumps, Inc.	Fultz SP300	Portable; gear driven pump (positive displacement)	I	1.75" OD x 9.16" L	SS; PTFE gears, Viton®	0 - 200	100 mL/min to 2.4 gpm	Mfg./PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling. Low extraction rates are difficult to control.
GeoTech Environmental Equipment, Inc.	Keck SP12	Portable; progressive cavity pump (positive displacement)	I	1.75" OD x 25" L	SS; EPDM stator, PE	0 - 150	100 mL/min to 1.2 gpm	Mfg./PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling. Low extraction rates are difficult to control.
GeoTech Environmental Equipment, Inc.	SS Geosub	Portable; single speed submersible purge pump	I	1.75" OD x 13.2" L	SS; PTFE, Viton®	0 - 200	low flow to 10 mL/min	Mfg./Pine	Only 12V SS pump with Teflon® cable according to GeoTech brochure.
GeoTech Environmental Equipment, Inc.	NA	Portable; centrifugal purge pump		NA	NA	0 - 55	2.5 gpm max.	Mfg.	Not recommended for sampling.
GeoTech Environmental Equipment, Inc.	Various	Portable; bladder pump (positive displacement)	I	0.675-1.66" OD	SS or PVC; PTFE or PE bladder; FEP or PE tubing	0 - 200 SS; 0 - 250 PVC	NA	Mfg.	Various sizes are available. Pump is also available in PVC instead of SS.
GeoTech Environmental Equipment, Inc.	Bailer	Portable; grab (positive displacement)	I	Various sizes	Various materials - HDPE, PVC, SS, or fluoropolymer	No limit	NA	Mfg.	Low cost, easy operation; potential churning could increase turbidity. Typically a last-resort option.
Grundfos Pumps Corporation	Redi-Flo3	Portable; submersible pump	I	2.9" OD	SS; PVDF, Viton®, Tefzel®	0 - 360	8 gpm max.	Pine/PNNL	Not designed for low flow use.
Grundfos Pumps Corporation	Redi-Flo4	Portable; submersible pump	I	3.8" OD	SS; PTFE	0 - 600	100 mL/min to 10 gpm	Pine/PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling.
KYB	HydroStar™	Portable; single-action piston pump (positive displacement)	I	1.66" OD	SS; PTFE	0 - 400	100 mL/min to 5 gpm	Mfg./PNNL	Variable speed (adjustable flow rate); ideal for purging or sampling. Discharge rates are difficult to control.

ATTACHMENT A
Purging and Sampling Equipment Selection (Updated July 2016)

Manufacturer	Model Name/ Number	Principle of Operation	I/E[1]	Maximum Outer Diameter (OD)/ Length (L)[2]	Construction Materials[3] (with Lines and Tubing)	Lift Range (Feet)	Delivery Rates or Volumes[4]	Main Source(s) of Information[5]	Comments
Landtec North America	Nu-Matic 4	Dedicated; pneumatic displacement pump	I	3.5" OD x 43.25" L	SS	0 - 275	10 gpm max.	Pine	Float activated, fully automatic; ideal for the harsh environment of landfill conditions.
ProActive Environmental Products	SS Monsoon (and others)	Portable; Low Flow pumps available in a variety of sizes	I	1.82" OD x 7.5" L	SS; PE	0 - 120	10 mL/min to 3.5 gpm	Pine/GeoTech	12V DC - designed for continuous purging and low flow sampling.
QED Environmental Systems	Eliminator	Portable; bladder pump (positive displacement)	I	3" OD x 40" L	SS; PTFE or elastomer bladder, Q-Tal®, Viton®	0 - 230	6 gpm max.	Pine	High capacity; designed for light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) removal in 4" wells.
QED Environmental Systems	Pulse Pump	Portable; pneumatic displacement pump	I	1.66" OD x 20" L	SS; PTFE	0 - 230	2 gpm max.	Pine	Especially suited for DNAPL recovery. Requires compressed air, external timer.
Solinst Canada Ltd.	404 WaTerra	Portable; inertial reciprocating pump (positive displacement)	I	Various sizes	SS or Delrin® footvalve; HDPE tubing	0 - 200	2 gpm max.	Pine	Low cost, easy operation; potential churning could increase turbidity. Simple alternative to a bailer.
Solinst Canada Ltd.	407 Integra	Portable; bladder pump	I	1" or 1.66" OD	SS or PVC; FEP bladder (disposable PE available)	SS - 0 - 500 PVC - 0-100	3.3 L/min at 150'	Pine	Regular or low flow applications.
Solinst Canada Ltd.	408 DVP	Portable; pneumatic drive pump	I	1.66" OD x 24" L	SS or PVC; FEP bladder	SS - 0 - 500 PVC - 0-100	3.3 L/min at 150'	Pine	Regular or low flow applications - can deliver high flow rates.
Solinst Canada Ltd.	408M DVP	Portable; micro pneumatic drive pump	I	0.375" OD	FEP tubing	0 - 240	20 - 150 mL/min	Pine	Uses coaxial FEP tubing, easy to transport and install; ideal for low flow and narrow down-hole applications.
Solinst Canada Ltd.	410	Portable; peristaltic (negative pressure) pump	E	13" x 5" x 6"	NA	0 - 27	120 - 3,500 mL/min	Pine	Ideal for vapor sampling, water from shallow wells, or surface water.
TIMCO Mfg. Co., Inc.	Bailer	Portable; grab (positive displacement)	I	Various sizes	PVC, PP, others	No limit	250 mL/foot of bailer	Old SOP	Other sizes, materials, models available; optional bottom-emptying device available, no solvents used.
No-Purge Sampling Equipment (Available Options on Some Projects)									
Amplified Geochemical Imaging (AGI), LLC	AGI Universal Sampler (formerly Gore-Sorber™ Module)	Passive container; diffusion-type sampler	I	0.25" OD x 8" L	Waterproof, vapor-permeable GORE-TEX™ polymer membrane of expanded PTFE	0 - 32	NA	ITRC PSC-5	Demonstrated to be applicable to a variety of (but not all) VOCs, semivolatile organic compounds (SVOCs), and polycyclic aromatic hydrocarbons (PAHs); not designed for inorganics.
GeoInsight, Inc.	HydraSleeve™	Passive container; grab-type sampler	I	1.5-2.6" OD x 30" L	PE tubing with PE reed-valve	No limit	650 - 1,250 mL	ITRC PSC-5	Demonstrated to be applicable to a variety of VOCs and inorganics.
Mutiple Manufacturers	RPPS	Rigid Porous Polyethylene Sampler (RPPS); diffusion-type sampler	I	1.5" OD x 5" L	Rigid PE tube - thin sheets of foamlike porous PE with a Delrin® plug	No limit	80 - 100 mL	ITRC PSC-5	Developed by Don Vroblesky (USGS). Demonstrated to be applicable to a variety of water-soluble organics and inorganics.
Mutiple Manufacturers	PDB	Passive Diffusion Bag (PDB) Sampler; diffusion-type sampler	I	1.2-2" OD, 18-24" L	LDPE with HDPE cap; some vendors use other materials and sizes	No limit	75 - 350 mL	ITRC PSC-3	Developed by Don Vroblesky (USGS) and Thomas Hyde (GE). Demonstrated to be applicable to a variety of (but not all) VOCs; not for inorganics.

ATTACHMENT A
Purging and Sampling Equipment Selection (Updated July 2016)

Manufacturer	Model Name/ Number	Principle of Operation	I/E[1]	Maximum Outer Diameter (OD)/ Length (L)[2]	Construction Materials[3] (with Lines and Tubing)	Lift Range (Feet)	Delivery Rates or Volumes[4]	Main Source(s) of Information[5]	Comments
ProHydro, Inc.	Snap Sampler™	Pneumatic actuator; grab-type sampler	I	1.7-3.4" OD x 19-22+" L	Acetal with PFA-coated SS spring; optional SS weight; 40 mL glass vials or 125-350 mL PP bottles	0 - 2,500	40 - 1,400 mL	ITRC PSC-5	Demonstrated to be applicable to a variety of VOCs and inorganics. Up to 4 bottles may be employed together.
Multi-Level Groundwater Monitoring System (MLS) (Used on Some Projects based on Stakeholder Agreement)									
FLUT, Ltd. Co.	Water FLUTe™	Dedicated; gas drive sampling, liner seals entire borehole wall.	I	Various sizes	NA	NA	NA	Mfg.	Practical to collect large volumes; can use low flow method; minimizes investigation-derived waste (IDW); proven technology.
Solinst Canada Ltd.	Continuous Multichannel Tubing (CMT)	Dedicated; 3 or 7-channel tubing designed to isolate and monitor depth discrete zones.	I	Up to 7 ports	NA	NA	NA	Mfg.	Low cost and easy to install; ideal for shallow applications; single tube for effective sealing.
Solinst Canada Ltd.	Waterloo	Dedicated; double valve or bladder pump sampling; packers separate ports at multiple depths.	I	Various sizes	NA	NA	NA	Mfg.	Practical to collect large volumes; can use low flow method; minimizes IDW; proven technology.
Schlumberger	Westbay	Dedicated; packers separate ports at multiple depths.	I	Various sizes	NA	NA	NA	Mfg.	Transducer and sampler are on a wire line; minimizes IDW; proven technology. Low long-time maintenance costs.

Footnotes:
1 - I/E - Internal (I) or external (E) to the well.
2 - For external pumps, the size is given in three dimensions (i.e. length, width, height); for internal pumps, the size is given in outside diameter (OD) and length (L) (in inches).
3 - Construction materials for pumps and associated equipment include: SS = stainless steel; PTFE = polytetrafluoroethylene; HDPE = high density polyethylene; PP = polypropylene; PE = polyethylene; PVC = polyvinyl chloride; FEP = fluorinated ethylene propylene; PVDF = polyvinylidene difluoride; EPDM = ethylene-propylene-diene elastomr; LDPE = low density polyethylene; PFA = perfluoroalkoxy.
4 - Rate or volume abbreviations: mL/min = milliliters per minute; gpm = gallons per minute; L/min = liters per minute; max. = maximum; mL = milliliters.
5 - Sources of information include specification sheets from the manufacturer (i.e., "Mfg."); equipment rental company websites - Pine Environmental (www.pine-environmental.com); GeoTech (www.geoenvtech.com); and guidance documents from Pacific Northwest National Laboratory (PNNL) (i.e., PNNL-13690) and Interstate Technology & Regulatory Council (ITRC) (i.e., PSC-3 and PSC-5 available at www.itrcweb.org).

ATTACHMENT B
GROUNDWATER SAMPLE LOG SHEET (EXAMPLE)

Tetra Tech

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[ ] Domestic Well Data
[x] Monitoring Well Data
[ ] Other Well Type: _____
[ ] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____
Type of Sample:
[X] Low Concentration
[ ] High Concentration

SAMPLING DATA:

Date: / Time: / Method:	Color Visual	pH Standard	S.C. mS/cm	Temp. Degrees C	Turbidity NTU	DO mg/l	ORP mV	Other NA

PURGE DATA:

Date:	Volume	pH	S.C.	Temp. (C)	Turbidity	DO	ORP	Other
Method:								
Monitor Reading (ppm):			SEE LOW FLOW PURGE DATA SHEET					
Well Casing Diameter & Material								
Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

ATTACHMENT C
EQUIPMENT CALIBRATION LOG (EXAMPLE)

Tetra Tech

EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____ INSTRUMENT NAME/MODEL: _____

SITE NAME: _____ MANUFACTURER: _____

PROJECT No.: _____ SERIAL NUMBER: _____

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT D (EXAMPLE)
LOW FLOW PURGE DATA SHEET

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: _____ WELL ID.: _____
PROJECT NUMBER: _____ DATE: _____

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes procedures and equipment commonly used for collecting environmental samples of surface water and aquatic sediment either for onsite examination and chemical testing or for offsite laboratory analysis.

2.0 SCOPE AND APLICABILITY

The information presented in this document is applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.5), except where the analyte(s) may interact with the sampling equipment or may leach from the sampling equipment into the collected samples. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions, and equipment different from those described herein and should be described in site-specific planning documents.

WARNING:

Sample containers can be contaminated during storage if nearby volatile substances infiltrate the surrounding air and migrate into the containers. This can occur even when containers are capped. Therefore, containers that have been stored on site for longer than 6 months should not be used.

Note: Whereas most air-borne contamination is likely to be associated with organic substances, inorganic substances such as hydrochloric acid (muriatic acid) can emit inorganic vapors that infiltrate sample containers.

3.0 GLOSSARY

Analyte – Chemical or radiochemical material whose concentration, activity, or mass is measured.

Composite Sample – A sample representing a physical average of grab samples.

Environmental Sample – A quantity of material collected in support of an environmental investigation that does not require special handling or transport considerations as detailed in SOP SA-6.1.

Grab Sample – A portion of material collected to represent material or conditions present at a single unit of space and time.

Hazardous Waste Sample – A sample containing (or suspected to contain) concentrations of contaminants that are high enough to require special handling and/or transport considerations per SOP SA-6.1.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of soil samples. The Project Manager also

has the overall responsibility for seeing that all surface water and sediment sampling activities are properly conducted by appropriately trained personnel in accordance with applicable planning documents.

Field Operations Leader (FOL) - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface water and sediment samples. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self-acquisition or through the management of a field team of samplers.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters such as mitigative measures to address potential hazards from hazardous objects or conditions.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- OSHA 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Precautions to preserve the health and safety of field personnel implementing this SOP are distributed throughout. The following general hazards may also exist during field activities, and the means of avoiding them must be used to preserve the health and safety of field personnel:

Bridge/Boat Sampling – Potential hazards associated with this activity include:

- Traffic – one of the primary concerns as samplers move across a bridge because free space of travel is not often provided. Control measures should include:
    - When sampling from a bridge, if the samplers do not have at least 6 feet of free travel space or physical barriers separating them and the traffic patterns, the HASP will include a Traffic Control Plan.
    - The use of warning signs and high-visibility vests are required to warn oncoming traffic and to increase the visibility of sample personnel.

- Slips, trips, and falls from elevated surfaces are a primary concern. Fall protection shall be worn when or if samplers must lean over a rail to obtain sample material. A Fall Protection Competent Person (in accordance with OSHA fall protection standards) must be assigned to ensure that fall protection is appropriately and effectively employed.

- Water hazards/drowning – if someone enters the water from an elevated surface (such as a bridge or dock) and when sampling from a boat. To minimize this potential, personnel shall wear United states Coast Guard (USCG)-approved floatation devices, and the sampling crew must also have on hand a Type IV Throwable Personal Floatation Device with at least 90 feet of 3/8-inch rope. See Section 5.5.2 of this SOP.

- Within the HASP, provisions will also be provided concerning the requirement of a Safe Vessel Certification or the necessity to conduct a boat inspection prior to use. In addition, the HASP shall also specify requirements as to whether the operator must be certified as a commercial boat operator and whether members of the sampling team must have a state-specific safe boating certification.

Entering Water to Collect Samples – Several hazards are associated with this activity and can be mitigated as follows:

- Personnel must wear a USCG-approved Floatation Device (selected and identified in the HASP). The SSO shall ensure that the device selected is in acceptable condition and suitable for the individual using it. This includes consideration of the weight of the individual.

- Lifelines shall be employed from a point on the shore. This activity will always be conducted with a Buddy. See Section 6.5.2.

- Personnel shall carry a probe to monitor the bottom ahead of them for drop offs or other associated hazards.

- The person in the water shall exercise caution concerning the path traveled so that the lifeline does not become entangled in underwater obstructions such as logs, branches, stumps, etc., thereby restricting its effectiveness in extracting the person from the water.

- Personnel shall not enter waters on foot in situations where natural hazards including alligators, snakes, as well as sharks, gars, and other predators within inland waterways may exist.

- In all cases, working along and/or entering the water during high currents or flood conditions shall be prohibited.

- Personnel shall not enter bodies of water where known debris exists that could result in injuries from cuts and lacerations.

Sampling in marshes or tidal areas in some instances can be accomplished using an all-terrain vehicle (ATV). This is not the primary recommended approach because the vehicle may become disabled, or weather conditions or tidal changes could result in environmental damage as well as loss of the vehicle. The primary approach is recommended to be on foot where minimal disturbance would occur. The same precautions specified above with regard to sediment disturbance apply as well as the previously described safety concerns associated with natural hazards. The natural hazards include alligators, bees (nests in dead falls and tree trunks), snakes, etc. In addition, moving through and over this terrain is difficult and could result in muscle strain and slips, trips, and falls. Common sense dictates that the sampler selects the most open accessible route over moderate terrain. Move slowly and deliberately through challenging terrain to minimize falls. Mud boots or other supportive personal protective equipment (PPE) should be considered and specified in the HASP to permit samplers to move over soft terrain with the least amount of effort. In

these situations, it is also recommended, as the terrain allows, that supplies be loaded and transported in a sled over the soft ground.

Working in these areas, also recognize the following hazards and means of protection against them:

Insects are also a primary concern. These include mosquitoes, ticks, spiders, bees, ants, etc. The HASP will identify those particular to your area. Typical preventative measures include:

- Use insect repellant. Approval of various repellants should be approved by the Project Chemist or Project Manager.
- Wearing light-colored clothing to control heat load due to excessive temperatures. In addition, it makes it easier to detect crawling insects on your clothing.
- Taping pants to boots to deny access. Again, this is recommended to control access to the skin by crawling insects. Consultation with the Project Health and Safety Officer SSO/Health and Safety Manager is recommended under extreme heat loads because this will create conditions of heat stress.
- Performing a body check to remove insects. The quicker you remove ticks, the less likely they will become attached and transfer bacteria to your bloodstream. Have your Buddy check areas inaccessible to yourself. This includes areas such as the upper back and between shoulder blades where it is difficult for you to examine and even more difficult for you to remove.

Safety Reminder

If you are allergic to bee or ant stings, it is especially critical that you carry your doctor-recommended antidote with you in these remote sampling locations due to the extended time required to extract incapacitated individuals as well as the effort required to extract them. In these scenarios, instruct your Buddy in the proper administration of the antidote. In all cases, if you have received a sting, administer the antidote regardless of the immediate reaction, evacuate, and seek medical attention as necessary. The FOL and/or SSO will determine when and if you may return to the field based on the extent of the immune response and hazards or potential hazards identified in these locations. To the FOL and SSO, this is a serious decision you have to make as to whether to take someone vulnerable to these hazards into a remote location where you may not be able to carry them out. Consider it wisely.

Poisonous Plants – To minimize the potential of encountering poisonous plants in the field, at least one member of the field team needs to have basic knowledge of what these plants look like so that they can be recognized, pointed out to other field personnel, and avoided if at all possible. If the field team cannot avoid contact and must move through an area where these plants exist, the level of PPE shall include Tyvek coveralls and enhanced decontamination procedures for the removal of oils from the tooling and/or equipment.

Temperature-Related Stress – Excessively cold temperatures may result in cold stress, especially when entering the water either intentionally or by accident. Provisions for combating this hazard should be maintained at the sample location during this activity. Excessively hot temperatures may result in heat stress especially in scenarios where equipment is packed through the marsh.

Because all of these activities are conducted outside, electrical storms are a significant concern. The following measures will be incorporated to minimize this hazard:

- Where possible, utilize commercial warning systems and weather alerts to detect storms moving into the area.

- If on or in the water, get out of the water. Move to vehicles or preferably into enclosed buildings with plumbing and wiring.

- Where warning systems are not available, follow the 30/30 Rule (i*f there are less than 30 seconds between thunder and lightning, go inside for at least 30 minutes after the last thunder).*

See the Tetra Tech Health and Safety Manual (available at the Health and Safety link of the "My Tetra Tech" intranet page) for additional protective measures.

6.0 PROCEDURES

NOTE: If documentation such as a Certificate of Analysis is provided with sample containers to demonstrate their cleanliness, submit the documentation to the project manager for inclusion in the project file.

NOTE: If sample containers that have been stored on site for more than 6 months are used for sampling, a note should be entered into the field log to explain why the containers were used. In such cases, collection of additional field blanks may be useful. These blanks may be used to identify the contamination source.

6.1 Introduction

Collecting a representative sample of surface water or sediment may be difficult because of water movement, stratification, or heterogeneous distribution of the targeted analytes. To collect representative samples, one must standardize sampling methods related to site selection, sampling frequency, sample collection, sampling devices, and sample handling, preservation, and identification. Regardless of quality control applied during laboratory analyses and subsequent scrutiny of analytical data packages, reported data are no better than the confidence that can be placed in the representativeness of the samples. Consult Appendix C for guidance on sampling that should be considered during project planning and that may be helpful to field personnel.

6.1.1 Surface Water Sampling Technique

Samples collected during site investigations may be grab samples or composite samples. The following general procedures apply to various types of surface water and sediment collection techniques:

- If a pre-preserved sample container is not used and the container is not pre-cleaned (See Section 6.1.2), rinse the sample container at least once with the surface water to be sampled before the sample is collected. This is not applicable when sample containers are provided pre-preserved with chemicals because doing so will wash some or all of the preservative out of the bottle. For sample containers that are certified to be clean, pre-rinsing is not recommended.

- For sampling moving water, collect the farthest downstream sample first, and continue sample collection in an upstream direction. In general, work from zones suspected of low contamination to zones of high contamination.

- Take care to avoid excessive agitation of water samples because loss of volatile constituents could result.

- When obtaining water samples in 40 mL vials with septum-lined lids for volatile organics analysis, fill the container completely (with a meniscus) to exclude any air space in the top of the vial and to be sure that the Teflon liner of the septum faces in after the vial is filled and capped. Turn the vial upside down and tap gently on your wrist to check for air bubbles. If air bubbles rise in the bottle, add additional sample volume to the container or recollect the sample to obtain a representative sample that has not lost VOCs through volatilization.

- Do not sample at a water surface, unless sampling specifically for a known constituent that is immiscible with, and on top of, the water.

- Do not sample at the bottom of the water column, unless sampling specifically for a known constituent that is immiscible with, and is expected to be found at the bottom of, the water column.

6.1.2 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type to be acquired. In general, the most representative surface water samples are obtained from mid-channel at a stream depth of 0.5 foot below water surface in a well-mixed stream; however, project-specific planning documents will address site-specific sampling requirements including sample collection points and sampling equipment. The most frequently used samplers include the following:

- Peristaltic pump
- Bailer
- Dip sampler
- Weighted bottle
- Hand pump
- Kemmerer
- Depth-integrating sampler

The dip sampler and weighted bottle sampler are used most often, and detailed discussions for these devices and the Kemmerer sampler are addressed subsequently in this section.

The criteria for selecting a sampler include:

1. Disposability and/or easy decontamination.

2. Inexpensive cost (if the item is to be disposed).

3. Ease of operation.

4. Non-reactive/non-contaminating properties. Samples may be contaminated by contaminated sample containers, and analytes may be lost through precipitation, decomposition, adsorption or other mechanisms that result from interaction with the sample container. Decomposition also may occur when analytes volatilize out of a sample or react with light. Correct sample container selection and use of preservation such as chemical preservatives, cooling, and protection from light are necessary to retard the degradation of samples.

Measurements collected for each sample (grab or each aliquot collected for compositing) shall include but not be limited to:

- Specific conductance
- Temperature
- pH

- Dissolved oxygen

Sample measurements shall be conducted as soon as the sample is acquired. Measurement techniques described in SOP SA-1.1 shall be followed. All pertinent data and results shall be recorded in a field notebook or on sample log sheets (see Attachment A) or an equivalent electronic form(s). These analyses may be selected to provide information on water mixing/stratification and potential contamination. Various types of water bodies have differing potentials for mixing and stratification.

In general, the following equipment is necessary for obtaining surface water samples. Additional equipment may be necessary depending on circumstances and field conditions.

- Required sampling equipment and associated documentation, which may include:
  - Remote sampling pole.
  - Sample containers Sample containers shall conform to the guidelines in SOP SA-6.1.
  - Weighted bottle sampler.
  - Kemmerer sampler, or other device.
  - Decontamination equipment.
  - Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).
  - Required decontamination equipment.
  - Sealable polyethylene bags (e.g., Ziploc® baggies).
  - Heavy-duty cooler.
  - Ice.
  - Paper towels and garbage bags.
  - Chain-of-custody records and custody seals.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.
- Required PPE as directed in the project-specific planning document, which may include:
  - Nitrile surgeon's or latex gloves (layered as necessary).
  - Safety glasses.
  - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

Dip Sampling

Specific procedures for collecting a dip or grab sample of surface water can vary based on site-specific conditions (e.g., conditions near the shore and how closely a sampler can safely get to the shore). In some cases, e.g., when a sample container does not fit onto an available remote sampling pole, or pre-preserved sample containers are required, a transfer bottle must be used to collect sample material that is then transferred to the actual sample container. The general procedure for collecting a sample using a pole or directly from the water body is as follows:

1. Select the appropriate sample container based on the governing project-specific planning document.

NOTE: Samples designated for volatile chemical analyses should be collected first.

2. Remove the sample container cap. Do not place the cap where it might become contaminated (e.g., on the ground).

2. If sample material will be collected directly into an unpreserved container that can be dipped below the water surface, follow the steps immediately below; otherwise, proceed to Step 4.

    a. Securely attach the sample container to a remote sampling pole of sufficient length to reach below the surface of the water to be sampled.

    b. While facing upstream, invert the sample container connected to the pole so the opening faces downward, and carefully dip it to a stream depth of 0.5 foot below the water surface (or as directed by project-specific planning documents). If possible, avoid contacting the bottom of the water body because this could disturb sediment that may compromise the integrity of the surface water sample.

    c. Slowly turn the bottle right-side up allowing the bottle to fill.

    d. Replace the cap quickly and securely on the sample container. In the case of samples designated for VOC analysis, ensure that the cumulative size of air bubbles in the 40 mL vial is no greater than the size of a pea. It is best to exclude all air, if possible.

4. When using a transfer bottle (e.g., because the final sample container contains preservative or does not fit securely onto a dip pole), follow the steps below:

    a. Attach a transfer bottle to a remote sampling dip pole or plan to fill the transfer bottle directly. This bottle may be a large- or wide-mouth bottle, but small openings may be better for shallow surface water bodies to prevent inclusion of surface debris.

    b. While facing upstream, invert the transfer bottle so the opening faces downward and carefully dip it to a stream depth of 0.5 foot below the water surface (or as directed by project-specific planning documents). If possible, avoid contacting the bottom of the water body because this could disturb sediment that may compromise the integrity of the surface water sample.

    c. While avoiding contact between the transfer bottle and sample container, transfer the surface water sample from this intermediate container to the appropriate sample container with minimal agitation.

For samples to be analyzed for VOCs, minimal agitation is especially important to prevent loss of the volatiles.

d. Replace the cap quickly and securely on the sample container. In the case of samples designated for VOC analysis, ensure that the cumulative size of air bubbles in the 40 mL vial is no greater than the size of a pea. It is best to exclude all air, if possible.

5. Use a paper towel to clean and dry the outside of the sample container.

6. Affix a sample label to each sample container, ensuring that each label is completed legibly and completely, addressing all of the categories described in SOP SA-6.3.

7. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

Constituents measured in grab samples collected near the water surface may not be a true representation of the total concentration distributed throughout the water column and in the horizontal cross section. Therefore, as possible based on site conditions, the sampler may be required to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

CAUTION

In areas prone to natural hazards such as alligators and snakes, etc., always use a buddy as a watch. Always have and use a lifeline or throwable device to extract persons who could potentially fall into the water. Be attentive to the signs, possible mounds indicating nests, and possible slides into the water. Remember that although snakes are typically encountered on the ground, they can appear on low-hanging branches. Be attentive to your surroundings because these may indicate that hazards are nearby.

Weighted Bottle Sampling

A grab sample can also be collected using a weighted holder that allows a bottle to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects a sample throughout the total water column depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of glass or plastic bottle with a stopper, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The general procedure for sampling with this device is as follows:

1. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).

2. When the desired depth is reached, pull out the stopper with a sharp jerk of the stopper line.

3. Allow the bottle to fill completely, as evidenced by the absence of air bubbles.

4. Raise the sampler and cap the bottle quickly and securely. In the case of samples designated for VOC analysis, ensure that the cumulative size of air bubbles in the 40 mL vial is no greater than the size of a pea. It is best to exclude all air, if possible.

5. Use a paper towel to clean and dry the outside of the container. This bottle may be used as the sample container as long as the bottle is an approved container type. If this bottle is not the sample bottle, transfer the sample from this intermediate container to the appropriate sample container with minimal agitation while avoiding contact between the two sample containers. For samples to be analyzed for VOCs, minimal agitation is especially important to prevent loss of the volatiles.

6. Affix a sample label to each sample container, ensuring that each label is completed legibly and completely, addressing all of the categories described in SOP SA-6.3.

7. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

Kemmerer Sampler

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon-coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless steel or acrylic cylinder with rubber stoppers that leave the ends open while it is lowered in a vertical position (thus allowing free passage of water through the cylinder). A "messenger" is sent down the line when the sampler is at the designated depth to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles. The general procedure for sampling with this device is as follows:

1. Gently lower the sampler to the desired depth.

2. When the desired depth is reached, send down the messenger to close the cylinder and then raise the sampler.

3. Open the sampler valve to fill each sample bottle (filling bottles for volatile analysis first, with minimal agitation). For samples to be analyzed for VOCs, minimal agitation is required to prevent loss of the VOCs.

4. Cap the bottle quickly and securely. Ensure that the cumulative size of air bubbles in 40 mL VOC vials is no greater than the size of a pea. It is best to exclude all air, if possible.

5. Use a paper towel to clean and dry the outside of the sample container.

6. Affix a sample label to each sample container, ensuring that each label is completed legibly, and completely, addressing all of the categories described in SOP SA-6.3.

7. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

6.2 Onsite Water Quality Testing

Onsite water quality testing shall be conducted as described in SOP SA-1.1.

6.3 Sediment Sampling

6.3.1 General

If composite surface water samples are collected, sediment samples are usually collected at the same locations as the associated surface water samples. If only one sediment sample is to be collected, the sampling location shall be approximately at the center of the water body, in a depositional area if possible based on sample location restraints (see below), unless the SAP states otherwise.

Generally, coarser-grained sediments are deposited near the headwaters of reservoirs. Bed sediments near the center of a water body will be composed of fine-grained materials that may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations of contaminants. The shape, flow pattern, bathymetry (i.e., depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (e.g., bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled, in general, and areas likely to show net erosion (i.e., high-velocity, turbulent areas) and suspension of fine solid materials shall be generally avoided. Follow instructions in the SAP, as applicable.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are less than detection limits). Therefore, it is important to minimize the loss of low-density "fines" during any sampling process.

Samples collected for volatile organic compound (VOC) analysis must be collected prior to any sample homogenization. Regardless of the method used for collection, the aliquot for VOC analysis must be collected directly from the sampling device (hand auger bucket, scoop, trowel), to the extent practical. If a device such as a dredge is used, the aliquot should be collected after the sample is placed in the mixing container prior to mixing.

In some cases, the sediment may be soft and not lend itself to collection by plunging Encore™ or syringe samplers into the sample matrix. In these cases, it is appropriate to open the sampling device, (Encore™ barrel or syringe) prior to sample collection, and carefully place the sediment in the device, filling it fully with the required volume of sample.

On active or former military sites, ordnance items may be encountered in some work areas. Care should be exercised when handling site media (such as if unloading a dredge as these materials may be scooped up). If suspected ordnance items are encountered, stop work immediately, move to shore and notify the Project Manager and Health and Safety Manager.

All relevant information pertaining to sediment sampling shall be documented as applicably described in SOP SA-6.3 and Attachment B or an equivalent electronic form.

6.3.2 Sampling Equipment and Techniques for Sampling Bottom Materials

A bottom-material sample may consist of a single scoop or core, or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using onshore or offshore techniques.

SAFETY REMINDER

The following health and safety provisions apply when working on/over/near water:

- At least two people are required to be present at the sampling location in situations where the water depth and/or movement deem it necessary, each wearing a USCG-approved Personal Flotation Device.
- A minimum of three people are required if *any* of the following conditions are anticipated or observed:

  - Work in a waterway that is turbulent *or* swift that could sweep a sampler downstream should he or she fall in accidentally.

- The underwater walking surface (e.g., stream/river bed) is suspected or observed to involve conditions that increase the potential for a worker to fall into the water. Examples include large/uneven rocks or boulders, dense mud or sediment that could entrap worker's feet, etc.

- Waterway is tidal, and conditions such as those listed above could rapidly change.

The third person in the above condition must be equipped and prepared to render emergency support [e.g., lifeline, tethered Personal Flotation Device (Throwable Type IV, life saver), skiff, means to contact external emergency response support, etc.]

The following sampling devices may be used to collect sediment samples:

- Scoop sampler
- Dredge sampler
- Coring sampler
- Stainless steel or disposable trowel

Each type of sampler is discussed below.

In general, the following equipment if necessary for obtaining sediment samples:

- Required sampling equipment, which may include a scoop sampler, dredge sampler, coring sampler, or stainless steel or pre-cleaned disposable trowel.
- Stainless steel bowl or pre-cleaned disposable bowl to homogenize sample.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in the project-specific planning document.
- Required PPE as directed in the project-specific planning document, which may include:
  - Nitrile surgeon's or latex gloves (layered as necessary).
  - Safety glasses.
  - Other items identified on the Safe Work Permit that may be required based on location-specific requirements (e.g., hearing protection, steel-toed work boots, hard hat). These provisions will be listed in the HASP or addressed by the FOL and/or SSO.
  - Required paperwork (see SOP SA-6.3 and Attachments A and B to this SOP).
  - Required decontamination equipment.
  - Required sample containers.
  - Sealable polyethylene bags (e.g., Ziploc® baggies).
  - Heavy-duty cooler.
  - Ice.

- Paper towels and garbage bags.

- Chain-of-custody records and custody seals.

Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood, PVC, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if the sampler can safely wade to the required location, the easiest and best way to collect a sediment sample is to use a scoop sampler. Scoop sampling also reduces the potential for cross-contamination. The general scoop sampling procedure is as follows:

1. Reach over or wade into the water body.

2. While facing upstream (into the current), scoop the sampler along the bottom in an upstream direction. Although it is very difficult not to disturb fine-grained materials at the sediment-water interface when using this method, try to keep disturbances to a minimum.

3. If collecting sediment for VOC analysis, fill the sample container(s) for VOC analysis at this time and quickly and securely replace the cap(s) on the container(s).

4. Transfer the remaining sediment sample material to the bowl and homogenize the sediment.

5. Fill the containers for all remaining analyses and quickly and securely replace the caps on the containers as they are filled.

6. Use a paper towel to clean and dry the outside of each container.

7. Affix a sample label to each container, ensuring that each label is completed legibly and completely, addressing all of the categories described in SOP SA-6.3.

8. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

Dredge Samplers

Dredges are generally used to sample sediments that cannot easily be obtained using coring devices (e.g., coarse-grained or partially cemented materials) or when large quantities of sample are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a "messenger." Some dredges are heavy and may require use of a winch and crane assembly for sample retrieval. The three major types of dredges are Peterson, Eckman, and Ponar.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The Peterson dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends, thus reducing the "shock wave." The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates.

The general procedure for using a dredge sampler is as follows:

1. Gently lower the dredge to the desired depth.
2. When the desired depth is reached, send the messenger down the cable to close the cylinder and then carefully raise the sampler.
3. Open the sampler to retrieve the sediment.
4. If collecting sediment for VOC analysis, fill the sample container(s) for VOC analysis at this time and quickly and securely replace the cap(s) on the container(s).
5. Transfer the remaining sediment sample material to the bowl and homogenize the sediment.
6. Fill the containers for all remaining analyses and quickly and securely replace the caps on the containers as they are filled.
7. Use a paper towel to clean and dry the outside of each container.
8. Affix a sample label to each container, ensuring that each label is completed legibly and completely, addressing all of the categories described in SOP SA-6.3.
9. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

SAFETY REMINDER

Safety concerns using these dredges include lifting hazards, pinches, and compressions (several pinch points exist within the jaws and levers). In all cases, handle the dredge by the rope to avoid capturing fingers/hands.

Coring Samplers

Coring samplers are used to sample vertical columns of sediment. Many types of coring devices have been developed depending on the depth of water from which the sample is to be obtained, the nature of the bottom material, and the length of core to be collected. They vary from hand-push tubes to electronic vibrational core tube drivers.

Coring devices are particularly useful in pollutant monitoring because turbulence created by descent through the water is minimal, thus the fines at the sediment-water interface are only minimally disturbed. The sample is withdrawn intact, permitting the removal of only those layers of interest.

In shallow, wadeable waters, the use of a core liner or tube manufactured of Teflon or plastic is recommended for the collection of sediment samples. Caution should be exercised not to disturb the bottom sediments when the sample is obtained by wading in shallow water. The general procedure to collecting a sediment sample with a core tube is as follows:

1. Push the coring tube into the substrate until 4 inches or less of the tube is above the sediment-water interface. When sampling hard or coarse substrates, a gentle rotation of the tube while it is being pushed will facilitate greater penetration and decrease core compaction.

2. Cap the top of the tube to provide suction and reduce the chance of losing the sample.

3. Slowly extract the tube so as not to lose sediment from the bottom of the tube during extraction, and cap the bottom of the tube before removing it from the water. This will also help to minimize loss of sample.

4. If collecting sediment for VOC analysis, fill the sample container(s) for VOC analysis at this time and quickly and securely replace the cap(s) on the container(s).

5. Transfer the remaining sediment sample material to the bowl in which it will be homogenized and homogenize the remainder of the sediment.

6. Fill the containers for all analyses other than VOCs, and quickly and securely replace their caps as they are filled.

7. Use a paper towel to clean and dry the outside of each container.

8. Affix a sample label to each container, ensuring that each label is completed legibly and completely, addressing all of the categories described in SOP SA-6.3.

9. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

In deeper, non-wadeable water bodies, sediment cores may be collected from a bridge or boat using different coring devices such as Ogeechee Sand Pounders, gravity cores, and vibrating coring devices. All three devices utilize a core barrel with a core liner tube system. The core liners can be removed from the core barrel and replaced with a clean core liner after each sample. Before extracting the sediment from the coring tubes, the clear supernatant above the sediment-water interface in the core should be decanted from the tube. This is accomplished by turning the core tube to its side and gently pouring the liquid out until fine sediment particles appear in the waste liquid. Post-retrieval processing of samples is the same as above.

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ATTACHMENT A
SURFACE WATER SAMPLE LOG SHEET (EXAMPLE)

Tetra Tech

SURFACE WATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Date:	Visual	Standard	mS/cm	Degrees C	NTU	mg/l	%	NA
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B
SOIL & SEDIMENT SAMPLE LOG SHEET (EXAMPLE)

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: / Time: / Method: / Monitor Reading (ppm):	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

COMPOSITE SAMPLE DATA:

Date: / Method: / Monitor Readings (Range in ppm):	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

APPENDIX C
GUIDANCE ON SAMPLING DESIGN AND SAMPLE COLLECTION

C.1 Defining the Sampling Program

Many factors are considered in developing a sampling program for surface water and/or sediment, including study objectives, accessibility, site topography, physical characteristics of the water body (e.g., flow and mixing), point and diffuse sources of contamination, and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on vertical and lateral mixing within the body of water. For sediment, dispersion depends on bottom current or flow characteristics, sediment characteristics (e.g., density, size), and geochemical properties (that affect adsorption/desorption). The hydrogeologist developing the sampling plan must therefore know not only the mixing characteristics of streams and lakes but must also understand the role of fluvial-sediment transport, deposition, and chemical sorption.

C.1.1 Sampling Program Objectives

The scope of the sampling program must consider the contaminant sources and potential pathways for transport of contamination to or within a surface water body. Contaminant sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., contaminated runoff). The major pathways for surface water contamination (not including airborne deposition) are overland runoff, leachate influx to the water body, direct waste disposal (solid or liquid) into the water body, and groundwater flow influx from upgradient contaminant sources. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) that encompasses the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the locations of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc. shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation include: (1) moving the sampling location far enough downstream to allow for adequate mixing, or (2) collecting integrated samples in a cross section. Also, non-homogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to adsorb onto particulate matter. Nitrogen, phosphorus, and heavy metals may also be transported by particulates. Samples must be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

C.1.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and consideration of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes, reservoirs, or larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each contaminant would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of stream flow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Stream flow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrogeologist shall explore the possibility of obtaining stream flow data by direct or indirect methods. Remember these locations are also where you may encounter natural hazards as these are areas where they hunt. Always exercise extreme caution.

C.1.3 Frequency of Sampling

The sampling frequency and objectives of the sampling event will be defined by the project planning documents. For single-event site or area characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of a contaminant between the solid and aqueous phases, it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes (i.e., consisting of repetitive, continuing measurements to define variations and trends at a given location), water samples should be collected at a pre-established and constant interval as specified in the project plans (often monthly or quarterly and during droughts and floods). Samples of bottom material should generally be collected from fresh deposits at least yearly, and preferably seasonally, during both spring and fall.

The variability in available water quality data shall be evaluated before determining the number and collection frequency of samples required to maintain an effective monitoring program.

C.2 Surface Water Sample Collection

C.2.1 Streams, Rivers, Outfalls, and Drainage Features

Methods for sampling streams, rivers, outfalls, and drainage features (ditches, culverts) at a single point vary from the simplest of hand-sampling procedures to the more sophisticated multi-point sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the watercourse taken during the same sampling episode shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, and discharge and on the suspended sediment the stream or river transports. The greater the number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of dissolved oxygen (DO), pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected, as directed in the project planning documents.

C.2.2 Lakes, Ponds, and Reservoirs

Lakes, ponds, and reservoirs have a much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained. The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, measurement of DO, pH, temperature, etc. is to be conducted on each aliquot of the vertical composite and on the composite itself. In naturally formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample if a sample representative of the water column is required. These vertical composites are often collected along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline that is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer that is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several vertical composites with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality because it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

Many lake measurements are now made in situ using sensors and automatic readout or recording devices. Single and multi-parameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, DO, some cations and anions, and light penetration.

C.2.3 Estuaries

Estuarine areas are, by definition, zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Knowledge of the estuary type may be necessary to determine sampling locations.

Estuaries are generally categorized into one of the following three types dependent on freshwater inflow and mixing properties:

- Mixed Estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically, this type of estuary is shallow and is found in major freshwater sheet flow areas. Because this type of estuary is well mixed, sampling locations are not critical.

- Salt Wedge Estuary - characterized by a sharp vertical increase in salinity and stratified freshwater flow along the surface. In these estuaries, the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally back and forth with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.

- Oceanic Estuary - characterized by salinities approaching full-strength oceanic waters. Seasonally, freshwater inflow is small, with the preponderance of the fresh-saline water mixing occurring near or at the shore line.

Sampling in estuarine areas is normally based on the tidal phase, with samples collected on successive slack tides (i.e., when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1- to 5-foot increments, coupled with vertical DO and temperature profiles.

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used to collect surface, near-surface, and subsurface soil samples. Additionally, it describes the methods for sampling of test pits and trenches to determine subsurface soil and rock conditions and for recovery of small-volume or bulk samples from pits.

2.0 SCOPE AND APPLICABILITTY

This document applies to the collection of surface, near-surface, and subsurface soil samples obtained through hand digging, hand augering, drilling, or machine excavating at sites for which laboratory testing, onsite visual examination, and onsite testing is required.

WARNING:

Sample containers can be contaminated during storage if nearby volatile substances infiltrate the surrounding air and migrate into the containers. This can occur even when containers are capped. Therefore, containers that have been stored on site for longer than 6 months should not be used.

NOTE: Whereas most air-borne contamination is likely to be associated with organic substances, inorganic substances such as hydrochloric acid (muriatic acid) can emit inorganic vapors that infiltrate sample containers.

3.0 GLOSSARY

Composite Sample - A composite sample is a combination of more than one grab sample from various locations and/or depths and times that is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples shall not be collected for volatile organics analysis.

Confined Space - As stipulated in 29 Code of Federal Regulations (CFR) 1910.146, a confined space means a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and (3) is not designed for continuous employee occupancy. Tetra Tech considers all confined space as permit-required confined spaces.

Grab Sample - One sample collected at one location and at one specific time.

Hand Auger - A sampling device used to extract soil from the ground.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

Sample for Non-Volatile Analyses - Includes all chemical parameters other than volatile organics (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in

two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2 to 3.5 inches outside diameter (OD). The larger sizes are commonly used when a larger volume of sample material is required (see Attachment B).

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher, excavator, or bulldozer).
Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches OD and from 18 to 54 inches in length.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager, who is qualified by having completed project management training and by being appointed as the program or office manager, is responsible for determining the sampling objectives, selecting planned sampling locations, and selecting field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP) or equivalent. This will include (but not be limited to) performing air quality monitoring during sampling, boring, and excavation activities and to ensure that workers and off-site (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the Field Operations Leader (FOL) on other safety-related matters regarding boring, excavation, and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for and qualified to execute the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface, near-surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits, and trenches and for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self-acquisition or through the management of a field team of samplers.

Project Geologist/Sampler - The Project Geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and/or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working

conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- OSHA 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Health and safety precautions are identified for individual sample collection procedures throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard or uneven surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas, along railroads, roadways and highways.

Methods of avoiding these hazards are provided below.

Knee injuries – If kneeling is required during soil sampling, this could result in knee injuries from stones/foreign objects and general damage due to stress on the joints. To minimize this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.
- Stretch ligaments, tendons and muscles before, during and after. Take breaks as frequently as necessary.
- Report pre-existing conditions to the SSO if you feel this activity will aggravate an existing condition.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample locations. To minimize these hazards:

- Pre-survey sampling locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations - To prevent cuts and lacerations associated with soil sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.
- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut – do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken sample jars or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel**. Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.
- When working along active rail lines, notify the proper organization to ensure they are aware that you are in the area and that working schedules can be determined.

Sample Containers - Sample containers shall conform to the guidelines in SOP SA-6.1.

6.0 PROCEDURES

The following procedures address surface and subsurface sampling. Equipment lists specific to each type of sampling are provided in the applicable sections below.

If documentation such as a Certificate of Analysis is provided with sample containers to demonstrate their cleanliness, submit the documentation to the Project Manager for inclusion in the project file.

Section 6.1 provides an overview of the sampling processes. The procedures described In Section 6.2 begin with transferring sample material from a sampling device or directly from the ground surface into a sample container. Beginning with Section 6.3, various sample collection techniques and processes that are used for collecting surface or subsurface soil samples prior to transferring to sample containers are described.

CAUTION

Each situation must be evaluated individually to determine the applicability and necessity for obtaining a utility clearance ticket/dig permit. Common sense dictates, prior to digging or boring with power equipment, no matter what the depth, or digging by hand in a manner that could damage unprotected underground utilities, that a dig permit is required. See SOP HS-1.0, Utility Locating and Excavation Clearance, for additional clarification. If you do not know or are unsure as to whether a ticket is necessary – **Get the Ticket**.

6.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate to the water table, and can establish the amount of contamination absorbed or adsorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during sampling operations, particularly noting sampling locations, depths, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. Certain vegetation species can create degradation products that can alter contaminant concentrations in soil. This is why vegetation types and extent of degradation of this foliage must be recorded. To prevent degradation, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible after collection. In addition, to the extent possible, vegetation should be removed from the sample.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. It is the intent of this document to present the most commonly employed soil sampling methods used at environmental investigation sites.

6.2 Soil Sample Collection

6.2.1 Procedure for Preserving and Collecting Soil Samples for Volatile Organic Compound Analysis

Samples collected using traditional methods such as collection in a jar with no preservation have been known to yield non-representative samples due to loss of volatile organic compounds (VOCs). To prevent such losses, preservation of samples with methanol or sodium bisulfate may be used to minimize volatilization and biodegradation. This preservation may be performed either in the field or laboratory, depending on the sampling methodology employed. Because of the large number of sampling methods and associated equipment required, careful coordination between field and laboratory personnel is needed.

Soil samples to be preserved by the laboratory and analyzed for VOCs may be collected using Method SW-846, 5035. Encore™ or equivalent samplers are used for this. For samples preserved in the field, laboratories are currently performing low-level analyses (sodium bisulfate preservation) and high- to medium-level analyses (methanol preservation) depending on the needs of the end user.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

6.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organic analysis that are to be preserved at the laboratory shall be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be obtained using a reusable sampling handle (T-handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the sample in the following manner for each EnCore™ sampler:

1. Scene Safety - Evaluate the area where sampling will occur. Ensure that the area is safe from physical, chemical, and natural hazards. Clear or barricade those hazards that have been identified.

2. Wear the appropriate personal protective equipment (PPE). This will include, at a minimum, safety glasses and nitrile surgeon's gloves. If you must kneel on the ground or place equipment on the surface being sampled, cover the ground surface with plastic to minimize surface contamination of your equipment and clothing. Wear knee pads to protect your knees from kneeling on hard or uneven surfaces.

3. Load the Encore™ sampler into the T-handle with the plunger fully depressed.

4. Expose the area to be sampled using a hand trowel or similar device to remove surface debris.

5. Press the T-handle against the freshly exposed soil surface, forcing soil into the sampler. The plunger will be forced upward as the cavity fills with soil.

6. When the sampler is full, rotate the plunger and lock it into place. If the plunger does not lock, the sampler is not full. This method ensures there is no headspace. Soft soil may require several plunges or forcing soil against a hard surface such as a sample trowel to ensure that headspace is eliminated.

7. Use a paper towel to remove soil from the side of the sampler so a tight seal can be made between the sample cap and the rubber O-ring.

8. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.

9. Remove any surface soil from the outside of the sampler and place in the foil bag provided with the sampler. Good work hygiene practices and diligent decontamination procedures prevents the spread of contamination even on the outside of the containers.

10. Label the bag with appropriate information in accordance with SOP SA-6.3.

11. Place the full sampler inside a lined cooler with ice and cool to <6°C. Make sure any required trip blanks and temperature blanks are also in the cooler. Secure custody of the cooler in accordance with SOP SA-6.3.

12. Typically, collect three Encore™ samplers at each location. Consult the SAP or laboratory to determine the required number of Encore™ samplers to be collected.

13. The T-handle shall be decontaminated before moving to the next interval or location using a soap and water wash and rinse, and where applicable, the selected solvent as defined in the project planning documents.

Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each Encore™ sampler.

After the Encore™ samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

6.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods.

Safety Reminder

When using chemicals in the field to preserve samples, the FOL and/or SSO must ensure that Safety Data Sheets (SDSs) have been provided with the chemicals to be used. They also must ensure that these chemicals have been added to the Chemical Inventory List contained within the Hazard Communication section of the HASP or equivalent. Lastly, but most importantly, the FOL and/or SSO must review the hazards with personnel using these chemicals and ensure that provisions are available for recommended PPE and emergency measures (e.g., eyewash, etc.).

Methanol Preservation (High to Medium Level):

Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40 to 60 mL glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

CAUTION

NEVER attempt to pipette by mouth

In situations where personnel are required to spike the septum using a hypodermic needle, the following provisions for handling sharps must be in place:

- Training of personnel regarding methods for handling of sharps
- Hard-sided containers for the disposal of sharps
- Provisions for treatment in cases where persons have received a puncture wound

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter (ID) of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol-preserved sample bottle. Calibration of the scale shall be performed prior to use and intermittently throughout the day according to the manufacturer's requirements.

The sample should be collected as follows:

1. Weigh the unused syringe and plunger to the nearest 0.01 gram.
2. Pull the plunger back and insert the syringe into the soil to be sampled.
3. Collect 8 to 12 grams of soil by pushing the syringe barrel into the soil.
4. Weigh the sample and adjust until obtaining the required amount of sample.
5. Record the sample weight to the nearest 0.01 gram in the field logbook and/or on the sample log sheet.
6. Extrude the weighed soil sample into the methanol-preserved sample bottle taking care not to contact the sample container with the syringe.
7. If dirty, wipe soil particles from the threads of the bottle and cap. Cap the bottle tightly.
8. After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol.
9. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

CAUTION

Care should be taken when adding the soil to sodium bisulfate solution. A chemical reaction of soil containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode. To avoid this hazard or hazards of this type, a small sample aliquot should be subjected to the sample preservative. If it effervesces in an open air environment, utilize an alternative method such as Encore™ or 2-ounce jar.

Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. When collecting samples in vials that are pre-preserved with sodium bisulfate, collect the samples as described above for methanol-preserved samples.

1. Samples to be preserved in the field using the sodium bisulfate method are to be prepared and collected as follows:
   a) Add 1 gram of sodium bisulfate to 5 mL of laboratory-grade deionized water in a 40 to 60 mL glass vial with septum-lined lid.

   b) Collect the soil sample and record the sample weight to the nearest 0.01 gram in the field logbook or on the sample log sheet as described for methanol preservation.

   c) Add the weighed sample to the sample vial.

   d) Collect duplicate samples using the methanol preservation method on a one-for-one sample basis because it is necessary for the laboratory to perform both low-level and medium-level analyses.

   e) Place the samples on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

> ***NOTE***
> If lower detection limits are necessary, an option to field preserving with sodium bisulfate may be to collect EnCore™ samplers at a given sample location. Consult the planning documents to determine whether this is required. If it is, collect samples in accordance with the Encore™ sampling procedure above and then send all samplers to the laboratory to perform the required preservation and analyses.

6.2.2 Procedure for Collecting Soil Samples for Non-Volatile Analyses

Samples collected for non-volatile analyses may be collected as either grab or composite samples as follows:

1. To ensure collection of a representative sample, use a stainless steel trowel or other approved tool, to transfer the entire depth interval of the soil to be sampled to a stainless steel bowl, re-sealable plastic bag, or disposable inert plastic tray.

NOTE: Contact with plastic materials, especially if the contact is prolonged, may cause contamination of samples with phthalates and other contaminants contained in the plastic. Loss of analytes due to adsorption or reaction with plastics also is possible. When in doubt about contamination potential, or potential loss of analyte due to adsorption/reaction, consult the Project Manager or use non-plastic bowls or other equipment to the extent possible when mixing samples.

2. Remove roots, vegetation, sticks, and stones larger than the size of a green pea.

3. Thoroughly mix the soil to obtain as uniform a texture and color as practicable. The soil type, moisture content, amount of vegetation, and other factors may affect the amount of time required to obtain a properly mixed sample. In some cases, it may be impossible to obtain a uniform sample appearance. Use the field logbook to describe any significant difficulties encountered in obtaining a uniform mixture.

4. Transfer a portion of the mixed soil to the appropriate sample containers and close the containers.

5. Label the sample containers in accordance with SOP SA-6.3.

6. Place the containers in a cooler of ice as soon after collection as possible.

7. Prepare the sample shipment and ship the samples in accordance with SOP SA-6.1.

NOTE

Cooling may not be required for some samples depending on the scheduled analyses. Consult the planning documents if in doubt regarding correct sample preservation conditions. When in doubt – Cool to <6˚C.

NOTE

Head space is permitted in soil sample containers for non-volatile analyses to allow for sample expansion.

6.2.3 Procedure for Collecting Undisturbed Soil Samples

NOTE

Use of thin-walled undisturbed tube samplers is restricted by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soil with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soil. Using these devices normally increases sampling costs, and therefore their use should be weighed against the need for acquiring an undisturbed sample. These devices are not discussed in this SOP because they are not commonly used.

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) shall be employed using the following collection procedure:

1. In preparation for sampling utilizing a drill rig, field personnel must complete the following activities:

    - Ensure that all subsurface drilling activities are preceded by a utility clearance for the area to be investigated. This includes activities described in SOP HS-1.0, Utility Location and Excavation Clearance, as well as any location-specific procedures that may apply.

REMEMBER

If you are digging near a marked utility (within the diameter of an underground utility that has been marked plus 18 inches), you must first locate the utility through vacuum extraction or hand digging to ensure that your activities will not damage the utility.

    - Complete an Equipment Inspection Checklist for the drill rig or direct-push technology (DPT) rig. This checklist will be provided in the HASP.

    - Review the Safe Work Permit prior to conducting the activity.

    - Review the activity to be conducted.

2. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and/or clean out the borehole to the desired sampling depth. Be careful to minimize potential disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

CAUTION
The use of bottom-discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Only the use of side-discharge bits is permitted.

3. Determine whether a stationary piston-type sampler is required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used.

4. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal. In addition, the check valve maintains a positive suction within the tube to help retain the sample.

5. A stainless steel tube sampler is typically used to minimize chemical reaction between the sample and the sampling tube.

6. Remove the plastic end caps from the sampling tube and, with the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil with a continuous and rapid motion, without impacting or twisting. If the soil is too hard to penetrate by pushing alone, careful hammering may be used by minimizing drop distance (tapping) of the hammer. Before pulling the tube, turn it at least one revolution to shear the sample off at the bottom. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.

7. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated.

8. Remove disturbed material in the upper end of the tube and measure the length of sample again.

9. After removing at least 1 inch of soil from the lower end, place enough packing material (clean inert material such as paper or cloth) tightly in each end of the Shelby tube and then pour melted wax into each end to make at least a ½-inch wax plug and then add more packing material to fill the voids at both ends.

10. Place plastic caps on the ends, tape the caps in place, and dip the ends in wax to prevent loss of soil.

11. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label.

12. Mark the "up" direction on the side and upper end of the tube with indelible ink.

13. Complete a chain-of-custody form (see SOP SA-6.3) and other required forms (including Attachment A of this SOP).

14. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

CAUTION
To preserve sample integrity do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times.

CAUTION

A primary concern in the preparation of the wax plugs is the potential for the heat source and melted wax to cause a fire and/or burns. Follow the directions below to prevent injury or fire.

Electrical Heating

Using hot plates to melt the wax is acceptable. In an outdoor setting, make sure a Ground Fault Circuit Interrupter (GFCI) is employed within the electrical circuit. If a portable generator is used, ensure that the generator is an adequate distance from the sampling operation (at least 50 feet). Ensure that the extension cord is rated for the intended load and for outdoor use and is free from recognizable damage. Ensure flammable preservatives are not employed or stored near the hot plate. Although a Hot Work Permit is not required, scene safety evaluation by site personnel of the above elements is. As always, if a fire potential exists, the provisions for extinguishing must be immediately accessible as well as any provisions for first aid measures.

Open Flame

If an open flame is used, the following provisions are necessary:

- Complete a Hot Work Permit and any local permit required for elevated temperature applications. The Hot Work Permit, provided in your HASP, will aid the FOL and/or the SSO in ensuring that fire protection provisions (extinguishers, fire watches, etc.) are in place as well as ensuring that local requirements have been addressed.

- Ensure that water is available to address any wax splashes or contact. If possible, immerse the contacted area. Where this is not possible, run water over the area and apply cold compresses. The need for medical attention or first aid shall be determined on site under the direction of the SSO.

6.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples for subsequent analysis is by use of a stainless steel shovel, hand auger, soil corer, or stainless steel or disposable plastic trowel.

NOTE

Multiple depth intervals are used to describe surface soil. Sometimes surface soil is defined as soil from 0 to 2 inches below ground surface (bgs), and sometimes it is defined as soil from other depths such as 0 to 2 feet bgs. Ensure that the definition of surface soil depth is clear before collecting surface soil samples.

For the purposes of instruction, the terms “surface soil” and “near-surface soil” are used in this SOP as follows:

- Surface soil - 0 to 6 inches bgs
- Near-surface soil - 6 to 18 inches bgs

If these intervals are defined differently in the planning documents, substitute the appropriate depth ranges.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Stainless steel hand auger, soil corer, or shovel.
- Real-time air monitoring instrument (e.g., photoionization or flame ionization detector [PID], [FID]) as directed in project planning document.
- Required PPE.
  - Nitrile surgeon's or latex gloves may be used, layered as necessary.
  - Safety glasses.
  - Other – Items identified on the Safe Work Permit may be required based on location-specific requirements such as hearing protection, steel-toed work boots, and a hard hat when working near a drill rig. These provisions will be listed in the HASP or directed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP).
- Required decontamination equipment.
- Required sample container(s).
- Wooden stakes or pin flags.
- Re-sealable plastic bags.
- Heavy duty cooler.
- Ice.
- Chain-of-custody records and custody seals.

When acquiring surface soil samples, use the following procedure:

1. Place padding or use knee pads when kneeling near the sample location. If necessary, place plastic sheeting to provide a clean surface for sample equipment to avoid possible cross- contamination.
2. Carefully remove vegetation, roots, twigs, litter, etc. to expose an adequate soil surface area to accommodate sample volume requirements.
3. Using a pre-cleaned syringe or EnCore™ samplers, follow the procedure in Section 6.2.1 for collecting surface soil samples for volatile analysis. Surface soil samples for volatile organic analysis should be collected deeper than 6 inches bgs because shallower material has usually lost most of the volatiles

through evaporation. Ensure that the appropriate surface soil depth is being analyzed in accordance with the planning document.

4. Using decontaminated sampling tools, thoroughly mix in place a sufficient amount of soil to fill the remaining sample containers. See Section 6.5 of this procedure for hand auger instruction, as needed.

5. Transfer the sample into those containers utilizing a stainless steel trowel.

6. Cap and securely tighten all sample containers.

7. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.

8. Proceed with the handling and processing of each sample container as described in SOP SA-6.1.

9. Site restoration – Whenever removing sample materials, always restore the surface. It is our intent to leave the area better than we found it. Do NOT create trip hazards in areas where pedestrian traffic may exist.

6.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6 to 18 inches) can be accomplished with tools such as shovels, hand auger, soil corers, and stainless steel or pre-cleaned disposable trowels and the equipment listed under Section 6.5 of this procedure.

To obtain near-surface soil samples, the following protocol shall be used:

1. With a clean shovel, make a series of vertical cuts in the soil to the depth required to form a square approximately 1 foot by 1 foot.

2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

3. Follow steps 1 through 9 of Section 6.3.

6.5 Subsurface Soil Sampling With Hand Augers and Soil Corers

Hand augering and Use of Soil Corers are similar. Hand augering requires turning the auger while it advances whereas soil corers are not necessarily turned during advancement.

6.5.1 Hand Augering

A hand augering system generally consists of a variety of stainless steel bucket bits (approximately 6.5 inches long and 2, 2.75, 3.25, and 4 inches in diameter), series of extension rods (available in 2-, 3-, 4- and 5-foot lengths), and a T-handle connected to extension rods and to the auger bucket. A larger diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then it is withdrawn. The larger-diameter bit is then replaced with a smaller-diameter bit, lowered down the hole, and slowly turned into the soil to the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil either from the surface, or to depths in excess of 12 feet. However, the presence of subsurface rocks and landfill material and collapse of the borehole normally limit sampling depth.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes).
- Stainless steel mixing bowls or re-sealable plastic bags.
- The equipment listed in Section 6.3.
- Miscellaneous hand tools as required to assemble and disassemble the hand auger units.

> ***CAUTION***
> Potential hazards associated with hand augering include:
>
> - Muscle strain and sprain due to over twisting and/or over compromising yourself.
> - Equipment failure due to excessive stress on the T-handle or rods through twisting. Failure of any of these components will result in a sudden release and potential injury due to that failure.
>
> As in all situations, any intrusive activities that could damage underground utilities shall be proceeded by a Dig/Excavation permit/ticket. Call the Utility Locating service in the area or your Site Safety Officer for more information. When in doubt – **Get the Ticket!**

To obtain soil samples using a hand auger, use the following procedure:

1. Wearing designated PPE, attach a properly decontaminated bucket bit to a clean extension rod and attach the T-handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Twist the bucket into the ground while pushing vertically downward on the auger. The cutting shoes fill the bucket as it is advanced into the ground.
4. As the auger bucket fills with soil, periodically remove any unneeded soil.
5. Add rod extensions as necessary to extend the reach of the auger. Also, note (in a field notebook, boring log, and/or on a standardized data sheet) any changes in the color, texture or odor of the soil as a function of depth. The project-specific planning document (SAP, HASP, etc.) describe requirements for scanning the soil with a real-time air monitoring instrument (e.g., PID, FID, etc.) and recording the measurements.
6. After reaching the desired depth (e.g., the top of the interval to be sampled), slowly and carefully withdraw the apparatus from the borehole to prevent or minimize movement of soil from shallower intervals to the bottom of the hole.
7. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is to be smaller in diameter than the bucket bit employed to initiate the borehole.
8. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.

9. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.

10. Discard the top of the core (approximately 1 inch), which represents any loose material collected by the bucket bit before penetrating the sample material.

11. Using a pre-cleaned syringe or EnCore™ sampler, follow the procedure in Section 6.2.1 for collecting a soil sample for volatile compound analysis directly from the bucket bit.

12. Utilizing a properly decontaminated stainless steel trowel or dedicated disposable trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl or re-sealable plastic bag.

13. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers. Refer to Section 6.2.2.

14. Follow steps 4 through 7 listed in Section 6.3.

6.5.2 Sampling Using Stainless Steel Soil Corers

A soil corer is a stainless steel tube equipped with a cutting shoe and sample window in the side. The soil corer is advanced into the soil by applying downward pressure (body weight). The soil is unloaded by then forcing a ram towards the cutting shoe, which results in the discharge of the soil core through a window in the sleeve.

Use, application, and sample protocol is the same as for hand augering provided above, but without necessarily rotating the corer while advancing it.

SAFETY REMINDER

Hand augering and soil corer sampling can be physically demanding based on the type of geology and subsurface encumbrances encountered. Soil coring has some added hazards such the corer collapsing under your weight. To reduce the potential for muscle strain and damage, the following measures will be incorporated:

- Stretch and limber your muscles before heavy exertion. This hazard becomes more predominant in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue).

- Job rotation – Share the duties so that repetitive actions do not result in fatigue and injury.

- Increase break frequencies as needed, especially as ambient conditions of heat and/or cold stress may dictate.

- Do not force the hand tools or use cheater pipes or similar devices to bypass an obstruction. Move to another location near the sampling point. Exerting additional forces on the sampling devices can result in damage and/or failure that could potentially injure someone in the immediate vicinity.

- Do not over compromise yourself when applying force to the soil corer or hand auger. If there is a sudden release, it could result in a fall or muscle injury due to strain.

6.6 Subsurface Soil Sampling with a Split-Barrel Sampler

A split-barrel (split-spoon) sampler consists of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-pound or larger casing driver.

Safety Reminder

It is intended through the Equipment Inspection for Drill Rigs form provided in the HASP that the hammer and hemp rope, where applicable, associated with this activity will be inspected (no physical damage is obvious), properly attached to the hammer (suitable knots or sufficient mechanical devices), and is in overall good condition.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (2-inch OD, 1-3/8-inch ID, either 20 inches or 26 inches long); Larger OD samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-pound weight, driving head, and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls or re-sealable plastic bags.
- Equipment listed in Section 6.3.

The following steps shall be followed to obtain split-barrel samples (Steps 1 through 4 are typically performed by the drilling subcontractor):

1. Attach the split-barrel sampler to the sampling rods.
2. Lower the sampler into the borehole inside the hollow stem auger bits.
3. Advance the split-barrel sampler by hammering the length (typically 18 or 24 inches) of the split-barrel sampler into the soil using 140-pound or larger hammer.
4. When the desired depth is achieved, extract the drill rods and sampler from the augers and/or borehole.
5. Detach the sampler from the drill rods.
6. Place the sampler securely in a vise so it can be opened using pipe wrenches.

CAUTION

Pipe wrenches are used to separate the split spoon into several components. The driller's helper should not apply excessive force through the use of cheater pipes or push or pull in the direction where, if the wrench slips, hands or fingers will be trapped against an immovable object.

7. Remove the drive head and nosepiece with the wrenches, and open the sampler to reveal the soil sample.

8. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.) (as project-specific planning documents dictate). Carefully separate (or cut) the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.

9. If elevated vapor readings were observed, collect the sample scheduled for volatile analysis from the center of the core where elevated readings occurred. If no elevated readings where encountered, the sample material should be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact) (refer to Section 6.2.1).

10. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl or re-sealable plastic bag.

11. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers (refer to Section 6.2.2).

12. Follow steps 4 through 7 in Section 6.3.

6.7 Subsurface Soil Sampling Using Direct-Push Technology

Subsurface soil samples can be collected to depths of 40+ feet using DPT. DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

6.8 Excavation and Sampling of Test Pits and Trenches

6.8.1 Applicability

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

CAUTION

During the excavation of trenches or pits, several health and safety concerns arise from the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden, steel, or aluminum support structures or through sloping and benching. Personnel entering the excavation may be exposed to toxic or explosive gases and

oxygen-deficient environments; therefore, monitoring will be conducted by the Competent Person to determine if it is safe to enter. Any entry into a trench greater than 4 feet deep will constitute a Confined Space Entry and must be conducted in conformance with OSHA standard 29 CFR 1910.146. In all cases involving entry, substantial air monitoring, before entry, appropriate respiratory gear and protective clothing determination, and rescue provisions are mandatory. There must be at least three people present at the immediate site before entry by one of the field team members. This minimum number of people will increase based on the potential hazards or complexity of the work to be performed. The reader shall refer to OSHA regulations 29 CFR 1926.650, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146. High-hazard entries such as this will be supported by members of the Health Sciences Group professionally trained in these activities.

Excavations are generally not practical where a depth of more than about 15 to 20-feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If soil data at depths greater than 15-feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

6.8.2 Test Pit and Trench Excavation

Test pits or trench excavations are constructed with the intent that they will provide an open view of subsurface lithology and/or disposal conditions that a boring will not provide. These procedures describe the methods for excavating and logging test pits and trenches installed to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

Test pits and trenches may be excavated by hand or power equipment to permit detailed descriptions of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration.
- The space required for efficient excavation.
- The chemicals of concern.
- The economics and efficiency of available equipment.

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table provides guidelines for design consideration based on equipment efficiencies.

Equipment	Typical Widths, in Feet
Trenching machine	0.25 to 1.0
Backhoe/Track Hoe	2 to 6

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, the following field conditions may necessitate revisions to the initial plans:

- Subsurface utilities.
- Surface and subsurface encumbrances.
- Vehicle and pedestrian traffic patterns.
- Purpose for excavation (e.g., the excavation of potential ordnance items).

The final depth and construction method shall be collectively determined by the FOL and designated Competent Person. The actual layout of each test pit, temporary staging area, and spoils pile may further be predicated based on site conditions and wind direction at the time the test pit is excavated. Prior to excavation, the area may be surveyed by magnetometer or metal detector or other passive methods specified in SOP HS1.0, Utility Location and Excavation Clearance, to identify the presence of underground utilities or drums. Where possible, the excavator should be positioned upwind and preferably within an enclosed cab.

No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is required, OSHA requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be placed for every 25 feet of lateral travel and extended 3 feet above ground surface). A temporary guard rail or vehicle stop must be placed along the surface of the hole before entry in situations where the excavation may be approached by traffic. Spoils will be stockpiled no closer than 2 feet from the sidewall of the excavation. The excavation equipment operator shall be careful not to undercut sidewalls and will, where necessary, bench back to increase stability. The top cover, when considered clean, will be placed separately from the subsurface materials to permit clean cover. It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example, samples of leachate, groundwater, or sidewall soil can be collected with telescoping poles or similar equipment.

Dewatering and watering may be required to ensure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation stable. This is an important consideration for excavations in cohesionless material below the groundwater table and for excavations left open greater than a day. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

Where possible, excavations and test pits shall be opened and closed within the same working day. Where this is not possible, the following engineering controls shall be put in place to control access:

- Trench covers/street plates.
- Fences encompassing the entire excavation intended to control access.

- Warning signs warning personnel of the hazards.
- Amber flashing lights to demarcate boundaries of the excavation at night.

Excavations left open will have emergency means to exit should someone accidentally enter.

6.8.3 Sampling in Test Pits and Trenches

6.8.3.1 General

Log test pits and trenches as they are excavated in accordance with the Test Pit Log presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable health and safety and OSHA requirements have been met as stated above. These provisions will be reiterated as appropriate in the project-specific HASP.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information includes soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples that can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

6.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottle ware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps, and right angle adapter for conduit (see Attachment D).

6.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 6.8.3.4.

- Excavate the trench or pit in several 0.5- to 1.0-foot depth increments. Where soil types support the use of a sand bar cutting plate, use of this device is recommended to avoid potentially snagging utilities with the excavator teeth. It is recommended that soil probes or similar devices be employed where buried items or utilities may be encountered. This permits the trench floor to be probed prior to the next cut.
- After each increment:
  - The operator shall wait while the sampler inspects the test pit from grade level.
  - The sampler shall probe the next interval where this is considered necessary. Practical depth increments for lithological evaluations may range from 2 to 4 feet or where lithological changes are noted.
- The backhoe operator, who will have the best view of the test pit, shall immediately cease digging if:
  - Any fluid phase, including groundwater seepage, is encountered in the test pit.
  - Any drums, other potential waste containers, obstructions, or utility lines are encountered.
  - Distinct changes of material being excavated are encountered.

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending on the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Use the backhoe to remove loose material from the excavation walls and floor to the greatest extent possible.
- Secure the walls of the pit, if necessary. (There is seldom any need to enter a pit or trench that would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)
- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material after it has been deposited on the ground, as follows:
  a. The sampler or FOL shall direct the backhoe operator to remove material from the selected depth or location within the test pit/trench.
  b. The backhoe operator shall bring the bucket over to a designated location on the sidewall a sufficient distance from the pit (at least 5 feet) to allow the sampler to work around the bucket.
  c. After the bucket has been set on the ground, the backhoe operator shall either disengage the controls or shut the machine down.
  d. When signaled by the operator that it is safe to do, the sampler will approach the bucket.
  e. The soil shall be monitored with a PID or FID as directed in the project-specific planning documents.

f. The sampler shall collect the sample from the center of the bucket or pile in accordance with surface soil sampling procedures of Section 6.3 or 6.4, as applicable. Collecting samples from the center of a pile or bucket eliminates cross-contamination from the bucket or other depth intervals.

- If a composite sample is desired, several depths or locations within the pit/trench will be selected, and the bucket will be filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket or re-sealable plastic bag and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

> ***CAUTION***
>
> Care must be exercised when using the remote sampler described in the next step because of potential instability of trench walls. In situations where someone must move closer than 2 feet to the excavation edge, a board or platform should be used to displace the sampler's weight to minimize the chance of collapse of the excavation edge. Fall protection should also be employed when working near the edges or trenches greater than 6 feet deep. An immediate means to extract people who have fallen into the trench will be immediately available. These means may include ladders or rope anchor points.

- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the sidewall or bottom of the pit as follows:

  a. Scrape the face of the pit/trench using a long-handled shovel or hoe to remove the smeared zone that has contacted the backhoe bucket.

  b. Collect the sample directly into the sample jar, by scraping with the jar edge, eliminating the need for sample handling equipment and minimizing the likelihood of cross-contamination.

  c. Cap the sample jar, remove it from the remote sampler assembly, and package the sample for shipment in accordance with SOP SA-6.3.

- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

6.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soil or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There are no practical alternative means of obtaining such data.

- The SSO and Competent Person determine that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of oxygen concentration, flammable gases, and toxic compounds, in that order). Action levels will be provided in project-specific planning documents.

- A company-designated Competent Person determines that the pit/trench is stable through soil classification evaluation/inspections or is made stable (by cutting/grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements shall be strictly observed.

If these conditions are satisfied, only one person may enter the pit/trench. On potentially hazardous waste sites, this individual shall be dressed in selected PPE as required by the conditions in the pit. He/she shall be affixed to a harness and lifeline and continuously monitored while in the pit.

A second and possible third individual shall be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations to support self-rescue or assisted self-rescue. The individual entering the pit shall remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon.

6.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 6.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., thin-walled tube samplers), that can be pushed or driven into the floor of the test pit.

- Suitable driving (e.g., sledge hammer) or pushing (e.g., backhoe bucket) equipment used to advance the sampler into the soil.

- Knives, spatulas, and other suitable devices for trimming hand-carved samples.

- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.

- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

Disturbed grab or bulk geotechnical soil samples may be collected for most soil in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification: larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soil using thin-walled tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability, and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the tube when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 6.8.3.4 shall be followed. The thin-walled tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate because the sample will not have the correct orientation.

A sledge hammer or backhoe may be used to drive or push the tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus

minimizing disturbance to the sample. When using a sledge hammer, it is recommended that the sampler be stabilized using a rope/strap wrench or pipe wrench to replace the person's hands holding the sampler from the strike zone. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hook the sampler to the excavator or backhoe and extract. This means an alternative head will be used as a connection point or that multiple choke hitches will be applied to extract the sampler. If this fails and the excavator can dig deeper without potentially impacting subsurface utilities, excavate the sampler. If this fails or if the excavator cannot be used due to subsurface utilities, hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry into the test pit, the requirements in Section 6.8.3.4 must be followed. Prepare the sample as described in Steps 9 through 13 in Section 6.2.3, and label, pack and transport the sample in the required manner, as described in SOPs SA-6.3 and SA-6.1.

6.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew may photograph, if required by the project-specific work plan, all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL. Backfill should be returned to the trench or test pit in 6-inch to 1-foot lifts and compacted with the bucket. Remote controlled tampers or rollers may be lowered into the trench and operated from top side. This procedure will continue to the grade surface. It is recommended that the trench be tracked or rolled in. During excavation, clean soil from the top 2 feet may have been separated to be used to cover the last segments. Where these materials are not clean, it is recommended that clean fill be used for the top cover.

If a low-permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.9 Records

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler for all samples collected. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining global positioning system (GPS) coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. If the project-specific work plan requires photographs, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits, and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.
Other data to be recorded in the field logbook include the following:

- Name and location of job

- Date of boring and excavation
- Approximate surface elevation
- Total depth of boring and excavation
- Dimensions of pit
- Method of sample acquisition
- Type and size of samples
- Soil and rock descriptions
- Photographs, if required
- Groundwater levels
- PID/FID/LEL/O_2 meter readings
- Other pertinent information, such as waste material encountered

In addition, site-specific documentation to be maintained by the SSO and/or Competent Person will be required including:

- Calibration logs
- Excavation inspection checklists
- Soil type classification

7.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

U.S. EPA, 1992. Specifications and Guidance for Contaminant-Free Sample Containers. EPA-540/R-93/051.

USEPA, November 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.

ATTACHMENT A
SOIL & SEDIMENT SAMPLE LOG SHEET (EXAMPLE)

Tetra Tech

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: _____
Project No.: _____

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: _____
[] QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: / Time: / Method: / Monitor Reading (ppm):	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

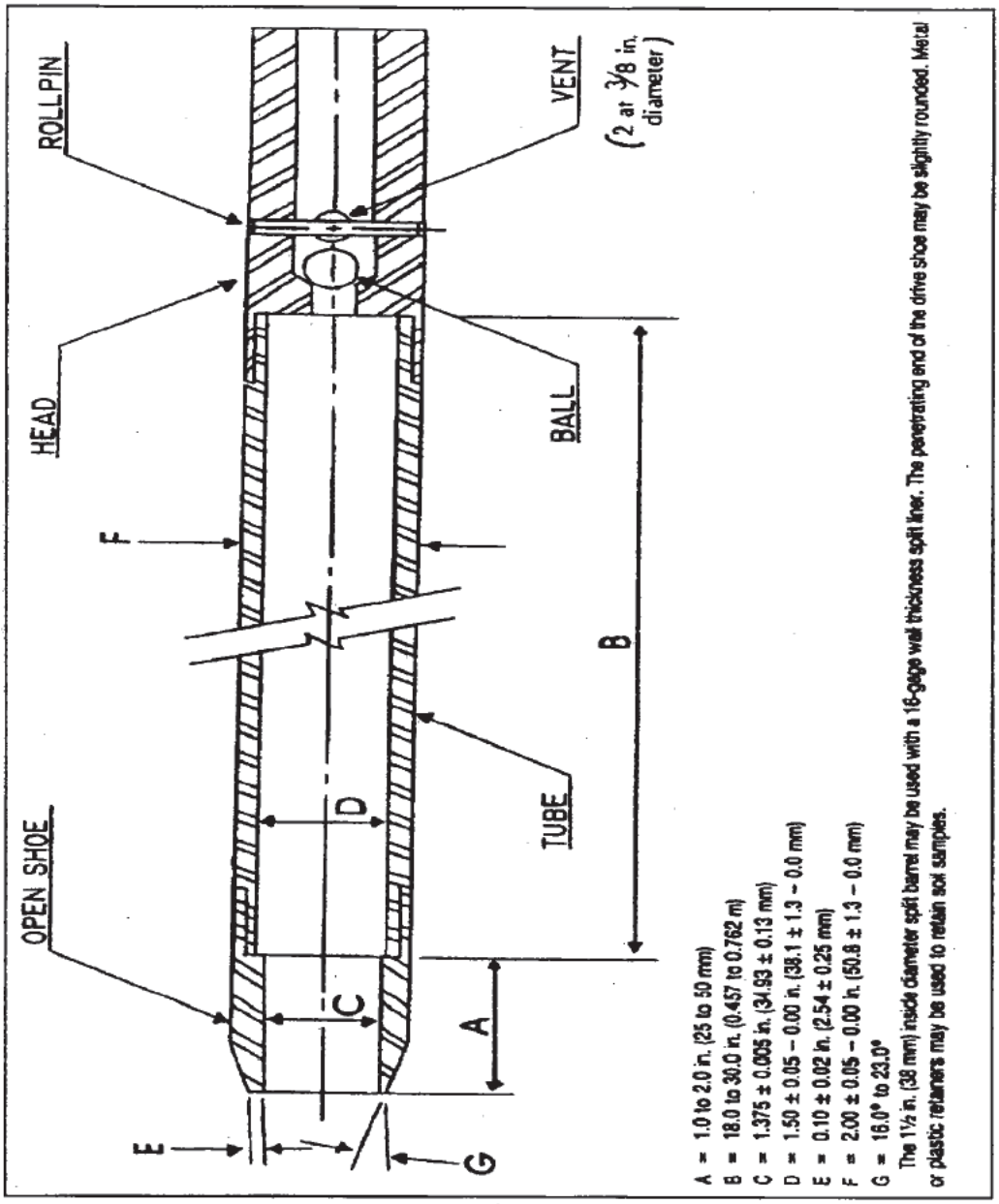
Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):

ATTACHMENT B
SPLIT-SPOON SAMPLER (EXAMPLE)



ATTACHMENT C
TEST PIT LOG (EXAMPLE)

Tetra Tech

TEST PIT LOG

Page ___ of ___

PROJECT NAME: _____ TEST PIT No.: _____
PROJECT NUMBER: _____ DATE: _____
LOCATION: _____ GEOLOGIST: _____

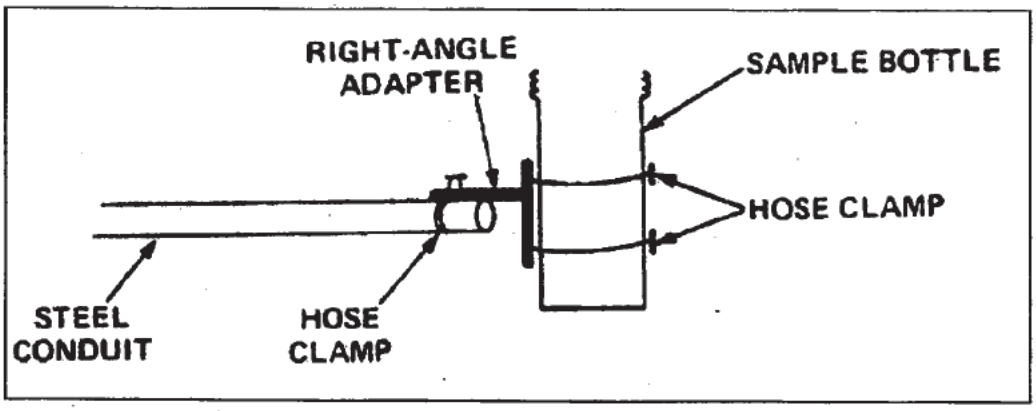
Depth (Ft.)	Lithology Change (Depth/Ft.)	MATERIAL DESCRIPTION: Soil/Waste Characteristics (lithology, density, color, etc.)	USCS	Remarks	PID/FID READING: Source (ppm)	PID/FID READING: BZ (ppm)

TEST PIT CROSS SECTION AND / OR PLAN VIEW

REMARKS: _____

PHOTO LOG: _____

ATTACHMENT D
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING (EXAMPLE)



TETRA TECH	STANDARD OPERATING PROCEDURE (GUIDANCE)	Number SA-2.4	Page 1 of 9
		Effective Date 09/30/2016	Revision 4
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	
Subject SOIL GAS SAMPLING		[redacted]	

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1.0 PURPOSE

This guidance provides general reference information for soil gas sampling. Soil gas investigations measure the general extent of volatile organic compound (VOC) contamination, such as chlorinated solvents and petroleum products, emitted by subsurface soil and groundwater. Other organic chemicals not commonly classified as VOCs may be volatile enough to be detected using soil gas sampling. The methods and equipment described in this procedure are for collection of soil gas from the unsaturated zone of subsurface soil.

2.0 SCOPE AND APPLICABILITY

This procedure provides guidance on selecting and using proper sampling equipment and techniques for soil gas sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable; however, site-specific conditions or project-specific plans may require adjustments in methodology.

A wide range of organic contaminants may be detected using the methods described in this guide. Passive samplers, for example, such as Gore-Sorber® Passive Samplers and BEACON BeSURESoil Gas Samplers,™ can be used to accumulate organic vapors associated with VOCs, semivolatile organic chemicals (SVOCs), explosives, polychlorinated biphenyls (PCBs), chemical warfare agents, and breakdown products of these chemicals. Active gas samplers may be used to detect a similar variety of compounds. Consult manufacturer guidance and specifications regarding the applicability of any particular passive sorbent material and consult analytical laboratories to establish their capabilities with regard to onsite chemical analysis of various organic compounds in gas samples.

3.0 GLOSSARY

Sampling Grid – A sampling grid is a two-dimensional array of sampling locations. These grids typically consist of a series of equidistant sampling points arranged along parallel transect lines in two perpendicular directions. When sampling locations are equally spaced with the same spacing in both directions the grid is a square grid (a subset of rectangular grids). When spacing along one direction is different than the other direction, the grid is called a rectangular grid. The spacing of sampling locations in each direction and the number of parallel grid lines will depend upon site specific conditions and project objectives. Triangular grid configurations also are possible but are not commonly used.

Transect Line - A network consisting of a straight-line arrangement of sampling locations or other items. Transects are useful for establishing concentration gradients along a given direction, such as a groundwater flow path. For example, sampling points could be placed along a transect line between an area affected by a chemical contaminant and the suspected contaminant source area. The transects could be situated along a known groundwater flow path. This sampling location arrangement can significantly limit the number of sampling points required to locate a contaminant source compared to a randomized sampling grid. Transect sampling also can fail to detect contamination that is not intersected by transects. The use of transects, therefore, is typically coupled with site-specific information that enhances their effectiveness.

Biased Location – A location whose selection is deliberate and typically related, or expected to be related, to a certain constraint or characteristic. When placed near a suspected contaminant source area, for example, these locations can be useful for establishing the locations of "hot spots" for further delineation or remediation.

Random Location – A random location is a location selected without bias and with a probability of being selected that is equal to the probability of any other potential sampling location to be selected. Selection may be accomplished by rolling dice, using a computerized random number generator, using printed random number tables, or using other randomization devices. Sampling networks based on random sampling are often used at a site when little information is available about the site, no contamination is suspected, or when an unbiased representation of site conditions is desired.

Combined Strategies – Sampling networks based on combined (or hybrid) strategies are the most commonly used sampling strategies. They include any combination of the four previously described sampling approaches.

Head Space Analysis - The screening or analysis of volatile organic vapors that have accumulated in the air space within a soil or groundwater sample container.

Flame Ionization Detector (FID) - A detector sensitive to many combustible organic compounds and a few inorganic compounds in air at parts-per million (ppm) levels. In the field FIDs are commonly packaged in portable FID instruments which, themselves, are called FIDs. A flame in the FID ionizes gaseous species. The electrical charges of the ions generate an electrical signal that is measured by the FID.

Photo Ionization Detector (PID) - A detector designed for the measurement of many combustible organic compounds and a few inorganic compounds in air at ppm levels. A PID will not detect methane gas. A high intensity lamp ionizes gaseous species utilizing ultraviolet radiation and the ions generate an electrical signal that is measured by the PID. Field PIDs are commonly packaged in portable PID instruments which, themselves, are called PIDs

Direct Push Technology (DPT) - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste (soil cuttings, purge water, etc.). DPT use is limited to unconsolidated materials such as soil overburden that can be penetrated by the DPT apparatus.

4.0 RESPONSIBILITIES AND QUALIFICATIONS

Project Manager - The Project Manager is responsible for selecting and/or reviewing the appropriate soil gas sampling procedure required to support the project objectives. Program Manager qualifications are described in the current NUS Operating Unit Quality Assurance Program Manual available on the intranet Quality Assurance link.

Field Operations Leader (FOL)-The FOL is primarily responsible for performing the soil gas sampling technique in accordance with the project-specific plan. Program Managers appoint PMs based on their experience and past performance and qualifications of PMs are described in the current NUS Operating Unit Quality Assurance Program Manual, which is available on the intranet Quality Assurance link.

5.0 HEALTH AND SAFETY

Many accidents in subsurface investigations are due to encountering subsurface utilities. Prior to mobilizing for any soil gas investigation, health and safety concerns must be addressed. Locating and avoiding contact with underground utilities is a primary concern. Use the "One Call" system to contact the state in which the investigation is being done.

"One Call" personnel will contact all utility companies that may have services in the area of investigation. Enough lead time must be provided to allow the necessary utility marking to take place. For example, in New Jersey, calls must not be made less than three full working days and not more than 10 working days prior to the planned work. If work is delayed and the ticket expires, the applicable clearance ticket must be renewed before work can be done. The Tetra Tech person making telephone contact with "One Call" will typically be asked to provide the following information:

- County in which the work is being done
- Municipality in which the work is being done
- Street address of the location where the work is being done
- Nearest cross street
- Type of work being performed
- Extent of work
- Name of caller and title
- Start date of work

It is important to contact the municipal utility authority in the town in which the work will be done. There may be "road-opening" permits that must be obtained prior to the start of the investigation. Police departments and emergency services often wish to know if a roadway is going to be partially blocked or detoured, and may require that a traffic safety officer be present during any road work.

Utility companies are only obligated to mark-out the utility lines on public property. They are not required to mark out the utility lines on private property. The property owner or a private company must complete utility mark-outs on private property.

CAUTION

If the presence of a utility line is suspected where intrusive work will take place, move the sampling location a few feet away from the suspected location of the utility and double check to ensure there are no indications that a utility could be located at the newly selected location. Relocating a soil gas sampling point by a few feet generally will not have a significant effect on the gas analysis results and it could save a life. If moving a designated sampling point will have an adverse effect on the project, consider other options with the PM.

6.0 EQUIPMENT LIST

Multiple sampling methods are described below and each one is short, with a limited amount of required equipment for each method. Therefore, the reader is referred to each sampling subsection to determine which equipment is needed to implement a particular sampling method. The essential equipment is identified with bold italic font.

7.0 PROCEDURES

Licenses may be required for installing soil borings used to collect soil gas samples. When in doubt about the need to obtain a license or to use a subcontractor who has the appropriate licenses, consult the applicable state regulations.

7.1 General

Soil gas measurements are used to delineate volatile contamination in subsurface soil and groundwater. Soil gas surveys are not intended to be a substitute for conventional subsurface investigation methodologies (e.g., monitoring well installation and groundwater sampling) but rather are most useful as screening tools to focus subsequent investigations to areas of potential concern. The advantages of using soil gas methodologies to define contamination include:

1. Minimizing the number of subsequent test borings and monitoring wells required to characterize the nature and extent of contamination.
2. Optimizing the placement of subsequent monitoring wells and test borings.
3. Allowing the collection of large amounts of data in a short time period relative to conventional methods.
4. Generating little or no investigation-derived waste.

To assess the potential effectiveness of a soil gas survey, consider the following items:

1. The near surface geology.
2. The type of contamination present.
3. The anticipated concentration of contamination present.
4. The anticipated depth to the zone of contamination.

Common soil gas methods are most effective in geological settings that contain coarse textured soils (e.g., silty sands, sands and gravels) and are least effective in areas of fine textured soils (e.g., silty clays and clays). Soil gas methods may be effective at mapping areas of dense non-aqueous phase liquid VOC contamination that are present beneath the water table. Areas with deep water tables or low concentrations of VOC contamination may require the use of specialized soil gas techniques. These techniques could require the use of more expensive passive sorbent samplers left in place for a relatively long time period.

7.2 Soil Gas Sampling Grids

The first stage of a soil gas survey is to establish a sampling grid or network. The grid should be designed to obtain all necessary information with a minimal expenditure of time and resources. The development of the grid should be based on background information regarding chemical properties of the contaminant, properties of the vadose zone, and hydrogeological conditions of the area. All of this information should be used to design a sampling protocol specific to the conditions at the site. Some of the designs that are used include grids, transect lines, and biased, random, or combined methodologies (see Section 3.0).

The size of the grid spacing is determined on a site specific basis. Sampling locations should be marked, e.g., with pin flags or wooden stakes, and numbered sequentially. To avoid confusing measurements from different sites, numbering should be unique to each site being investigated. The grid should be referenced to permanent site features and the stakes left in place long enough to assist with future subsurface investigations, if necessary. The location of any nearby surface or subsurface features which may affect the results of the survey (sewer line, fuel farm, etc.) shall be noted in the field notebook. Detailed notes and a sketch of each site, including station locations and station numbers will be documented in the field logbook. After the grid has been laid-out a dig permit must be applied for and approved prior to the start of sampling.

7.3 Sampling Methodologies

There are several methods for the collection of soil gas samples. The most common types are described in the following sections. Variations of the following methods may be conducted if approved by the Project Manager.

7.3.1 Head Space Screening

Head space screening is a method of obtaining rapid information concerning the presence of VOC contamination in the subsurface. Head space screening is usually applicable to soil samples but can also be modified to include groundwater samples. Although head space screening is not a direct measurement of in-situ soil vapors, the procedure is included in this guidance because soil vapors are the actual media being screened or analyzed during headspace screening.

- Upon sample retrieval from the subsurface, remove a small quantity of undisturbed soil (approximately 6 oz.) from the sampler (e.g., hand auger, split-spoon sampler, Shelby tube, etc.) and immediately placed it in a re-sealable (Ziploc®-type) plastic bag.

- After the bag is sealed, gently massage the sample to break apart any large soil clumps. Be careful not to puncture he bag. If the bag is punctured, start over at the previous step.

Warm the bag for 15 minutes to volatilize contaminants from the soil sample into the head-space of the bag. For consistent readings at a particular site, it is important to warm each sample for the same time period and to approximately the same temperature. Placing the sample in the passenger compartment of a warm vehicle may provide a reasonably consistent ambient temperature. Other methods of gently warming the sample may be used as long as the resulting temperature is consistent and the procedure is documented in the field log book.

- After 15 minutes of warming, carefully push the tip of the PID or FID directly through the plastic bag and obtain a direct reading of the maximum detection in the headspace of the bag. The PID or FID should be capable of storing the maximum detection value for a given reading.

- Record all head-space measurements (maximum detection per sample) on the appropriate soil boring log and/or sample log form.

7.3.2 Pipe Probes

Pipe probes involve the use of a hollow steel tube to collect the soil gas sample. The probes can be passively placed into a predrilled hole or driven to the required depth. The predrilled hole can be made using a ***slide hammer, bucket auger, electric hammer, or DPT drill rig***. The following three soil gas procedures using pipe probes are commonly used for preliminary screening in the field.

Non-Depth-Specific Active Sampling Method

This first active sampling method described is the simplest and will provide immediate results that may help in the location of subsequent test pits, soil borings, etc. The steps are as described below:

1. Drive a ***3/4-inch steel pipe*** into the ground using ***a slide hammer, electric hammer or equivalent*** to the desired depth. Generally this will not exceed five feet due to the difficulty in retrieving the pipe.

2. Remove the steel pipe from the ground by hand ***or jack***.

3. Place a hollow ***3/4-inch diameter by 1-foot long steel pipe*** into the previously created hole and seal off the outside of the pipe with ***bentonite clay*** so that no soil gas can escape from between the pipe and adjacent soil.

4. Allow 5 minutes for vapors in the hole to reach equilibrium and connect ***a sampling port*** to the top of the 1-foot long steel pipe.

5. Using **silicone tubing**, attach the tip of the PID/FID to the hollow pipe sampling port and collect instrument readings for a minimum of 1 minute, or until the readings peak and begin to decline. Record the highest value in the field notebook along with the time, date, and sampling location.

6. Decontaminate the steel pipes before moving to the next location to minimize the potential for cross-borehole contamination.

   Note: Any ancillary observations made such as soil type, soil color, depth to water table, etc., should be recorded in the ***field logbook***.

First Depth-Specific Active Sampling Method

This second active sampling method is a variation of the first, but provides a more depth-specific sample and uses a Tedlar® bag for collecting the soil gas.

1. Drive an ***expandable steel drive point (3/4-inches diameter)*** attached to a **5 foot connecting rod** into the ground using a ***slide or electric hammer or DPT drill rig***.

2. Retract the rod ***by hand or jack*** a sufficient distance to leave a space for the soil gas to enter the drive point (approximately 6 inches). Allow 5 minutes for vapors in the hole to reach equilibrium.

3. After the drive point and connecting rod have been retracted, assemble the sampling apparatus by attaching 1**/4-inch I.D. polyethylene tubing** to the top of the connecting rod.

4. Place the tubing to the inlet side of a ***peristaltic pump*** and connect the discharge side of the pump to a ***1-Liter Tedlar® bag***.

5. Fill the **Tedlar® bag** twice to adequately purge the sampling equipment and ambient air that exists in the bag.

6. Collect the soil gas sample in ***a separate Tedlar® bag*** as above and then connect it directly to the inlet of a ***PID/FID***.

7. Obtain the maximum reading from the PID/FID in ppm and record the data in the **field notebook or sample log form**.

8. Decontaminate the equipment before moving to the next location.

Second Depth-Specific Active Sampling Method

This third active sampling method is similar to the above, except that the soil gas collected in the Tedlar® bag shall be analyzed in the field using either a portable or onsite lab gas chromatograph (GC). This procedure can identify specific contaminant(s) of concern. These instruments, though more expensive, can be very sensitive and selective to the contaminant(s) of concern.

1. Follow Steps 1 through 5 for the First Depth-Specific Method.

2. Again following Steps 1 through 5 for the First Depth-Specific Method, collect the soil gas sample in ***a different Tedlar® bag*** than the one used in Steps 1 through 5.

3. Submit the gas sample in the ***Tedlar® bag*** under chain of custody for analysis by portable or onsite laboratory GC. Details of this chain of custody requirements and analysis are beyond the scope of this guidance.

4. Decontaminate the equipment before moving to the next location.

5. When available, collect the onsite analytical results and provide them to the FOL or Project Manager for interpretation.

7.3.3 Passive Sorbent Sampling

Passive sample collection includes two general sample collection techniques. These techniques include the passive collection of contaminants onto sorbent material placed in the vadose zone and a whole-air passive collection technique for collecting vapors emissions from the soil surface using an emission isolation flux chamber.

The most common type of sorbent sampler used is known as a Petrex® tube, which consists of activated charcoal chemically fused to the tip of a Curie-point ferromagnetic wire and inserted into a glass tube. The collector is buried at a depth of 2 to 4 feet in an inverted position with the glass tube acting as a flux chamber for an optimal period of time as specified in the manufacturer's recommendations. Sample analysis is by thermal desorption onto a mass spectrometer (MS) or GC.

This method is recommended when the contaminants are unknown and concentrations are expected to be low. Specialized sorbent samplers may require the use of a soil gas subcontractor.

Follow the manufacturer's guidance and specifications for deployment and retrieval of these passive samplers.

Other types of passive samplers include Gore-Sorber® Passive Samplers and BEACON BeSURESoil Gas Samplers™. Follow manufacturer directions for the use of these devices. Be aware that the Gore-Sorber manufacturer may require that the sampling devices be returned to the W. L Gore and Associates laboratory for analysis.

7.3.4 Well Points

Well points can be installed to obtain data on subsurface gas concentrations at depths or areas inaccessible by other monitoring techniques. Single or multiple probes may be installed in a single borehole. Well points are recommended for projects if more than one soil gas sampling event is to occur to monitor contaminant migration versus time. The construction of the well points may vary and may require the use of a conventional drill rig, DPT drill rig, power auger, or hand auger. The need for this type of soil gas survey shall be determined by the Project Manager and site specific conditions. The installation of a soil gas well point is described below:

1. Drill the borehole to the desired depth using ***an appropriate drilling technique***.

2. Set the screened well point at the desired depth and backfill with a ***clean silica sand*** to approximately 1 foot above the screened length.

3. Place soil cuttings ***or bentonite pellets*** on top of the sand pack.
4. Place 1 to 2 feet of ***cement/bentonite grout*** on top of the soil or bentonite plug.
5. ***If necessary, install a steel protective casing*** over the well point to prevent damage.
6. Place **sample outlets** inside the protective casing for sampling.

8.0 REFERENCES

New Jersey Department of Environmental Protection and Energy, Field Sampling Procedures Manual, May, 2005 (available on the Intranet at: http://www.nj.gov/dep/srp/guidance/fspm/pdf/fsmp2005.pdf).

9.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the ***field logbook***. Entries should include all pertinent data regarding the soil gas survey. The use of sketches, photographs, and field landmarks will help to supplement the investigation and evaluation.

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1.0 PURPOSE

This guidance document provides information on how to perform subsurface investigations using Direct Push Technology (DPT) drilling methods.

2.0 SCOPE

This guidance document addresses standard DPT methodologies, and their benefits and drawbacks. It provides standardized instructions for using this type of drilling. Project Managers should consult Staff Geologists and prospective DPT Subcontractors to determine if DPT drilling can meet the project objectives.

3.0 GLOSSARY

Direct Push Technology (DPT) – DPT refers to a drilling method that uses hydraulic pressure and/or percussion hammers to advance sampling tools directly into the ground without the use of rotary type drilling equipment. DPT drilling is restricted to unconsolidated materials.

Geoprobe® – Geoprobe® is a manufacturer of DPT drilling rigs capable of multiple types of drilling methods; DPT, HSA, rotary, and sonic drilling see SOP GH-1.3 for addition guidance for these other drilling methods.

Halogenated Hydrocarbons – Hydrocarbon compounds containing atoms of elements such as bromine, chlorine, or fluorine (called halogens).

Gas Chromatography (GC) – A technique for analyzing a mixture of volatile substances in which the mixture is carried by an inert gas through a column packed with a selective material.

Flame Ionization Detector (FID) – An instrument for the measurement of combustible organic compounds and inorganic compounds in air at parts-per million levels. The basis for detection is the ionization of gaseous species using a hydrogen flame as the energizing source.

Photo Ionization Detector (PID) – An instrument for the measurement of combustible organic compounds and inorganic compounds in air at parts-per million levels. The basis for detection is the ionization of gaseous species using ultraviolet radiation as the energizing source.

Halogen Specific Detector (XSD) – A device for detecting halogenated hydrocarbons in a carrier gas using an electron emitter anode and cathode transducer. The XSD is less prone to non-halogen interferences than ionization detectors.

Dual Tube Soil Sampling System – This sampling system is used for collecting continuous soil core samples. The system uses inner sampling string of tools and an outer casing which is advanced to keep the hole open. The system is susceptible to sandy material entering into the outer casing (heaving or running sands) when the inner string is extracted. For more details click on the following Web link: - Dual Tube Soil Sampling System | Geoprobe® Systems.

Macro-Core®® Sampling System – This sampling system is a single tube, discrete or continuous sampling tool for use when running sands are to be expected. For more details click on the following link: Macro-Core® Geoprobe® Systems.

Pre-packed Screen – Pre-packed screens consist of slotted PVC well screen pipe surrounded by a stainless steel mesh or slotted PVC. Sand is packed between the slotted PVC and the outer screen material. Since the sand is packed around the slotted PVC before the well screen is installed it ensures proper sand pack emplacement.

Membrane Interface Probe (MIP) – This tool is a semi-quantitative, field-screening tool that can detect volatile organic compounds (VOCs) in soil and sediment.

4.0 RESPONSIBILITIES

Project Manager – The Project Manager (PM) is responsible for overall planning, staffing, and execution of a field project. The PM is also responsible to ensure that a Site Specific Health and Safety Plan (or equivalent) is generated by Health and Safety department for the site specific field investigation activities.

Project Geologist – The Project Geologist, with input from the PM, is responsible for selecting the appropriate drilling methods and technical approach required to meet project objectives. He is also responsible for providing input to the field team regarding daily activities on an as-needed basis.

Field Operations Leader (FOL) – The FOL responsibilities include but are not limited to:

- Serving as a liaison with facility and subcontractor personnel.
- Ensuring and enforcing compliance with the health and safety plan for all personnel involved in the execution of the field investigation activities.
- Coordinating field investigation activities such that they may be performed in an effective, efficient, and safe manner consistent with the governing planning documents.
- Supporting the utility clearance process. Refer to SOP HS-1.0 for additional guidance.
- Supporting logistics including access to items such as, but not limited to:
  - Potable water for decontamination operations
  - Areas for equipment lay down and storage

Site Geologist – The Site Geologist is responsible for verifying that the standard and approved DPT procedures are followed while working onsite. The Site Geologist will generate a detailed boring log for each borehole drilled in accordance to SOP GH-1.5. The Site Geologist will inspect the drill rig and components to ensure that it is in safe operating condition. These responsibilities may be assigned to other Tetra Tech personnel with the PM approval.

Proposed boring locations should be shown on a site map provided in the governing planning documents such as a Work Plan or Sampling and Analysis Plan. The Site Geologist or the FOL is responsible to finalize the exact drilling location. The drilling location may need to be moved slightly for a variety of reasons such as: utility avoidance, trees, or physical barriers, etc. If the proposed drilling location needs to be moved a significant distance (e.g., more than 10 feet), as determine by communiques between the FOL and the project manager, possible options need to be discussed with the project team based on field observations. A map sketch showing the drill location(s) relative to a permanent site feature(s) should be made in the field note book.

DPT Subcontractor – The DPT Subcontractor is responsible for obtaining required drilling permits, and supplying all labor, equipment, and material required to perform the drilling tasks as specified in the subcontract documents. The DPT Subcontractor is also responsible for equipment maintenance and quality control of their operation. The DPT Subcontractor shall be licensed in the State/Territory where the DPT work is to occur. The DPT Subcontractor maybe required by State law to complete the state utility clearance One-Call process; however, this requirement may vary from state to state. Therefore, check with the state One -Call requirements. Tetra Tech should determine who will be responsible to initiate the One-Call process prior to contracting a drilling company (see SOP HS-1.0 for additional guidance).

The DPT Subcontractor must report to the FOL within 24 hours any major technical or analytical problems encountered in the field, and must provide advance written notification of any changes in field procedures, describing and justifying such changes. No such changes shall be made unless requested and authorized in writing by the FOL (with the concurrence of the Project Manager). Depending on the subcontract, the Project Manager may need to obtain written authorization from appropriate administrative personnel before approving any changes.

5.0 METHODS

This sections provides an overview of the common DPT drilling procedures and associated sampling systems.

5.1 General

DPT is a recommended drilling method for subsurface investigations when other drilling methods are not required. For additional guidance regarding other drilling methods see SOP GH-1.3. The DPT investigation methods described herein include the following:

- Soil sampling, surface and subsurface
- Groundwater grab or single point samplers
- Monitoring well installation (temporary and permanent)
- Screening tools (MIP/EC)

Soil gas sampling is discussed in SOP SA-2.4.

The advantage of using DPT over other drilling methods includes:

- Fewer drill cuttings.
- Lower decontamination fluid volumes.
- Smaller and lighter track mounted rigs providing a wide range of access capabilities.
- Lower overhead clearance requirements.
- Lower mobilization costs.

Disadvantages include:

- Limited penetration depth, this is becoming less of a concern with bigger and stronger DPT rigs.
- Limited well diameter size, 2-inch inside diameter (ID) or less.
- Limited to unconsolidated material.
- The rig may have difficulties penetrating gravelly material, again this is less of a concern with the larger DPT rigs.
- Not recommended when drilling beyond a confining unit requiring dual cased installation.

5.2 Soil Sampling Methods

There are two common types of DPT soil sampling methods: Macro-Core® and dual tube. Both sampling methodologies use plastic liners or tubes to retrieve the soil sample for processing. The plastic liners are extracted from the sample barrel and cut by the driller for processing in accordance with SOPs GH-1.5 and SA-1.3. The driller is responsible to use the proper cutting tools to ensure that the plastic liners are cut safely.

5.2.1 Macro Core Methodology

Macro-Core® is a single tube, discrete interval or continuous soil sampling system. There are two types of Macro-Core® systems, 1) the light-weight center rod (LWCR), and 2) the stop-pin. These systems use different tools to unlock a piston point allowing soil to enter the sample barrel at the desired sample interval.

The LWCR system uses center rods within the tool string to keep the piston point inside the cutting shoe and preventing soil from entering the sample barrel. When the desired sampling depth is reached, the center rods are removed. Then the tool string is advanced to the sampling depth allowing the center piston to be displaced by the in-coming soil filling the plastic liner. The Geoprobe® SOP is provide here (Macro-Core® LWCR) for more details.

The stop-pin system uses a locking pin and a piston rod to hold the center piston in the cutting shoe till the sample depth is reached. The piston rod extends down through the sample barrel into the drive head. When the desired depth is reached, extension rods are sent down through the tool string to release the stop pin and piston. Then the tool string is advanced allowing the soil to enter the plastic liner. Additional Geoprobe® guidance is provided at this link: Macro-Core® stop-pin.

5.2.2 Dual Tube Methodology

The dual tube system uses two sets of probe rods to retrieve soil sample core. An outer casing (pipe) and the inner sampling rod. A plastic sample tube is attached to the inner rods and is advanced with the outer casing into undisturbed soil filling the plastic tube. The plastic tube is then withdrawn from the outer casing using the inner rods while the outer casing with a cutting shoe remains in the ground. The sampling method should be changed to Macro-Core® when loose sand enters and heaves upward by several feet (running sands) into the otter casing. The Geoprobe® SOP for dual tube sampling is provided at this link: dual tube sampling system.

5.3 Groundwater Sampling Methods

Groundwater sampling generally occurs after a soil boring has been completed characterizing the subsurface material and identifying the water producing zones. There are two types of groundwater sampling methods used with DPT: 1) groundwater grab samplers and 2) monitoring wells (permanent or temporary). Groundwater sampling guidance is provided in SOP SA-1.1. Monitoring well installation guidance is provided in SOP GH-2.8.

5.3.1 Groundwater Grab Samplers

Groundwater grab samplers are used for screening purposes during one field event. The sampling device is removed from the ground and the hole is abandoned after the sampling is completed. There are two common systems used to collect groundwater grab samples, 1) screen-point samplers and 2) PVC slotted-screen and riser (1-inch nominal diameter).

Screen-Point Samplers

Screen-point samplers consist of a wire-wound stainless steel screen or slotted PVC screen sealed within a steel pipe with an expendable tip. The sampler is driven to the sampling depth and deployed by retracting upward the steel pipe to expose the screen to the formation material. The screen has a nominal diameter of 1 inch. The screen interval can be adjusted depending on the distance the steel pipe is retracted, from a few inches to 4 feet. Additional information for the Geoprobe® screen-point sampler is provided at the following link: Geoprobe® groundwater sampler.

When using screen-point samplers in aquifers with low yields the following problems may be encountered:

- Being sampled without purging or development resulting in high turbidity.
- High sample volume requirements, causing the point sampler to go dry. Well recovery and resampling can be time consuming.

PVC Slotted-Screen and Riser

The PVC slotted-screen and riser sampler can mitigate the screen-point sampler problems. This type of grab sampler is installed using DPT drill pipe with an expendable tip. The drill pipe is pushed to the desired depth, and the screen and riser are lowered into the drill pipe. The expendable tip is knocked out while the pipe is pulled out of the ground, exposing the screen to the formation material. The PVC slotted screen grab sampler can be installed and sampled over a period of days allowing for recovery prior to removal and abandonment. This approach enables the driller to proceed to other well point installations. If metals are to be analyzed and low turbidity samples are desired, a filter pack can be installed provided proper size pipe is used to accommodate the filter pack. The PVC material is discarded or decontaminated once the sample is collected to minimize cross contamination. This type of grab sampler can be converted to a monitoring well by placing the proper back fill materials above the filter pack in accordance with State regulations, and client and project requirements. Monitoring well installation is discussed in more detail in the following section.

5.3.2 Monitoring Well Installation

There are two types of monitoring well installations: temporary and permanent. Pre-packed screens are recommended for both types to expedite and ensure proper installation of the filter sand. However, PVC slotted screen cost less, and can provide equivalent data quality. The most common well diameter for DPT installation is 1-inch inside diameter. The steel pipe used for the installation has a nominal inside diameter of 3 inches allowing for backfill materials to be installed and measured during the installation.

The definition of a temporary well can vary depending on State regulations, client or project requirements, and budgetary concerns. For example, in accordance with South Carolina regulations, a temporary well is to be abandoned within 5 days of installation. Temporary wells can provide groundwater level and chemical data of the same quality as permanent wells. A temporary well is installed with the intent of easy abandonment and not intended for long term monitoring. A permanent well is installed for long term use with durable surface seal and protection.

Temporary Well

The well riser and screen are joined and lowered to the desired depth inside the drill pipe. The expendable tip can be knocked out with the PVC well riser and screen. However, in some cases, light weight DPT rod string is needed to knock out the expendable tip. The well filter pack is installed while the drill pipe is withdrawn from the ground. The annular space around the screen is filled with silica sand to at least 1 to 2 feet

above the screen. A bentonite seal is installed above the filter pack with a nominal thickness of 2 to 4 feet, or the project may require that the bentonite be installed up to the ground surface. The riser pipe is capped and the annulus covered with plastic sheeting to prevent rain water from entering into the well.

Permanent Well

Permanent monitoring wells are installed in the same manner as the temporary wells except that the proper back fill materials (some type of grout) are installed above the bentonite seal. In addition, a surface protection cover and bollards (if required) are installed in accordance with the State regulations, and client and project specifications. Comprehensive procedures regarding well installation and completion are provided in SOP GH-2.8.

5.4 Membrane Interface Probe/Electrical Conductivity Probe

The Membrane Interface Probe/Electrical Conductivity (MIP/EC) probe is a semi-quantitative field screening tool developed by Geoprobe® for vertical profiling of volatile organic compounds (VOCs) and soil conductivity for lithologic characterization. A permeable membrane device is driven into the subsurface. The membrane is heated to approximately 250 degrees Fahrenheit (°F) which leads to diffusion of VOCs across the membrane into a carrier gas stream which is transported to a laboratory grade GC. Various detectors are used: PID, FID, and XSD in the GC instrument to detect VOCs. An EC probe on the device measures the soil conductivity. A depth transducer is attached to the direct push drive head to track the depth of the probe. The MIP/EC profile response can be viewed while the probe in advancing downward allowing the user to determine the completion depth of the MIP/EC point. Hard copy of the MIP/EC results are provided when the MIP/EC point is completed. The real time data can be used:

- To determine plume size.
- To determine placement of temporary wells or permanent monitoring wells.
- For a one-phase investigation (eliminating a multiple phased effort).
- To determine quickly if contamination is present or not.
- To large sites where the MIP cost would offset taking numerous samples.
- To determine if there are contamination pathways present.
- To define contamination in fine-grained saturated material which doesn't yield water into a well.
- To characterize the lithology and the extent of contamination to provide support for remediation system installation (i.e., which zones would most significantly benefit from chemical treatment injection).

For additional MIP/EC operational guidance go to this link: Geoprobe® MIP SOP.

6.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation. Comprehensive guides and procedures regarding records and documentation are provided in the following SOPs:

- GH-1.5 – Borehole and Sample Logging
- GH-2.8 – Groundwater Monitoring Well Installation

- SA-1.3 – Soil Sampling
- SA-1.1 – Groundwater sampling and Onsite Testing

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		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	
Subject NON-RADIOLOGICAL SAMPLE HANDLING		[redacted]	

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (§261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (§261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:
- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives
- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Proper sample containers, sample volumes, preservation methods such as chemical preservatives/cooling requirements, and holding times should be provided in the project-specific work plan. Some of these requirements may be laboratory-specific and should be arranged during the laboratory procurement phase of a project. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted.

The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. These containers shall be pre-cleaned to meet or exceed requirements of the latest U.S. Environmental Protection Agency (EPA) "Specifications and Guidance for Contaminant-Free Sample Containers." I-Chem 200 and 300 Series containers meet these requirements; other certifications may be available that also meet these requirements. Each case of 300 Series containers comes with a "Certificate of Analysis," and every container bears a similar bar-coded label for traceability. I-Chem Series 200 containers do not come with a Certificate of Analysis but a certificate may be accessed upon request to the supplier. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Upon being opened, the container must be used at once for collection/storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

Sample containers can be contaminated during storage if nearby volatile substances infiltrate the surrounding air and migrate into the containers. This can occur even when containers are capped.

Therefore, containers should not be stored on site but if on site storage is necessary, sample containers that have been stored on site for longer than 6 months should not be used.

Note: Whereas most air-borne contamination is likely to be associated with organic substances, inorganic substances such as hydrochloric acid (muriatic acid) can emit inorganic vapors that infiltrate sample containers.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation and field preservation of samples is discouraged for reasons of potential cross-contamination of samples and worker safety. Most samples require cooling to <6°C and the project-specific planning documents should be consulted for detailed preservation and storage requirements.

The following subsections describe the procedures for preparing and adding chemical preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site. Furthermore, the FOL must ensure that a corresponding Safety Data Sheet (SDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate SDS for substances they will work with. The Chemical Inventory and the SDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5 to 10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 to 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 to 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5 to 10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.

- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).

- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 mL of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing) or hand pump.

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 mL of sample through the filter and discard prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Only employees who have successfully completed the corporate “Shipping Hazardous Materials” training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified and labeled sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking. Glass bottles should be individually wrapped in bubblewrap.

- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

American Public Health Association, 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

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US EPA (U.S. Environmental Protection Agency), 2015. Test Methods for Evaluating Solid Waste (SW-846, Third Edition), Physical/Chemical Methods, as amended by Updates I, II, IIA, IIB, III, IIIA, IIIB, IVA, IVB, and V, August.

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs, and reports generally initiated and maintained for documenting NUS Operating Unit field activities.

2.0 SCOPE AND APPLICABILITY

Documents presented within this SOP (and related sampling SOPs) shall be used for all NUS Operating Unit field activities, as applicable. All personnel are encouraged to review the information contained herein to facilitate planning of the field sampling and documentation effort. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - The PM is responsible for obtaining hardbound controlled-distribution logbooks (from the appropriate source), as needed. In addition, the PM is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The FOL is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports included in this SOP (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time frame.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP) (or equivalent).

Project Geologist/Sampler - The Project Geologist/Sampler is responsible for the proper documentation of field activities in accordance with this SOP and/or other project-specific documents.

General personnel qualifications for field documentation activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate procedures for documentation, handling, packaging, and shipping.

5.0 PROCEDURES

5.1 SITE LOGBOOK

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major on-site activities are documented. At a minimum, record or reference the following activities/events (daily) in the site logbook:

- All field personnel present
- Arrival/departure times and names of site visitors
- Times and dates of health and safety training
- Arrival/departure times of equipment
- Times and dates of equipment calibration
- Start and/or completion of borehole, trench, monitoring well installation activities, etc.
- Daily on-site activities
- Sample pickup information
- Health and safety issues (level of protection, personal protective equipment [PPE], etc.)
- Weather conditions

Maintain a site logbook for each project and initiate it at the start of the first on-site activity (e.g., site visit or initial reconnaissance survey). Make entries every day that on-site activities take place involving NUS Operating Unit or subcontractor personnel. Upon completion of the fieldwork, provide the site logbook to the PM (or qualified designee) for inclusion in the project's central file.

Record the following information on the cover of each site logbook:

- Project name
- NUS Operating Unit project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2) but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, either record the measurements and equipment used in the site logbook or reference the field notebook in which the measurements are recorded (see Attachment A).

Make all logbook, notebook, and log sheet entries in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, cross out the entry with a single strike mark, initial, and date it. At the completion of entries by any individual, the logbook pages used must be signed and dated by the person making the entries. The site logbook must also be signed by the FOL at the end of each day.

5.1.2 Photographs and Other Images

Permission to take photographs, make movies, or otherwise record visual representations of site features, activities, or facility personnel on certain properties such as military installations is a temporary privilege bestowed upon a person (i.e., the photographer) by the property owner and the particular facility at which the photographs are taken. In the case of U.S. military installations, the U.S. Government and Installation Command bestow this privilege. For the remainder of this section the term “image” is intended to represent

all visual forms of documentation of site features, activities, or personnel, such as film and digital still images and movies.

It may be illegal to record images without proper authorization and the photographer may be criminally liable for their actions. This is especially true on or near U.S. Government property. A particular image alone may not constitute an act of espionage or a national security threat; however, nefarious persons and organizations could conceivably combine information from multiple sources to create a national security threat. Therefore, the photographer must comply with any and all restrictions imposed on them by authorized facility personnel.
The instructions below apply to formal and casual photography sessions conducted, for example, during on-site meetings, walkovers, and other visits. Persons recording images should be aware that images recorded on or near military installations, and possibly at other installations, may be subject to censorship and clearance, e.g., through Public Affairs or Public Relations Offices.

CAUTION

Fieldwork-specific SOPs establish safety precautions for the fieldwork that they govern. When recording images, adhere to all safety precautions associated with fieldwork described in those SOPs. Pay attention to your surroundings. Avoid unsafe locations and positions. Avoid walking or turning your body while looking through the lens or viewfinder of a camera unless the path of movement has been cleared in advance and the movements will be made safely. Be especially alert to trip and fall hazards. Dress appropriately for the weather, topography, and the flora and fauna. Stay hydrated, and be aware of the effects of heat and cold stress on the body. Consult the SSO if in doubt about your safety or the safety of others while recording images.

5.1.2.1 Prior to and during photography sessions, follow these steps:

Note: In general, avoidance of specialty photographic equipment reduces the amount of work required of the photographer. The photographer is not required to record aperture, shutter speed, ISO rating, or other camera settings within automatic exposure ranges available on digital cameras; however use of special lenses (e.g., tilt-and-shift), filters (e.g., neutral density, warming, and polarizing filters), and other image enhancement equipment or techniques must be noted in the logbook/notebook. If possible, use of such equipment items or special techniques should be avoided because they can adversely affect the accuracy of recorded images.

- By communicating with the facility point of contact prior to recording images, obtain permission directly from, or on behalf of, the property owner and/or operator to record the images. In the case of U.S. Government military installations, the point of contact typically represents the Installation Command or a higher authority. The actual point of contact is frequently a Public Works or Environmental Department staff member.

- Request from the facility point of contact a written pass that allows permission to record images (hereafter referred to as a photography pass) but do not insist on obtaining one if the facility declines to issue such a pass.

- If the facility does not issue a written photography pass, either do not record images or verify via written communication with the facility point of contact that image making will be permitted while on the Installation property.

  Note: The intent of these permissions and communications is to ensure that the photographer clearly communicates his or her intentions to the facility and to avoid disputes regarding appropriateness of images, ownership of images or property depicted in the images, violation of privacy, etc. During

communication with the facility point of contact, ensure that they understand the types of scenes, activities, equipment, features, processes, etc., to be recorded visually and under what conditions the images will be made.

- If the facility issues a written photography pass:
  - Prior to recording images, verify that the photography pass is valid for the time period during which images will be made.
  - Carry the written photography pass in your possession when recording images.
  - Be prepared to produce the photography pass as proof of permission to record images.

- Prior to recording images, if using a digital recording medium, enable automatic collection of Exchangeable Image File (EXIF) data. Doing so will provide automatic documentation of the camera settings (ISO rating, shutter speed, aperture, focal length, etc.) used during image capture. Most digital cameras will record this information by default; but the use of special filters or other attachments to the image capture device is not recorded because such equipment is not an integral part of the device.

- While recording images, enter the name of the photographer, date, time, site location, and site description in the logbook/notebook and update this information as necessary to document important changes. Include other pertinent information such as weather conditions, if such information will support interpretation of the images.

- When orientation of the camera is important to interpreting the contents of the images, record the camera angles and positions for each image. This may be done by drawing an arrow on a site figure that points in the same direction the camera was pointed when the image was recorded. Alternatively, some digital cameras may automatically record the geographical coordinates and orientation angle during image capture.

- Sequentially number images of a site or monitoring location to correspond to logbook/notebook entries. Digital still image media typically provide automatic numbering of images. If desired, the image numbers may be altered later (e.g., during download to a computer) but it may be desirable to retain the original file name in the EXIF data for traceability.

5.1.2.2 <u>After recording images follow these steps:</u>

- Verify that the name of the photographer, date, time, site location, site description, and other pertinent notes were correctly entered in the logbook/notebook.

- Compile the images and associated information that will be necessary to interpret them in a manner suitable for the associated project. For example, consecutively number still images and label them according to the logbook/notebook descriptions. If camera angle, camera position, or camera settings are important, record this important information with the images. For moving images, edit and compile the images a manner consistent with the intended use.

- Docket the images and associated film negatives or digital files to the central project file and/or compact disk. If EXIF data were captured and are needed for the project, ensure the EXIF data are transferred along with the image to the final storage location. This final storage location may be a project file or a report compiled to document site conditions.

- If multiple versions of image files are generated (e.g., high resolution and low resolution), arrange for proper storage and management of all versions of files for ready retrieval and safe storage.

5.2 FIELD NOTEBOOKS

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the SSO may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each Project Geologist/Sampler assigned to oversee a rig must maintain a field notebook.

5.3 FIELD FORMS

Field forms (see list in Section 6.0 of this SOP) can be found on the NUS Operating Unit intranet site under "Field Log Sheets." Forms may be altered or revised for project-specific needs, subject to client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOPs.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample log sheets are used to record specified types of data while sampling. The data recorded on these sheets are useful in describing the sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. Complete a sample log sheet for each sample obtained, including field quality assurance (QA) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B. Complete the required information on the adhesive labels and apply them to every sample container. Obtain sample labels from the appropriate program/project source, request that they be electronically generated in house, or request them from the laboratory subcontractor.

CAUTION

Some labels (e.g., paper labels) may become soaked with water from melted ice or condensation during shipping. This soaking could render the labels illegible or cause them to fall off of their containers. Therefore, all paper labels and other labels subject to such deterioration should be covered with clear protective tape (e.g., packing tape) to keep them dry during shipment. Avoid wrinkles in the tape that could directly interfere with legibility of the label or allow contact with water. **Covering all hand-written sample container labels (paper or otherwise) with protective tape in this manner is an absolute requirement when collecting samples in support of United States Environmental Protection Agency (USEPA) Contract Laboratory Program (CLP) projects.**

5.3.1.3 Chain-of-Custody Record

The chain-of-custody record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used as follows for any samples collected for chemical or geotechnical analysis whether the analyses are performed on-site or off-site:

- Retain one carbonless copy of the completed chain-of-custody form in the field.
- Send one copy to the PM (or qualified designee).
- Send the original (top, signed copy) to the laboratory with the associated samples. Place the original chain-of-custody copy inside a large Ziploc®-type bag taped inside the lid of the shipping cooler. If

multiple coolers are sent, but are included on one chain-of-custody form, send the form with the cooler containing vials for volatile organic compounds (VOCs) analysis or the cooler with the air bill attached. Indicate on the air bill how many coolers are included with that shipment.

An example of a chain-of-custody form is provided as Attachment C. After the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed chain-of-custody form (any discrepancies between the sample labels and chain-of-custody form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the PM or qualified designee). The chain-of-custody form is signed and copied. The laboratory will retain the copy, and the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Custody Seal

Attachment D is an example of a custody seal. The custody seal is an adhesive-backed label that is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. Sign and date custody seals and affix them across the lid and body of each cooler (front and back of opposite sides) containing environmental samples (see SOP SA-6.1). Obtain custody seals from the laboratory (if available) or purchase them from a supplier.

5.3.1.5 Geochemical Parameters Log Sheets

Complete Field Analytical Log Sheets to record geochemical and/or natural attenuation field test results.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

Complete a Groundwater Level Measurement Sheet for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. Use a Pumping Test Data Sheet to facilitate this task by standardizing the data collection format for the pumping well and observation wells, and allowing the time interval for collection to be established in advance.

5.3.2.3 Packer Test Report Form

Complete a Packer Test Report Form for each well at which a packer test is conducted.

5.3.2.4 Boring Log

Complete a Summary Log of Boring, or Boring Log for each soil boring performed to document the materials encountered, operation and driving of casing, and locations/depths of samples collected. In addition, if volatile organic vapors are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a photoionization detector [PID] or flame ionization detector [FID]), enter these readings on the boring log at the appropriate depth. When they become available, enter the laboratory sample number, concentrations of key contaminants, or other pertinent information in the "Remarks" column. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

Complete a Monitoring Well Construction Details Form for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock, stick-up or flush mount), different forms are used.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log must be filled out by the responsible Project Geologist/Sampler.

5.3.2.7 Miscellaneous Monitoring Well Forms

Miscellaneous monitoring well forms that may be required on a project-specific basis include the Monitoring Well Materials Certificate of Conformance and Monitoring Well Development Record. Use a Monitoring Well Materials Certificate of Conformance to document all materials utilized during each monitoring well installation. Use a Monitoring Well Development Record to document all well development activities.

5.3.2.8 Miscellaneous Field Forms – Quality Assurance and Checklists

Miscellaneous field forms/checklists that may be required on a project-specific basis include the following:

- Container Sample and Inspection Sheet – use this form when a container (drum, tank, etc.) is sampled and/or inspected.
- QA Sample Log Sheet – use this form when a QA sample such as an equipment rinsate blank, source blank, etc. is collected.
- Field Task Modification Request (FTMR) – use this form to document deviations from the project planning document(s). The FOL is responsible for initiating the FTMRs. Maintain copies of all FTMRs with the on-site planning documents, and place originals in the final evidence file.
- Field Project Daily Activities Checklist and Field Project Pre-Mobilization Checklist – use these during both the planning and field effort to ensure that all necessary tasks are planned for and completed. These two forms are not requirements, but are useful tools for most field work.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring, or test equipment is necessary to ensure the proper operation and response of the equipment, to document the accuracy, precision, or sensitivity of the measurements, and to determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log, which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. Maintain an Equipment Calibration Log for each electronic measuring device used in the field; make entries for each day the equipment is used or in accordance with manufacturer recommendations.

5.4 FIELD REPORTS

The primary means of recording on-site activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation but are not easily used for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain on site for extended periods of time and are thus not accessible for timely review by project management. Other reports useful for tracking and reporting the progress of field activities are described below.

5.4.1 Daily Activities Report

To provide timely oversight of on-site contractors, complete and submit Daily Activities Reports (DARs) as described below.

5.4.1.1 Description

The DAR documents the activities and progress for each day's field work. Complete this report on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring that involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors. The DAR form can be found on the NUS Operating Unit intranet site.

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the DAR to the FOL for review and filing. The DAR is not a formal report and thus requires no further approval. The DARs are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the PM.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

In addition to those described herein, other summary reports may also be contractually required.
Field forms can be found on the NUS Operating Unit intranet site.

6.0 LISTING OF FIELD FORMS ON THE NUS OPERATING UNIT INTRANET SITE

- Boring Log
- Container Sample and Inspection Sheet
- Daily Activities Checklist
- Daily Activities Record
- Equipment Calibration Log
- Field Task Modification Request Form
- Field Analytical Log Sheet - Geochemical Parameters
- Groundwater Level Measurement Sheet
- Groundwater Sample Log Sheet
- Hydraulic Conductivity Testing Data Sheet
- Low Flow Purge Data Sheet

- Bedrock Monitoring Well Construction (Stick Up)
- Bedrock Monitoring Well Construction (Flush Mount)
- Bedrock Monitoring Well Construction (Open Hole)
- Confining Layer Monitoring Well Construction
- Monitoring Well Development Record
- Monitoring Well Materials Certificate of Conformance
- Overburden Monitoring Well Construction (Flush Mount)
- Overburden Monitoring Well Construction (Stick Up)
- Packer Test Report Form
- Pumping Test Data Sheet
- QA Sample Log Sheet
- Soil & Sediment Sample Log Sheet
- Surface Water Sample Log Sheet
- Test Pit Log
- Field Project Pre-Mobilization Checklist

7.0 REFERENCES

USEPA, 2016.Sampler's Guide, Contract Laboratory Program Guidance for Filed Samplers, Office of Superfund Remediation and Technology Transfer, OSWER 9200.2-147, EPA-540-R-014-013, October.

ATTACHMENT A

TYPICAL SITE LOGBOOK ENTRY

START TIME: _____ DATE: _____

SITE LEADER: _____

PERSONNEL:

NUS	DRILLER	SITE VISITORS
_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manager arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

_____

Field Operations Leader

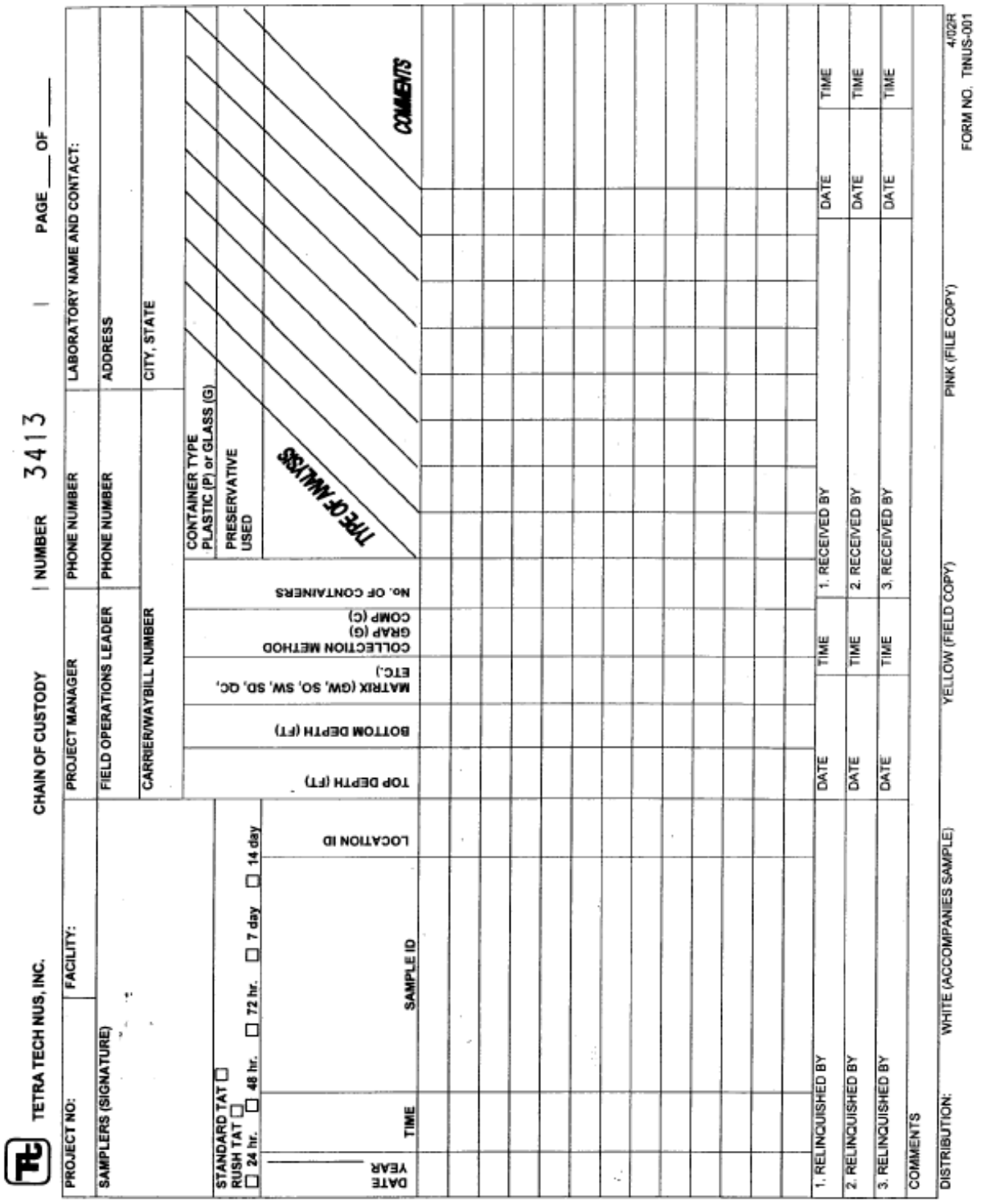
ATTACHMENT B

SAMPLE LABEL (EXAMPLE)

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Site:** **Location:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory:**	

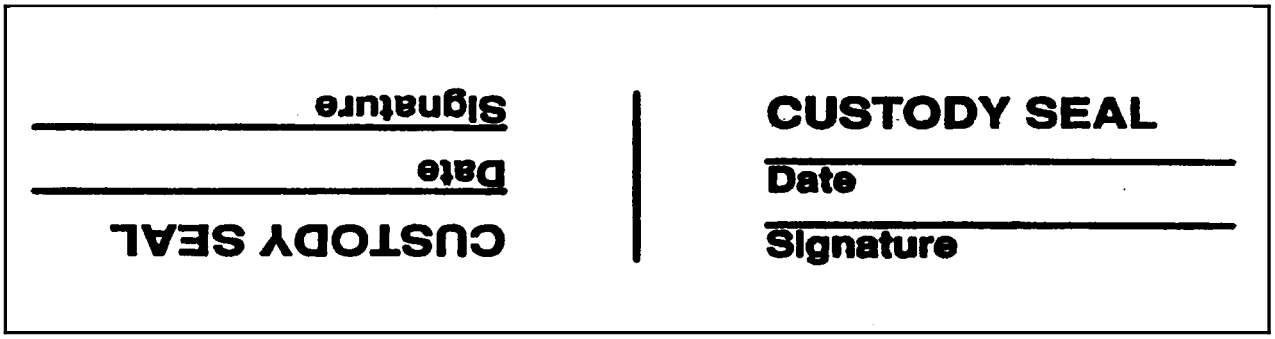
ATTACHMENT C

CHAIN-OF-CUSTODY FORM (EXAMPLE)



ATTACHMENT D

CHAIN-OF-CUSTODY SEAL (EXAMPLE)



TETRA TECH	STANDARD OPERATING PROCEDURE	Number SA-7.1	Page 1 of 17
		Effective Date 7/15/2016	Revision 8
		Applicability Tetra Tech, Inc., NUS Operating Unit	
		Prepared Earth Sciences Department	

Subject

DECONTAMINATION OF FIELD EQUIPMENT AND MANAGEMENT OF INVESTIGATION DERIVED WASTE

[redacted]

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1.0 PURPOSE

Decontamination is the process of removing, or neutralizing contaminants that have contacted and/or accumulated on equipment and/or personnel. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination to prevent either direct or indirect contamination of drilling equipment, earth-moving equipment, chemical sampling equipment, and analytical equipment. It is also intended through the application of these principles to prevent cross-contamination of the environment.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Chemical/Hygienic/Sanitizing wipes – These types of devices offer a portable solution when there are no sources of water and soap to allow hands, face, or equipment to be cleaned of gross contamination. Some of these wipes and solution based detergents are chemical specific such as D-Lead or D-Wipes are used to remove lead and other heavy metals from hands and face.

Decontamination Solution - A solution selected/identified in the Health and Safety Plan (HASP), Project-Specific Quality Assurance Project Plan (QAPP), or other governing document. The solution is selected and employed as directed by the project chemist/health and safety professional as it has been shown to be most effective in the removal, neutralization, and/or stabilization of the contaminants in question without creating unwanted byproducts.

Deionized Water (DI) – This is water that has been treated by passing it through a deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

Dry decontamination – This method physically removes contaminates from the surface through the use of High Efficiency Particulate Filter vacuums employed for lead and asbestos operations.

Potable Water - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from the surface of equipment. This process can be coupled with wash solutions or used solely as a pressure washer to physically remove surface artifacts.

Solvent – A solvent is a liquid that is able to dissolve other substances, or solutes, (gases, liquids and/or solids) to form a solution. A solution is a homogeneous mixture of solvent and solute. Water is often referred to as a universal solvent because of its ability to dissolve many different types of substances. The category "solvent" includes but is not limited to pesticide-grade isopropanol; methanol; acetone; and hexane. These solvents may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, polychlorinated biphenyls (PCBs), or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on polyvinyl chloride (PVC) equipment or well construction materials. Acidic and caustic materials may also serve as solutes and when mixed with water may be used for the purpose of decontamination.

Steam Pressure Washing - A cleaning method employing a high-pressure spray of heated potable water (steam) to remove various organic/inorganic chemicals from equipment. This method is useful for removing organic substances such as pesticides, PCBs, oils, and fuels.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager (PM) - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Decontamination Personnel - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process, including:

- A working knowledge of the use of all equipment involved (pressure washers, steam cleaners, etc.).
- Hazards associated with the solutions used for this purpose.
- The monitoring of the decontamination process to ensure that it is working properly. This is accomplished through:
    - Visual evaluation (i.e., answering the question: "Does it appear to be clean?"),
    - Employing monitoring instruments and scanning of decontaminated items do determine if off-gassing indicates the presence of contaminants , and/or
    - Through the collection of equipment rinsate blanks to verify contaminant removal.
    - Focusing on tools that contact sampled media as well as areas on those tools that trap dirt and contaminated water.
    - Diligent use of PPE and self-decontamination to minimize the potential for cross contamination.
- Replace wash waters often to minimize the collection of contaminants.

Field Operations Leader (FOL) - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation as well as assigning or evaluating the decontamination process. Additionally, through concurrence with the PM, the FOL may:

- Initiate site investigation/remediation efforts in the area where the least amount of contamination is reported thereby minimizing the potential for cross contamination.

- Use disposable devices to collect sample aliquots to minimize cross contamination that might otherwise occur through the use of reusable items.

Site Safety and Health Officer (SSHO) - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination process and evaluation. This is accomplished through visual examination and/or instrument screening, where contaminants can be detected to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour General Site Worker and/or applicable 8-Hour General Site Worker Refresher training.

- Capability of performing field work under the expected physical (heavy lifting and moving auger flights and drill rods) and environmental (i.e., weather – heat and/or cold extremes) conditions.

- Familiarity with appropriate decontamination procedures. Throughout this SOP, the procedures remove gross contamination from top down, outside in, then moving to what may be described as “polishing stages” where solvents including laboratory grade isopropanol and deionized water are used to remove residual levels of contaminants.

5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer’s/supplier’s Safety Data Sheet (SDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.

- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific HASP (or equivalent) for this activity.

6.0 EQUIPMENT LIST

- Wood for decontamination pad construction, when applicable (see Section 7.1).

- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).

- Plastic sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).

- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).

- PPE as specified in the project HASP (or equivalent).

- Soap and water for physical washing and rinsing.

- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting equipment rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants or neutralization of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities
- Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

7.1 Decontamination Pad Design/Construction Considerations

7.1.1 Temporary Decontamination Pads

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be and are generally employed for smaller articles (auger flights, drill rods, split spoons, etc.).

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location – Establish the decontamination site far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or his/her designee, compliance with as many of the following characteristics as practicable:

  - Away from pedestrian/vehicle thoroughfares.
  - Avoidance of areas where control/custody cannot be maintained.
  - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.
  - Avoidance of potentially contaminated areas.
  - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

The selected decontamination site should include the following, where possible:

- Areas where potable water and electricity are provided.

> ***Safety Reminder***
> When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:
>
> - All power is routed through a Ground Fault Circuit Interrupter (GFCI).
>
> - All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.
>
> In situations where accomplishing these elements are not possible, it will be necessary to implement a site electrical grounding program.

- Areas where support activities such as removing decontamination waters, soil, and sediment are possible without entering an active exclusion zone.
- Areas that offer sufficient size to carry out the specific decontamination sequence.

- Decontamination pad (decon pad) – Construct the decontamination pad to meet the following characteristics:

  - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size of the decontamination pad should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.

  - Slope – An adequate slope should be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below. When preparing the pad, remove sticks, roots, stones, and debris that could puncture the liner. The area should be lightly graded and possibly covered with sand to minimize the possibility of puncture.

  - Sidewalls – The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with plastic sheeting to control overspray.

  - Liner – Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.

  - Wash/drying racks – Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange, because dual tube or Macro-Core Samplers and drive rods require little space for decontamination

- Maintenance – Maintain the decontamination area by:

  - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

  - Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.

  - PPE – Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety

of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

7.1.2 Decontamination Activities at Drill Rigs/DPT Units

7.1.2.1 During subsurface sampling activities including drilling and DPT activities, conduct decontamination of drive rods, Macro Core Samplers, split spoons, etc. at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

7.1.2.2 Place buckets within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media.

7.1.2.3 Use drying racks where possible to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

7.1.3 Decontamination Activities at Remote Sample Locations

7.1.3.1 When sampling at remote locations, evacuate sampling equipment such as trowels and pumps/tubing of potentially contaminated media to the extent possible.

7.1.3.2 Wrap this equipment in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition.

7.1.3.3 Flush and clean single-use equipment such as disposable trowels, tubing, and surgeon's gloves to allow disposal of this equipment after visible soil and water remnants have been removed.

7.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

7.2.1 Monitoring Well Sampling Equipment

7.2.1.1 Groundwater sampling equipment – This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.

1. Evacuate to the extent possible, any purge water within the pump/bailer.

2. Scrub the external components using soap and water and/or steam clean* the outside of the pump/bailer and, if applicable, the pump tubing.

3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.

4. Remove the pump and tubing/bailer from the container.

5. Rinse external pump components using tap water.

6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

> ***CAUTION***
> Do not rinse polyethylene (PE), PVC, and associated tubing with solvents – These are considered single use items and can be removed and disposed of after use. Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 should be omitted and tubing or plastic components replaced.

7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol. If groundwater contains these contaminants employ single use sampling apparatus that can be wash, rinsed, and disposed of after use.

8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.

9. Drain residual deionized water to the extent possible.

10. Allow components of the equipment to air dry.

11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect an equipment rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for equipment rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as ultraviolet light may be used.

12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

> ***SAFETY REMINDER***
> Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

1. Wash with soap and water
2. Rinse with tap water
3. Rinse with deionized water

NOTE

In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

7.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity – Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.

- Cleanliness – As per protocol, only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler should be decontaminated prior to use as follows:

    1. Wash with soap and water
    2. Rinse with tap water
    3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

7.2.2 Downhole Drilling Equipment

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

CAUTION

Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

1. Remove loose soil using shovels, scrapers, etc.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

CAUTION

In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol

   ☞***Note:*** *Steam cleaning does the best job removing contaminants especially the more volatile components. Not only is the water pressure sufficient to remove caked on soils, the heat associated with the steam is very effective in removing contaminants (even those more stubborn ones such as PAHs and PCBs). Steam cleaning units, however, are more dangerous to use due to pressurized steam and water. Care must be taken to avoid thermal burns by ensuring all guards are in place and gloves are employed. When using steam, the items that have been washed dry relatively quickly because heated water and steam are applied.*

5. To the extent possible, allow components to air dry.

6. If the decontaminated equipment is to be used immediately after decontamination, screen it with a calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all contaminants and possible decontamination solvents (if they were used) have been adequately removed.

7. Wrap or cover equipment in clear plastic until it is time to be used.

SAFETY REMINDER

Even when equipment is disconnected from power sources, dangers such as the following may persist:

Falls - An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.

Burns - Steam cleaner water is heated to more than 212 °F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

High water pressure - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0° tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 15-25° fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.

2. Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with high- temperature or high-pressure water.

3. Always wear PPE as specified in the HASP (or equivalent) such as:

   - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.

4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.

5. Do not modify equipment unless the manufacturer has approved the modifications.

7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1. Remove all loose soil from the equipment through manual means.

2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.

3. Rinse the equipment with tap water.

4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol followed by steam cleaning. Where cleanliness is considered suspect, dispose and replace the suspect item.

5. Rinse the equipment with deionized water.

6. To the extent possible, allow components to air dry.

7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.

8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device. If sufficient surface water exists remove visible sediments by dunking within the water from where the sediment sample was obtained. Because of this always work from downstream to upstream

- Extract the dredge and wash it in soap and water per the project-specific planning documents.

CAUTION

When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

☞***Note:*** *In all cases when cleaning stainless steel sampling equipment minimize if not eliminate the use of acids as this will leach certain metals (e.g., chromium, nickel, iron, and antimony) and may result in sample contamination. Use soap and water wash and rinse and, where necessary, steam clean to remove stubborn contaminants.*

7.3 Contact Waste/Materials

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with project planning documents.

NOTE

Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

1. Assume that all investigation-derived waste (IDW) generated from decontamination activities contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

NOTE

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers); frac tanks, or tankers that can be sealed until ultimate disposal at an approved facility.

3. Properly label waste storage containers (see Attachment A).

4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:

   - Enclose areas accessible by the general public using construction fencing and signs.
   - Store materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.
   - Maintain the retaining bolt and label on the outside of storage containers where readily visible.

- Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.

- As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.

- Maintain spill response equipment at the IDW storage area in case it is required for immediate access.

- Where possible, use equipment for moving containers. Where not possible, obtain help to manipulate containers.

-

CAUTION

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. These heavy objects may constitute a safety hazard. To minimize hazards such as this, limit the filling of drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties, and to allow for expansion caused by freezing. Use powered equipment as the preferred method for moving staging and disposal of IDW. Where this is not possible, use drum carts to move partially filled drums.

Where drums have to be manually handled:
Get help
Secure the drum to the cart
Clear the pathway to the staging area.
Employ safe lifting techniques.
Consult the Project Planning Documents, most importantly, the Activity Hazard Analysis for additional direction.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

Airborne Contaminant Exposure
To minimize potential airborne contaminant exposure close and seal all containers transported them inside the sampling support vehicle.
Periodically decontaminate temporary portable containers to minimize off-gassing inside the vehicle. When working at the well or storage container always work from an upwind position.

7.4 Decontamination Evaluation

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation – A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended. Pay particular attention to points where soils and sediments may become trapped including threads cutting shoes to

body, etc. It is often necessary to combine these types of decontamination methods to ensure the adequacy is sufficient to pass chemical rinsate.

- Instrument Screening – A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.

> ***NOTE***
> When required by project-specific planning documents, collection of equipment rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Equipment Rinsate Blanks – It is recommended that equipment rinsate blank samples be collected to:

  - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.

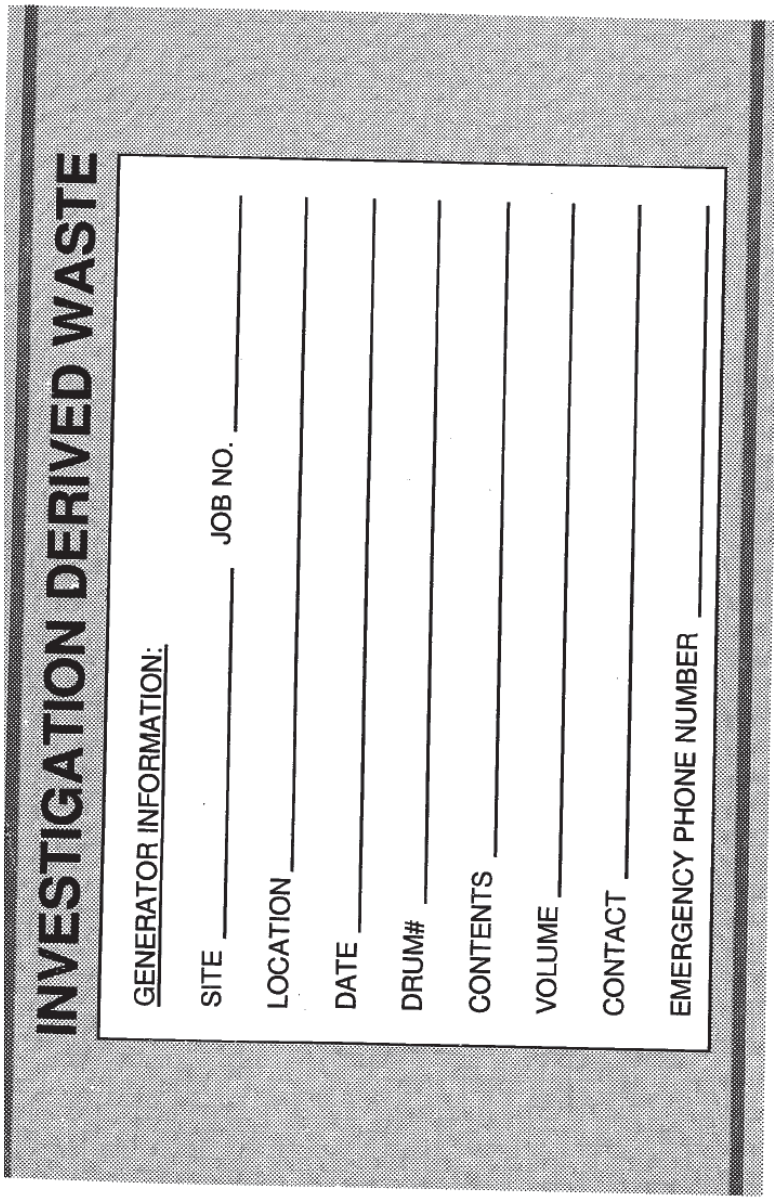
  - Single-use disposable equipment – The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.

  - The collection and the frequency of equipment rinsate blank samples are as follows unless specified differently in the project-specific planning documents:
    - Per decontamination method.
    - Per disposable article/batch number of disposable articles

> ***NOTE***
> It is recommended that an initial equipment rinsate blank sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.
>
> Equipment rinsate blank sample collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional equipment rinsate blank samples due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL supporting and/or resigning not to collect.

ATTACHMENT A

IDW LABEL (EXAMPLE)



ATTACHMENT B, INVESTIGATIVE DERIVED WASTE DRUM/CONTAINER INVENTORY LOG (EXAMPLE)

This attachment should be completed as investigative derived waste is accumulated. An updated inventory should be provided to the site Point of Contact at the end of each 10-day shift. Add additional rows on extra pages, as needed.

Drum/ Container Number #	Drum/ Container Type	Media (Contents)	Location (SWMU and Well #, etc.)	Estimated Volume	Date Filed	Comments
1				( )-Gallons		
2				( )-Gallons		
3				( )-Gallons		
4				( )-Gallons		

Emergency Point of Contact: _____ Phone Number: _____

(Name of Facility) Point of Contact: _____ Phone Number: ( ) _____

Information Point of Contact (Name): _____ Phone Number: _____

Distribution of Inventory Log: Facility Point of Contact, Phone Number: ( ) _____

Fire Dept/Emergency Services Provider, Phone Number: ( ) _____

Comments: _____

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WIPE SAMPLING PROCEDURE FOR PCBS*

1. Remove absorbent pad from its wrapper and fold twice so that a square is formed.
2. Grasp the two inner pockets formed in folding with freshly gloved fingers.
3. Wet both external surfaces of pad with hexane (do not use solvent when surface to be sampled is visibly wet, simply blot liquid within measured area.)
4. Place 100cm^2 template on surface to delineate area to be sampled.
5. Blot 10cm square area horizontally with one side of the wet swab and then vertically with the other. Blot uniformly at least five times in each direction.
6. Carefully roll the pad into a cylinder with exposed, wet areas inside.
7. Insert rolled pad into vial and cap with Teflon-lined lid.
8. Seal, label, and prepare jar for transport to the laboratory.
9. Please include one blank with hexane only.
10. Fill out chain of custody completely insuring to include wipe area.
11. Place used template and gloves in plastic bag and dispose of properly.

Please note:

It is possible that dirt or finishes, such as wax, paint, lacquer, or other debris could give rise to analytical interference. Blotting versus wiping or rubbing is recommended to minimize inadvertent collection to debris and to maximize uptake of PCB's. For quality control, you may wish to take a side-by-side duplicate for each surface type. It also may be desirable to obtain a background sample from an untreated or "clean" area of the same surface composition as the area of interest.

* For cyanide analysis analyses follow the same procedure as above but substitute hexane with 2% sodium hydroxide. For petroleum hydrocarbon, semi-volatile or metals analyses the follow same procedure but use a *Ghost wipe* without additional solvent (note that mercury analysis has a separate digestion and 2 wipes should be collected if mercury in addition to other metals are sought).

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APPENDIX J

EXPLANATION AND JUSTIFICATION OF PSLs

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Soil

Analyte	CAS Number	R-RSL[(1)]		WVDEP[(2)]		HHRA PSL[(3)]	PSL Reference
VOCs (mg/kg)							
1,1,1-Trichloroethane	71-55-6	810	N	640	Csat	640	WVDEP
1,1,2,2-Tetrachloroethane	79-34-5	0.6	C	0.64	C	0.60 C	R-RSL
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	670	N	910	Csat	670 N	R-RSL
1,1,2-Trichloroethane	79-00-5	0.15	N	1.2	C	0.15 N	R-RSL
1,1-Dichloroethane	75-34-3	3.6	C	3.8	C	3.6 C	R-RSL
1,1-Dichloroethene	75-35-4	23	N	24	N	23 N	R-RSL
1,2,3-Trichlorobenzene	87-61-6	6.3	N	NC		6.3 N	R-RSL
1,2,4-Trichlorobenzene	120-82-1	5.8	N	24	C	5.8 N	R-RSL
1,2-Dibromo-3-chloropropane	96-12-8	0.0053	C	0.0057	C	0.0053 C	R-RSL
1,2-Dibromoethane	106-93-4	0.036	C	0.039	C	0.036 C	R-RSL
1,2-Dichlorobenzene	95-50-1	180	N	380	Csat	180 N	R-RSL
1,2-Dichloroethane	107-06-2	0.46	C	0.5	C	0.46 C	R-RSL
1,2-Dichloropropane	78-87-5	1.6	N	1.1	C	1.1 C	WVDEP
1,3-Dichlorobenzene	541-73-1	NC		NC		NC	None
1,4-Dichlorobenzene	106-46-7	2.6	C	2.8	C	2.6 C	R-RSL
2-Butanone	78-93-3	2700	N	2800	N	2,700 N	R-RSL
2-Hexanone	591-78-6	20	N	NC		20 N	R-RSL
4-Methyl-2-pentanone	108-10-1	3300	N	3400	Csat	3,300 N	R-RSL
Acetone	67-64-1	6100	N	6100	N	6,100 N	R-RSL/WVDEP
Benzene	71-43-2	1.2	C	1.2	C	1.2 C	R-RSL/WVDEP
Bromochloromethane	74-97-5	15	N	NC		15 N	R-RSL
Bromodichloromethane	75-27-4	0.29	C	0.31	C	0.29 C	R-RSL
Bromoform	75-25-2	19	C	20	C	19 C	R-RSL
Bromomethane	74-83-9	0.68	N	0.73	N	0.68 N	R-RSL
Carbon disulfide	75-15-0	77	N	740	Csat	77 N	R-RSL
Carbon tetrachloride	56-23-5	0.65	C	0.7	C	0.65 C	R-RSL
Chlorobenzene	108-90-7	28	N	29	N	28 N	R-RSL
Chloroethane	75-00-3	1400	N	2100	Csat	1,400 N	R-RSL
Chloroform	67-66-3	0.32	C	0.34	C	0.32 C	R-RSL
Chloromethane	74-87-3	11	N	12	N	11 N	R-RSL
cis-1,2-Dichloroethene	156-59-2	16	N	1.7	N	1.7 N	WVDEP
cis-1,3-Dichloropropene	10061-01-5	1.8	C[(4)]	1.9	C[(4)]	1.8 C[(4)]	R-RSL
Cyclohexane	110-82-7	650	N	120	Csat	120	WVDEP
D bromochloromethane	124-48-1	8.3	C	8.3	C	8.3 C	R-RSL/WVDEP
Dichlorodifluoromethane	75-71-8	8.7	N	9.4	N	8.7 N	R-RSL
Ethy benzene	100-41-4	5.8	C	6.2	C	5.8 C	R-RSL
Isopropylbenzene	98-82-8	190	N	270	Csat	190 N	R-RSL
m,p-Xylenes	179601-23-1	55	N[(5)]	NC		55 N[(5)]	R-RSL
Methyl acetate	79-20-9	7800	N	2300	N	2,300 N	WVDEP
Methyl cyclohexane	108-87-2	NC		NC		NC	None
Methylene chloride	75-09-2	35	N	58	C	35 N	R-RSL
Methyl-tert-butyl ether	1634-04-4	47	C	50	C	47 C	R-RSL
o-Xylene	95-47-6	65	N	NC		65 N	R-RSL
Styrene	100-42-5	600	N	870	Csat	600 N	R-RSL
Tetrachloroethene	127-18-4	8.1	N	25	C	8.1 N	R-RSL
Toluene	108-88-3	490	N	820	Csat	490 N	R-RSL
trans-1,2-Dichloroethene	156-60-5	160	N	13	N	13 N	WVDEP
trans-1,3-Dichloropropene	10061-02-6	1.8	C[(4)]	1.9	C[(4)]	1.8 C[(4)]	R-RSL
Trichloroethene	79-01-6	0.41	N	0.5	C	0.41 N	R-RSL
Trichlorofluoromethane	75-69-4	2300	NS	79	N	79 N	WVDEP
Vinyl chloride	75-01-4	0.059	C	0.057	C	0.057 C	WVDEP
Xylenes (total)	1330-20-7	58	N	260	Csat	58 N	R-RSL
SVOCs (mg/kg)							
1,1-Biphenyl	92-52-4	4.7	N	5.1	N	4.7 N	R-RSL
1,2,4,5-Tetrachlorobenzene	95-94-3	2.3	N	1.7	N	1.7 N	WVDEP
1,4-Dioxane[3]	123-91-1	5.3	C	5.4	C	5.3 C	R-RSL
2,2'-Oxybis(1-chloropropane)	108-60-1	310	N	5.1	C	5.1 C	WVDEP
2,3,4,6-Tetrachlorophenol	58-90-2	190	N	190	N	190 N	R-RSL/WVDEP
2,4,5-Trichlorophenol	95-95-4	630	N	630	N	630 N	R-RSL/WVDEP
2,4,6-Trichlorophenol	88-06-2	6.3	N	49	C	6.3 N	R-RSL
2,4-Dichlorophenol	120-83-2	19	N	19	N	19 N	R-RSL/WVDEP
2,4-Dimethylphenol	105-67-9	130	N	130	N	130 N	R-RSL/WVDEP
2,4-Dinitrophenol	51-28-5	13	N	13	N	13 N	R-RSL/WVDEP
2,4-Dinitrotoluene	121-14-2	1.7	C	1.7	C	1.7 C	R-RSL/WVDEP
2,6-Dinitrotoluene	606-20-2	0.36	C	0.36	C	0.36 C	R-RSL/WVDEP
2-Chloronaphthalene	91-58-7	480	N	500	N	480 N	R-RSL
2-Chlorophenol	95-57-8	39	N	34	N	34 N	WVDEP
2-Methylphenol	95-48-7	320	N	320	N	320 N	R-RSL/WVDEP
2-Nitroaniline	88-74-4	63	N	63	N	63 N	R-RSL/WVDEP

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Soil

Analyte	CAS Number	R-RSL[(1)]		WVDEP[(2)]		HHRA PSL[(3)]	PSL Reference
2-Nitrophenol	88-75-5	NC		NC		NC	None
3,3'-Dichlorobenzidine	91-94-1	1.2	C	1.2	C	1.2 C	R-RSL/WVDEP
3-Methylphenol	108-39-4	320	N	320	N	320 N	R-RSL/WVDEP
3-Nitroaniline	99-09-2	NC		NC		NC	None
4,6-Dinitro-2-methylphenol	534-52-1	0.51	N	NC		0.51 N	R-RSL
4-Bromophenyl phenyl ether	101-55-3	NC		NC		NC	None
4-Chloro-3-methylphenol	59-50-7	630	N	NC		630 N	R-RSL
4-Chloroanaline	106-47-8	2.7	C	2.7	C	2.7 C	R-RSL/WVDEP
4-Chlorophenyl phenyl ether	7005-72-3	NC		NC		NC	None
4-Methylphenol	106-44-5	630	N	630	N	630 N	R-RSL/WVDEP
4-Nitroaniline	100-01-6	25	N	NC		25 N	R-RSL
4-Nitrophenol	100-02-7	NC		NC		NC	None
Acetophenone	98-86-2	780	N	2500	Csat	780 N	R-RSL
Atrazine	1912-24-9	2.4	C	2.4	C	2.4 C	R-RSL/WVDEP
Benzaldehyde	100-52-7	170	C	1200	Csat	170 C	R-RSL
Bis(2-chloroethoxy)methane	111-91-1	19	N	NC		19 N	R-RSL
Bis(2-chloroethyl)ether	111-44-4	0.23	C	0.24	C	0.23 C	R-RSL
Bis(2-ethylhexyl)phthalate	117-81-7	39	C	39	C	39 C	R-RSL/WVDEP
Butyl benzyl phthalate	85-68-7	290	C	290	C	290 C	R-RSL/WVDEP
Caprolactam	105-60-2	3100	N	3100	N	3,100 N	R-RSL/WVDEP
Carbazole	86-74-8	NC		NC		NC	None
D benzofuran	132-64-9	7.3	N	7.8	N	7.3 N	R-RSL
Diethyl phthalate	84-66-2	5100	N	5100	N	5,100 N	R-RSL/WVDEP
Dimethyl phthalate	131-11-3	NC		NC		NC	None
Di-n-butyl phthalate	84-74-2	630	N	630	N	630 N	R-RSL/WVDEP
Di-n-octyl phthalate	117-84-0	63	N	NC		63 N	R-RSL
Hexachlorobenzene	118-74-1	0.21	C	0.22	C	0.21 C	R-RSL
Hexachlorobutadiene	87-68-3	1.2	C	1.3	C	1.2 C	R-RSL
Hexachlorocyclopentadiene	77-47-4	0.18	N	0.19	N	0.18 N	R-RSL
Hexachloroethane	67-72-1	1.8	C	2	C	1.8 C	R-RSL
Isophorone	78-59-1	570	C	570	C	570 C	R-RSL/WVDEP
Nitrobenzene	98-95-3	5.1	C	5.5	C	5.1 C	R-RSL
N-Nitrosodi-n-propylamine	621-64-7	0.078	C	0.078	C	0.078 C	R-RSL/WVDEP
N-Nitrosodiphenylamine	86-30-6	110	C	110	C	110 C	R-RSL/WVDEP
Phenol	108-95-2	1900	N	1900	N	1,900 N	R-RSL/WVDEP

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Shaffer Equipment/Arbuckle Creek Area Site

Soil

Analyte	CAS Number	R-RSL[1]		WVDEP[2]		HHRA PSL[3]	PSL Reference
PAHs and PCP (mg/kg)							
2-Methylnaphthalene	91-57-6	24	N	31	N	24 N	R-RSL
Acenaphthene	83-32-9	360	N	410	N	360 N	R-RSL
Acenaphthylene	208-96-8	NC		420	N	420 N	WVDEP
Anthracene	120-12-7	1800	N	2300	N	1800 N	R-RSL
Benzo(a)anthracene	56-55-3	1.1	C	0.21	C	0.21 C	WVDEP
Benzo(a)pyrene	50-32-8	0.11	C	0.016	C	0.016 C	WVDEP
Benzo(b)fluoranthene	205-99-2	1.1	C	0.16	C	0.16 C	WVDEP
Benzo(g,h,i)perylene	191-24-2	180	N[6]	180	N	180 N[6]	R-RSL/WVDEP
Benzo(k)fluoranthene	207-08-9	11	C	1.6	C	1.6 C	WVDEP
Chrysene	218-01-9	110	C	16	C	16 C	WVDEP
D benzo(a,h)anthracene	53-70-3	0.11	C	0.016	C	0.016 C	WVDEP
Fluoranthene	206-44-0	240	N	240	N	240 N	R-RSL/WVDEP
Fluorene	86-73-7	240	N	290	N	240 N	R-RSL
Indeno(1,2,3-c,d)pyrene	193-39-5	1.1	C	0.16	C	0.16 C	WVDEP
Naphthalene	91-20-3	3.8	C	4.1	C	3.8 C	R-RSL
Phenanthrene	85-01-8	180	N[6]	2300	N	180 N[6]	R-RSL
Pyrene	129-00-0	180	N	230	N	180 N	R-RSL
Pentachlorophenol	87-86-5	1	C	1	C	1 C	R-RSL/WVDEP
Pesticides (mg/kg)							
4,4'-DDD	72-54-8	0.19	N	2.3	C	0.19 N	R-RSL
4,4'-DDE	72-55-9	2	C	2	C	2 C	R-RSL/WVDEP
4,4'-DDT	50-29-3	1.9	C	1.9	C	1.9 C	R-RSL/WVDEP
Aldrin	309-00-2	0.039	C	0.039	C	0.039 C	R-RSL/WVDEP
Alpha-BHC	319-84-6	0.086	C	0.086	C	0.086 C	R-RSL/WVDEP
beta-BHC	319-85-7	0.3	C	0.3	C	0.3 C	R-RSL/WVDEP
cis-Chlordane	5103-71-9	1.7	C[7]	1.9	C[7]	1.7 C[7]	R-RSL
delta-BHC	319-86-8	0.086	C[8]	0.086	C[8]	0.086 C[8]	R-RSL/WVDEP
Dieldrin	60-57-1	0.034	C	0.042	C	0.034 C	R-RSL
Endosulfan I	959-98-8	47	N[9]	45	N[9]	45 N[9]	WVDEP
Endosulfan II	33213-65-9	47	N[9]	45	N[9]	45 N[9]	WVDEP
Endosulfan sulfate	1031-07-8	38	N	NC		38 N	R-RSL
Endrin	72-20-8	1.9	N	1.9	N	1.9 N	R-RSL/WVDEP
Endrin aldehyde	7421-93-4	1.9	N[10]	1.9	N[10]	1.9 N[10]	R-RSL/WVDEP
Endrin ketone	53494-70-5	1.9	N[10]	1.9	N[10]	1.9 N[10]	R-RSL/WVDEP
gamma-BHC (Lindane)	58-89-9	0.57	C	0.57	C	0.57 C	R-RSL/WVDEP
Heptachlor	76-44-8	0.13	C	0.14	C	0.13 C	R-RSL
Heptachlor epoxide	1024-57-3	0.07	C	0.071	C	0.07 C	R-RSL
Methoxychlor	72-43-5	32	N	32	N	32 N	R-RSL/WVDEP
Toxaphene	8001-35-2	0.49	C	0.49	C	0.49 C	R-RSL/WVDEP
trans-Chlordane	5103-74-2	1.7	C[7]	1.9	C[7]	1.7 C	R-RSL
PCB Congeners (mg/kg)							
PCB-8	34883-43-7	NC		NC		NC	None
PCB-18	37680-65-2	NC		NC		NC	None
PCB-28	7012-37-5	NC		NC		NC	None
PCB-44	41464-39-5	NC		NC		NC	None
PCB-52	35693-99-3	NC		NC		NC	None
PCB-66	32598-10-0	NC		NC		NC	None
PCB-77	32598-13-3	0.038	C	NC		0.038 C	R-RSL
PCB-81	70362-50-4	0.012	C	NC		0.012 C	R-RSL
PCB-101	37680-73-2	NC		NC		NC	None
PCB-105	32598-14-4	0.12	C	NC		0.12 C	R-RSL
PCB-114	74472-37-0	0.12	C	NC		0.12 C	R-RSL
PCB-118	31508-00-6	0.12	C	NC		0.12 C	R-RSL
PCB-123	65510-44-3	0.12	C	NC		0.12 C	R-RSL
PCB-126	57465-28-8	0.000036	C	NC		0.000036 C	R-RSL
PCB-128	38380-07-3	NC		NC		NC	None
PCB-138	35065-28-2	NC		NC		NC	None
PCB-153	35065-27-1	NC		NC		NC	None
PCB-156	38380-08-4	0.12	C	NC		0.12 C	R-RSL
PCB-157	69782-90-7	0.12	C	NC		0.12 C	R-RSL
PCB-167	52663-72-6	0.12	C	NC		0.12 C	R-RSL
PCB-169	32774-16-6	0.00012	C	NC		0.00012 C	R-RSL
PCB-170	35065-30-6	NC		NC		NC	None
PCB-180	35065-29-3	NC		NC		NC	None
PCB-187	52663-68-0	NC		NC		NC	None
PCB-189	39635-31-9	0.13	C	NC		0.13 C	R-RSL
PCB-195	52663-78-2	NC		NC		NC	None
PCB-206	40186-72-9	NC		NC		NC	None

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Soil

Analyte	CAS Number	R-RSL[1]		WVDEP[2]		HHRA PSL[3]	PSL Reference
PCB Aroclors (mg/kg)							
Aroclor-1016	12674-11-2	0.41	N	0.55	N	0.41 N	R-RSL
Aroclor-1221	11104-28-2	0.2	C	0.26	C	0.2 C	R-RSL
Aroclor-1232	11141-16-5	0.17	C	0.22	C	0.17 C	R-RSL
Aroclor-1242	53469-21-9	0.23	C	0.31	C	0.23 C	R-RSL
Aroclor-1248	12672-29-6	0.23	C	0.31	C	0.23 C	R-RSL
Aroclor-1254	11097-69-1	0.12	N	0.32	C	0.12 N	R-RSL
Aroclor-1260	11096-82-5	0.24	C	0.33	C	0.24 C	R-RSL
Aroclor-1262	37324-23-5	NC		NC		NC	None
Aroclor-1268	11100-14-4	NC		NC		NC	None
Dioxins/Furans (ng/kg)							
2,3,7,8-TCDD	1746-01-6	4.8	C	5.2	C	4.8 C	R-RSL
1,2,3,7,8-PeCDD	40321-76-4	4.8	C[11]	5.2	C[11]	4.8 C[11]	R-RSL
1,2,3,4,7,8-HxCDD	39227-28-6	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,6,7,8-HxCDD	57653-85-7	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,7,8,9-HxCDD	19408-74-3	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,4,6,7,8-HpCDD	35822-46-9	480	C[11]	520	C[11]	480 C[11]	R-RSL
OCDD	3268-87-9	16000	C[11]	17333	C[11]	16000 C[11]	R-RSL
2,3,7,8-TCDF	51207-31-9	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,7,8-PeCDF	57117-41-6	160	C[11]	173	C[11]	160 C[11]	R-RSL
2,3,4,7,8-PeCDF	57117-31-4	16	C[11]	17	C[11]	16 C[11]	R-RSL
1,2,3,4,7,8-HxCDF	70648-26-9	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,6,7,8-HxCDF	57117-44-9	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,7,8,9-HxCDF	72918-21-9	48	C[11]	52	C[11]	48 C[11]	R-RSL
2,3,4,6,7,8-HxCDF	60851-34-5	48	C[11]	52	C[11]	48 C[11]	R-RSL
1,2,3,4,6,7,8-HpCDF	67562-39-4	480	C[11]	520	C[11]	480 C[11]	R-RSL
1,2,3,4,7,8,9-HpCDF	55673-89-7	480	C[11]	520	C[11]	480 C[11]	R-RSL
OCDF	39001-02-0	16000	C[11]	17333	C[11]	16000 C[11]	R-RSL
Inorganics (mg/kg)							
Aluminum	7429-90-5	7700	N	7700	N	7,700 N	R-RSL/WVDEP
Antimony	7440-36-0	3.1	N	3.1	N	3.1 N	R-RSL/WVDEP
Arsenic	7440-38-2	0.68	C	0.43	C	0.43 C	WVDEP
Barium	7440-39-3	1500	N	1500	N	1500 N	R-RSL/WVDEP
Beryllium	7440-41-7	16	N	16	N	16 N	R-RSL/WVDEP
Cadmium	7440-43-9	7.1	N	3.7	N	3.7 N	WVDEP
Calcium	7440-70-2	NC		NC		NC	None
Chromium	7440-47-3	0.3	C[12]	0.31	C[12]	0.3 C[12]	R-RSL
Cobalt	7440-48-4	2.3	N	2.3	N	2.3 N	R-RSL/WVDEP
Copper	7440-50-8	310	N	310	N	310 N	R-RSL/WVDEP
Iron	7439-89-6	5500	N	5500	N	5500 N	R-RSL/WVDEP
Lead	7439-92-1	200	[13]	400		200	USEPA[13]
Magnesium	7439-95-4	NC		NC		NC	None
Manganese	7439-96-5	180	N	350	N	180 N	R-RSL
Mercury	7439-97-6	1.1	N	3.1	Csat	1.1 N	R-RSL
Nickel	7440-02-0	150	N	150	N	150 N	R-RSL/WVDEP
Potassium	7440-09-7	NC		NC		NC	None
Selenium	7782-49-2	39	N	39	N	39 N	R-RSL/WVDEP
Silver	7440-22-4	39	N	39	N	39 N	R-RSL/WVDEP
Sodium	7440-23-5	NC		NC		NC	None
Thallium	7440-28-0	0.078	N	0.078	N	0.078 N	R-RSL/WVDEP
Vanadium	7440-62-2	39	N	0.55	N	0.55 N	WVDEP
Zinc	7440-66-6	2300	N	2300	N	2300 N	R-RSL/WVDEP
Cyanide	57-12-5	2.3	N	2.3	N	2.3 N	R-RSL/WVDEP

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Residential Soil (R-RSL), May 2019.
Target cancer risk = 1E-06 and target hazard quotient = 0.1.
2 - West Virginia Department of Environmental Protection (WVDEP) Voluntary Cleanup Standards De Minimus Table 60-3B, 2017.
Values are for residential soil. Target cancer risk = 1E-06 and target hazard quotient = 0.1 (noncancer values were divided by 10).
3 - The lower of the USEPA R-RSLs and WVDEP criteria was selected as the project screening level (PSL).
4 - Value is for 1,3-dichloropropene.
5 - Value is for m-xylene.
6 - The R-RSL value is for pyrene.
7 - Value is for chlordane.
8 - Value is for alpha-BHC.
9 - Value is for endosulfan.
10 - Value is for endrin.
11 - Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.
12 - Value is for hexavalent chromium.
13 - Value referenced in December 2016 OLEM Memo (USEPA, 2016).

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Sediment

Analyte	CAS Number	R-RSL x 10[1]		WVDEP x 10[2]		HHRA PSL[3]	PSL Reference
VOCs (mg/kg)							
1,1,1-Trichloroethane	71-55-6	8100	N	6400	Csat	6,400	WVDEP
1,1,2,2-Tetrachloroethane	79-34-5	6	C	6.4	C	6 C	R-RSL
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	6700	N	9100	Csat	6,700 N	R-RSL
1,1,2-Trichloroethane	79-00-5	1.5	N	12	C	1.5 N	R-RSL
1,1-Dichloroethane	75-34-3	36	C	38	C	36 C	R-RSL
1,1-Dichloroethene	75-35-4	230	N	240	N	230 N	R-RSL
1,2,3-Trichlorobenzene	87-61-6	63	N	NC		63 N	R-RSL
1,2,4-Trichlorobenzene	120-82-1	58	N	240	C	58 N	R-RSL
1,2-Dibromo-3-chloropropane	96-12-8	0.053	C	0.057	C	0.053 C	R-RSL
1,2-Dibromoethane	106-93-4	0.36	C	0.39	C	0.36 C	R-RSL
1,2-Dichlorobenzene	95-50-1	1800	N	3800	Csat	1,800 N	R-RSL
1,2-Dichloroethane	107-06-2	4.6	C	5	C	4.6 C	R-RSL
1,2-Dichloropropane	78-87-5	16	N	11	C	11 C	WVDEP
1,3-Dichlorobenzene	541-73-1	NC		NC		NC	None
1,4-Dichlorobenzene	106-46-7	26	C	28	C	26 C	R-RSL
2-Butanone	78-93-3	27000	N	28000	N	27,000 N	R-RSL
2-Hexanone	591-78-6	200	N	NC		200 N	R-RSL
4-Methyl-2-pentanone	108-10-1	33000	N	34000	Csat	33,000 N	R-RSL
Acetone	67-64-1	61000	N	61000	N	61,000 N	R-RSL/ WVDEP
Benzene	71-43-2	12	C	12	C	12 C	R-RSL/ WVDEP
Bromochloromethane	74-97-5	150	N	NC		150 N	R-RSL
Bromodichloromethane	75-27-4	2.9	C	3.1	C	2.9 C	R-RSL
Bromoform	75-25-2	190	C	200	C	190 C	R-RSL
Bromomethane	74-83-9	6.8	N	7.3	N	6.8 N	R-RSL
Carbon disulfide	75-15-0	770	N	7400	Csat	770 N	R-RSL
Carbon tetrachloride	56-23-5	6.5	C	7	C	6.5 C	R-RSL
Chlorobenzene	108-90-7	280	N	290	N	280 N	R-RSL
Chloroethane	75-00-3	14000	N	21000	Csat	14,000 N	R-RSL
Chloroform	67-66-3	3.2	C	3.4	C	3.2 C	R-RSL
Chloromethane	74-87-3	110	N	120	N	110 N	R-RSL
cis-1,2-Dichloroethene	156-59-2	160	N	17	N	17 N	WVDEP
cis-1,3-Dichloropropene	10061-01-5	18	C[4]	19	C[4]	18 C[4]	R-RSL
Cyclohexane	110-82-7	6500	N	1200	Csat	1,200	WVDEP
D bromochloromethane	124-48-1	83	C	83	C	83 C	R-RSL/ WVDEP
Dichlorodifluoromethane	75-71-8	87	N	94	N	87 N	R-RSL
Ethy benzene	100-41-4	58	C	62	C	58 C	R-RSL
Isopropylbenzene	98-82-8	1900	N	2700	Csat	1,900 N	R-RSL
m,p-Xylenes	179601-23-1	550	N[5]	NC		550 N[5]	R-RSL
Methyl acetate	79-20-9	78000	N	23000	N	23,000 N	WVDEP
Methyl cyclohexane	108-87-2	NC		NC		NC	None
Methylene chloride	75-09-2	350	N	580	C	350 N	R-RSL
Methyl-tert-butyl ether	1634-04-4	470	C	500	C	470 C	R-RSL
o-Xylene	95-47-6	650	N	NC		650 N	R-RSL
Styrene	100-42-5	6000	N	8700	Csat	6000 N	R-RSL
Tetrachloroethene	127-18-4	81	N	250	C	81 N	R-RSL
Toluene	108-88-3	4900	N	8200	Csat	4900 N	R-RSL
trans-1,2-Dichloroethene	156-60-5	1600	N	130	N	130 N	WVDEP
trans-1,3-Dichloropropene	10061-02-6	18	C[4]	19	C[4]	18 C[4]	R-RSL
Trichloroethene	79-01-6	4.1	N	5	C	4.1 N	R-RSL
Trichlorofluoromethane	75-69-4	23000	N	790	N	790 N	WVDEP
Vinyl chloride	75-01-4	0.59	C	0.57	C	0.57 C	WVDEP
Xylenes (total)	1330-20-7	580	N	2600	Csat	580 N	R-RSL
SVOCs (mg/kg)							
1,1-Biphenyl	92-52-4	47	N	51	N	47 N	R-RSL
1,2,4,5-Tetrachlorobenzene	95-94-3	23	N	17	N	17 N	WVDEP
1,4-Dioxane[3]	123-91-1	53	C	54	C	53 C	R-RSL
2,2'-Oxybis(1-chloropropane)	108-60-1	3100	N	51	C	51 C	WVDEP
2,3,4,6-Tetrachlorophenol	58-90-2	1900	N	1900	N	1,900 N	R-RSL/ WVDEP
2,4,5-Trichlorophenol	95-95-4	6300	N	6300	N	6,300 N	R-RSL/ WVDEP
2,4,6-Trichlorophenol	88-06-2	63	N	490	C	63 N	R-RSL
2,4-Dichlorophenol	120-83-2	190	N	190	N	190 N	R-RSL/ WVDEP
2,4-Dimethylphenol	105-67-9	1300	N	1300	N	1,300 N	R-RSL/ WVDEP
2,4-Dinitrophenol	51-28-5	130	N	130	N	130 N	R-RSL/ WVDEP
2,4-Dinitrotoluene	121-14-2	17	C	17	C	17 C	R-RSL/ WVDEP
2,6-Dinitrotoluene	606-20-2	3.6	C	3.6	C	3.6 C	R-RSL/ WVDEP
2-Chloronaphthalene	91-58-7	4800	N	5000	N	4,800 N	R-RSL
2-Chlorophenol	95-57-8	390	N	340	N	340 N	WVDEP
2-Methylphenol	95-48-7	3200	N	3200	N	3,200 N	R-RSL/ WVDEP
2-Nitroaniline	88-74-4	630	N	630	N	630 N	R-RSL/ WVDEP

Sediment

Analyte	CAS Number	R-RSL x 10[(1)]		WVDEP x 10[(2)]		HHRA PSL[(3)]	PSL Reference
2-Nitrophenol	88-75-5	NC		NC		NC	None
3,3'-Dichlorobenzidine	91-94-1	12	C	12	C	12 C	R-RSL/ WVDEP
3-Methylphenol	108-39-4	3200	N	3200	N	3,200 N	R-RSL/ WVDEP
3-Nitroaniline	99-09-2	NC		NC		NC	None
4,6-Dinitro-2-methylphenol	534-52-1	5.1	N	NC		5.1 N	R-RSL
4-Bromophenyl phenyl ether	101-55-3	NC		NC		NC	None
4-Chloro-3-methylphenol	59-50-7	6300	N	NC		6,300 N	R-RSL
4-Chloroanaline	106-47-8	27	C	27	C	27 C	R-RSL/ WVDEP
4-Chlorophenyl phenyl ether	7005-72-3	NC		NC		NC	None
4-Methylphenol	106-44-5	6300	N	6300	N	6,300 N	R-RSL/ WVDEP
4-Nitroaniline	100-01-6	250	N	NC		250 N	R-RSL
4-Nitrophenol	100-02-7	NC		NC		NC	None
Acetophenone	98-86-2	7800	N	25000	Csat	7,800 N	R-RSL
Atrazine	1912-24-9	24	C	24	C	24 C	R-RSL/ WVDEP
Benzaldehyde	100-52-7	1700	C	12000	Csat	1,700 C	R-RSL
Bis(2-chloroethoxy)methane	111-91-1	190	N	NC		190 N	R-RSL
Bis(2-chloroethyl)ether	111-44-4	2.3	C	2.4	C	2.3 C	R-RSL
Bis(2-ethylhexyl)phthalate	117-81-7	390	C	390	C	390 C	R-RSL/ WVDEP
Butyl benzyl phthalate	85-68-7	2900	C	2900	C	2,900 C	R-RSL/ WVDEP
Caprolactam	105-60-2	31000	N	31000	N	31,000 N	R-RSL/ WVDEP
Carbazole	86-74-8	NC		NC		NC	None
D benzofuran	132-64-9	73	N	78	N	73 N	R-RSL
Diethyl phthalate	84-66-2	51000	N	51000	N	51,000 N	R-RSL/ WVDEP
Dimethyl phthalate	131-11-3	NC		NC		NC	None
Di-n-butyl phthalate	84-74-2	6300	N	6300	N	6,300 N	R-RSL/ WVDEP
Di-n-octyl phthalate	117-84-0	630	N	NC		630 N	R-RSL
Hexachlorobenzene	118-74-1	2.1	C	2.2	C	2.1 C	R-RSL
Hexachlorobutadiene	87-68-3	12	C	13	C	12 C	R-RSL
Hexachlorocyclopentadiene	77-47-4	1.8	N	1.9	N	1.8 N	R-RSL
Hexachloroethane	67-72-1	18	C	20	C	18 C	R-RSL
Isophorone	78-59-1	5700	C	5700	C	5,700 C	R-RSL/ WVDEP
Nitrobenzene	98-95-3	51	C	55	C	51 C	R-RSL
N-Nitrosodi-n-propylamine	621-64-7	0.78	C	0.78	C	0.78 C	R-RSL/ WVDEP
N-Nitrosodiphenylamine	86-30-6	1100	C	1100	C	1,100 C	R-RSL/ WVDEP
Phenol	108-95-2	19000	N	19000	N	19,000 N	R-RSL/ WVDEP

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Sediment

Analyte	CAS Number	R-RSL x 10[1]		WVDEP x 10[2]		HHRA PSL[3]	PSL Reference
PAHs and PCP (mg/kg)							
2-Methylnaphthalene	91-57-6	240	N	310	N	240 N	R-RSL
Acenaphthene	83-32-9	3600	N	4100	N	3,600 N	R-RSL
Acenaphthylene	208-96-8	NC		4200	N	4200	WVDEP
Anthracene	120-12-7	18000	N	23000	N	18,000 N	R-RSL
Benzo(a)anthracene	56-55-3	11	C	2.1	C	2.1 C	WVDEP
Benzo(a)pyrene	50-32-8	1.1	C	0.16	C	0.16 C	WVDEP
Benzo(b)fluoranthene	205-99-2	11	C	1.6	C	1.6 C	WVDEP
Benzo(g,h,i)perylene	191-24-2	1800	N[6]	1800	N	1800 N[6]	R-RSL/ WVDEP
Benzo(k)fluoranthene	207-08-9	110	C	16	C	16 C	WVDEP
Chrysene	218-01-9	1100	C	160	C	160 C	WVDEP
D benzo(a,h)anthracene	53-70-3	1.1	C	0.16	C	0.16 C	WVDEP
Fluoranthene	206-44-0	2400	N	2400	N	2,400 N	R-RSL/ WVDEP
Fluorene	86-73-7	2400	N	2900	N	2,400 N	R-RSL
Indeno(1,2,3-c,d)pyrene	193-39-5	11	C	1.6	C	1.6 C	WVDEP
Naphthalene	91-20-3	38	C	41	C	38 C	R-RSL
Phenanthrene	85-01-8	1800	N[6]	23000	N	1,800 N[6]	R-RSL
Pyrene	129-00-0	1800	N	2300	N	1,800 N	R-RSL
Pentachlorophenol	87-86-5	10	C	10	C	10 C	R-RSL/ WVDEP
Pesticides (mg/kg)							
4,4'-DDD	72-54-8	1.9	N	23	C	1.9 N	R-RSL
4,4'-DDE	72-55-9	20	C	20	C	20 C	R-RSL/ WVDEP
4,4'-DDT	50-29-3	19	C	19	C	19 C	R-RSL/ WVDEP
Aldrin	309-00-2	0.39	C	0.39	C	0.39 C	R-RSL/ WVDEP
Alpha-BHC	319-84-6	0.86	C	0.86	C	0.86 C	R-RSL/ WVDEP
beta-BHC	319-85-7	3	C	3	C	3 C	R-RSL/ WVDEP
cis-Chlordane	5103-71-9	17	C[7]	19	C[7]	17 C[7]	R-RSL
delta-BHC	319-86-8	0.86	C[8]	0.86	C[8]	0.86 C[8]	R-RSL/ WVDEP
Dieldrin	60-57-1	0.34	C	0.42	C	0.34 C	R-RSL
Endosulfan I	959-98-8	470	N[9]	450	N[9]	450 N[9]	WVDEP
Endosulfan II	33213-65-9	470	N[9]	450	N[9]	450 N[9]	WVDEP
Endosulfan sulfate	1031-07-8	380	N	NC		380 N	R-RSL
Endrin	72-20-8	19	N	19	N	19 N	R-RSL/ WVDEP
Endrin aldehyde	7421-93-4	19	N[10]	19	N[10]	19 N[10]	R-RSL/ WVDEP
Endrin ketone	53494-70-5	19	N[10]	19	N[10]	19 N[10]	R-RSL/ WVDEP
gamma-BHC (Lindane)	58-89-9	5.7	C	5.7	C	5.7 C	R-RSL/ WVDEP
Heptachlor	76-44-8	1.3	C	1.4	C	1.3 C	R-RSL
Heptachlor epoxide	1024-57-3	0.7	C	0.71	C	0.7 C	R-RSL
Methoxychlor	72-43-5	320	N	320	N	320 N	R-RSL/ WVDEP
Toxaphene	8001-35-2	4.9	C	4.9	C	4.9 C	R-RSL/ WVDEP
trans-Chlordane	5103-74-2	17	C[7]	19	C[7]	17 C[7]	R-RSL
PCB Congeners (mg/kg)							
PCB-8	34883-43-7	NC		NC		NC	None
PCB-18	37680-65-2	NC		NC		NC	None
PCB-28	7012-37-5	NC		NC		NC	None
PCB-44	41464-39-5	NC		NC		NC	None
PCB-52	35693-99-3	NC		NC		NC	None
PCB-66	32598-10-0	NC		NC		NC	None
PCB-77	32598-13-3	0.38	C	NC		0.38 C	R-RSL
PCB-81	70362-50-4	0.12	C	NC		0.12 C	R-RSL
PCB-101	37680-73-2	NC		NC		NC	None
PCB-105	32598-14-4	1.2	C	NC		1.2 C	R-RSL
PCB-114	74472-37-0	1.2	C	NC		1.2 C	R-RSL
PCB-118	31508-00-6	1.2	C	NC		1.2 C	R-RSL
PCB-123	65510-44-3	1.2	C	NC		1.2 C	R-RSL
PCB-126	57465-28-8	0.00036	C	NC		0.00036 C	R-RSL
PCB-128	38380-07-3	NC		NC		NC	None
PCB-138	35065-28-2	NC		NC		NC	None
PCB-153	35065-27-1	NC		NC		NC	None
PCB-156	38380-08-4	1.2	C	NC		1.2 C	R-RSL
PCB-157	69782-90-7	1.2	C	NC		1.2 C	R-RSL
PCB-167	52663-72-6	1.2	C	NC		1.2 C	R-RSL
PCB-169	32774-16-6	0.0012	C	NC		0.0012 C	R-RSL
PCB-170	35065-30-6	NC		NC		NC	None
PCB-180	35065-29-3	NC		NC		NC	None
PCB-187	52663-68-0	NC		NC		NC	None
PCB-189	39635-31-9	1.3	C	NC		1.3 C	R-RSL
PCB-195	52663-78-2	NC		NC		NC	None
PCB-206	40186-72-9	NC		NC		NC	None

Sediment

Analyte	CAS Number	R-RSL x 10[1]		WVDEP x 10[2]		HHRA PSL[3]	PSL Reference
PCB Aroclors (mg/kg)							
Aroclor-1016	12674-11-2	4.1	N	5.5	N	4.1 N	R-RSL
Aroclor-1221	11104-28-2	2	C	2.6	C	2 C	R-RSL
Aroclor-1232	11141-16-5	1.7	C	2.2	C	1.7 C	R-RSL
Aroclor-1242	53469-21-9	2.3	C	3.1	C	2.3 C	R-RSL
Aroclor-1248	12672-29-6	2.3	C	3.1	C	2.3 C	R-RSL
Aroclor-1254	11097-69-1	1.2	N	3.2	C	1.2 N	R-RSL
Aroclor-1260	11096-82-5	2.4	C	3.3	C	2.4 C	R-RSL
Aroclor-1262	37324-23-5	NC		NC		NC	None
Aroclor-1268	11100-14-4	NC		NC		NC	None
Dioxins/Furans (ng/kg)							
2,3,7,8-TCDD	1746-01-6	48	C	52	C	48 C	R-RSL
1,2,3,7,8-PeCDD	40321-76-4	48	C[12]	52	C[12]	48 C[12]	R-RSL
1,2,3,4,7,8-HxCDD	39227-28-6	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,6,7,8-HxCDD	57653-85-7	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,7,8,9-HxCDD	19408-74-3	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,4,6,7,8-HpCDD	35822-46-9	4800	C[12]	5200	C[12]	4,800 C[12]	R-RSL
OCDD	3268-87-9	160000	C[12]	173333	C[12]	160,000 C[12]	R-RSL
2,3,7,8-TCDF	51207-31-9	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,7,8-PeCDF	57117-41-6	1600	C[12]	1733	C[12]	1,600 C[12]	R-RSL
2,3,4,7,8-PeCDF	57117-31-4	160	C[12]	173	C[12]	160 C[12]	R-RSL
1,2,3,4,7,8-HxCDF	70648-26-9	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,6,7,8-HxCDF	57117-44-9	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,7,8,9-HxCDF	72918-21-9	480	C[12]	520	C[12]	480 C[12]	R-RSL
2,3,4,6,7,8-HxCDF	60851-34-5	480	C[12]	520	C[12]	480 C[12]	R-RSL
1,2,3,4,6,7,8-HpCDF	67562-39-4	4800	C[12]	5200	C[12]	4,800 C[12]	R-RSL
1,2,3,4,7,8,9-HpCDF	55673-89-7	4800	C[12]	5200	C[12]	4,800 C[12]	R-RSL
OCDF	39001-02-0	160000	C[12]	173333	C[12]	160,000 C[12]	R-RSL
Inorganics (mg/kg)							
Aluminum	7429-90-5	77000	N	77000	N	77,000 N	R-RSL/ WVDEP
Antimony	7440-36-0	31	N	31	N	31 N	R-RSL/ WVDEP
Arsenic	7440-38-2	6.8	C	4.3	C	4.3 C	WVDEP
Barium	7440-39-3	15000	N	15000	N	15,000 N	R-RSL/ WVDEP
Beryllium	7440-41-7	160	N	160	N	160 N	R-RSL/ WVDEP
Cadmium	7440-43-9	71	N	37	N	37 N	WVDEP
Calcium	7440-70-2	NC		NC		NC	None
Chromium	7440-47-3	3	C[13]	3.1	C[13]	3 C[13]	R-RSL
Cobalt	7440-48-4	23	N	23	N	23 N	R-RSL/ WVDEP
Copper	7440-50-8	3100	N	3100	N	3,100 N	R-RSL/ WVDEP
Iron	7439-89-6	55000	N	55000	N	55,000 N	R-RSL/ WVDEP
Lead	7439-92-1	200	[14]	400		200	USEPA[14]
Magnesium	7439-95-4	NC		NC		NC	None
Manganese	7439-96-5	1800	N	3500	N	1,800 N	R-RSL
Mercury	7439-97-6	11	N	31	Csat	11 N	R-RSL
Nickel	7440-02-0	1500	N	1500	N	1,500 N	R-RSL/ WVDEP
Potassium	7440-09-7	NC		NC		NC	None
Selenium	7782-49-2	390	N	390	N	390 N	R-RSL/ WVDEP
Silver	7440-22-4	390	N	390	N	390 N	R-RSL/ WVDEP
Sodium	7440-23-5	NC		NC		NC	None
Thallium	7440-28-0	0.78	N	0.78	N	0.78 N	R-RSL/ WVDEP
Vanadium	7440-62-2	390	N	5.5	N	5.5 N	WVDEP
Zinc	7440-66-6	23000	N	23000	N	23,000 N	R-RSL/ WVDEP
Cyanide	57-12-5	23	N	23	N	23 N	R-RSL/ WVDEP

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Residential Soil (R-RSL), May 2019, multiplied by a factor of 10 to account for anticipated reduced exposure to sediment. Before the factor is applied, the target cancer risk = 1E-06 and target hazard quotient = 0.1.
2 - West Virginia Department of Environmental Protection (WVDEP) Voluntary Cleanup Standards De Minimus Table 60-3B, 2017; values are for residential soil, multiplied by a factor of 10 to account for anticipated reduced exposure to sediment. Before the factor was applied, target cancer risk = 1E-06 and target hazard quotient = 0.1 (noncancer values were divided by 10).
3 - The lower of the adjusted USEPA R-RSLs and WVDEP criteria was selected as the project screening level (PSL).
4 - Value is for 1,3-dichloropropene.
5 - Value is for m-xylene.
6 - The R-RSL value is for pyrene.
7 - Value is for chlordane.
8 - Value is for alpha-BHC.
9 - Value is for endosulfan.
10 - Value is for endrin.
12 - Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.
13 - Value is for hexavalent chromium.
14 - Value referenced in December 2016 OLEM Memo (USEPA, 2016).

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Groundwater

Analyte	CAS Number	T-RSL[1]		WVDEP[2]		PSL[3]		PSL Reference
VOCs (ug/L)								
1,1,1-Trichloroethane	71-55-6	800	N	200		200		WVDEP
1,1,2,2-Tetrachloroethane	79-34-5	0.076	C	0.076	C	0.076	C	T-RSL/WVDEP
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1000	N	5700	N	1000	N	T-RSL
1,1,2-Trichloroethane	79-00-5	0.041	N	5		0.041	N	T-RSL
1,1-Dichloroethane	75-34-3	2.8	C	2.8	C	2.8	C	T-RSL/WVDEP
1,1-Dichloroethene	75-35-4	28	N	7		7		WVDEP
1,2,3-Trichlorobenzene	87-61-6	0.7	N	NC		0.7	N	T-RSL
1,2,4-Trichlorobenzene	120-82-1	0.4	N	70		0.4	N	T-RSL
1,2-D bromo-3-chloropropane	96-12-8	0.00033	C	0.2		0.00033	C	T-RSL
1,2-D bromoethane	106-93-4	0.0075	C	0.05		0.0075	C	T-RSL
1,2-Dichlorobenzene	95-50-1	30	N	600		30	N	T-RSL
1,2-Dichloroethane	107-06-2	0.17	C	5		0.17	C	T-RSL
1,2-Dichloropropane	78-87-5	0.82	N	5		0.82	N	T-RSL
1,3-Dichlorobenzene	541-73-1	NC		NC		NC		None
1,4-Dichlorobenzene	106-46-7	0.48	C	75		0.48	C	T-RSL
2-Butanone	78-93-3	560	N	560	N	560	N	T-RSL/WVDEP
2-Hexanone	591-78-6	3.8	N	NC		3.8	N	T-RSL
4-Methyl-2-pentanone	108-10-1	630	N	120	N	120	N	WVDEP
Acetone	67-64-1	1400	N	1400	N	1400	N	T-RSL/WVDEP
Benzene	71-43-2	0.46	C	5		0.46	C	T-RSL
Bromochloromethane	74-97-5	8.3	N	NC		8.3	N	T-RSL
Bromodichloromethane	75-27-4	0.13	C	0.13	C	0.13	C	T-RSL/WVDEP
Bromoform	75-25-2	3.3	C	3.3	C	3.3	C	T-RSL/WVDEP
Bromomethane	74-83-9	0.75	N	0.75	N	0.75	N	T-RSL/WVDEP
Carbon disulfide	75-15-0	81	N	81	N	81	N	T-RSL/WVDEP
Carbon tetrachloride	56-23-5	0.46	C	5		0.46	C	T-RSL
Chlorobenzene	108-90-7	7.8	N	100		7.8	N	T-RSL
Chloroethane	75-00-3	2100	N	2100	N	2100	N	T-RSL/WVDEP
Chloroform	67-66-3	0.22	C	0.22	C	0.22	C	T-RSL/WVDEP
Chloromethane	74-87-3	19	N	19	N	19	N	T-RSL/WVDEP
cis-1,2-Dichloroethene	156-59-2	3.6	N	70		3.6	N	T-RSL
cis-1,3-Dichloropropene	10061-01-5	0.47	C[4]	0.47	C[4]	0.47	C[4]	T-RSL/WVDEP
Cyclohexane	110-82-7	1300	N	1300	N	1300	N	T-RSL/WVDEP
D bromochloromethane	124-48-1	0.87	C	0.87	C	0.87	C	T-RSL/WVDEP
Dichlorodifluoromethane	75-71-8	20	N	20	N	20	N	T-RSL/WVDEP
Ethylbenzene	100-41-4	1.5	C	700		1.5	C	T-RSL
Isopropylbenzene	98-82-8	45	N	45	N	45	N	T-RSL/WVDEP
m,p-Xylenes	179601-23-1	19	N	NC		19	N	T-RSL
Methyl acetate	79-20-9	2000	N	530	N	530	N	WVDEP
Methyl cyclohexane	108-87-2	NC		NC		NC		None
Methylene chloride	75-09-2	11	N	5		5		WVDEP
Methyl-tert-butyl ether	1634-04-4	14	C	14	C	14	C	T-RSL/WVDEP
o-Xylene	95-47-6	19	N	NC		19	N	T-RSL
Styrene	100-42-5	120	N	100		100		WVDEP
Tetrachloroethene	127-18-4	4.1	N	5		4.1	N	T-RSL
Toluene	108-88-3	110	N	1000		110	N	T-RSL
trans-1,2-Dichloroethene	156-60-5	36	N	100		36	N	T-RSL
trans-1,3-Dichloropropene	10061-02-6	0.47	C[4]	0.47	C[4]	0.47	C[4]	T-RSL/WVDEP
Trichloroethene	79-01-6	0.28	N	5		0.28	N	T-RSL
Trichlorofluoromethane	75-69-4	520	N	110	N	110	N	WVDEP
Vinyl chloride	75-01-4	0.019	C	2		0.019	C	T-RSL
Xylenes (total)	1330-20-7	19	N	10000		19	N	T-RSL

Groundwater

Analyte	CAS Number	T-RSL[1]		WVDEP[2]		PSL[3]		PSL Reference
SVOCs (ug/L)								
1,1-Biphenyl	92-52-4	0.083	N	0.083	N	0.083	N	T-RSL/WVDEP
1,2,4,5-Tetrachlorobenzene	95-94-3	0.17	N	0.098	N	0.098	N	WVDEP
1,4-Dioxane	123-91-1	0.46	C	0.46	C	0.46	C	T-RSL/WVDEP
2,2'-Oxybis(1-chloropropane)	108-60-1	71	N	0.36	C	0.36	C	WVDEP
2,3,4,6-Tetrachlorophenol	58-90-2	24	N	24	N	24	N	T-RSL/WVDEP
2,4,5-Trichlorophenol	95-95-4	120	N	120	N	120	N	T-RSL/WVDEP
2,4,6-Trichlorophenol	88-06-2	1.2	N	4.1	C	1.2	N	T-RSL
2,4-Dichlorophenol	120-83-2	4.6	N	4.6	N	4.6	N	T-RSL/WVDEP
2,4-Dimethylphenol	105-67-9	36	N	36	N	36	N	T-RSL/WVDEP
2,4-Dinitrophenol	51-28-5	3.9	N	3.9	N	3.9	N	T-RSL/WVDEP
2,4-Dinitrotoluene	121-14-2	0.24	C	0.24	C	0.24	C	T-RSL/WVDEP
2,6-Dinitrotoluene	606-20-2	0.049	C	0.049	C	0.049	C	T-RSL/WVDEP
2-Chloronaphthalene	91-58-7	75	N	33	N	33	N	WVDEP
2-Chlorophenol	95-57-8	9.1	N	2.7	N	2.7	N	WVDEP
2-Methylphenol	95-48-7	93	N	93	N	93	N	T-RSL/WVDEP
2-Nitroaniline	88-74-4	19	N	19	N	19	N	T-RSL/WVDEP
2-Nitrophenol	88-75-5	NC		NC		NC		None
3,3'-Dichlorobenzidine	91-94-1	0.13	C	0.13	C	0.13	C	T-RSL/WVDEP
3-Methylphenol	108-39-4	93	N	93	N	93	N	T-RSL/WVDEP
3-Nitroaniline	99-09-2	NC		NC		NC		None
4,6-Dinitro-2-methylphenol	534-52-1	0.15	N	NC		0.15	N	T-RSL
4-Bromophenyl phenyl ether	101-55-3	NC		NC		NC		None
4-Chloro-3-methylphenol	59-50-7	140	N	NC		140	N	T-RSL
4-Chloroanaline	106-47-8	0.37	C	0.37	C	0.37	C	T-RSL/WVDEP
4-Nitroaniline	100-01-6	3.8	C	NC		3.8	C	T-RSL
4-Nitrophenol	100-02-7	NC		NC		NC		None
Acetophenone	98-86-2	190	N	190	N	190	N	T-RSL/WVDEP
Atrazine	1912-24-9	0.3	C	3		0.3	C	T-RSL
Benzaldehyde	100-52-7	19	C	190	N	19	C	T-RSL
Bis(2-chloroethoxy)methane	111-91-1	5.9	N	NC		5.9	N	T-RSL
Bis(2-chloroethyl)ether	111-44-4	0.014	C	0.014	C	0.014	C	T-RSL/WVDEP
Bis(2-ethylhexyl)phthalate	117-81-7	5.6	C	6		5.6	C	T-RSL
Butyl benzyl phthalate	85-68-7	16	C	16	C	16	C	T-RSL/WVDEP
Caprolactam	105-60-2	990	N	990	N	990	N	T-RSL/WVDEP
Carbazole	86-74-8	NC		NC		NC		None
D benzofuran	132-64-9	0.79	N	0.79	N	0.79	N	T-RSL/WVDEP
Diethyl phthalate	84-66-2	1,500	N	1500	N	1500	N	T-RSL/WVDEP
Dimethyl phthalate	131-11-3	NC		NC		NC		None
Di-n-butyl phthalate	84-74-2	90	N	90	N	90	N	T-RSL/WVDEP
Di-n-octyl phthalate	117-84-0	20	N	NC		20	N	T-RSL
Hexachlorobenzene	118-74-1	0.0098	C	1		0.0098	C	T-RSL
Hexachlorobutadiene	87-68-3	0.14	C	0.14	C	0.14	C	T-RSL/WVDEP
Hexachlorocyclopentadiene	77-47-4	0.041	N	50		0.041	N	T-RSL
Hexachloroethane	67-72-1	0.33	C	0.33	C	0.33	C	T-RSL/WVDEP
Isophorone	78-59-1	78	C	78	C	78	C	T-RSL/WVDEP
Nitrobenzene	98-95-3	0.14	C	0.14	C	0.14	C	T-RSL/WVDEP
N-Nitrosodi-n-propylamine	621-64-7	0.011	C	0.011	C	0.011	C	T-RSL/WVDEP
N-Nitrosodiphenylamine	86-30-6	12	C	12	C	12	C	T-RSL/WVDEP
Phenol	108-95-2	580	N	580	N	580	N	T-RSL/WVDEP

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Groundwater

Analyte	CAS Number	T-RSL[1]		WVDEP[2]		PSL[3]		PSL Reference
PAHs and PCP (ug/L)								
2-Methylnaphthalene	91-57-6	3.6	N	3.6	N	3.6	N	T-RSL/WVDEP
Acenaphthene	83-32-9	53	N	24	N	24	N	WVDEP
Acenaphthylene	208-96-8	53	N[4]	32	N	32	N	WVDEP
Anthracene	120-12-7	180	N	180	N	180	N	T-RSL/WVDEP
Benzo(a)anthracene	56-55-3	0.03	C	0.012	C	0.012	C	WVDEP
Benzo(a)pyrene	50-32-8	0.025	C	0.2		0.025	C	T-RSL
Benzo(b)fluoranthene	205-99-2	0.25	C	0.034	C	0.034	C	WVDEP
Benzo(g,h,i)perylene	191-24-2	12	N[5]	60	N	12	N[5]	T-RSL
Benzo(k)fluoranthene	207-08-9	2.5	C	0.34	C	0.34	C	WVDEP
Chrysene	218-01-9	25	C	3.4	C	3.4	C	WVDEP
D benzo(a,h)anthracene	53-70-3	0.025	C	0.0034	C	0.0034	C	WVDEP
Fluoranthene	206-44-0	80	N	80	N	80	N	T-RSL/WVDEP
Fluorene	86-73-7	29	N	15	N	15	N	WVDEP
Indeno(1,2,3-c,d)pyrene	193-39-5	0.25	C	0.034	C	0.034	C	WVDEP
Naphthalene	91-20-3	0.17	C	0.17	C	0.17	C	T-RSL/WVDEP
Phenanthrene	85-01-8	12	N[5]	600	N	12	N[5]	T-RSL
Pyrene	129-00-0	12	N	7.9	N	7.9	N	WVDEP
Pentachlorophenol	87-86-5	0.041	C	1		0.041	C	T-RSL
Pesticides (ug/L)								
4,4'-DDD	72-54-8	0.0063	N	0.032	C	0.0063	N	T-RSL
4,4'-DDE	72-55-9	0.046	C	0.046	C	0.046	C	T-RSL/WVDEP
4,4'-DDT	50-29-3	0.23	C	0.23	C	0.23	C	T-RSL/WVDEP
Aldrin	309-00-2	0.00092	C	0.00092	C	0.00092	C	T-RSL/WVDEP
alpha-BHC	319-84-6	0.0072	C	0.0072	C	0.0072	C	T-RSL/WVDEP
beta-BHC	319-85-7	0.025	C	0.025	C	0.025	C	T-RSL/WVDEP
cis-Chlordane	5103-71-9	0.02	C[6]	2	[6]	0.02	C[6]	T-RSL
delta-BHC	319-86-8	0.0072	C[7]	0.0072	C[7]	0.0072	C[7]	T-RSL/WVDEP
Dieldrin	60-57-1	0.0018	C	0.00072	C	0.00072	C	WVDEP
Endosulfan I	959-98-8	10	N[8]	3.1	N[8]	3.1	N[8]	WVDEP
Endosulfan II	33213-65-9	10	N[8]	3.1	N[8]	3.1	N[8]	WVDEP
Endosulfan sulfate	1031-07-8	11	N	3.1	N[8]	3.1	N[8]	WVDEP
Endrin	72-20-8	0.23	N	2		0.23	N	T-RSL
Endrin aldehyde	7421-93-4	0.23	N[9]	2	[9]	0.23	N[9]	T-RSL
Endrin ketone	53494-70-5	0.23	N[9]	2	[9]	0.23	N[9]	T-RSL
gamma-BHC (Lindane)	58-89-9	0.042	C	0.2		0.042	C	T-RSL
Heptachlor	76-44-8	0.0014	C	0.4		0.0014	C	T-RSL
Heptachlor epoxide	1024-57-3	0.0014	C	0.2		0.0014	C	T-RSL
Methoxychlor	72-43-5	3.7	N	40		3.7	N	T-RSL
Toxaphene	8001-35-2	0.071	C	3		0.071	C	T-RSL
trans-Chlordane	5103-74-2	0.02	C[6]	2	[6]	0.02	C[6]	T-RSL

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Groundwater

Analyte	CAS Number	T-RSL[1]		WVDEP[2]		PSL[3]		PSL Reference
PCB Congeners (ug/L)								
PCB-8	34883-43-7	NC		NC		NC		None
PCB-18	37680-65-2	NC		NC		NC		None
PCB-28	7012-37-5	NC		NC		NC		None
PCB-44	41464-39-5	NC		NC		NC		None
PCB-52	35693-99-3	NC		NC		NC		None
PCB-66	32598-10-0	NC		NC		NC		None
PCB-77	32598-13-3	0.006	C	NC		0.006	C	T-RSL
PCB-81	70362-50-4	0.0004	C	NC		0.0004	C	T-RSL
PCB-101	37680-73-2	NC		NC		NC		None
PCB-105	32598-14-4	0.004	C	NC		0.004	C	T-RSL
PCB-114	74472-37-0	0.004	C	NC		0.004	C	T-RSL
PCB-118	31508-00-6	0.004	C	NC		0.004	C	T-RSL
PCB-123	65510-44-3	0.004	C	NC		0.004	C	T-RSL
PCB-126	57465-28-8	0.0000012	C	NC		0.0000012	C	T-RSL
PCB-128	38380-07-3	NC		NC		NC		None
PCB-138	35065-28-2	NC		NC		NC		None
PCB-153	35065-27-1	NC		NC		NC		None
PCB-156	38380-08-4	0.004	C	NC		0.004	C	T-RSL
PCB-157	69782-90-7	0.004	C	NC		0.004	C	T-RSL
PCB-167	52663-72-6	0.004	C	NC		0.004	C	T-RSL
PCB-169	32774-16-6	0.000004	C	NC		0.000004	C	T-RSL
PCB-170	35065-30-6	NC		NC		NC		None
PCB-180	35065-29-3	NC		NC		NC		None
PCB-187	52663-68-0	NC		NC		NC		None
PCB-189	39635-31-9	0.004	C	NC		0.004	C	T-RSL
PCB-195	52663-78-2	NC		NC		NC		None
PCB-206	40186-72-9	NC		NC		NC		None
PCB Aroclors (ug/L)								
Aroclor-1016	12674-11-2	0.14	N	0.22	C	0.14	N	T-RSL
Aroclor-1221	11104-28-2	0.0047	C	0.0079	C	0.0047	C	T-RSL
Aroclor-1232	11141-16-5	0.0047	C	0.0079	C	0.0047	C	T-RSL
Aroclor-1242	53469-21-9	0.0078	C	0.0079	C	0.0078	C	T-RSL
Aroclor-1248	12672-29-6	0.0078	C	0.0079	C	0.0078	C	T-RSL
Aroclor-1254	11097-69-1	0.0078	C	0.0079	C	0.0078	C	T-RSL
Aroclor-1260	11096-82-5	0.0078	C	0.0079	C	0.0078	C	T-RSL
Aroclor-1262	37324-23-5	NC		NC		NC		None
Aroclor-1268	11100-14-4	NC		NC		NC		None

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Shaffer Equipment/Arbuckle Creek Area Site

Groundwater

Analyte	CAS Number	T-RSL[1]		WVDEP[2]		PSL[3]		PSL Reference
Dioxins/Furans (pg/L)								
2,3,7,8-TCDD	1746-01-6	0.12	C	30		0.12	C	T-RSL
1,2,3,7,8-PeCDD	40321-76-4	0.12	C[10]	30	[10]	0.12	C[10]	T-RSL
1,2,3,4,7,8-HxCDD	39227-28-6	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,6,7,8-HxCDD	57653-85-7	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,7,8,9-HxCDD	19408-74-3	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,4,6,7,8-HpCDD	35822-46-9	12	C[10]	3000	[10]	12	C[10]	T-RSL
OCDD	3268-87-9	400	C[10]	100000	[10]	400	C[10]	T-RSL
2,3,7,8-TCDF	51207-31-9	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,7,8-PeCDF	57117-41-6	4	C[10]	1000	[10]	4	C[10]	T-RSL
2,3,4,7,8-PeCDF	57117-31-4	0.4	C[10]	100	[10]	0.4	C[10]	T-RSL
1,2,3,4,7,8-HxCDF	70648-26-9	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,6,7,8-HxCDF	57117-44-9	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,7,8,9-HxCDF	72918-21-9	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
2,3,4,6,7,8-HxCDF	60851-34-5	1.2	C[10]	300	[10]	1.2	C[10]	T-RSL
1,2,3,4,6,7,8-HpCDF	67562-39-4	12	C[10]	3000	[10]	12	C[10]	T-RSL
1,2,3,4,7,8,9-HpCDF	55673-89-7	12	C[10]	3000	[10]	12	C[10]	T-RSL
OCDF	39001-02-0	400	C[10]	100000	[10]	400	C[10]	T-RSL
Inorganics (ug/L)								
Aluminum	7429-90-5	2,000	N	2000	N	2000	N	T-RSL/WVDEP
Antimony	7440-36-0	0.78	N	0.78	N	0.78	N	T-RSL/WVDEP
Arsenic	7440-38-2	0.052	C	10		0.052	C	T-RSL
Barium	7440-39-3	380	N	2000		380	N	T-RSL
Beryllium	7440-41-7	2.5	N	4		2.5	N	T-RSL
Cadmium	7440-43-9	0.92	N	5		0.92	N	T-RSL
Calcium	7440-70-2	NC		NC		NC		None
Chromium	7440-47-3	0.035	C[11]	0.035	C[11]	0.035	C[11]	T-RSL/WVDEP
Cobalt	7440-48-4	0.6	N	0.6	N	0.6	N	T-RSL/WVDEP
Copper	7440-50-8	80	N	80	N	80	N	T-RSL/WVDEP
Iron	7439-89-6	1,400	N	1400	N	1400	N	T-RSL/WVDEP
Lead	7439-92-1	15		15		15		T-RSL/WVDEP
Magnesium	7439-95-4	NC		NC		NC		None
Manganese	7439-96-5	43	N	85	N	43	N	T-RSL
Mercury	7439-97-6	0.063	N	2		0.063	N	T-RSL
Nickel	7440-02-0	39	N	39	N	39	N	T-RSL/WVDEP
Potassium	7440-09-7	NC		NC		NC		None
Selenium	7782-49-2	10	N	50		10	N	T-RSL
Silver	7440-22-4	9.4	N	9.4	N	9.4	N	T-RSL/WVDEP
Sodium	7440-23-5	NC		NC		NC		None
Thallium	7440-28-0	0.02	N	2		0.02	N	T-RSL
Vanadium	7440-62-2	8.6	N	0.12	N	0.12	N	WVDEP
Zinc	7440-66-6	600	N	600	N	600	N	T-RSL/WVDEP
Cyanide	57-12-5	0.15	N	200		0.15	N	T-RSL

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Tapwater (T-RSL), May 2019.
Target cancer risk = 1E-06 and target hazard quotient = 0.1.
2 - West Virginia Department of Environmental Protection (WVDEP) Voluntary Cleanup Standards De Minimus Table 60-3B, 2017.
Values are for groundwater. Target cancer risk = 1E-06 and target hazard quotient = 0.1 (noncancer values were divided by 10).
3 - The lower of USEPA T-RSLs and WVDEP criteria was selected as the project screening level (PSL).
4 - Value is for 1,3-dichloropropene.
4 - Value is for acenaphthene.
5 - Value is for pyrene
6 - Value is for chlordane.
7 - Value is for alpha-BHC.
8 - Value is for endosulfan.
9 - Value is for endrin.
10 - Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.
11 - Value is for hexavalent chromium.

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

Surface Water

Analyte	CAS Number	T-RSL x 10[1]		WVDEP WQS[2]	PSL[3]		PSL Reference
VOCs (ug/L)							
1,1,1-Trichloroethane	71-55-6	8000	N	12000	8,000	N	T-RSL
1,1,2,2-Tetrachloroethane	79-34-5	0.76	C	0.17	0.17		WVDEP
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	10000	N	NC	10000	N	T-RSL
1,1,2-Trichloroethane	79-00-5	0.41	N	NC	0.41	N	T-RSL
1,1-Dichloroethane	75-34-3	28	C	NC	28	C	T-RSL
1,1-Dichloroethene	75-35-4	280	N	0.03	0.03		WVDEP
1,2,3-Trichlorobenzene	87-61-6	7	N	NC	7	N	T-RSL
1,2,4-Trichlorobenzene	120-82-1	4	N	NC	4	N	T-RSL
1,2-Dibromo-3-chloropropane	96-12-8	0.0033	C	NC	0.0033	C	T-RSL
1,2-Dibromoethane	106-93-4	0.075	C	NC	0.075	C	T-RSL
1,2-Dichlorobenzene	95-50-1	300	N	2700	300	N	T-RSL
1,2-Dichloroethane	107-06-2	1.7	C	0.035	0.035		WVDEP
1,2-Dichloropropane	78-87-5	8.2	N	NC	8.2	N	T-RSL
1,3-Dichlorobenzene	541-73-1	NC		400	400		WVDEP
1,4-Dichlorobenzene	106-46-7	4.8	C	400	4.8	C	T-RSL
2-Butanone	78-93-3	5600	N	NC	5600	N	T-RSL
2-Hexanone	591-78-6	38	N	NC	38	N	T-RSL
4-Methyl-2-pentanone	108-10-1	6300	N	NC	6300	N	T-RSL
Acetone	67-64-1	14000	N	NC	14000	N	T-RSL
Benzene	71-43-2	4.6	C	0.66	0.66		WVDEP
Bromochloromethane	74-97-5	83	N	NC	83	N	T-RSL
Bromodichloromethane	75-27-4	1.3	C	0.55	0.55		WVDEP
Bromoform	75-25-2	33	C	4.3	4.3		WVDEP
Bromomethane	74-83-9	7.5	N	47	7.5	N	T-RSL
Carbon disulfide	75-15-0	810	N	NC	810	N	T-RSL
Carbon tetrachloride	56-23-5	4.6	C	0.25	0.25		WVDEP
Chlorobenzene	108-90-7	78	N	680	78	N	T-RSL
Chloroethane	75-00-3	21000	N	NC	21000	N	T-RSL
Chloroform	67-66-3	2.2	C	5.7	2.2	C	T-RSL
Chloromethane	74-87-3	190	N	NC	190	N	T-RSL
cis-1,2-Dichloroethene	156-59-2	36	N	0.035[4]	0.035	[4]	WVDEP
cis-1,3-Dichloropropene	10061-01-5	4.7	C[5]	NC	4.7	C[5]	T-RSL
Cyclohexane	110-82-7	13000	N	NC	13000	N	T-RSL
Dibromochloromethane	124-48-1	8.7	C	NC	8.7	C	T-RSL
Dichlorodifluoromethane	75-71-8	200	N	NC	200	N	T-RSL
Ethylbenzene	100-41-4	15	C	3100	15	C	T-RSL
Isopropylbenzene	98-82-8	450	N	NC	450	N	T-RSL
m,p-Xylenes	179601-23-1	190	N	NC	190	N	T-RSL
Methyl acetate	79-20-9	20000	N	NC	20000	N	T-RSL
Methyl cyclohexane	108-87-2	NC		NC	NC		None
Methylene chloride	75-09-2	110	N	4.6	4.6		WVDEP
Methyl-tert-butyl ether	1634-04-4	140	C	NC	140	C	T-RSL
o-Xylene	95-47-6	190	N	NC	190	N	T-RSL
Styrene	100-42-5	1200	N	NC	1200	N	T-RSL
Tetrachloroethene	127-18-4	41	N	0.8	0.8		WVDEP
Toluene	108-88-3	1100	N	6800	1100	N	T-RSL
trans-1,2-Dichloroethene	156-60-5	360	N	0.035[4]	0.035	[4]	WVDEP
trans-1,3-Dichloropropene	10061-02-6	4.7	C[5]	NC	4.7	C[5]	T-RSL
Trichloroethene	79-01-6	2.8	N	2.7	2.7		WVDEP
Trichlorofluoromethane	75-69-4	5200	N	NC	5200	N	T-RSL
Vinyl chloride	75-01-4	0.19	C	2	0.19	C	T-RSL
Xylenes (total)	1330-20-7	190	N	NC	190	N	T-RSL

SVOCs (ug/L)							
1,1-Biphenyl	92-52-4	0.83	N	NC	0.83	N	T-RSL
1,2,4,5-Tetrachlorobenzene	95-94-3	1.7	N	NC	1.7	N	T-RSL
1,4-Dioxane	123-91-1	4.6	C	NC	4.6	C	T-RSL
2,2'-Oxybis(1-chloropropane)	108-60-1	710	N	NC	710	N	T-RSL
2,3,4,6-Tetrachlorophenol	58-90-2	240	N	NC	240	N	T-RSL
2,4,5-Trichlorophenol	95-95-4	1200	N	NC	1200	N	T-RSL
2,4,6-Trichlorophenol	88-06-2	12	N	2.1	2.1		WVDEP
2,4-Dichlorophenol	120-83-2	46	N	93	46	N	T-RSL
2,4-Dimethylphenol	105-67-9	360	N	540	360	N	T-RSL
2,4-Dinitrophenol	51-28-5	39	N	70	39	N	T-RSL
2,4-Dinitrotoluene	121-14-2	2.4	C	NC	2.4	C	T-RSL
2,6-Dinitrotoluene	606-20-2	0.49	C	NC	0.49	C	T-RSL
2-Chloronaphthalene	91-58-7	750	N	1000	750	N	T-RSL
2-Chlorophenol	95-57-8	91	N	120	91	N	T-RSL
2-Methylphenol	95-48-7	930	N	NC	930	N	T-RSL
2-Nitroaniline	88-74-4	190	N	NC	190	N	T-RSL
2-Nitrophenol	88-75-5	NC		NC	NC		None
3,3'-Dichlorobenzidine	91-94-1	1.3	C	NC	1.3	C	T-RSL
3-Methylphenol	108-39-4	930	N	NC	930	N	T-RSL
3-Nitroaniline	99-09-2	NC		NC	NC		None
4,6-Dinitro-2-methylphenol	534-52-1	1.5	N	13.4	1.5	N	T-RSL
4-Bromophenyl phenyl ether	101-55-3	NC		NC	NC		None
4-Chloro-3-methylphenol	59-50-7	1400	N	NC	1400	N	T-RSL
4-Chloroanaline	106-47-8	3.7	C	NC	3.7	C	T-RSL
4-Chlorophenyl phenyl ether	7005-72-3	NC		NC	NC		None
4-Methylphenol	106-44-5	1900	N	NC	1900	N	T-RSL
4-Nitroaniline	100-01-6	38	C	NC	38	C	T-RSL
4-Nitrophenol	100-02-7	NC		NC	NC		None
Acetophenone	98-86-2	1900	N	NC	1900	N	T-RSL
Atrazine	1912-24-9	3	C	NC	3	C	T-RSL
Benzaldehyde	100-52-7	190	C	NC	190	C	T-RSL
Bis(2-chloroethoxy)methane	111-91-1	59	N	NC	59	N	T-RSL
Bis(2-chloroethyl)ether	111-44-4	0.14	C	NC	0.14	C	T-RSL
Bis(2-ethylhexyl)phthalate	117-81-7	56	C	NC	56	C	T-RSL
Butyl benzyl phthalate	85-68-7	160	C	NC	160	C	T-RSL
Caprolactam	105-60-2	9900	N	NC	9900	N	T-RSL
Carbazole	86-74-8	NC		NC	NC		None
Dibenzofuran	132-64-9	7.9	N	NC	7.9	N	T-RSL
Diethyl phthalate	84-66-2	15000	N	NC	15000	N	T-RSL
Dimethyl phthalate	131-11-3	NC		NC	NC		None
Di-n-butyl phthalate	84-74-2	900	N	NC	900	N	T-RSL
Di-n-octyl phthalate	117-84-0	200	N	C	200	N	T-RSL
Hexachlorobenzene	118-74-1	0.098	C	0.00072	0.00072		WVDEP
Hexachlorobutadiene	87-68-3	1.4	C	NC	1.4	C	T-RSL
Hexachlorocyclopentadiene	77-47-4	0.41	N	NC	0.41	N	T-RSL
Hexachloroethane	67-72-1	3.3	C	NC	3.3	C	T-RSL
Isophorone	78-59-1	780	C	NC	780	C	T-RSL
Nitrobenzene	98-95-3	1.4	C	NC	1.4	C	T-RSL
N-Nitrosodi-n-propylamine	621-64-7	0.11	C	NC	0.11	C	T-RSL
N-Nitrosodiphenylamine	86-30-6	120	C	NC	120	C	T-RSL
Phenol	108-95-2	5800	N	21000	5,800	N	T-RSL

PAHs and PCP (ug/L)							
2-Methylnaphthalene	91-57-6	36	N	NC	36	N	T-RSL
Acenaphthene	83-32-9	530	N	670	530	N	T-RSL
Acenaphthylene	208-96-8	530	N[6]	NC	530	N[6]	T-RSL
Anthracene	120-12-7	1800	N	8300	1800	N	T-RSL
Benzo(a)anthracene	56-55-3	0.3	C	0.0038	0.0038		WVDEP
Benzo(a)pyrene	50-32-8	0.25	C	0.0038	0.0038		WVDEP
Benzo(b)fluoranthene	205-99-2	2.5	C	0.0038	0.0038		WVDEP
Benzo(g,h,i)perylene	191-24-2	120	N[7]	NC	120	N[7]	T-RSL
Benzo(k)fluoranthene	207-08-9	25	C	0.0038	0.0038		WVDEP
Chrysene	218-01-9	250	C	0.0038	0.0038		WVDEP
Dibenzo(a,h)anthracene	53-70-3	0.25	C	0.0038	0.0038		WVDEP
Fluoranthene	206-44-0	800	N	300	300		WVDEP
Fluorene	86-73-7	290	N	1100	290	N	T-RSL
Indeno(1,2,3-c,d)pyrene	193-39-5	2.5	C	0.0038	0.0038		WVDEP
Naphthalene	91-20-3	1.7	C	NC	1.7	C	T-RSL
Phenanthrene	85-01-8	120	N[7]	NC	120	N[7]	T-RSL
Pyrene	129-00-0	120	N	830	120	N	T-RSL
Pentachlorophenol	87-86-5	0.41	C	0.28	0.28		WVDEP
Pesticides (ug/L)							
4,4'-DDD	72-54-8	0.063	N	NC	0.063	N	T-RSL
4,4'-DDE	72-55-9	0.46	C	NC	0.46	C	T-RSL
4,4'-DDT	50-29-3	2.3	C	0.000024	0.000024		WVDEP
Aldrin	309-00-2	0.0092	C	0.000071	0.000071		WVDEP
Alpha-BHC	319-84-6	0.072	C	0.0039	0.0039		WVDEP
beta-BHC	319-85-7	0.25	C	0.014	0.014		WVDEP
cis-Chlordane	5103-71-9	0.2	C[8]	0.00046[8]	0.00046	C[8]	WVDEP
delta-BHC	319-86-8	0.072	C[9]	0.0039[9]	0.0039	C[9]	WVDEP
Dieldrin	60-57-1	0.018	C	0.000071	0.000071		WVDEP
Endosulfan I	959-98-8	100	N[10]	NC	100	N[10]	T-RSL
Endosulfan II	33213-65-9	100	N[10]	NC	100	N[10]	T-RSL
Endosulfan sulfate	1031-07-8	110	N	NC	110	N	T-RSL
Endrin	72-20-8	2.3	N	0.0023	0.0023		WVDEP
Endrin aldehyde	7421-93-4	2.3	N[11]	0.0023[11]	0.0023	N[11]	WVDEP
Endrin ketone	53494-70-5	2.3	N[11]	0.0023[11]	0.0023	N[11]	WVDEP
gamma-BHC (Lindane)	58-89-9	0.42	C	0.019	0.019		WVDEP
Heptachlor	76-44-8	0.014	C	0.00021	0.00021		WVDEP
Heptachlor epoxide	1024-57-3	0.014	C	NC	0.014	C	T-RSL
Methoxychlor	72-43-5	37	N	0.03	0.03		WVDEP
Toxaphene	8001-35-2	0.71	C	0.00073	0.00073		WVDEP
trans-Chlordane	5103-74-2	0.2	C[8]	0.00046[6]	0.00046	C[8]	WVDEP
PCB Congeners (ug/L)							
PCB-8	34883-43-7	NC		NC	NC		None
PCB-18	37680-65-2	NC		NC	NC		None
PCB-28	7012-37-5	NC		NC	NC		None
PCB-44	41464-39-5	NC		NC	NC		None
PCB-52	35693-99-3	NC		NC	NC		None
PCB-66	32598-10-0	NC		NC	NC		None
PCB-77	32598-13-3	0.06	C	NC	0.06	C	T-RSL
PCB-81	70362-50-4	0.004	C	NC	0.004	C	T-RSL
PCB-101	37680-73-2	NC		NC	NC		None
PCB-105	32598-14-4	0.04	C	NC	0.04	C	T-RSL
PCB-114	74472-37-0	0.04	C	NC	0.04	C	T-RSL
PCB-118	31508-00-6	0.04	C	NC	0.04	C	T-RSL
PCB-123	65510-44-3	0.04	C	NC	0.04	C	T-RSL
PCB-126	57465-28-8	0.000012	C	NC	0.000012	C	T-RSL
PCB-128	38380-07-3	NC		NC	NC		None
PCB-138	35065-28-2	NC		NC	NC		None
PCB-153	35065-27-1	NC		NC	NC		None
PCB-156	38380-08-4	0.04	C	NC	0.04	C	T-RSL
PCB-157	69782-90-7	0.04	C	NC	0.04	C	T-RSL
PCB-167	52663-72-6	0.04	C	NC	0.04	C	T-RSL
PCB-169	32774-16-6	0.00004	C	NC	0.00004	C	T-RSL
PCB-170	35065-30-6	NC		NC	NC		None
PCB-180	35065-29-3	NC		NC	NC		None
PCB-187	52663-68-0	NC		NC	NC		None
PCB-189	39635-31-9	0.04	C	NC	0.04	C	T-RSL
PCB-195	52663-78-2	NC		NC	NC		None
PCB-206	40186-72-9	NC		NC	NC		None

Appendix J
Explanation and Justification of PSLs
Shaffer Equipment/Arbuckle Creek Area Site

PCB Aroclors (ug/L)							
Aroclor-1016	12674-11-2	1.4	N	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1221	11104-28-2	0.047	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1232	11141-16-5	0.047	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1242	53469-21-9	0.078	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1248	12672-29-6	0.078	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1254	11097-69-1	0.078	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1260	11096-82-5	0.078	C	0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1262	37324-23-5	NC		0.000044[12]	0.000044	[12]	WVDEP
Aroclor-1268	11100-14-4	NC		0.000044[12]	0.000044	[12]	WVDEP
Dioxions/Furans (pg/L)							
2,3,7,8-TCDD	1746-01-6	1.2	C	0.013	0.013		WVDEP
1,2,3,7,8-PeCDD	40321-76-4	1.2	C[13]	0.013[12]	0.013	C[13]	WVDEP
1,2,3,4,7,8-HxCDD	39227-28-6	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,6,7,8-HxCDD	57653-85-7	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,7,8,9-HxCDD	19408-74-3	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,4,6,7,8-HpCDD	35822-46-9	120	C[13]	1.3[12]	1.3	C[13]	WVDEP
OCDD	3268-87-9	4000	C[13]	43[12]	43	C[13]	WVDEP
2,3,7,8-TCDF	51207-31-9	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,7,8-PeCDF	57117-41-6	40	C[13]	0.43[12]	0.43	C[13]	WVDEP
2,3,4,7,8-PeCDF	57117-31-4	4	C[13]	0.043[12]	0.043	C[13]	WVDEP
1,2,3,4,7,8-HxCDF	70648-26-9	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,6,7,8-HxCDF	57117-44-9	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,7,8,9-HxCDF	72918-21-9	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
2,3,4,6,7,8-HxCDF	60851-34-5	12	C[13]	0.13[12]	0.13	C[13]	WVDEP
1,2,3,4,6,7,8-HpCDF	67562-39-4	120	C[13]	1.3[12]	1.3	C[13]	WVDEP
1,2,3,4,7,8,9-HpCDF	55673-89-7	120	C[13]	1.3[12]	1.3	C[13]	WVDEP
OCDF	39001-02-0	4000	C[13]	43[12]	43	C[13]	WVDEP
Inorganics (ug/L)							
Aluminum	7429-90-5	20000	N	NC	20000	N	T-RSL
Antimony	7440-36-0	7.8	N	NC	7.8	N	T-RSL
Arsenic	7440-38-2	0.52	C	10	0.52	C	T-RSL
Barium	7440-39-3	3800	N	1000	1,000		WVDEP
Beryllium	7440-41-7	25	N	4	4		WVDEP
Cadmium	7440-43-9	9.2	N	1	1		WVDEP
Calcium	7440-70-2	NC		NC	NC		None
Chromium	7440-47-3	0.35	C[14]	50	0.35	C[14]	T-RSL
Cobalt	7440-48-4	6	N	NC	6	N	T-RSL
Copper	7440-50-8	800	N	1000	800	N	T-RSL
Iron	7439-89-6	14000	N	1500	1,500		WVDEP
Lead	7439-92-1	15		50	15		T-RSL
Magnesium	7439-95-4	NC		NC	NC		None
Manganese	7439-96-5	430	N	1000	430	N	T-RSL
Mercury	7439-97-6	0.63	N	0.14	0.14		WVDEP
Nickel	7440-02-0	390	N	510	390	N	T-RSL
Potassium	7440-09-7	NC		NC	NC		None
Selenium	7782-49-2	100	N	50	50		WVDEP
Silver	7440-22-4	94	N	1	1		WVDEP
Sodium	7440-23-5	NC		NC	NC		None
Thallium	7440-28-0	0.2	N	1.7	0.2	N	T-RSL
Vanadium	7440-62-2	86	N	NC	86	N	T-RSL
Zinc	7440-66-6	6000	N	NC	6,000	N	T-RSL
Cyanide	57-12-5	1.5	N	5	1.5	N	T-RSL

1 - United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) for Tapwater (T-RSL), May 2019, multiplied by a factor of 10 to account for anticipated reduced exposure to surface water. Before the factor is applied, the target cancer risk = 1E-06 and target hazard quotient = 0.1.
2 - WVDEP Water Quality Standards (WQS) for Human Health (Acute), 47CSR2 Appendix E, Table 1, (WVDEP, 2016).
3 - The lower of the adjusted USEPA T-RSLs and WVDEP WQS criteria was selected as the project screening level (PSL).
4 - The value is for 1,2-dichloroethane.
5 - The value is for 1,3-dichloropropene.
6 - The value is for acenaphthene.
7 - The value is for pyrene.
8 - The value is for chlordane.
9 - The value is for alpha-BHC.
10 - Value is for endosulfan.
11 - The value is for endrin.
12 - Value is for total PCBs.
13 - Value is derived by dividing criteria for 2,3,7,8-TCDD by World Health Organization Toxicity Equivalent Factor.
14 - The value is for hexavalent chromium.

Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (mg/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
1,1,1-Trichloroethane	71-55-6	0.04	0.04	NC	260	Region 4	Region 4	None	LANL
1,1,2,2-Tetrachloroethane	79-34-5	0.127	0.19	NC	0.127	Region 4	Region 4	None	Region 4
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NC	NC	NC	NC	None	None	None	None
1,1,2-Trichloroethane	79-00-5	0.32	0 32	NC	28.6	Region 4	Region 4	None	Region 4
1,1-Dichloroethane	75-34-3	0.14	0.14	NC	210	Region 4	Region 4	None	LANL
1,1-Dichloroethene	75-35-4	0.04	0.04	NC	11	Region 4	Region 4	None	LANL
1,2,3-Trichlorobenzene	87-61-6	20	20	NC	NC	Region 4	ORNL	None	None
1,2,4-Trichlorobenzene	120-82-1	0.27	1.2	NC	0.27	Region 4	LANL	None	LANL
1,2-Dibromo-3-chloropropane	96-12-8	NC	NC	NC	NC	None	None	None	None
1,2-Dibromoethane	106-93-4	NC	NC	NC	1.23	None	None	None	Region 5
1,2-Dichlorobenzene	95-50-1	0.09	0.09	NC	0.92	Region 4	Region 4	None	LANL
1,2-Dichloroethane	107-06-2	0.4	0.4	0.85	27	Region 4	Region 4	LANL	LANL
1,2-Dichloropropane	78-87-5	0.28	700	NC	32.7	Region 4	ORNL	None	Region 4
1,3-Dichlorobenzene	541-73-1	0.08	0.08	NC	0.74	Region 4	Region 4	None	LANL
1,4-Dichlorobenzene	106-46-7	0.88	1.2	NC	0.89	Region 4	LANL	None	LANL
2-Butanone	78-93-3	1	1	NC	350	Region 4	Region 4	None	LANL
2-Hexanone	591-78-6	0.36	2.5	0.36	5.4	Region 4	Region 4	LANL	LANL
4-Methyl-2-pentanone	108-10-1	NC	NC	NC	9.7	None	None	None	LANL
Acetone	67-64-1	1.2	0.04	7.5	1.2	Region 4	Region 4	LANL	LANL
Benzene	71-43-2	0.12	0.12	NC	24	Region 4	Region 4	None	LANL
Bromochloromethane	74-97-5	NC	NC	NC	NC	None	None	None	None
Bromodichloromethane	75-27-4	NC	NC	NC	0.54	None	None	None	Region 5
Bromoform	75-25-2	0.07	0.07	NC	15.9	Region 4	Region 4	None	Region 4
Bromomethane	74-83-9	0 002	0 002	NC	0.24	Region 4	Region 4	None	Region 4
Carbon disulfide	75-15-0	0 005	0 005	NC	0.81	Region 4	Region 4	None	LANL
Carbon tetrachloride	56-23-5	0.05	1000	NC	2.98	Region 4	ORNL	None	Region 4
Chlorobenzene	108-90-7	2.4	2.4	NC	43	Region 4	LANL	None	LANL
Chloroethane	75-00-3	NC	NC	NC	NC	None	None	None	None
Chloroform	67-66-3	0.05	0.05	NC	8	Region 4	Region 4	None	LANL
Chloromethane	74-87-3	NC	NC	NC	10.4	None	None	None	Region 5
cis-1,2-Dichloroethene	156-59-2	0.04	0.04	NC	NC	Region 4	Region 4	None	None
cis-1,3-Dichloropropene	10061-01-5	NC	NC	NC	NC	None	None	None	None
Cyclohexane	110-82-7	NC	NC	NC	NC	None	None	None	None
Dibromochloromethane	124-48-1	NC	NC	NC	2.05	None	None	None	Region 5
Dichlorodifluoromethane	75-71-8	NC	NC	NC	39 5	None	None	None	Region 5
Ethylbenzene	100-41-4	0.27	0.27	NC	5.16	Region 4	Region 4	None	Region 4
Isopropylbenzene	98-82-8	0.04	0.04	NC	NC	Region 4	Region 4	None	None
m,p-Xylenes	179601-23-1	100	0.1	41	1.4	LANL	Region 4	LANL	LANL
Methyl acetate	79-20-9	NC	NC	NC	NC	None	None	None	None
Methyl cyclohexane	108-87-2	NC	NC	NC	NC	None	None	None	None
Methylene chloride	75-09-2	1600	NC	NC	2.6	LANL	None	None	LANL
Methyl-tert-butyl ether	1634-04-4	NC	NC	NC	NC	None	None	None	None
o-Xylene	95-47-6	NC	NC	NC	NC	None	None	None	None
Styrene	100-42-5	3.2	1.2	NC	4.69	LANL	LANL	None	Region 5
Tetrachloroethene	127-18-4	10	0.06	NC	0.18	LANL	Region 4	None	LANL
Toluene	108-88-3	200	0.15	NC	23	LANL	Region 4	None	LANL
trans-1,2-Dichloroethene	156-60-5	0.04	0 04	NC	0.784	Region 4	Region 4	None	Region 4
trans-1,3-Dichloropropene	10061-02-6	NC	NC	NC	NC	None	None	None	None
Trichloroethene	79-01-6	NC	0.06	NC	42	None	Region 4	None	LANL
Trichlorofluoromethane	75-69-4	NC	NC	NC	52	None	None	None	LANL
Vinyl chloride	75-01-4	NC	0.03	NC	0.12	None	Region 4	None	LANL
Xylenes (total)	1330-20-7	100	0.1	41	1.4	LANL	Region 4	LANL	LANL

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Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (mg/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
1,1-Biphenyl	92-52-4	60	0.2	NC	NC	Region 4	Region 4	None	None
1,2,4,5-Tetrachlorobenzene	95-94-3	NC	0.18	NC	2.02	None	Region 4	None	Region 5
1,4-Dioxane[3]	123-91-1	NC	NC	NC	2.05	None	None	None	Region 5
2,2'-Oxybis(1-chloropropane)	108-60-1	NC	NC	NC	19.9	None	None	None	Region 5
2,3,4,6-Tetrachlorophenol	58-90-2	NC	0.04	NC	0 2	None	Region 4	None	Region 4
2,4,5-Trichlorophenol	95-95-4	4	9	NC	14.1	ORNL	ORNL	None	Region 4
2,4,6-Trichlorophenol	88-06-2	NC	10	NC	NC	None	ORNL	None	None
2,4-Dichlorophenol	120-83-2	NC	0.05	NC	87.5	None	Region 4	None	Region 4
2,4-Dimethylphenol	105-67-9	0.01	0.04	NC	NC	Region 5	Region 4	None	None
2,4-Dinitrophenol	51-28-5	20	0.15	NC	0.061	ORNL	Region 4	None	Region 4
2,4-Dinitrotoluene	121-14-2	6	18	NC	14	LANL	LANL	None	LANL
2,6-Dinitrotoluene	606-20-2	NC	30	52	4	None	LANL	LANL	LANL
2-Chloronaphthalene	91-58-7	NC	NC	NC	0 0122	None	None	None	Region 5
2-Chlorophenol	95-57-8	NC	0.06	0.39	0.54	None	Region 4	LANL	LANL
2-Methylphenol	95-48-7	0.67	0.1	NC	580	LANL	Region 4	None	LANL
2-Nitroaniline	88-74-4	NC	0.02	NC	5 3	None	Region 4	None	LANL
2-Nitrophenol	88-75-5	NC	NC	NC	1.6	None	None	None	Region 5
3,3'-Dichlorobenzidine	91-94-1	NC	0.03	NC	0.646	None	Region 4	None	Region 4
3-Methylphenol	108-39-4	0.69	0.09	NC	3.49	LANL	Region 4	None	Region 4
3-Nitroaniline	99-09-2	NC	NC	NC	3.16	None	None	None	Region 5
4,6-Dinitro-2-methylphenol	534-52-1	NC	NC	NC	0.144	None	None	None	Region 5
4-Bromophenyl phenyl ether	101-55-3	NC	NC	NC	NC	None	None	None	None
4-Chloro-3-methylphenol	59-50-7	NC	NC	NC	7.95	None	None	None	Region 5
4-Chloroanaline	106-47-8	1	1.8	NC	1.1	LANL	LANL	None	Region 5
4-Chlorophenyl phenyl ether	7005-72-3	NC	NC	NC	NC	None	None	None	None
4-Methylphenol	106-44-5	NC	0.08	NC	163	None	Region 4	None	Region 4
4-Nitroaniline	100-01-6	NC	NC	NC	21.9	None	None	None	Region 5
4-Nitrophenol	100-02-7	NC	7	NC	5.12	None	ORNL	None	Region 4
Acetophenone	98-86-2	NC	NC	NC	300	None	None	None	Region 5
Atrazine	1912-24-9	NC	0.00005	NC	NC	None	Region 4	None	None
Benzaldehyde	100-52-7	NC	NC	NC	NC	None	None	None	None
Bis(2-chloroethoxy)methane	111-91-1	NC	NC	NC	0.302	None	None	None	Region 5
Bis(2-chloroethyl)ether	111-44-4	NC	NC	NC	23.7	None	None	None	Region 5
Bis(2-ethylhexyl)phthalate	117-81-7	NC	8.4	0.02	0.6	None	Region 4	LANL	LANL
Butyl benzyl phthalate	85-68-7	NC	0.59	NC	90	None	Region 4	None	LANL
Caprolactam	105-60-2	NC	NC	NC	NC	None	None	None	None
Carbazole	86-74-8	NC	0.07	NC	79	None	Region 4	None	LANL
Dibenzofuran	132-64-9	6.1	0.15	NC	NC	LANL	Region 4	None	None
Diethyl phthalate	84-66-2	100	0.25	NC	3600	LANL	Region 4	None	LANL
Dimethyl phthalate	131-11-3	NC	10	NC	38	None	LANL	None	LANL
Di-n-butyl phthalate	84-74-2	160	0.22	0.011	180	LANL	Region 4	LANL	LANL
Di-n-octyl phthalate	117-84-0	NC	303	NC	0.91	None	Region 4	None	LANL
Hexachlorobenzene	118-74-1	10	10	0.079	0 2	LANL	LANL	LANL	LANL
Hexachlorobutadiene	87-68-3	NC	0 009	NC	0.04	None	Region 4	None	Region 4
Hexachlorocyclopentadiene	77-47-4	10	0 001	NC	0.755	ORNL	Region 4	None	Region 4
Hexachloroethane	67-72-1	NC	0 024	NC	0.596	None	Region 4	None	Region 5
Isophorone	78-59-1	NC	NC	NC	139	None	None	None	Region 5
Nitrobenzene	98-95-3	NC	2 2	NC	4 8	None	LANL	None	LANL
N-Nitrosodi-n-propylamine	621-64-7	NC	NC	NC	0.544	None	None	None	Region 5
N-Nitrosodiphenylamine	86-30-6	NC	20	NC	0.545	None	ORNL	None	Region 4
Phenol	108-95-2	0.79	1.8	NC	37	LANL	LANL	None	LANL
PAHs and PCP[4]									
2-Methylnaphthalene	91-57-6	NC	29	NC	100	None	Eco SSL	None	Eco SSL
Acenaphthene	83-32-9	0.25	29	NC	100	LANL	Eco SSL	None	Eco SSL
Acenaphthylene	208-96-8	NC	29	NC	100	None	Eco SSL	None	Eco SSL
Anthracene	120-12-7	6 8	29	NC	100	LANL	Eco SSL	None	Eco SSL
Benzo(a)anthracene	56-55-3	18	18	0.73	1.1	LANL	Eco SSL	LANL	Eco SSL
Benzo(a)pyrene	50-32-8	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Benzo(b)fluoranthene	205-99-2	18	18	NC	1.1	LANL	Eco SSL	None	Eco SSL
Benzo(g,h,i)perylene	191-24-2	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Benzo(k)fluoranthene	207-08-9	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Chrysene	218-01-9	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Dibenzo(a,h)anthracene	53-70-3	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Fluoranthene	206-44-0	NC	29	NC	100	None	Eco SSL	None	Eco SSL
Fluorene	86-73-7	NC	29	NC	100	None	Eco SSL	None	Eco SSL
Indeno(1,2,3-c,d)pyrene	193-39-5	NC	18	NC	1.1	None	Eco SSL	None	Eco SSL
Naphthalene	91-20-3	1	29	3.4	100	LANL	Eco SSL	LANL	Eco SSL
Phenanthrene	85-01-8	NC	29	NC	100	None	Eco SSL	None	Eco SSL
Pyrene	129-00-0	NC	18	33	1.1	None	Eco SSL	LANL	Eco SSL
Pentachlorophenol	87-86-5	5	31	2.1	2 8	Eco SSL	Eco SSL	Eco SSL	Eco SSL

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Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (mg/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
4,4'-DDD	72-54-8	NC	NC	0.093	0.021	None	None	Eco SSL	Eco SSL
4,4'-DDE	72-55-9	NC	NC	0.093	0.021	None	None	Eco SSL	Eco SSL
4,4'-DDT	50-29-3	4.1	NC	0.093	0.021	LANL	None	Eco SSL	Eco SSL
Aldrin	309-00-2	0.0033	0.03	NC	0.037	Region 5	Region 4	None	LANL
Alpha-BHC	319-84-6	NC	0.0003	NC	59	None	Region 4	None	LANL
beta-BHC	319-85-7	0.004	0.0003	14	0.27	Region 5	Region 4	LANL	LANL
cis-Chlordane	5103-71-9	2.2	0.0029	0.27	0.27	LANL	Region 4	LANL	LANL
delta-BHC	319-86-8	NC	NC	NC	9.94	None	None	None	Region 5
Dieldrin	60-57-1	10	0.0029	0.022	0.0049	LANL	Region 4	Eco SSL	Eco SSL
Endosulfan I	959-98-8	NC	0.0009	NC	0.119	None	Region 4	None	Region 4
Endosulfan II	33213-65-9	NC	0.0009	NC	0.119	None	Region 4	None	Region 5
Endosulfan sulfate	1031-07-8	NC	0.0007	NC	0.036	None	Region 4	None	Region 4
Endrin	72-20-8	0.0034	0.0019	0.0014	0.023	LANL	Region 4	LANL	LANL
Endrin aldehyde	7421-93-4	NC	NC	NC	0.0105	None	None	None	Region 5
Endrin ketone	53494-70-5	NC	NC	NC	NC	None	None	None	None
gamma-BHC (Lindane)	58-89-9	0.1	0.0031	0.21	0.0095	LANL	Region 4	LANL	LANL
Heptachlor	76-44-8	0.4	0.0016	0.3	0.059	LANL	Region 4	LANL	LANL
Heptachlor epoxide	1024-57-3	NC	0.00015	NC	0.152	None	Region 4	None	Region 4
Methoxychlor	72-43-5	NC	0.0021	18	5.1	None	Region 4	LANL	LANL
Toxaphene	8001-35-2	NC	0.00015	4.1	5.9	None	Region 4	LANL	LANL
trans-Chlordane	5103-74-2	2.2	NC	2.2	2.3	LANL	None	LANL	LANL

1 - Surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003).

Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (mg/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
PCB-8	34883-43-7	NC	NC	NC	NC	None	None	None	None
PCB-18	37680-65-2	NC	NC	NC	NC	None	None	None	None
PCB-28	7012-37-5	NC	NC	NC	NC	None	None	None	None
PCB-44	41464-39-5	NC	NC	NC	NC	None	None	None	None
PCB-52	35693-99-3	NC	NC	NC	NC	None	None	None	None
PCB-66	32598-10-0	NC	NC	NC	NC	None	None	None	None
PCB-77(1)	32598-13-3	NC	NC	0.00032	0.0029	None	None	Region 4	LANL
PCB-81(1)	70362-50-4	NC	NC	0.00016	0.00097	None	None	Region 4	LANL
PCB-101	37680-73-2	NC	NC	NC	NC	None	None	None	None
PCB-105(1)	32598-14-4	NC	NC	0.16	0.0097	None	None	Region 4	LANL
PCB-114(1)	74472-37-0	NC	NC	0.16	0.0097	None	None	Region 4	LANL
PCB-118(1)	31508-00-6	NC	NC	1.6	0.0097	None	None	Region 4	LANL
PCB-123(1)	65510-44-3	NC	NC	1.6	0.0097	None	None	Region 4	LANL
PCB-126(1)	57465-28-8	NC	NC	0.00016	0.0000029	None	None	Region 4	LANL
PCB-128	38380-07-3	NC	NC	NC	NC	None	None	None	None
PCB-138	35065-28-2	NC	NC	NC	NC	None	None	None	None
PCB-153	35065-27-1	NC	NC	NC	NC	None	None	None	None
PCB-156(1)	38380-08-4	NC	NC	0.16	0.0097	None	None	Region 4	LANL
PCB-157(1)	69782-90-7	NC	NC	0.16	0.0097	None	None	Region 4	LANL
PCB-167(1)	52663-72-6	NC	NC	1.6	0.0097	None	None	Region 4	LANL
PCB-169(1)	32774-16-6	NC	NC	0.016	9.70E-06	None	None	Region 4	LANL
PCB-170	35065-30-6	NC	NC	NC	NC	None	None	None	None
PCB-180	35065-29-3	NC	NC	NC	NC	None	None	None	None
PCB-187	52663-68-0	NC	NC	NC	NC	None	None	None	None
PCB-189(1)	39635-31-9	NC	NC	1.6	0.0097	None	None	Region 4	LANL
PCB-195	52663-78-2	NC	NC	NC	NC	None	None	None	None
PCB-206	40186-72-9	NC	NC	NC	NC	None	None	None	None
Aroclor-1016	12674-11-2	40	0.33	0.041	1.1	ORNL(3)	Region 4(3)	Region 4(3)	LANL
Aroclor-1221	11104-28-2	40	0.33	0.041	0.371	ORNL(3)	Region 4(3)	Region 4(3)	Region 4(3)
Aroclor-1232	11141-16-5	40	0.33	0.041	0.371	ORNL(3)	Region 4(3)	Region 4(3)	Region 4(3)
Aroclor-1242	53469-21-9	40	0.33	0.041	0.39	ORNL(3)	Region 4(3)	LANL	LANL
Aroclor-1248	12672-29-6	40	0.33	0.041	0.0073	ORNL(3)	Region 4(3)	LANL	LANL
Aroclor-1254	11097-69-1	160	0.33	0.041	0.45	LANL	Region 4(3)	LANL	LANL
Aroclor-1260	11096-82-5	40	0.33	0.88	10	ORNL(3)	Region 4(3)	LANL	LANL
Aroclor-1262	37324-23-5	40	0.33	0.041	0.371	ORNL(3)	Region 4(3)	Region 4(3)	Region 4(3)
Aroclor-1268	11100-14-4	40	0.33	0.041	0.371	ORNL(3)	Region 4(3)	Region 4(3)	Region 4(3)
Total PCBs(2)	NA	40	0.33	0.041	0.371	ORNL	Region 4	Region 4	Region 4

1 - Screening levels for dioxin-like congeners are calculated based on toxicity equivalence factor to 2,3,7,8-TCDD (USEPA, 2008).

2 - Results for the sum of 18 NOAA congeners multiplied by two will compared to the screening level for total PCBs.

3 - Value for total PCBs.

Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (ng/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
2,3,7,8-TCDD	1746-01-6	NC	5	16	0.29	None	LANL	Region 4	LANL
1,2,3,7,8-PeCDD	40321-76-4	NC	NC	16	0.29	None	LANL	None	LANL
1,2,3,4,7,8-HxCDD	39227-28-6	NC	NC	320	2.9	None	LANL	None	LANL
1,2,3,6,7,8-HxCDD	57653-85-7	NC	NC	1600	2.9	None	LANL	None	LANL
1,2,3,7,8,9-HxCDD	19408-74-3	NC	NC	160	2.9	None	LANL	None	LANL
1,2,3,4,6,7,8-HpCDD	35822-46-9	NC	NC	16000	29	None	LANL	None	LANL
OCDD	3268-87-9	NC	NC	160000	967	None	LANL	None	LANL
2,3,7,8-TCDF	51207-31-9	NC	NC	16	2.9	None	LANL	None	LANL
1,2,3,7,8-PeCDF	57117-41-6	NC	NC	160	9.7	None	LANL	None	LANL
2,3,4,7,8-PeCDF	57117-31-4	NC	NC	16	0.97	None	LANL	None	LANL
1,2,3,4,7,8-HxCDF	70648-26-9	NC	NC	160	2.9	None	LANL	None	LANL
1,2,3,6,7,8-HxCDF	57117-44-9	NC	NC	160	2.9	None	LANL	None	LANL
1,2,3,7,8,9-HxCDF	72918-21-9	NC	NC	160	2.9	None	LANL	None	LANL
2,3,4,6,7,8-HxCDF	60851-34-5	NC	NC	160	2.9	None	LANL	None	LANL
1,2,3,4,6,7,8-HpCDF	67562-39-4	NC	NC	1600	29	None	LANL	None	LANL
1,2,3,4,7,8,9-HpCDF	55673-89-7	NC	NC	1600	29	None	LANL	None	LANL
OCDF	39001-02-0	NC	NC	160000	967	None	LANL	None	LANL

1 - Surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003).

Appendix J
Ecological Soil Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	PSL (mg/kg)				PSL Reference[1]			
		ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)	ERA (plant)	ERA (invert)	ERA (avian)	ERA (mammal)
Aluminum	7429-90-5	pH>5.5[(2)]	pH>5.5[(2)]	NC	NC	Eco SSL	Eco SSL	None	None
Antimony	7440-36-0	11	78	NC	0.27	LANL	Eco SSL	None	Eco SSL
Arsenic	7440-38-2	18	6.8	43	46	Eco SSL	LANL	Eco SSL	Eco SSL
Barium	7440-39-3	110	330	720	2000	LANL	Eco SSL	LANL	Eco SSL
Beryllium	7440-41-7	2.5	40	NC	21	LANL	Eco SSL	None	Eco SSL
Cadmium	7440-43-9	32	140	0.77	0.36	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Calcium	7440-70-2	NC	NC	NC	NC	None	None	None	None
Chromium	7440-47-3	0.35	0.34	26	34	LANL	LANL	Eco SSL	Eco SSL
Cobalt	7440-48-4	13	1000	120	230	Eco SSL	ORNL	Eco SSL	Eco SSL
Copper	7440-50-8	70	80	28	49	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Iron	7439-89-6	5<pH>8[(3)]	200	NC	NC	Eco SSL	ORNL	None	None
Lead	7439-92-1	120	1700	11	56	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Magnesium	7439-95-4	NC	NC	NC	NC	None	None	None	None
Manganese	7439-96-5	220	450	4300	4000	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Mercury	7439-97-6	34	0.05	0.013	1.7	LANL	LANL	LANL	LANL
Nickel	7440-02-0	38	280	210	130	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Potassium	9/7/7440	NC	NC	NC	NC	None	None	None	None
Selenium	7782-49-2	0.52	4.1	1.2	0.63	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Silver	7440-22-4	560	50	4.2	14	Eco SSL	ORNL	Eco SSL	Eco SSL
Sodium	7440-23-5	NC	NC	NC	NC	None	None	None	None
Thallium	7440-28-0	0.05	NC	4.5	0.42	LANL	None	LANL	LANL
Vanadium	7440-62-2	60	20	7.8	280	LANL	ORNL	Eco SSL	Eco SSL
Zinc	7440-66-6	160	120	46	79	Eco SSL	Eco SSL	Eco SSL	Eco SSL
Cyanide	57-12-5	NC	NC	0.098	330	None	None	LANL	LANL

1 - Surface soil screening are the following, in order of preference: Eco-SSL – Ecological Soil Screening Levels (USEPA, 2005); LANL – LANL Ecological Screening Values (LANL, 2017) ORNL – Lowest appropriate value from the ORNL Soil Values (Efroymson, 1997a-b); Region 4 Soil Screening Levels (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003).

2 - Aluminum is considered a COPC only when the soil pH is less than 5.5.

3 - Iron is not expected to be toxic to plants with a soil pH between 5 and 8.

Appendix J
Ecological Surface Water Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Surface Water

Analyte	CAS Number	R3 BTAG	WV WQS	PSL[(1)]	PSL Reference
VOCs (ug/L)					
1,1,1-Trichloroethane	71-55-6	11	NC	11	R3 BTAG SW
1,1,2,2-Tetrachloroethane	79-34-5	610	NC	610	R3 BTAG SW
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	NC	NC	NC	NC
1,1,2-Trichloroethane	79-00-5	1200	NC	1200	R3 BTAG SW
1,1-Dichloroethane	75-34-3	47	NC	47	R3 BTAG SW
1,1-Dichloroethene	75-35-4	25	NC	25	R3 BTAG SW
1,2,3-Trichlorobenzene	87-61-6	8	NC	8	R3 BTAG SW
1,2,4-Trichlorobenzene	120-82-1	24	NC	24	R3 BTAG SW
1,2-Dibromo-3-chloropropane	96-12-8	NC	NC	NC	NC
1,2-Dibromoethane	106-93-4	NC	NC	NC	NC
1,2-Dichlorobenzene	95-50-1	0.7	NC	0.7	R3 BTAG SW
1,2-Dichloroethane	107-06-2	100	NC	100	R3 BTAG SW
1,2-Dichloropropane	78-87-5	NC	NC	520	R4
1,3-Dichlorobenzene	541-73-1	150	NC	150	R3 BTAG SW
1,4-Dichlorobenzene	106-46-7	26	NC	26	R3 BTAG SW
2-Butanone	78-93-3	14,000	NC	14,000	R3 BTAG SW
2-Hexanone	591-78-6	99	NC	99	R3 BTAG SW
4-Methyl-2-pentanone	108-10-1	170	NC	170	R3 BTAG SW
Acetone	67-64-1	1,500	NC	1,500	R3 BTAG SW
Benzene	71-43-2	370	NC	370	R3 BTAG SW
Bromochloromethane	74-97-5	NC	NC	NC	NC
Bromodichloromethane	75-27-4	NC	NC	340	R4
Bromoform	75-25-2	320	NC	320	R3 BTAG SW
Bromomethane	74-83-9	NC	NC	16	R4
Carbon disulfide	75-15-0	0.92	NC	0.92	R3 BTAG SW
Carbon tetrachloride	56-23-5	13.3	NC	13.3	R3 BTAG SW
Chlorobenzene	108-90-7	1.3	NC	1.3	R3 BTAG SW
Chloroethane	75-00-3	NC	NC	NC	NC
Chloroform	67-66-3	1.8	NC	1.8	R3 BTAG SW
Chloromethane	74-87-3	NC	NC	NC	NC
cis-1,2-Dichloroethene	156-59-2	NC	NC	590	ORNL
cis-1,3-Dichloropropene	10061-01-5	0.055	NC	0.055	R3 BTAG SW
Cyclohexane	110-82-7	NC	NC	158	R4
Dibromochloromethane	124-48-1	NC	NC	320	R4
Dichlorodifluoromethane	75-71-8	NC	NC	NC	NC
Ethylbenzene	100-41-4	90	NC	90	R3 BTAG SW
Isopropylbenzene	98-82-8	2.6	NC	2.6	R3 BTAG SW
m,p-Xylenes	179601-23-1	13	NC	13	R3 BTAG SW
Methyl acetate	79-20-9	NC	NC	NC	NC
Methyl cyclohexane	108-87-2	NC	NC	52	R4
Methylene chloride	75-09-2	98.1	NC	98.1	R3 BTAG SW
Methyl-tert-butyl ether	1634-04-4	11,070	NC	11,070	R3 BTAG SW
o-Xylene	95-47-6	NC	NC	NC	NC
Styrene	100-42-5	72	NC	72	R3 BTAG SW
Tetrachloroethene	127-18-4	111	NC	111	R3 BTAG SW
Toluene	108-88-3	2	NC	2	R3 BTAG SW
trans-1,2-Dichloroethene	156-60-5	970	NC	970	R3 BTAG SW
trans-1,3-Dichloropropene	10061-02-6	0.055	NC	0.055	R3 BTAG SW
Trichloroethene	79-01-6	21	NC	21	R3 BTAG SW
Trichlorofluoromethane	75-69-4	NC	NC	NC	NC
Vinyl chloride	75-01-4	930	NC	930	R3 BTAG SW
Xylenes (total)	1330-20-7	13	NC	13	R3 BTAG SW
SVOCs (ug/L)					
1,1-Biphenyl	92-52-4	14	NC	14	R3 BTAG SW
1,2,4,5-Tetrachlorobenzene	95-94-3	3	NC	3	R3 BTAG SW
1,4-Dioxane	123-91-1	NC	NC	22,000	R5
2,2'-Oxybis(1-chloropropane)	108-60-1	NC	NC	NC	None
2,3,4,6-Tetrachlorophenol	58-90-2	1.2	NC	1.2	R3 BTAG SW
2,4,5-Trichlorophenol	95-95-4	NC	NC	1.9	R4
2,4,6-Trichlorophenol	88-06-2	4.9	NC	4.9	R3 BTAG SW
2,4-Dichlorophenol	120-83-2	11	NC	11	R3 BTAG SW

Appendix J
Ecological Surface Water Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	**CAS Number**	R3 BTAG	WV WQS	PSL[(1)]	PSL Reference
2,4-Dimethylphenol	105-67-9	NC	NC	15	R4
2,4-Dinitrophenol	51-28-5	NC	NC	71	R4
2,4-Dinitrotoluene	121-14-2	44	NC	44	R3 BTAG SW
2,6-Dinitrotoluene	606-20-2	81	NC	81	R3 BTAG SW
2-Chloronaphthalene	91-58-7	NC	NC	0.396	R5
2-Chlorophenol	95-57-8	24	NC	24	R3 BTAG SW
2-Methylphenol	95-48-7	13	NC	13	R3 BTAG SW
2-Nitroaniline	88-74-4	NC	NC	NC	None
2-Nitrophenol	88-75-5	1920	NC	1920	R3 BTAG SW
3,3'-Dichlorobenzidine	91-94-1	4.5	NC	4.5	R3 BTAG SW
3-Methylphenol	108-39-4	NC	NC	NC	None
3-Nitroaniline	99-09-2	NC	NC	NC	None
4,6-Dinitro-2-methylphenol	534-52-1	NC	NC	23	R5
4-Bromophenyl phenyl ether	101-55-3	1.5	NC	1.5	R3 BTAG SW
4-Chloro-3-methylphenol	59-50-7	NC	NC	1	R4
4-Chloroanaline	106-47-8	232	NC	232	R3 BTAG SW
4-Chlorophenyl phenyl ether	7005-72-3	NC	NC	NC	None
4-Methylphenol	106-44-5	543	NC	543	R3 BTAG SW
4-Nitroaniline	100-01-6	NC	NC	NC	None
4-Nitrophenol	100-02-7	60	NC	60	R3 BTAG SW
Acetophenone	98-86-2	NC	NC	NC	None
Atrazine	1912-24-9	1.8	NC	1.8	R3 BTAG SW
Benzaldehyde	100-52-7	NC	NC	143	R4
Bis(2-chloroethoxy)methane	111-91-1	NC	NC	NC	None
Bis(2-chloroethyl)ether	111-44-4	NC	NC	1900	R5
Bis(2-ethylhexyl)phthalate	117-81-7	16	NC	16	R3 BTAG SW
Butyl benzyl phthalate	85-68-7	19	NC	19	R3 BTAG SW
Caprolactam	105-60-2	NC	NC	NC	None
Carbazole	86-74-8	NC	NC	NC	None
Dibenzofuran	132-64-9	3.7	NC	3.7	R3 BTAG SW
Diethyl phthalate	84-66-2	210	NC	210	R3 BTAG SW
Dimethyl phthalate	131-11-3	NC	NC	3	LANL
Di-n-butyl phthalate	84-74-2	19	NC	19	R3 BTAG SW
Di-n-octyl phthalate	117-84-0	22	NC	22	R3 BTAG SW
Hexachlorobenzene	118-74-1	0.0003	NC	0.0003	R3 BTAG SW
Hexachlorobutadiene	87-68-3	1.3	NC	1.3	R3 BTAG SW
Hexachlorocyclopentadiene	77-47-4	NC	NC	0.45	R4
Hexachloroethane	67-72-1	12	NC	12	R3 BTAG SW
Isophorone	78-59-1	NC	NC	920	R4
Nitrobenzene	98-95-3	NC	NC	550	LANL
N-Nitrosodi-n-propylamine	621-64-7	NC	NC	NC	None
N-Nitrosodiphenylamine	86-30-6	210	NC	210	R3 BTAG SW
Phenol	108-95-2	4	NC	4	R3 BTAG SW
PAHs and PCP (ug/L)					
2-Methylnaphthalene	91-57-6	4.7	NC	4.7	R3 BTAG SW
Acenaphthene	83-32-9	5.8	NC	5.8	R3 BTAG SW
Acenaphthylene	208-96-8	5.8	NC	5.8	R3 BTAG SW
Anthracene	120-12-7	0.012	NC	0.012	R3 BTAG SW
Benzo(a)anthracene	56-55-3	0.018	NC	0.018	R3 BTAG SW
Benzo(a)pyrene	50-32-8	0.015	NC	0.015	R3 BTAG SW
Benzo(b)fluoranthene	205-99-2	NC	NC	9	LANL
Benzo(g,h,i)perylene	191-24-2	NC	NC	7.6	LANL
Benzo(k)fluoranthene	207-08-9	NC	NC	0.0041	LANL
Chrysene	218-01-9	NC	NC	0.0018	LANL
Dibenzo(a,h)anthracene	53-70-3	NC	NC	0.0034	LANL
Fluoranthene	206-44-0	0.04	NC	0.04	R3 BTAG SW
Fluorene	86-73-7	3	NC	3	R3 BTAG SW
Indeno(1,2,3-c,d)pyrene	193-39-5	NC	NC	4.3	LANL
Naphthalene	91-20-3	1.1	NC	1.1	R3 BTAG SW
Phenanthrene	85-01-8	0.4	NC	0.4	R3 BTAG SW
Pyrene	129-00-0	0.025	NC	0.025	R3 BTAG SW
Pentachlorophenol	87-86-5	0.5	pH[(3)]	0.5	R3 BTAG SW

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Ecological Surface Water Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	**CAS Number**	R3 BTAG	WV WQS	PSL[(1)]	PSL Reference
Pesticides (ug/L)					
4,4'-DDD	72-54-8	0.011	NC	0.011	R3 BTAG SW
4,4'-DDE	72-55-9	NC	NC	100	LANL
4,4'-DDT	50-29-3	0.0005	1	0.0005	R3 BTAG SW
Aldrin	309-00-2	3	NC	3	R3 BTAG SW
Alpha-BHC	319-84-6	NC	NC	NC	None
beta-BHC	319-85-7	NC	NC	2.2	LANL
cis-Chlordane	5103-71-9	0.0022	0.0043	0.0022	R3 BTAG SW
delta-BHC	319-86-8	141	NC	141	R3 BTAG SW
Dieldrin	60-57-1	0.056	0.0019	0.0019	WV WQS
Endosulfan I	959-98-8	0.051	NC	0.051	R3 BTAG SW
Endosulfan II	33213-65-9	0.051	NC	0.051	R3 BTAG SW
Endosulfan sulfate	1031-07-8	NC	NC	0.06	R4
Endrin	72-20-8	0.036	0.0023	0.0023	WV WQS
Endrin aldehyde	7421-93-4	NC	NC	0.15	R5
Endrin ketone	53494-70-5	NC	NC	NC	None
gamma-BHC (Lindane)	58-89-9	0.01	0.00008	0.00008	WV WQS
Heptachlor	76-44-8	0.0019	0.0038	0.0019	R3 BTAG SW
Heptachlor epoxide	1024-57-3	0.0019	NC	0.0019	R3 BTAG SW
Methoxychlor	72-43-5	0.019	0.00003	0.00003	WV WQS
Toxaphene	8001-35-2	0.0002	0.0002	0.0002	R3 BTAG SW/WV WQS
trans-Chlordane	5103-74-2	0.0022	0.0043	0.0022	R3 BTAG SW
PCB Congeners (ug/L)					
PCB-8	34883-43-7	NC	NC	NC	None
PCB-18	37680-65-2	NC	NC	NC	None
PCB-28	7012-37-5	NC	NC	NC	None
PCB-44	41464-39-5	NC	NC	NC	None
PCB-52	35693-99-3	NC	NC	NC	None
PCB-66	32598-10-0	NC	NC	NC	None
PCB-77	32598-13-3	NC	NC	0.000031	USEPA
PCB-81	70362-50-4	NC	NC	0.0000062	USEPA
PCB-101	37680-73-2	NC	NC	NC	None
PCB-105	32598-14-4	NC	NC	0.00062	None
PCB-114	74472-37-0	NC	NC	0.00062	None
PCB-118	31508-00-6	NC	NC	0.00062	None
PCB-123	65510-44-3	NC	NC	0.00062	None
PCB-126	57465-28-8	NC	NC	0.00000062	USEPA
PCB-128	38380-07-3	NC	NC	NC	None
PCB-138	35065-28-2	NC	NC	NC	None
PCB-153	35065-27-1	NC	NC	NC	None
PCB-156	38380-08-4	NC	NC	0.00062	None
PCB-157	69782-90-7	NC	NC	0.00062	None
PCB-167	52663-72-6	NC	NC	0.00062	None
PCB-169	32774-16-6	NC	NC	0.000062	None
PCB-170	35065-30-6	NC	NC	NC	None
PCB-180	35065-29-3	NC	NC	NC	None
PCB-187	52663-68-0	NC	NC	NC	None
PCB-189	39635-31-9	NC	NC	0.00062	USEPA
PCB-195	52663-78-2	NC	NC	NC	None
PCB-206	40186-72-9	NC	NC	NC	None
Aroclor-1016	12674-11-2	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1221	11104-28-2	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1232	11141-16-5	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1242	53469-21-9	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1248	12672-29-6	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1254	11097-69-1	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1260	11096-82-5	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1262	37324-23-5	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Aroclor-1268	11100-14-4	0.000074[(4)]	0.014[(4)]	0.000074	R3 BTAG SW[(4)]
Total PCBs	NA	0.000074	0.014	0.000074	R3 BTAG SW

Appendix J
Ecological Surface Water Screening Values for Each Receptor
Shaffer Equipment/Arbuckle Creek Area Site

Analyte	CAS Number	R3 BTAG	WV WQS	PSL[1]	PSL Reference
Dioxions/Furans (pg/L)					
2,3,7,8-TCDD	1746-01-6	0.0031	NC	0.0031	R3 BTAG SW
1,2,3,7,8-PeCDD	40321-76-4	0.0031	NC	0.0031	R3 BTAG SW
1,2,3,4,7,8-HxCDD	39227-28-6	0.0062	NC	0.0062	R3 BTAG SW
1,2,3,6,7,8-HxCDD	57653-85-7	0.31	NC	0.31	R3 BTAG SW
1,2,3,7,8,9-HxCDD	19408-74-3	0.31	NC	0.31	R3 BTAG SW
1,2,3,4,6,7,8-HpCDD	35822-46-9	3.1	NC	3.1	R3 BTAG SW
OCDD	3268-87-9	31	NC	31	R3 BTAG SW
2,3,7,8-TCDF	51207-31-9	0.062	NC	0.062	R3 BTAG SW
1,2,3,7,8-PeCDF	57117-41-6	0.062	NC	0.062	R3 BTAG SW
2,3,4,7,8-PeCDF	57117-31-4	0.0062	NC	0.0062	R3 BTAG SW
1,2,3,4,7,8-HxCDF	70648-26-9	0.031	NC	0.031	R3 BTAG SW
1,2,3,6,7,8-HxCDF	57117-44-9	0.031	NC	0.031	R3 BTAG SW
1,2,3,7,8,9-HxCDF	72918-21-9	0.031	NC	0.031	R3 BTAG SW
2,3,4,6,7,8-HxCDF	60851-34-5	0.031	NC	0.031	R3 BTAG SW
1,2,3,4,6,7,8-HpCDF	67562-39-4	0.31	NC	0.31	R3 BTAG SW
1,2,3,4,7,8,9-HpCDF	55673-89-7	0.31	NC	0.31	R3 BTAG SW
OCDF	39001-02-0	31	NC	31	R3 BTAG SW
Inorganics (ug/L)					
Aluminum	7429-90-5	87	750	87	R3 BTAG SW
Antimony	7440-36-0	30	NC	30	R3 BTAG SW
Arsenic	7440-38-2	5	150	5	R3 BTAG SW
Barium	7440-39-3	4	NC	4	R3 BTAG SW
Beryllium	7440-41-7	0.66	NC	0.66	R3 BTAG SW
Cadmium	7440-43-9	0.25	NC	0.25	R3 BTAG SW
Calcium	7440-70-2	116000	NC	116000	R3 BTAG SW
Chromium	7440-47-3	85	11	11	WV WQS
Cobalt	7440-48-4	23	NC	23	R3 BTAG SW
Copper	7440-50-8	9	5.2[2]	5.2	WV WQS[2]
Iron	7439-89-6	300	1500	300	R3 BTAG SW
Lead	7439-92-1	2.5	1.3[2]	1.3	WV WQS[2]
Magnesium	7439-95-4	82000	NC	82000	R3 BTAG SW
Manganese	7439-96-5	120	NC	120	R3 BTAG SW
Mercury	7439-97-6	0.026	NC	0.026	R3 BTAG SW
Nickel	7440-02-0	52	29[2]	29	WV WQS[2]
Potassium	7440-09-7	53000	NC	53000	R3 BTAG SW
Selenium	7782-49-2	1	5	1	R3 BTAG SW
Silver	7440-22-4	3.2	NC	3.2	R3 BTAG SW
Sodium	7440-23-5	680000	NC	680000	R3 BTAG SW
Thallium	7440-28-0	0.8	NC	0.8	R3 BTAG SW
Vanadium	7440-62-2	20	NC	20	R3 BTAG SW
Zinc	7440-66-6	120	67[2]	67	WV WQS[2]
Cyanide	57-12-5	5	5	5	R3 BTAG SW / WV WQS

1- Minimum of R3 BTAG SW - USEPA Region 3 Ecological Freshwater Surface Water Screening Benchmarks (USEPA, 2006b) and West Virginia Water Quality Standards, chronic aquatic life for warmwater and wetlands (B1, B4) (WVDEP, 2016); followed by, WQC – National Recommended Water Quality Criteria for aquatic life, lowest freshwater value (USEPA, 2018b) ; LANL – LANL Ecological Screening Values (LANL, 2017); ORNL surface water benchmarks (Suter and Tsao, 1996); Region 4 Freshwater surface water screening levels (chronic) (USEPA, 2018b); R5 – Region V Ecological Screening Level (USEPA, 2003).

2 - WV DEP criteria based on hardness, assumed 50 mg/L for SAP.

3 - WV DEP criteria based on pH.

4 - Value for total PCBs.