REMEDIAL DESIGN ASSESSMENT QUALITY ASSURANCE PROJECT PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

Prepared for:

United States Environmental Protection Agency
Region 8 Montana Office
10 W. 15th Street, Suite 3200
Helena, Montana 59626

and

Montana Department of Environmental Quality
Remediation Division
P.O. Box 200901
Helena, Montana 59620

Prepared by:

ATC Associates Inc.
917 1st Avenue North, Suite 3
Billings, Montana 59101

August 3, 2012
Revision 1
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ATC Project No. 051.24884.0001

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Prepared for:

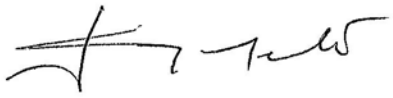
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

and

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

SOCO WEST APPROVAL (A1)

As required in Section X, Paragraph 36 of the Consent Decree, Remedial Design/Remedial Action for Operable Unit 2 at the Lockwood Solvent Superfund Site, all documents, other than progress reports, which purport to document Soco West Inc.'s compliance with the terms of this Consent Decree shall be signed by an authorized representative of Soco.



Raj Mehta
Soco West, Inc. President

8/3/12
Date

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

August 3, 2012
Revision 0

REVIEWS AND APPROVALS (A1)

Roger Hoogerheide
EPA Remedial Project Manager and
Delegated Quality Assurance Approving Officer

8/6/12
Date

John Podolinsky
DEQ Project Officer

9/7/12
Date

James Sullivan
ATC Project Manager

8/3/12
Date

Leilani Carlson
ATC Quality Assurance Manager

8/3/12
Date

REVISION TRACKING TABLE
LSGPS REMEDIAL DESIGN ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

Revision Number	Date	Section Revised	Changes/Comments	Revised Page Color
1	12/14/2012	Table of Contents, Acronyms and Abbreviations, Distribution Lists, Sections 1.0 (incl. Table 1-7), 2.0, and 5.0, Figure 3, and Appendices B, C, and D (laboratory forms).	Changed approved laboratory to Energy Laboratories, Inc. from Pace Analytical Services, Inc. and laboratory analysis of groundwater to EPA Method 8260B from EPA Method 524.2.	Yellow

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Appendix D Sample Labels and Forms
Appendix E Montana Department of Environmental Quality Data Validation Guidelines for Evaluating Analytical Data

ACRONYMS AND ABBREVIATIONS

ATC	ATC Associates Inc.
Beall	Beall Trailers of Montana, Inc.
BGS	Below Ground Surface
CD	Remedial Design/Remedial Action Consent Decree
CLP	Contract Laboratory Program
COC	Contaminants of Concern
cis-1,2-DCE	*cis*-1,2-Dichloroethene
DEQ	Montana Department of Environmental Quality
DM	Database Manager
DNAPL	Dense Non-Aqueous Phase Liquid
DO	Dissolved Oxygen
DQA	Data Quality Assessment
DQI	Data Quality Indicators
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
Energy	Energy Laboratories, Inc.
EPA	United States Environmental Protection Agency
GAC	Granular Activated Carbon
GWMR	Groundwater Monitoring Reports
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
ICB	Initial Calibration Blank
ICV	Initial Calibration Verification
IDW	Investigation-Derived Waste
ISCO	*In-Situ* Chemical Oxidation
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
LNAPL	Light Non-Aqueous Phase Liquid
LSGPS	Lockwood Solvent Groundwater Plume Site
LWSD	Lockwood Water and Sewer District
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MRL	Method Reporting Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ORP	Oxidation-Reduction Potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PARCCS	Precision, Accuracy, Representativeness, Completeness, Comparability, and Sensitivity
PCE	Perchloroethene (tetrachloroethene)
PID	Photoionization Detector
PM	Project Manager
PPE	Personal Protective Equipment
PRRLs	Project-Required Reporting Limits
QA	Quality Assurance

ACRONYMS AND ABBREVIATIONS

QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QA/QC	Quality Assurance/Quality Control
%R	Percent Recovery
RA	Remedial Action
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDA	Remedial Design Assessment
RDAQAPP	Remedial Design Assessment Quality Assurance Project Plan
RDAR	Remedial Design Assessment Report
RDAWP	Remedial Design Assessment Work Plan
RDWP	Remedial Design Work Plan
RD/RA	Remedial Design/Remedial Action
RL	Reporting Limit
ROD	Record of Decision
RPD	Relative Percent Difference
S-D	Duplicate Sample
SA	Spike Added
SAP	Sampling and Analysis Plan
SC	Specific Conductance
SDG	Sample Delivery Group
Soco	Soco West, Inc.
SOP	Standard Operating Procedure
SOW	Statement of Work
SR	Sample Result or Background
SSR	Spiked Sample Result
SVE	Soil Vapor Extraction
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leach Procedure
TOV	Total Organic Vapor
TSD	Transport, Storage And Disposal
VC	Vinyl Chloride
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WSU	Washington State University

DISTRIBUTION LIST (A3)

The following individuals will receive a copy of this RDAQAPP upon approval, and will receive copies of any subsequent revisions:

Roger Hoogerheide
Remedial Project Manager
U.S. Environmental Protection Agency,
Region 8 Montana Office
10 West 15th Street, Suite 3200
Helena, MT 59626
(406) 457-5032

Andrew P. Schmidt, P.G.
Regional Superfund Hydrogeologist
U.S. Environmental Protection Agency,
Region 8, 8EPR-PS
1595 Wynkoop Street
Denver, CO 80202-1129
(303) 312-6283

John Podolinsky
Project Officer
Remediation Division
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620
(406) 841-5040

Raj Mehta
President
Soco West, Inc.
100 First Stamford Place
Mail Box #14
Stamford, CT 06902
(203) 363-5218

Jim Sullivan
Project Manager
ATC Associates Inc.
917 First Avenue North, Suite 3
Billings, MT 59101
(406) 259-1033

Leilani Carlson
ATC Quality Assurance Manager
ATC Associates Inc.
129 Oakland Road
Belgrade, ME 04917
(207) 512-2486

Jake Conver
Project Database Manager
ATC Associates Inc.
917 First Avenue North, Suite 3
Billings, Montana 59101
(406) 259-1033

Michael Ellerd
ATC Associates Inc.
Project Scientist/Safety Manager
P.O. Box 116
Bozeman, MT 59771
(406) 794-5711

Wynn Pippin
Project Manager
Energy Laboratories, Inc.
1120 S. 27th Street
Billings, MT 59101
(406) 252-6325

It is the responsibility of the ATC Project Manager to ensure that all other ATC personnel working on the LSGPS OU2 project have received a copy of, have read, and understand all the provisions of this RDAQAPP.

1.0 PROJECT MANAGEMENT (GROUP A)

This Remedial Design Assessment Quality Assurance Project Plan (RDAQAPP) has been prepared by ATC Associates Inc. (ATC), on behalf Soco West, Inc. (Soco) for remedial design assessment (RDA) activities to be performed by ATC at Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS) near Billings, Montana (Figures 1 and 2). The RDAQAPP has been prepared in response to the selected remedy as set forth in the Record of Decision (ROD) (EPA/DEQ, 2005), Statement of Work (SOW) (EPA/DEQ, 2011a), and in accordance with the requirements of the October 2011 Remedial Design/Remedial Action Consent Decree (CD) for OU 2 (EPA/DEQ, 2011b). This RDAQAPP specifies quality assurance and quality control (QA/QC) requirements and criteria for all U.S. Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (DEQ) RDA activities conducted at OU2 on behalf of Soco by ATC and its subcontractors.

This RDAQAPP was developed in accordance with EPA requirements and guidelines (EPA, 2002; 2001a and 2001b; 2000a), and consists of the following group of quality assurance elements:

Group A: Project Management

Group B: Data Generation and Acquisition

Group C: Assessment and Oversight

Group D: Data Validation and Usability

Where applicable, each Section heading of this RDAQAPP contains the EPA required quality assurance element in parentheses, e.g., EPA element A4 is addressed in Section 1.1.

1.1 Project/Task Organization (A4)

This section identifies key personnel involved in the OU2 RDA along with their respective responsibilities. These key personnel represent the EPA, DEQ, Soco, ATC and ATC's subcontractors. It also presents procedures for updating or amending this RDAQAPP.

1.1.1 Key Personnel (A4)

The following are key personnel involved in quality assurance for the LSGPS OU2 project:

- Roger Hoogerheide, EPA Region 8 Remedial Project Manager. Mr. Hoogerheide is the lead agency regulatory remedial project officer and is responsible for all regulatory oversight and management of the project;

- John Podolinsky, DEQ Project Officer. Mr. Podolinsky has all responsibilities on behalf of the MDEQ on the project and works directly with Mr. Hoogerheide in regulatory oversight and management of the project;

- Raj Mehta, Soco West President. Mr. Mehta has all responsibilities on behalf of Soco on the project;

- Jim Sullivan, ATC Project Manager. Mr. Sullivan is responsible for all work performed on the project by ATC. Mr. Sullivan reports directly to EPA Remedial Project Manager Roger Hoogerheide and Soco President, Raj Mehta;

- Leilani Carlson, ATC Quality Assurance Manager (QAM). Ms Carlson is responsible for all quality assurance matters performed by ATC. Ms. Carlson reports directly to ATC Project Manager Jim Sullivan. Furthermore, as the ATC QAM, Ms. Carson is responsible for maintaining the official, approved LSGPS OU2 RDAQAPP. Ms. Carlson is a senior ATC engineer based in Belgrade, Maine. Ms. Carlson is independent of the ATC unit involved in data acquisition and information generation;

- Jake Conver, ATC Database Manager. Mr. Conver is responsible for all database management performed on the project by ATC. Mr. Conver reports directly to ATC Project Manager Jim Sullivan;

- Paul Bray, Haz-Tech Drilling, Inc. Mr. Bray is responsible for contract drilling services for boring and monitoring well installation;

- Wynn Pippin, Energy Laboratories, Inc. (Energy) Project Manager. Ms. Pippin is responsible for all work performed on the project by Energy. Ms. Pippin reports directly to ATC QAM Leilani Carlson; and

- Dr. Rick Watts, P.E., Washington State University (WSU) Professor of Civil and Environmental Engineering. Dr. Watts will be conducting the bench-scale treatability study for ISCO in the Chemical Oxidation Laboratory at WSU. Dr. Watts recently conducted a similar ISCO bench-scale treatability study for EPA Region 1 (Watts, 2011). The curriculum vitae of Dr. Watts is included in Appendix C of the RDAWP, along with pertinent papers authored by Dr. Watts.

In addition, ATC will designate an On-Site Field Supervisor to be on-site at OU2 during all field activities. The On-Site Field Supervisor need not always be the same person but will be an ATC employee meeting all training and experience requirements discussed in Section 1.5.

The project organization chart shown on Figure 3 summarizes the roles and lines of authority of the individuals involved in operations covered by this RDAQAPP.

1.1.2 Principal Decision Makers

Principal decision makers for OU2 are the EPA and DEQ. EPA's Region 8 Remedial Project Manager is Mr. Roger Hoogerheide, and his designee is Mr. Andrew Schmidt. The DEQ Project Officer for the LSGPS is Mr. John Podolinsky.

1.1.3 RDAQAPP Amendment Procedures

The QA/QC procedures and requirements presented in this RDAQAPP are based on information available to date. Data collected during the implementation of the OU2 Remedial Design Assessment Work Plan (RDAWP; ATC, 2012a) and RDAQAPP will be reviewed on a regular basis to further optimize the sampling design. As described above, this document is intended to be applicable to all RDA activities. If the scope of the RDA as specified in the

RDAWP, changes, this RDAQAPP can be modified accordingly, by implementing the following procedures:

- ATC will prepare a letter addendum outlining the proposed changes to the RDAQAPP. The addendum will include revised text, tables, figures and appendices, as necessary;

- ATC will submit the letter addendum to the EPA and DEQ for review and approval;

- EPA and DEQ will review and provide comments on the proposed changes;

- ATC will finalize the letter addendum based on comments received from EPA and DEQ, and will update any RDAQAPP tables and figures, as necessary. Addendum will be provided to the EPA and DEQ as requested; and

- The RDAWP and this corresponding RDAQAPP have been prepared to minimize or eliminate the need to revise the text of the documents if future addendums are required. However, if a revision to the text in the RDAQAPP is necessary, these amendment procedures allow for the use of colored page inserts to address the required changes. If more than one RDAQAPP addendum is required over time, each set of changes will use page inserts of a different color. The Revision Tracking Table above will be updated to reflect the changes and the corresponding revision number will be included in the footer of each revised page. The use of colored page inserts for revisions will begin with revisions to the final, approved version of this RDAQAPP.

1.2 Problem Definition/Background (A5)

The specific problem identified at OU2 is chlorinated solvent impacts in the subsurface, and the ultimate outcome is mitigation of such impacts. The ultimate outcome of remedial design and remedial action (RD/RA) is to reduce contaminants of concern (COC) concentrations to below applicable regulatory standards in order to protect human health and the environment in accordance with requirements and criteria specified in the ROD, SOW and CD. Mitigation of impacts at OU2 has two primary components; 1) RD/RA intended to remove or destroy fugitive chlorinated solvent mass, and 2) regular groundwater monitoring to assess changes in the magnitude and extent of such impacts over time.

Decisions to be made in the RD/RA process will be made based on investigative, remediation performance, and groundwater monitoring data. Such decisions include: decisions on the need for additional data; decisions on testing and implementation of various remedial technologies; decisions on the effectiveness and eventual termination of various remedial technologies; decisions regarding the scope of on-going groundwater monitoring; and ultimately decisions regarding site closure.

Investigative and remediation performance data will be acquired during further site investigations and remedial activities, such as treatability studies, pilot tests and full-scale remediation. Work plans and corresponding QAPPs for these activities will be prepared on a task-specific basis. This RDAQAPP specifies QC objectives, requirements and methods for RDA activities conducted by ATC at OU2.

Remedial Action Objectives (RAOs) have been established in the ROD for each impacted medium at OU2, including groundwater and soil. RAOs are general descriptions, goals and

objectives necessary to protect human health against unacceptable risk. The RAOs for groundwater are:

- Prevent human exposure to groundwater and surface water contaminants in concentrations above regulatory standards;
- Reduce contaminant concentrations in the alluvial aquifer and surface water to below regulatory standards; and
- Prevent or minimize further migration of the contaminant plume (plume containment).

The RAOs for soil are:

- Prevent or minimize further migration of contaminants from source materials (soil) to groundwater.

1.2.1 Background (A5)

The LSGPS site is a 580-acre site on the outskirts of Billings, Montana, that has been found to have chlorinated solvent contamination in soils and groundwater. Figure 1 shows the general location of OU2 of the LSGPS, and Figure 2 is a map of OU2. OU2 consists of residential and light industrial commercial facilities. Based on current data, the contaminated groundwater plume sourced at Soco in OU2 is estimated to extend from Taylor Place on the south, to the Yellowstone River on the north and west, and Klenck Lane on the east (Figure 2).

1.2.1.1 Site History, Description and Regulatory Perspectives (A5)

The OU2 is in the RA/RD stage because of the existence of chlorinated solvent impacts that potentially pose a threat to human health and the environment. The following sections present historical, scientific and regulatory perspectives of OU2 necessary for an adequate understanding of the need for remedial action.

1.2.1.1.1 Site History (A5)

In June 1998, DEQ performed an integrated assessment focusing on the collection of samples upgradient of the Lockwood Water and Sewer District Treatment Plant wells and numerous petroleum release sites. Based on results from this study and subsequent sampling, EPA and DEQ preliminarily identified Beall Trailers of Montana, Inc. (Beall) as a potential source for trichloroethene (TCE) and its chemical breakdown products of *cis*-1,2-dichloroethene *(cis*-1,2-DCE) and vinyl chloride (VC) in the groundwater. A tetrachloroethene (also known as perchloroethene or PCE) source investigation in the Lomond Lane area began in September 1999, which identified PCE and its chemical breakdown products, TCE, *cis*-1,2-DCE, and VC in the groundwater on the Soco property. EPA proposed the LSGPS for placement on the National Priorities List in May 2000 and listed the LSGPS on December 1, 2000.

DEQ began the Remedial Investigation (RI) during the summer of 2002, which included surface and subsurface soil sampling, monitoring well construction and groundwater sampling, aquifer testing, and surface water and sediment sampling. In June 2003, DEQ released the Final Remedial Investigation Report (TtEMI, 2003a). Using the RI results, EPA and DEQ evaluated potential remedial alternatives and the detailed analysis was presented in the Final Feasibility

Study (DEQ, 2004a), dated July 2004. The Proposed Remedial Action Plan (Proposed Plan), issued by the DEQ in November 2004 (DEQ, 2004b), provided background information about LSGPS conditions, human health risks, activities performed to date, and the preferred cleanup response actions. EPA and DEQ held a public meeting during the Proposed Plan public comment period and received comments and information on the Proposed Plan. In August 2005, the DEQ and EPA released the ROD (EPA/DEQ, 2005) detailing DEQ's and EPA's final determination for the components of the Selected Remedy for cleanup at the LSGPS.

On October 3, 2011, the CD was entered in United States District Court for the District of Montana, Billings Division. The CD and the accompanying attachments outline the procedures, tasks, requirements, and schedule for the work to be performed at OU2. This RDAQAPP is consistent with the requirements specified in the SOW, which was included as Appendix B to the CD.

1.2.1.1.2 Site Description (A5)

The LSGPS is located on the outskirts of Billings, Montana and consists of chlorinated solvent contamination in soils and groundwater. As previously discussed, the primary COCs for OU2 are PCE, TCE, *cis*-1,2-DCE, and VC. OU2 has been defined as the geographic area where contaminated soil associated with the Soco property and the groundwater plume(s) emanating from this source area have come to be located.

1.2.1.1.3 Physical Setting (A5)

The LSGPS is located in south-central Montana, which is predominantly underlain by Cretaceous shale and sandstone deposited in an inland sea environment. The cliffs surrounding the Billings area and along the Yellowstone River are composed of Eagle Sandstone. These units, along with younger sedimentary deposits associated with the Yellowstone River, comprise the principal geologic units at the Site.

The LSGPS is situated within the active fluvial valley of the Yellowstone River immediately downriver and east of Billings, Montana. OU2 is situated on the southeast side of the Yellowstone River Valley north of the Burlington Northern Santa Fe Railroad and east of the U.S. Highway 87 bridge crossings. The Yellowstone River in the vicinity of Billings exhibits a typical braided channel environment characterized by high bed load sediment transport. The valley is defined by a relatively flat floodplain, low relief alluvial terraces, colluvial fans, and eroded bedrock hills and escarpments that define the valley margins. In the vicinity of LSGPS, the present river course is on the northwest side of the valley. As a result, little or no floodplain is developed on the northwest side of the river from the LSGPS. The LSGPS is located almost entirely within the floodplain and terrace area of the valley. Portions of the south side of the LSGPS are within areas of eroded bedrock hills with minor outcrop exposures. Elevation relief varies from approximately 3,160 feet above mean sea level at the uppermost terrace area to 3,090 feet above mean sea level at the riverbank.

The Yellowstone riverbank area in OU2 is composed of abandoned chute channels and gravel bars extending from the Lockwood Water Treatment Plant area downriver to the Sandy-Lomond Lane area, where a cut bank along the river is developed. A second island and chute channel complex is developed farther downriver from Sandy-Lomond Lane area. These chute channels were observed to contain water during elevated water table events resulting from river stage increases in early July 2002 and July and August 2011. However, local residents indicated that these channels contain flow in some years during high-river stage levels in spring runoff

periods.

As described in the RI Report (TtEMI, 2003a), as many as two alluvial terraces may be present within the LSGPS. The uppermost and oldest alluvial terrace boundary appears to have been located at or near the Interstate Highway 90 highway corridor. A second lower terrace boundary may be located along the approximate 3,100-foot elevation contour, southeast and parallel to the course of the Coulson Ditch, which was formerly used to convey irrigation water. The terraces generally parallel the southeast boundary of OU2 and occur primarily south of OU2. The presence of alluvial terraces represents the dissected remnant of the former Yellowstone River floodplain. Terraces within the LSGPS have been obscured by the extensive construction of highways, railroads, and buildings and overprinting of colluvial fan deposits originating from bedrock upland areas to the southeast.

1.2.1.1.4 Regional Geology (A5)

Alluvial and colluvial deposits within the greater Yellowstone floodplain consist of variable thicknesses of clay, silts, sand, and gravel. Alluvial deposits contain gravel of variable lithology derived from sources in the Yellowstone River drainage area while colluvial deposits are from locally derived bedrock sources, such as the Eagle Sandstone. Thickness of recent sedimentary deposits within the LSGPS varies from less than 10 feet near the Yellowstone River to greater than 65 feet thick southeast of Interstate Highway 90 in the vicinity of Beall. Alluvium in the Soco area is approximately 30 feet thick.

The majority of bedrock encountered in RI borings was identified as Upper Cretaceous Eagle Sandstone Formation. The Eagle Sandstone is resistant to erosion, as evident by the cliffs in and around Billings, Montana and in the vicinity of the LSGPS. Shale was also observed in some RI borings and likely represents thin layers of shale within the Eagle Sandstone. Outcrops of Eagle Sandstone occur near the LSGPS and exposures are visible where Interstate Highway 90 crosses the Yellowstone River. Eagle Sandstone is also exposed immediately south of the Town Pump Conoco station and the 2nd Shift Casino in the southwest portion of the U.S. 87 and Interstate Highway 90 interchange. From borehole data collected during the RI, the erosional contact between the alluvium and bedrock in the south portion of the LSGPS appears to be steeply dipping. Borehole data from previous investigations in the vicinity of the Lockwood Water Treatment Plant and east toward the Interstate Highway 90 and U.S. 87 interchange indicated a less steeply dipping contact and possibly a narrow erosional bench in the bedrock surface. Lopez (2000) mapped five geologic units within the LSGPS. These are, from youngest to oldest, Quaternary alluvium, Quaternary colluvium, Quaternary alluvial terrace gravels, Upper Cretaceous Claggett shale, and the Upper Cretaceous Eagle Sandstone. These units are generally described as follows:

- Quaternary alluvium (Holocene): gravel, sand, silt, and clay along active channels of rivers, creeks, and tributaries. Coarse, well-rounded gravel restricted mainly to the active channel of the Yellowstone River drainage. Most sediment in tributary drainages is sand, silt, and clay derived from local Cretaceous bedrock.

- Quaternary colluvium (Holocene and Pleistocene): locally derived slope-wash deposits mainly of sand, silt, and clay. Typically thin veneer-concealing bedrock, but locally as thick as 30 feet and commonly grades into Quaternary alluvium.

- Quaternary alluvial terrace gravels (Holocene and Pleistocene): composed of mostly cobbles and pebbles with minor amounts of sand and silt. Clasts are mainly granitic igneous rocks, granitic gneiss, schist, and quartzite, with much less limestone and sandstone 20 to 40 feet thick.

- Claggett Shale (Upper Cretaceous): brownish-gray fissile shale with minor interbeds of light brownish-gray, very argillaceous sandstone. Light brownish-gray to light-brown, calcareous concretions common, usually fossiliferous. The upper contact is gradational and conformable and is placed at the change to ledge-forming sandstones of the Judith River Formation.

- Eagle Sandstone (Upper Cretaceous): light brownish-gray to very pale-orange, very fine to fine-grained, cross bedded sandstone, burrowed to bioturbated in part. Locally contains calcareous, light-brown sandstone concretions up to 15 feet in diameter.

Regional geologic mapping by Lopez (2000) indicates a regional north-south trending anticline in the vicinity of Billings. This structural fold has limited influence on the course of the Yellowstone; however, the river course through the east side of Billings has down-cut a narrow channel through a thick section of resistant Eagle Sandstone.

Intensive fracturing of the Eagle Sandstone is not readily apparent in outcrops near the LSGPS. Regional structural analysis indicates the presence of northeast-southwest trending faults in the vicinity of LSGPS. No indication of significant vertical displacement of bedrock was observed in RI borings at the LSGPS. The elevation of the bedrock surface is likely controlled by erosional processes during river down-cutting.

1.2.1.1.5 Site Geology (A5)

The LSGPS is situated on Quaternary alluvium and alluvial terrace deposits. Upper Cretaceous Eagle Sandstone bedrock is exposed and present near the surface in the south portion of the LSGPS; however, most bedrock exposures are covered by colluvium deposits or have been buried by construction fill. The general contact between alluvium and bedrock follows the trace of the Lower Lockwood irrigation ditch from the Yellowstone River to the Beall property. This contact also marks the approximate extent of the shallow alluvial aquifer at the LSGPS. South of the Lower Lockwood irrigation ditch, bedrock is encountered at very shallow depths while north of the ditch alluvium in the upper alluvial terrace area averages 65 feet deep. Alluvium thickness in the lower terrace area averages approximately 40 feet. In the area of OU2, the alluvium is approximately 30 to 35 feet deep from the original ground surface.

1.2.1.1.6 Groundwater Hydrology (A5)

Previous investigations documented aspects of the groundwater flow regime in the vicinity of the LSGPS. In general, existing data suggest that the shallow, sandy gravel aquifer is the preferential pathway for migration of contaminants, and that the lower-permeability bedrock unit likely impedes downward vertical groundwater flow and contaminant migration. The predominant groundwater flow direction is northwest toward the Yellowstone River (Figures 4A and 4B of the RDA-WP). Depth to groundwater is approximately 10 to 14.5 feet below ground surface (bgs) near the river based on water level measurements collected by TtEMI from April 2008 to October 2011 in monitoring wells MW124 and MW126. Depth to groundwater on the southern boundary of OU2, near the Soco property, ranges from approximately 8.5 to 16.5 feet

bgs, as determined using water level measurements collected by TtEMI from April 2008 to October 2011 in monitoring well MW001 (Figures 4A and 4B of the RDA-WP).

1.2.1.1.7 Summary of Previous Investigations (A5)

The Lockwood Water and Sewer District (LWSD) began construction of a water treatment plant in 1986. In October 1986, the LWSD discovered the presence of benzene and chlorinated solvents in the groundwater supply. That discovery led to the initiation of a number of investigations, including the following:

1986 – CENEX Pipe Leak Investigation (Northern Engineering, 1986)

1990 – EZ Shoppe Investigation (Western States Tank & Testing)

1991 – CENEX and Conoco Pipeline Investigation (LSE, Inc., 1991)

1991 – Phase I LUST Trust Program Investigation (Chen Northern, Inc.)

1991 – EZ Shoppe Investigation (Matney-Frantz, 1991)

1992 – Ken's Interstate Conoco Investigation (Braun Intertec, 1992)

1992-1993 – LUST Trust Program Investigation (TtEMI)

1993 – Montana Department of Health and Environmental Services/Water Quality Bureau Field Investigation (MDHES, 1993)

1994 – EZ Shoppe Corrective Measures (Resource Technologies, Inc., 1994)

1995 – Phase IV LUST Trust Investigation (MSE/HKM)

1998 – Billings Lockwood Pumping Test Investigation and Groundwater Monitoring (MSE/HKM)

1998-1999 – Integrated Site Assessment (Pioneer/DEQ)

1998 – Lockwood-Lomond Lane Sampling Investigation (Pioneer/DEQ)

1999 – ATSDR Health Consultation (ATSDR, 1999)

1999 – Volatile Organic Compound (VOC) Groundwater Plume Delineation and Potential Source Area Assessment (Lockheed Martin, 1999)

2000 – Site Investigation, Dyce Chemical Facility (Maxim, 2000)

2001 – Beall Interim Action Phase A (Pentacore Resources, LLC, 2001)

2001 – Preliminary Residential Air Sampling (DEQ, 2001)

2001-2002 – Groundwater Monitoring (Pioneer, 2002a; Pioneer, 2002b)

2002 – Remedial Investigation (RI) Work Plan for the LSGPS (TtEMI, 2002a)

2003 – Ozone Sparging/Soil Vapor Extraction (OS/SVE) Pilot Test (ATC, 2003)

2003 – Remedial Investigation Report (TtEMI, 2003a)

2003 – Addendum 01 To The Final Remedial Investigation Report (TtEMI, 2003b)

2003-2011 – Semi-Annual Groundwater Monitoring (TtEMI)

2004 – Soil Vapor Extraction Interim Pilot Test (ATC, 2005)

2009 – Groundwater Drawdown Monitoring (TT, 2010)

2011 – RD/RA Consent Decree Entered (EPA/DEQ, 2011b)

2012 – On-going Semi-Annual Groundwater Monitoring (ATC)

1.2.1.1.8 Source Areas (A5)

Based on the investigations conducted to date, four areas of COC impacts have been identified on and near the Soco property (Figure 4). COC impacts identified in OU2 soil range as high as 4,670 mg/kg for PCE, 129 mg/kg for TCE, 50 mg/kg for *cis*-1,2-DCE, and 1.5 mg/kg for VC (Table 1-1). There are two primary source areas, the northwest source area and the former tank farm area. The COC impacts to soil source a groundwater plume that flows northwest from the Soco property. Downgradient of the Soco property, the axis of the plume shifts to a more northerly direction, and the plume ultimately discharges into the Yellowstone River. Dissolved COC concentrations detected in groundwater within the plume have historically been as high as 120,000 µg/L for PCE, 1,500 µg/L for TCE, 4,900 µg/L for *cis*-1,2-DCE, and 1,090 µg/L for VC (Table 1-2).

1.2.2 Technical or Regulatory Standards (A5)

The primary COCs at OU2 are PCE, TCE, *cis*-1,2-DCE, and VC. Concentrations of these COCs in groundwater and soil collected as part of the RDAWP can be compared to the performance (groundwater and soil remediation goal) standards as specified in the ROD (EPA/DEQ, 2005) and provided in the RDAWP. For this RDAQAPP, the project-required reporting limits (PRRLs) are compared to technical and regulatory standards. This comparison is made to ensure that the required PRRLs are less than the applicable groundwater and soil performance standards. This comparison is presented in Section 1.4.2.8.2 (Table 1-6).

1.3 Project/Task Description (A6)

RDA activities are soon to begin at OU2, and this RDAQAPP addresses all data and information generation/acquisition as described in ATC's RDAWP for OU2 (ATC, 2012a). The purpose of the RDA is to collect additional data related to the nature and extent of COC impacts to soil and groundwater, additional engineering data, to collect samples for use in the bench-scale treatability study, and to install wells to collect baseline water quality data and for later use as pilot test monitoring wells and performance monitoring wells.

- Appendix A contains ATC's Standard Operating Procedures specific to the RDA activities identified in the RDAWP (ATC, 2012a), Appendix B presents the laboratory quality assurance manual provided by Energy, ATC's contract laboratory for the project. Appendix C presents: 1) EPA Method 8260B, the laboratory analytical method used to analyze water and soil samples for volatile organic compounds (VOCs) and 2) EPA Method 1311, the laboratory method used to characterize the hazardous nature of solid waste material.

All work performed under the RDAWP will be performed in accordance with the ROD (EPA/DEQ, 2005), SOW (EPA/DEQ, 2011a), and in accordance with the requirements of the October 2011 CD (EPA/DEQ, 2011b). Likewise, all work performed under the RDAWP will be performed in accordance with this RDAQAPP for all QA/QC requirements for RDA at OU2, as well as the OU2 Health and Safety Plan (HASP), Management Plan, and Contingency Plan, all three of which are appended to ATC's Remedial Design Work Plan (RDWP; ATC, 2012b).

1.3.1 Purpose (A6)

The purpose of this RDA is to collect additional data related to the nature and extent of COC impacts to soil and groundwater, additional engineering data, to collect samples for use in the bench-scale treatability study, and to install wells to collect baseline water quality data and for later use as pilot test monitoring wells and performance monitoring wells. Additionally, the RDA will be used for decision-making and scheduling.

1.3.2 Summary of Work to be Performed (A6)

This RDA will consist of the installation of borings and/or groundwater monitoring wells, collection of soil and groundwater samples for laboratory analysis and collection of soil and groundwater samples for the bench-scale treatability study. Figure 4 indicates the general areas where additional monitoring wells will be installed. Additional borings or wells may be installed to further delineate impacts, based on findings during the field investigation. In general, this RDA will be conducted between the former tank farm area on the Soco property and the area immediately north of Coulson Ditch. This area encompasses all known source areas in OU2. The data collected during this RDA will be evaluated, along with existing data, and used to develop pilot studies that will evaluate the effectiveness of the selected remedy components in attaining the RAOs.

The goals of this RDA include:

- Delineate the nature and extent of COCs within the vadose zone and saturated-zone in the tank farm area;

- Identify the location of the COC mass that is sourcing the primary dissolved phase plume;

- Determine if there are significant vertical stratifications of dissolved COC concentrations in the saturated zone;

- Determine the lithology, including depth to bedrock, in the areas of the tank farm, the northwest source area, and in the area proposed for the treatment/containment barrier;

- Determine if, and to what extent, source soils are located immediately east of the acid tank farm area;

- Determine the current soil and groundwater COC concentrations in the northwest source area and evaluate any changes since the completion of the RI;

- Determine if the fine-grained section in the northwest source area is a large contributor to the downgradient dissolved phase plume;

- Collect baseline water quality, water level and field parameter data in the northwest source area and downgradient;

- Evaluate potential locations to install the treatment/containment barrier; and

- Install wells and collect data to evaluate the nature of the potential interaction between surface water in Coulson Ditch and adjacent groundwater, in the event that the ditch is returned to service.

Based on the RDA goals, the following proposed RDA scope has been developed;

- Install approximately 25 monitoring wells in the Soco area and downgradient. Additionally, install four shallow wells, completed near the bottom of the fine-grained section, off-set from the four proposed wells in the northwest source area (Figure 4). Collect at least one soil sample during the installation of each monitoring well;

- If impacts are detected in the well installed in the acid tank farm source area, install additional wells to delineate the extent of saturated source material (Figure 4);

- Conduct two multi-level groundwater sampling events, using discrete interval samplers, to evaluate vertical stratification of dissolved phase COCs and infer the location of source mass contributing to the dissolved phase plume.

- Collect monthly water level measurements from the Study Area wells for one year. The Study wells will include the monitoring wells installed as part of the RDA, “PT wells”, PT-01 through PT-07, previously installed in and near the northwest source area, MW100 through MW105, MW011 and MW007 previously installed as part of the RI. Monitoring well MW010 will also be included in the Study for water level measurement only.

- Collect at least five soil samples in the northwest source area, co-located with previous soil samples collected as part of the PT well or “PZ piezometer” (piezometers previously installed on the Soco property) installations, to evaluate potential changes in soil COC concentrations with time.

- Collect soil and groundwater samples from the sandy gravel section and the fine-grained section, as well as from the saturated section of the former tank farm area for *In-Situ* Chemical Oxidation (ISCO) bench-scale treatability testing.

- Survey, excavate, and attempt to locate and properly abandon MW125.

- Install a MW125 replacement well;

- Survey all new and existing wells; and
- Redevelop PT wells. Based on the field data collected during the April 2012 groundwater sampling event, the PT wells need to be redeveloped to remove silt and other fine-grained sediments that have accumulated within the monitoring well.

A detailed description of the work to be performed is provided in the RDAWP.

1.3.3 Work Schedules and Reporting (A6)

Upon approval of this RDAQAPP, discrete interval sampling will be conducted at five monitoring well locations to better understand potential contaminant stratification and for decision-making purposes related to well screening during the RDA.. Based on the results of the discrete groundwater sampling and securing the necessary access agreements, RDA field activities will begin, weather permitting and as allowed by the drilling contractor's schedule. Upon contingent approval of the RDAWP, the driller will be contacted and tentatively scheduled. Once the driller's schedule is confirmed, ATC will notify the EPA and DEQ so they may be present for the RDA field activities.

Effective management of environmental data collection requires 1) timely assessment and review of all activities, and 2) open communication, interaction, and feedback among all project participants. ATC will use the report described in the RDAWP to address any project-specific quality issues and to facilitate timely communication of these issues in accordance with reporting requirements specified in the SOW (EPA/DEQ, 2011a).

1.3.4 Geographic Area (A6)

OU2 of the LSGPS has been defined as the geographic area where contaminated soil associated with the Soco property and the groundwater plume emanating from this source area have come to be located. OU2 is shown on Figures 1 and 2.

1.3.5 Resource and Time Constraints (A6)

ATC has all the personnel and equipment necessary to perform all of the activities described in the RDAWP and this corresponding RDAQAPP. Therefore, ATC has not identified any resource constraints. Likewise, ATC has and will schedule activities far enough in advance so as to avoid any schedule conflicts and time constraints. However, there may be time constraints due to restricted access to Keller Transport, Inc. property until the necessary access agreement is secured. Soco will take reasonable steps to secure any necessary access agreements as discussed in Section 2.1.6.

1.4 Data Quality Objectives, Indicators, and Criteria for Measurement (A7)

This section identifies measurement criteria for the information and data to be acquired during RDA activities.

1.4.1 Data Quality Objectives (A7)

The data quality objectives (DQOs) for the RDA have been developed based on the EPA's seven-step DQO process (EPA, 2006). The purpose of the DQO planning process is to ensure

that the type, quantity and quality of data generated during the assessment are acceptable and appropriate for use in the decision-making process. The following are the seven steps of the DQO process:

Step 1: State the Problem
Step 2: Identify the Decision
Step 3: Identify Information Inputs
Step 4: Define the Study Boundaries
Step 5: Develop the Decisions
Step 6: Specify Performance or Acceptance Criteria
Step 7: Develop the Plan for Obtaining Data

The seven steps of the DQO process, as developed for the RDA, are discussed further below.

Step 1: State the Problem

VOCs have been released to soil and groundwater. COC impacted groundwater, exceeding Maximum Contaminant Levels (MCLs), is sourced at the SOCO property. Soils continuing to source groundwater exceedances are located within the Study Area. Additional data related to the current nature and extent of impacts, Study Area hydrogeology, and the effectiveness of ISCO as a saturated source treatment are needed to proceed with pilot testing and RD scheduling. Specifically:

- The location(s) of source mass that are the primary contributors to the groundwater plume in the northwest source area, former tank farm area, and acid tank farm area have not been delineated sufficiently to develop pilot test work plans as part of RD;

- The dissolved phase groundwater plume, lithology and depth to bedrock between the northwest source area and MW007 are not well defined or delineated. This area is where several remedy components will likely be implemented;

- Substantial COC mass was recovered during the operation of the SVE system in the northwest source area. It is unknown how the mass removal has effected soil COC concentrations in the area where mass was recovered; and

- ISCO is identified in the ROD as a remedy component to address saturated zone source soils. The effectiveness of various ISCO reagents has not been demonstrated on OU2 soils and the dosing rate for these reagents has not been determined.

Step 2: Identify the Decision

The primary decisions that must be made include:

- What is the vertical and horizontal location of the COC mass continuing to source groundwater impacts?

- Where is the groundwater plume located between the northwest source area and MW007 and what is the lithology and hydrogeology in that segment of the plume?

- How have the levels of impacts changed in the northwest source area since pilot testing was initiated?

- Is ISCO technology an effective technology to address saturated zone source mass? If so, which ISCO treatment(s) will be most efficient and effective?

Step 3: Identify Information Inputs

Based on the decisions identified in Step 2, necessary inputs are identified. These inputs include:

- The results of boring/monitoring well installation, including lithologic logging, field screening, soil sampling, multi-level discrete interval groundwater sampling, and fluid level measurements;

- The results of soil samples collected from co-located historic soil samples in the northwest source area;

- Historic data collected within OU2; and

- The results of the bench-scale treatability study.

Step 4: Define the Study Boundaries

The study will be conducted within a sub-set of OU2, which includes: Soco-owned property and within the lateral extent of impacted groundwater downgradient of the property, as far as the location of monitoring well MW007. Because the purpose of the RDA is to collect additional data related to the extent of contaminant sources, engineering data and samples for bench-scale treatability studies, data collection downgradient is not proposed as part of this Study. If additional data is needed to implement remedy components downgradient of MW007, data-specific work plans will be submitted at that time. Study data will be collected between the ground surface and the upper two feet of bedrock. The RDA is a single investigative event and does not involve regular, ongoing monitoring. Therefore, samples collected as part of the RDA will single, one-time samples
Fluid level data will be collected for Study Area wells monthly, for one year, to evaluate temporal fluid levels and establish seasonal baseline data prior to pilot testing and remedy implementation.

As an additional RDA task, monitoring well MW125 will be replaced and attempts will be made to locate and properly abandon the original, damaged well. These activities will be conducted downgradient of the Study boundary.

Step 5: Develop the Decisions

If the location(s) of COC source soils are determined or the locations are inferred sufficiently to allow pilot testing and if the ISCO bench-scale treatability study indicates that ISCO would be effective in reducing COC concentrations in saturated source soils, proceed with treatment barrier and ISCO pilot test design and implementation.

If the data collected is sufficient to understand the source location, plume and the hydrogeology

downgradient of the northwest source area adequately to implement pilot testing of treatment/containment barrier technologies downgradient of the northwest source area, proceed with pilot test design and implementation.

If the data collected is sufficient to allow scheduling of other RD activities, such as pilot testing/RD of the former tank farm area and former acid tank farm area, develop the RD project schedule.

Step 6: Specify Performance or Acceptance Criteria

Specifications for this step call for: 1) giving forethought to corrective actions to improve data usability and 2) understanding the representative nature of the sampling design. This RDAQAPP is designed to meet both specifications for this step. The RDA has been developed based on a review of previous OU2 data and knowledge of present OU2 conditions. The laboratory detection-levels and planned data-quality reviews presented within this RDAQAPP have been determined appropriate and adequate for the project. Corrective actions are described elsewhere in this RDAQAPP and in the appended documents. The representative nature of the sampling design has been determined by discussions among professionals familiar with the site and with the appropriate government agencies.

Performance and acceptance criteria for RD information and data have been developed based on accepted industry practices and are identified in Section 1.4.2.4 of this RDAQAPP. These criteria ensure the data are of sufficient quality to adequately determine if any additional measures may be necessary to design effective remediation system and remedial activities to achieve RAOs.

Two types of errors that can occur during groundwater and soil sampling are false positives and false negatives. The majority of these errors occur during field activities due to the variability of field conditions and sample collection procedures. Both false positive and false negative errors can adversely impact remedial design through a misallocation of resources. False positives can result in the allocation and expenditure of resources where they are not needed (i.e. overdesign). False negatives, conversely, can result in the lack or under use of resources where they are in fact needed, therefore leaving impacts to soil and/or groundwater unaddressed. This QAPP provides plans and procedures to prevent the acquisition of low-quality data and its use in the remedial design process.

Step 7: Develop the Plan for Obtaining Data

Existing data and OU2 history have been used to develop the scope of work and proposed sampling locations. Plans for acquiring the necessary data include soil sampling, a bench-scale treatability study, and multi-level discrete interval groundwater sampling to assist in delineating the source areas.

All data acquisition during the RDA will be performed in accordance with the RDAWP and this corresponding RDAQAPP and any subsequent updates, amendments, and/or addendums to either or both documents.

1.4.2 Data Quality Indicators and Measurement Criteria (A7)

All RDA data will be evaluated in accordance with the following data quality indicators (DQIs) to ensure that DQOs are achieved: precision, accuracy, representativeness, completeness,

comparability, and sensitivity (PARCCS). These DQIs are among those recommended by the EPA for data quality evaluation and measurement criteria (EPA, 2001a and 2001b).

1.4.2.1 Precision (A7)

Precision is the degree of agreement among repeated measurements of the same parameter under the same or similar conditions. Precision is reported as the relative percent difference (RPD):

$$RPD\# = \frac{|S-D|}{(S + D)/2} \times 100$$

where S is the original sample result, and D is the duplicate sample result.

1.4.2.1.1 Field Precision Objectives (A7)

Field precision will be assessed through the collection and analysis of field duplicate samples. RPDs will be calculated for the detected analytes from original and duplicate samples. A summary of duplicate samples to be collected, along with all other QC samples, is presented in Section 2.5. Groundwater and soil field duplicate samples will be collected for VOC samples at a minimum frequency of one duplicate for every 20 original samples. This frequency is consistent with the existing groundwater monitoring program and is sufficient for the intended data use.

1.4.2.1.2 Laboratory Precision Objectives (A7)

Precision of laboratory analyses will be based upon the RPD between laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) results. LCS/LCSD analyses will be performed at a rate of 5 percent (one per 20 samples received by the laboratory). Laboratory precision acceptance criteria are presented in Section 1.4.2.4.

1.4.2.2 Accuracy (A7)

Accuracy is the extent of agreement between an observed or measured value and the accepted reference, or true, value of the parameter being measured.

1.4.2.2.1 Field Accuracy Objectives (A7)

The objective for accuracy of the field sample collection procedures is to ensure that samples are not affected by sources external to the sample, such as sample contamination by ambient conditions or inadequate equipment decontamination procedures. Sampling accuracy will be assessed by evaluating the results of equipment and trip blank samples for contamination.

A trip blank will consist of a laboratory-prepared sample of reagent-grade water. Trip blanks will accompany sample coolers containing sample containers/samples intended for VOC analysis and will be subjected to the same handling procedures as the field samples, but will not be opened. The trip blanks will be shipped back to the laboratory with the field samples. Trip blanks are required only when VOCs will be analyzed. Trip blanks will be submitted at the rate of one trip blank per shipping container containing field samples for laboratory VOC analysis.

The trip blank samples will provide a measure of potential cross contamination of samples by VOCs during shipment and handling.

Equipment blanks (also known as rinsate blanks) will be collected by pouring or running clean water or distilled water over or through the field sampling equipment and collecting the rinsate in the proper analytical containers. Equipment blanks must be submitted to the laboratory with investigative samples and analyzed for the same parameters as the investigative samples. The minimum required equipment blank frequency for OU2 is one per day.

Temperature blanks will be used to ensure that samples remain at the proper preservation temperature prior to analysis (≤6°C). There shall be one temperature blank per cooler that is shipped or transported to the laboratory. The blank will be used by the sample custodian to check the temperature of samples upon receipt. However, if samples are delivered directly to the laboratory after sampling there may not be sufficient time for the temperature in the cooler to decrease to 6ºC, and in such cases this criteria will not be enforced and documented in the field logbook.

1.4.2.2.2 Laboratory Accuracy Objectives (A7)

Laboratory accuracy is assessed by evaluating the percent recovery (%R) from LCS according to the following expression:

$$\%R = \frac{SSR - SR}{SA} X100$$

where: SSR = Spiked Sample Result
SR = Sample Result or Background
SA = Spike Added

LCSs will be prepared and analyzed at a frequency of 5 percent (one LCS for every 20 field samples) for liquid samples.

Laboratory accuracy will also be evaluated by surrogate compound recovery where surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compounds are not expected to be found occurring naturally in the samples, but behave analytically similar to the compounds of interest. Consequently, surrogate compound percent recoveries provide information on the effect that the sample matrix exhibits on the accuracy of the analyses.

Matrix spike and matrix spike duplicate (MS/MSD) samples are routinely used as another measure of accuracy and are required for EPA Methods 8260B. MS/MSD samples will be used to assess the influence of the sample media (media interference) on the analysis. Samples for MS/MSD analysis will be OU2 site-specific and analyzed at a frequency of five percent or at a minimum one per sample delivery group (SDG). Each MS/MSD sample will be spiked with the compounds specified by the analytical method prior to sample extraction or analysis in accordance with Energy's SOPs. Laboratory accuracy acceptance criteria, including MS/MSD criteria, are presented in Section 1.4.2.4.

1.4.2.3 Anticipated Concentrations (A7)

The range of detected COC concentrations in groundwater and soil at OU2 over the period of record at the time the ROD was issued in 2005, are listed in Tables 1-1 and 1-2, respectively. These represent the order of magnitude range of COC concentrations potentially encountered at OU2 during the RDA.

Table 1-1
LSGPS OU2 Range of Detected Contaminants of Concern in Surface and Subsurface Soil

Analyte	Concentration Range
PCE	ND – 4,670 mg/kg
TCE	ND – 129 mg/kg
cis-1,2-DCE	ND – 50 mg/kg
VC	ND – 1.5 mg/kg

Source: EPA/DEQ, 2005.

Table 1-2
LSGPS OU2 Range of Detected Contaminants of Concern in Groundwater

Analyte	Concentration Range
PCE	0.22J – 120,000 µg/L
TCE	0.23J – 1,500 µg/L
cis-1,2-DCE	0.29J – 4,900 µg/L
Vinyl chloride	0.19J – 1,090 µg/L

Source: EPA/DEQ, 2005.
J - Estimated value. The analyte was present but less than the reporting limit.

1.4.2.4 Laboratory Precision and Accuracy Summary (A7)

LSGPS OU2 laboratory precision and accuracy criteria for water and soil (EPA Method 8260B) are summarized below in Table 1-3. Surrogate recovery acceptance criteria for the water and soil matrices are summarized in Table 1-4.

Table 1-3
LSGPS OU2 RDA Precision and Accuracy Acceptance Criteria

Analyte	LCS/LCSD		MS/MSD	
	RPD	Accuracy (%R)	RPD	Accuracy (%R)
EPA Method 8260B (Water)				
PCE	20	78 – 137	20	78 – 137
TCE	20	75 – 138	20	75 – 138
cis-1,2-DCE	20	74 – 133	20	74 – 133
VC	20	66 – 140	20	66 – 140
EPA Method 8260B (Soil)				
PCE	20	64 – 139	30	64 – 139
TCE	20	65 – 134	30	65 – 134
cis-1,2-DCE	20	63 – 131	30	63 – 131
VC	20	32 – 136	30	32 – 136

Table 1-4
LSGPS OU2 RDA Surrogate Recovery Acceptance Criteria

Surrogate	Accuracy (%R)
EPA Method 8260B (Water)	
1,2-Dichloroethane-d_4	70 – 130
4-Bromofluorobenzene	76 – 127
Dibromofluoromethane	77 – 126
Toluene-d_8	79 – 122
EPA Method 8260 (Soil)	
1,2-Dichloroethane-d_4	60 – 136
4-Bromofluorobenzene	78 – 160
Dibromofluoromethane	70 – 132
Toluene-d_8	75 – 138

1.4.2.5 Representativeness (A7)

Representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental conditions of OU2. It also reflects the ability of field personnel to collect samples and laboratory personnel to analyze those samples in such manners that the data generated accurately and precisely reflect the conditions at OU2.

1.4.2.5.1 Measures to Ensure Representativeness of Field Data (A7)

Representativeness will be achieved by ensuring that sampling locations are properly selected. Representativeness is dependent upon the proper design of the sampling program and will be accomplished by ensuring that this RDAQAPP, task-specific work plans, and standard operating procedures (SOPs) are followed. The QA goal will be to have all samples and measurements representative of the media sampled.

1.4.2.5.2 Measures to Ensure Representativeness of Laboratory Data (A7)

Representativeness of laboratory data cannot be quantified. However, adherence to the prescribed analytical methods and procedures, including holding times, blanks, and duplicates will ensure that the laboratory data are representative.

1.4.2.6 Completeness (A7)

Completeness is defined as the measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected under normal conditions. Completeness is quantified according to the following expression:

$$\% \text{ Completeness} = \frac{\text{Number of Valid (usable) measurements}}{\text{Number of Measurements Planned}} \times 100$$

While a completeness goal of 100 percent is desirable, an overall completeness goal of 90 percent may be realistically achieved under normal field sampling and laboratory analysis conditions.

1.4.2.6.1 Field Completeness Objectives (A7)

Field personnel will take measures to ensure the integrity and validity of field samples. However, some sample containers may be broken during handling and transit. Therefore, field completeness goals for this project will be to have 90 percent of all samples to be valid data.

1.4.2.6.2 Laboratory Completeness Objectives (A7)

Laboratory completeness will be a measure of the quantity of valid data measurements and analyses obtained from all the measurements and analyses completed for the project. The laboratory completeness goal is for 90 percent of the samples analyzed to be valid data.

1.4.2.7 Comparability (A7)

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical when a set of data for a specific parameter is compared to historical (secondary) data for determining trends.

To ensure comparability of field data, all samples will be consistently collected and properly handled in accordance with specific SOPs. Likewise, all samples will be consistently analyzed in accordance with the matrix-specific EPA methods.

1.4.2.8 Sensitivity (A7)

Sensitivity is the ability of a method or instrument to detect a parameter to be measured at a level of interest.

1.4.2.8.1 Field Data Sensitivity (A7)

The field data sensitivity requirement for OU2 is such that detection limits of direct-read field instruments used to measure field parameters are equal to or below the concentrations necessary for adequate characterization of the particular parameter. For groundwater, a YSI 556 MPS multi-probe meter or similar instrument will be used. For organic vapors (field headspace screening) a MultiRAE PGM50-5P photoionization detector (PID) or similar instrument will be used. Field instruments will be calibrated at least daily while in use as discussed in Section 2.6.1. The measurement ranges and corresponding accuracies for the parameters measured by these instruments are listed in Table 1-5.

Table 1-5
LSGPS OU2 Direct-Read Instrument Measurement Ranges and Accuracies

Matrix	Parameter	Instrument	Measurement Range	Accuracy
Liquid	Temperature	YSI 556 MPS	-5°C - 45°C	±0.15°C
	pH		0 to 14 units	±0.2 units
	DO		0 mg/L – 50 mg/L	0 to 20 mg/L: ±2% or 0.2 mg/L, whichever is greater 20-50 mg/L: ±6% of reading
	ORP		-999 mV to +999 mV	±20 mV
	SC		0 to 200 mS/cm	4 m cable: ±0.5% of reading or ±0.001 mS/cm, whichever is greater 20 m cable: ±1.0% of reading or 0.001 mS/cm, whichever is greater
Vapor	VOCs	MultiRAE PGM50-5P	0 to 2000 ppm	0 – 200 ppm: 0.1 ppm 200 – 2000 ppm: 1 ppm

DO: Dissolved oxygen
ORP: Oxidation-reduction potential
SC: Specific conductance

1.4.2.8.2 Laboratory Data Sensitivity (A7)

The laboratory sensitivity requirement for OU2 is such that laboratory detection limits are equal to or below EPA/DEQ standards for all analytes in all matrices. Laboratory detection and reporting limits (RLs) along with PRRLs for groundwater and soil are summarized in Table 1-6.

Table 1-6
LSGPS OU2 COC Sample Method Detection, Reporting, and Project Required Reporting Limits for Liquid and Solids

Analyte	Liquid/8260B				Solid/8260B			
	MDL	RL	PRRL	CL	MDL	RL	PRRL[1]	CL
PCE	0.156 µg/L	0.5 µg/L	0.5 µg/L	5 µg/L	13.2 µg/kg	50 µg/kg	50 µg/kg	0.65 mg/kg
TCE	0.113 µg/L	0.5 µg/L	0.5 µg/L	5 µg/L	16.5 µg/kg	50 µg/kg	50 µg/kg	0.72 mg/kg
cis-1,2-DCE	0.080 µg/L	0.5 µg/L	0.5 µg/L	70 µg/L	16.8 µg/kg	50 µg/kg	50 µg/kg	4.9 mg/kg
VC	0.165 µg/L	0.5 µg/L	0.5 µg/L	2 µg/L	9.34 µg/kg	20 µg/kg	20 µg/kg	0.16 mg/kg

MDL: Method Detection Limit
RL: Laboratory Reporting Limit
PRRL: Project Required Reporting Limit
CL: Cleanup Level
1. PRRLs are not established for soil so the PRRLs listed are the laboratory RLs.

Table 1-7 summarizes the sample collection and analysis requirements for the RDA.

TABLE 1-7
SAMPLE ANALYSIS SUMMARY TABLE
REMEDIAL DESIGN ASSESSMENT QUALITY ASSURANCE PROJECT PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Analyte	Anticipated Concentration Range	Cleanup Level[A]	Reporting Limits		Analytical Method	Laboratory / Field Parameter	Sample Type	Estimated Number of Field Samples	Duplicates/ Replicates/ MS/MSD	Holding Time[B]	Lab Turnaround Time	Data Use [C]	Sample Volume	Sample Container Quantity/Type	Preservative	Shipping Temp	Estimated Total Number of Samples[D]
				RL	PRRL													
Liquid	Tetrachloroethene (PCE)	0.22J – 120,000 µg/L	5 µg/L	0.5 µg/L	0.5 µg/L	8260B	Pace Analytical Services, Inc.	Grab	127	5 percent	14 days	10 business days	1	40 mL	3 VOA vials	HCl	≤6°C	136
	Trichloroethene (TCE)	0.23J – 1,500 µg/L	5 µg/L	0.5 µg/L	0.5 µg/L		Pace Analytical											
	cis -1,2-Dichloroethene (DCE)	0.29J – 4,900 µg/L	70 µg/L	0.5 µg/L	0.5 µg/L		Pace Analytical											
	Vinyl Chloride (VC)	0.19J – 1,090 µg/L	2 µg/L	0.5 µg/L	0.5 µg/L		Pace Analytical											
	pH	6.6 - 7.8 s.u.	NA	NA	NA	NA	Field parameter	Low-flow	44	0	NA	NA	1	NA	Flow-through cell	None	NA	29
	Oxidation Reduction Potential	-165 - +210 mV	NA	NA	NA	NA	Field parameter	Low-flow	44	0	NA	NA	1	NA	Flow-through cell	None	NA	29
	Dissolved Oxygen	0.02 - 5.0 mg/L	NA	NA	NA	NA	Field parameter	Low-flow	44	0	NA	NA	1	NA	Flow-through cell	None	NA	29
	Specific Conductivity	650-2980 µS/cm	NA	NA	NA	NA	Field parameter	Low-flow	44	0	NA	NA	1	NA	Flow-through cell	None	NA	29
	ISCO Bench-scale Treatability Test	NA	NA	NA	NA	NA	WSU	Composite	4	0	NA	NA	2	2L	Amber Glass Bottle	None	≤6°C	4
	ISCO Bench-scale Treatability Test	NA	NA	NA	NA	NA	WSU	Grab	1	0	NA	NA	2	30 L	Amber Glass or plastic sealable bottle	None	≤6°C	1
Solid	Tetrachloroethene (PCE)	ND – 4,670 mg/kg	0.65 mg/kg	50 µg/kg	50 µg/kg	8260B	Pace Analytical		35	5 percent	14 days	10 business days	1	125 mL	1 Wide mouth glass	Unpreserved	≤6°C	47
	Trichloroethene (TCE)	ND – 129 mg/kg	0.72 mg/kg	50 µg/kg	50 µg/kg		Pace Analytical											
	cis -1,2-Dichloroethene (DCE)	ND – 50 mg/kg	4.9 mg/kg	50 µg/kg	50 µg/kg		Pace Analytical											
	Vinyl Chloride (VC)	ND – 1.5 mg/kg	0.16 mg/kg	20 µg/kg	20 µg/kg		Pace Analytical											
	ISCO Bench-scale Treatability Test	NA	NA	NA	NA	NA	WSU	Composite	4	0	NA	NA	2	4 Kg	Wide mouth glass or sealable plastic container	Unpreserved	≤6°C	4
	ISCO Bench-scale Treatability Test	NA	NA	NA	NA	NA	WSU	Composite	1	0	NA	NA	2	15 Kg	Wide mouth glass or sealable plastic container	Unpreserved	≤6°C	1
IDW - Liquid	Tetrachloroethene (PCE)	NA	5 µg/L	0.5 µg/L	0.5 µg/L	8260B	Pace Analytical	Grab	1	0	14 days	10 business days	3	40 mL	3 VOA vials	HCl	≤6°C	1
	Trichloroethene (TCE)	NA	5 µg/L	0.5 µg/L	0.5 µg/L													
	cis -1,2-Dichloroethene (DCE)	NA	70 µg/L	0.5 µg/L	0.5 µg/L													
	Vinyl Chloride (VC)	NA	2 µg/L	0.5 µg/L	0.5 µg/L													
IDW - Solid	TCLP[A]	NA	See Table 2-3 in RDA QAPP Text	NA	NA	1311	Pace Analytical	Composite	1	0	14 days	10 business days	3	125 mL	1 Wide mouth glass	Unpreserved	≤6°C	1

Notes:
A - Source: EPA/DEQ, 2005.
B - The number refers to the maximum number of days from sampling to analysis
C - Data Use categories are as follows"
1- Nature and Extent of Contamination
2- ISCO Bench-Scale Treatability Study
3- Investigation-Derived Waste Characterization
D - Total of Samples, Duplicates, and Equipment Rinsate Blanks (1 per day). Other samples not considered in the total number of samples will include Trip Blanks and temperature blanks (1 each per cooler. Trip blanks only used for coolers containing samples for VOC analysis
WSU- Chemical Oxidation Laboratory at Washington State University
IDW - Investigation-derived waste
J - Estimated value. The analyte was present but less than the reporting limit
RL - Laboratory Reporting Limit
PRRL - Project Required Reporting Limit
HCl - Hydrochloric acid
TCLP- Toxicity Characteristic Leaching Procedures (See Table 2-3 in text for specific analytes and the maximum concentration limits

1.5 Special Training Needs/Certification (A8)

There are no special training requirements implementing RDA activities except for specialized health and safety training. However, all personnel must be experienced in the specific areas in which they work, such as groundwater monitoring and data evaluation. Personnel without sufficient training or experience must be directly supervised by personnel with sufficient training and/or experience until proficiency has been demonstrated as determined by the ATC PM. This requirement applies to ATC personnel and laboratory personnel.

1.5.1 Health and Safety Training (A8)

ATC personnel who work on-site at OU2 are required to meet the Occupational Safety and Health Administration (OSHA) training requirements defined in Title 29 of the Code of Federal Regulations (29 CFR) Part 1910.120(e) for hazardous waste projects. These requirements include 1) 40 hours of formal off-site instruction in Hazardous Waste Operations and Emergency Response (HAZWOPER); 2) a minimum of 3 days of actual on-site field experience under the supervision of a trained and experienced field supervisor; and 3) 8 hours of annual HAZWOPER refresher training.

Field personnel who directly supervise employees engaged in hazardous waste operations also receive at least 8 additional hours of specialized OSHA supervisor training. The supervisor training covers ATC health and safety program requirements, training requirements, personal protective equipment (PPE) requirements, spill containment program, and health-hazard monitoring procedures and techniques.

Before work begins at OU2, personnel are required to undergo site-specific training that thoroughly covers the following areas:

- Names of personnel and alternates responsible for health and safety at OU2;
- Health and safety hazards present at OU2;
- Selection of the appropriate personal protection levels;
- Correct use of PPE;
- Work practices to minimize risks from hazards;
- Safe use of engineering controls and equipment on-site at OU2;
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazardous substances; and
- Contents of the HASP.

Copies of ATC's health and safety training records, including course completion certifications for the initial and refresher health and safety training, specialized supervisor training, and first aid and CPR training, are maintained in project files in ATC's Billings, Montana office.

1.6 Documents and Records (A9)

Documentation is critical for evaluating the success of any environmental data collection activity. Records to be used for project documentation include field forms, field logbooks, laboratory data sheets, chain-of-custody forms, and technical papers. ATC will retain the records generated during monitoring activities as discussed in Section 2.10. The following sections discuss the requirements for documenting field activities, for preparing laboratory data packages, and for monitoring reporting.

1.6.1 Field Documentation (A9)

Recording of notes on field sheets or in a field notebook will follow ATC's SOP 051-102 Field Forms (Appendix A). Field personnel will use permanently bound field notebooks to record and document field activities. The field notebook will list the project name, the names of field personnel, and the project manager (PM). All field entries will be written in black or blue indelible ink. All corrections will be made utilizing a single line through the error, along with the date the correction was made, and the field personnel's initial. At a minimum, the following information will be recorded in the field notebook:

- Date and time of starting work and weather conditions during the field activity;
- Name and affiliation of all OU2 on-site personnel or visitors;
- Notes of conversations with coordinating officials;
- Description of site conditions and any unusual circumstances or problems encountered and the associated resolution;
- References to other field notebooks or forms that contain specific information;
- Equipment ID numbers, if relevant;
- Details of actual work effort, particularly any deviations from the RDAWP or other governing documents;
- A description of any photographs taken, etc.;
- Field observations; and
- Any field measurement made that isn't recorded on a dedicated field form.

1.6.2 Summary Laboratory Data Packages (A9)

The laboratory subcontractor will prepare summary data packages in accordance with the instructions provided in the EPA Contract Laboratory Program (CLP) statements of work (SOW) (EPA, 2004 and 2003) and the EPA National Functional Guidelines (EPA, 2010 and 2008). The summary data package will consist of a case narrative, copies of all associated chain-of-custody forms, sample results, and QA/QC summaries. The case narrative will include the following information:

- Subcontractor name, project name, project order number, SDG number, and a table that cross-references client and laboratory sample identification numbers;

- Detailed documentation of all sample shipping and receiving, preparation, analytical, and quality deficiencies, including analyses performed without an American Association for Laboratory Accreditation-certified standard;

- Thorough explanation of all instances of manual integration;

- Copies of all associated nonconformance and corrective action forms that will describe the nature of the deficiency and the corrective action taken; and

- Copies of all associated sample receipt notices.

The laboratory subcontractor (Energy) will provide ATC with a hard copy and an electronic data deliverable (EDD) of the summary data package within 35 days after it receives the last sample in the SDG. ATC will deliver the validated raw summary data package to the EPA and DEQ for discussion, planning, and scheduling purposes as soon as ATC has validated the data.

1.6.3 Full Laboratory Data Packages (A9)

The laboratory will prepare data packages in accordance with the instructions provided in the EPA CLP SOW (EPA, 2004 and 2003) and the EPA National Functional Guidelines (EPA, 2010 and 2008). Data packages will contain all of the information from the summary data package and all associated raw data. Data packages are due to ATC within 35 days after the last sample in the SDG is received. Unless otherwise requested, the laboratory will deliver one hard copy and an EDD of the data package. ATC will incorporate the full laboratory data package into the Remedial Design Assessment Report (RDAR) as described in the RDAWP.

1.6.4 Laboratory Data Package Format (A9)

EDDs are required for all sample analytical results. An automated Laboratory Information Management System (LIMS) must be used to produce the EDD. Manual creation of the deliverable (data entry by hand) is unacceptable. The laboratory will verify EDDs internally before they are issued.

The EDD will correspond exactly to the hard copy data. No duplicate data will be submitted. EDDs will be delivered in a format compatible with EPA specified standards. Those standards include numerical data in a text (comma or tab delimited) or similar file and image files in a PDF, JPG, GIF, or similar file format (EPA, 2011). Results that should be included in all EDDs are as follows:

- Target analyte results for each sample and associated analytical methods requested on the chain-of-custody form;

- Method and instrument blanks and preparation and calibration blank results reported for the SDG;

- Percent recoveries for the spike compounds in the in LCSs, blank spikes, or any matrix spikes that may be necessary;

- Matrix duplicate results reported for the SDG;
- All re-analysis, re-extractions, or dilutions reported for the SDG, including those associated with samples and the specified laboratory QC samples; and
- Method reporting limits and method detection limits.

Electronic and hard copy data must be retained for a minimum of three and ten years, respectively, after final data have been submitted. The subcontractor will use an electronic storage device capable of recording data for long-term, off-line storage. Raw data will be retained on an electronic data archival system.

1.6.5 Reporting (A9)

The results of the RDA will be incorporated into a draft RDAR and submitted to the EPA and DEQ for review and approval. The report will describe sampling and monitoring activities and summarize the data collected during the RDA. The report will include all field and laboratory data generated including QA/QC samples and the results of the data verification and validation performed on the data. The report shall also include an appendix with all of the field and laboratory data in electronic format. The draft RDAR will be submitted to EPA and DEQ for review within 90 days of receipt of final laboratory data/validation packages. Following review by the EPA and DEQ, a final report will be prepared and submitted. EPA and DEQ comments and responses to each comment on the draft RDAR will be incorporated into the final RDAR. Details of the content of the RDAR are presented in the RDAWP (ATC, 2012a).

ATC will deliver the raw validated laboratory data to the EPA and DEQ for discussion, planning, and scheduling purposes. The data will subsequently be incorporated into the RDAR.

1.6.6 RDAQAPP Maintenance (A9)

This RDAQAPP is to be maintained as a working document to assure and control data quality throughout duration of OU2 RDA activities. The ATC QAM is responsible for maintaining and updating this RDAQAPP as necessary. The QAM is also responsible for ensuring that all ATC personnel working on the project have received, have read, and are familiar with all aspects of the RDAQAPP that affect their roles and responsibilities. The ATC QAM will provide laboratory project managers with the most current version of the RDAQAPP, and the laboratory project managers are then responsible for disseminating the appropriate information in the RDAQAPP to laboratory personnel involved in sample receipt, preparation and analysis, and data reporting.

This RDAQAPP will be updated and/or amended, as necessary, whenever conditions change and an update or amendment is warranted. The ATC QAM will inform all personnel working on the project whose function in the project may be affected by any such updates, amendments, and/or addendums. This includes ATC and/or laboratory personnel.

1.6.7 Maintenance of Records (A9)

All physical and electronic records in ATC's possession or generated by ATC will be preserved by ATC for a period of 10 years after Soco's receipt of a Certificate of Completion by the EPA for OU2 in accordance with all provisions in Section XXVI of the CD (EPA/DEQ, 2011b).

1.6.7.1 Physical Records (A9)

ATC will maintain physical records in its Billings, Montana office, which has a large records storage capacity. Such records will be maintained in project-dedicated, task-specific files to facilitate access to physical records, as necessary.

1.6.7.2 Electronic Records (A9)

It is critical that electronic records are managed through their entire life cycle from creation until their final disposition, which could be destruction, or preservation as a permanent record. Electronic records may include numeric, graphic, audio, video, and textual information which is recorded or transmitted in analog or digital form such as electronic spreadsheets, word processing files, databases, electronic mail, instant messages, scanned images, digital photographs, and multimedia files.

Electronic records are stored in project-specific file folders, located on ATC's server. The electronic records located on the server must be backed up on a regular basis to safeguard against loss of information due to equipment malfunctions, human error, or other disaster. ATC's Information Support department establishes a regular cycle of backup overwrites based on the office needs for the management of electronic records. Retention periods are determined by the content, nature, and purpose of records, and are set based on their legal, fiscal, administrative, and historical values, regardless of the format in which they reside. The records are backed up on media tape drive storage device. Electronic records media are stored in a cool, dry, dark environment. If electronic records need to be restored, an Information System Support Analyst uses the archived backup tape to transfer the lost records from the tape to the server.

2.0 DATA GENERATION AND ACQUISITION (GROUP B)

This section summarizes the requirements for data generation and acquisition during RDA activities. In addition to the requirements below, all data generation and acquisition is to be conducted in accordance with the provisions of this RDAQAPP.

2.1 Sampling Process Design (B1)

Sampling process design is specific to the individual task associated with the RD/RA process. The sampling process designs will be developed such that all data acquisition will be performed in accordance with the provisions of a task-specific QAPP.

The sampling process design for the RDA was developed to enable direct comparison of data collected to historic monitoring data, and to ensure data collected is of sufficient quantity and quality to meet DQOs and the RDA objectives. This RDAQAPP is specific to RDA activities, and the following subsections present the sampling locations and analyses planned.

2.1.1 Groundwater and Soil Sampling (B1)

Groundwater monitoring wells will be installed and sampled following procedures specified in the RDAWP and in accordance with this RDAQAPP. Figure 4 presents proposed locations of new monitoring wells. All well installation and sampling will be performed in accordance with ATCs SOPs (Appendix A).

2.1.2 Opportunistic Sampling (B1)

Opportunistic groundwater or soil samples, or samples not specifically proposed in the RDAWP, may be collected as part of the RDA. Opportunistic samples may be collected by ATC, as appropriate. The EPA and DEQ may direct the collection of opportunistic samples. Opportunistic samples may include one-time-only or several samples collected over time, or may include collecting a sample for supplemental laboratory analysis.

2.1.3 Rationale for Selecting Analytical Parameters (B1)

Prior to this RDA numerous other investigations have been conducted at OU2 which have analyzed groundwater and soil samples for VOCs using EPA Method 8260B (EPA, 1996). EPA Method 8260B includes analyses for the four COCs identified in this investigation, in addition to other VOCs regulated under the National Primary Drinking Water Regulations.

The analytical methods selected for the RDA are standard EPA methods that have been previously used in other OU2 investigations, including the existing semi-annual monitoring program conducted by ATC (ATC, 2012c). This will ensure the data collected are comparable to historic data.

2.1.4 Surveying (B1)

Newly installed and existing monitoring well locations will be determined using Global Positioning System methods or other survey grade equipment and methods. Horizontal measurements should be accurate to 0.1 foot. All horizontal survey data will be reported using North American Datum 83, Montana State Plane coordinates. The elevation of the measuring point of each well will be surveyed to an accuracy of 0.01 foot. Vertical survey data will be

reported as feet above mean sea level. In addition, flush mount wells will be land-marked (e.g. using triangulation from permanent fixtures in close proximity).

2.1.5 Underground Utility Location and Clearance (B1)

All underground utilities will be located and marked through the one-call utility locate service (1-800-424-5555 or 811) before starting any intrusive or subsurface field activity. The utility locator will be responsible for clearing all proposed sample locations that require subsurface boring or excavation. If alternate sample locations are necessary, ATC will coordinate with EPA and DEQ to evaluate and finalize the alternate sample locations.

2.1.6 Access Arrangements (B1)

Soco will take reasonable steps to secure any necessary access agreements to residential, industrial, and commercial properties to conduct the RDA activities. If access cannot be secured by Soco, assistance in obtaining the necessary agreements will be requested of EPA, as described in the CD. Any necessary access agreements will be obtained prior to conducting the RDA. ATC will notify the EPA and DEQ if there are modifications to the list of sample locations before starting any field event.

2.2 Analytical Methods (B4)

Below is a description of the target laboratory analytes for RDA activities at the LSGPS OU2. The laboratory methods that will be used for the analyses of these analytes are listed Table 2-3. The methods identified in Table 2-3 all meet EPA National Functional Guidelines (EPA, 2008 and 2010).

- Liquid (groundwater) VOC analyses will be performed according to EPA Method 8260B, Volatile Organic Compounds by Gas Chromatograph/Mass Spectrometry (EPA, 1996). The method reporting limit (MRL) for all VOCs, including OU2 COCs, is 0.5 µg/L, which is the PRRL for each COC (Table 1-6).

- Solid (soil) VOC analyses will be performed according to EPA Method 8260B, Volatile Organic Compounds by Gas Chromatograph/Mass Spectrometry (EPA, 1996). The method detection limits (MDLs) for all VOCs in solid media are compound-specific, and for OU2 COCs the MDLs range from 9.24 µg/kg to 16.8 µg/kg. PRRLs have not been established for soil, so the laboratory MRL is used as a surrogate PRRL, which is 50 µg/kg (Table 1-6).

- Liquid IDW analyses will be performed according to EPA Method 8260B.

- Solid IDW analyses will be performed according to EPA Method 1311, which is a toxicity characteristic leach procedure (TCLP) that characterizes the hazardous nature of solid waste material.

Table 2-1
LSGPS OU2 Laboratory Analytes and Corresponding Analytical Methods

Matrix	Purpose	Parameter	Method No.
Liquid	Remedial Design Assessment	VOC	8260B
	Investigation-derived waste characterization	VOC	8260B
Solid	Remedial Design Assessment	VOC	8260B
	Investigation-derived waste characterization	TCLP[A]	1311

A: Toxicity Characteristic Leach Procedure is a leachate method that analyzes for a variety of toxic analytes, including PCE, TCE and VC.

2.2.1 Field and Laboratory SOPs (B2)

ATC's SOPs are identified in Section 2.3 and the SOPs are included in Appendix A. Energy SOPs are included in their quality assurance manual in Appendix B.

2.2.2 Equipment and Instrumentation (B2)

A discussion of ATC's field equipment and instruments is provided in Section 2.3.9. Energy will use laboratory equipment and instruments in accordance with their quality assurance program (Appendix B), and the requirements of EPA laboratory analytical methods (Appendix C).

2.2.3 Method Performance Standards (B2)

Field and laboratory performance standards are discussed in detail in Section 1.4 and Sections 2.5 through 2.7.

2.2.4 Failures and Corrective Action (B4)

In the event that any laboratory samples are lost or destroyed prior to laboratory analysis, ATC will contact the EPA and DEQ and a determination will be made on a case-by-case basis as to the need for re-sampling. This will be the responsibility of the ATC PM.

2.2.5 Sample Disposal Methods (B4)

Soil cuttings from soil borings will be handled as discussed in Section 2.3.5.1. Any groundwater collected for field analysis will be mixed with purge water and treated as discussed in Section 2.3.5.2. Energy will dispose of all samples following analysis in accordance with their SOPs following any and all state and federal waste regulations. The Chemical Oxidation Laboratory at WSU will dispose of samples following analysis in accordance with federal, state, and local regulations.

2.2.6 Laboratory Turnaround Times (B4)

The laboratory will provide ATC with analysis results within 10 business days and a validation summary data package, upon request, within 35 days after it receives the last sample in the SDG.

2.2.7 Non-Standard Methods (B4)

If any additional liquid analytes are later determined necessary for OU2, the appropriate laboratory method(s) will be identified and confirmed to meet National Functional Guidelines (EPA, 2008 and 2010), and this RDAQAPP will be updated accordingly.

2.3 Sampling and Field Measurement Methods (B2)

Sampling requirements for this project call for the collection and analysis of liquid and solid samples. This section describes the requirements for sample collection, including sampling methods and equipment, sample preservation requirements, decontamination procedures, and management of IDW. The descriptions below are general and all field activities are to be conducted in accordance with the specific and detailed sampling procedures described in ATC's SOPs, included in Appendix A of this RDAQAPP.

General

ATC-SOP-051-100	Equipment Decontamination – Inorganic Contamination
ATC-SOP-051-101	Equipment Decontamination – Organic Contamination
ATC-SOP-051-102	Field Forms
ATC-SOP-051-103	Quality Assurance/Quality Control Sampling
ATC-SOP-051-104	Sample Documentation
ATC-SOP-051-105	Sample Packaging and Shipping

Liquid

ATC-SOP-051-201	Groundwater Sampling Using Low-Flow Methods
ATC-SOP-051-204	Measuring Fluid Levels
ATC-SOP-051-205	Measuring Water Quality Field Parameters (Low-Flow, In-Situ, Ex-Situ, Surface Water)
ATC-SOP-051-209	Groundwater Sampling Using HydraSleeves™

Solid

ATC-SOP-051-301	Subsurface Soil Sampling: Well/Borehole Installation

Gas

ATC-SOP-051-400	Organic Vapor Headspace Measurement

Wastes

ATC-SOP-051-501	Management of Liquid Matrix Investigation-Derived Wastes
ATC-SOP-051-502	Management of Solid Matrix Investigation-Derived Wastes
ATC-SOP-051-504	Sampling of Liquid Matrix Investigation-Derived Wastes
ATC-SOP-051-505	Sampling of Solid Matrix Investigation-Derived Wastes

Monitoring Wells

ATC-SOP-051-600	Monitoring Well Installation and Development
ATC-SOP-051-601	Monitoring Well Abandonment

2.3.1 Groundwater Sample Collection (B2)

The RDA will include two multi-level groundwater sampling events, using discrete interval samplers as described in the RDAWP. The first multi-level groundwater sampling event will be conducted prior to installation of any new monitoring wells. The purpose of the initial discrete sampling event is to collect data to understand potential stratification of contaminants in the alluvial aquifer and to use the data collected to make decisions on screen intervals for wells installed as part of the RDA. The second multi-level groundwater sampling event will be conducted after the new monitoring wells installed as part of the RDA have been installed, developed and have reached equilibrium.

The groundwater sampling events will involve collection of three discrete interval groundwater samples from each of the fully-screened monitoring wells included in the Study as discussed in the RDAWP. In wells that are not fully screened, less that three discrete interval samples may be collected. Additionally, one discrete interval groundwater sample will be collected from the shallow monitoring wells to be installed as part of the RDA.

The discrete interval groundwater samples will be collected in accordance with SOP-051-209 Groundwater Sampling Using HydraSleeves™ (Appendix A). The three groundwater samples from each well will be collected simultaneously using discrete interval samplers. The samplers in each well will be set within three feet of bedrock, in the middle of the sandy gravel unit, and the upper sample in each well will be collected a minimum of one foot above the fine-grained/sandy gravel interface. Only one discrete interval groundwater sample will be collected from each of the four shallow wells. The sampler in each of the four shallow wells will be located at the bottom of the well casing, prior to deployment.

The groundwater samples will be analyzed for VOCs using EPA Method 8260B. The chemistry behind EPA Method 8260B is the same as EPA Method 524.2, the historic analytical method used for groundwater sample analysis at OU2.

Discrete interval groundwater sampling will be conducted as follows.

- At least 48 hours prior to the scheduled sample collection, measure the depth to fluid levels with an interface probe in accordance with the Measuring Fluid Levels SOP 051-204. The depth to water, non-aqueous fluid levels (if present), and total depth of the well will be measured using an interface probe and recorded on the groundwater sampling field data sheet. Fluid levels will be measured to the nearest 0.01 ft from the established measuring point.

- Using the lithologic data from well installation, the deployment depth for the discrete interval samplers in each well will be determined. The samplers for each well may be pre-assembled in the office prior to use. The sampling train for each well with screen intervals greater than ten feet will be constructed by attaching three, 30 inch long by 1.5 inch wide HydraSleeve™ samplers to the sampling tether at the predetermined depths. Two, 30 inch long by 1.5 inch wide HydraSleeve™ samplers will be used for wells with screen intervals less than ten feet attached to the sampling tether at the predetermined depths.

- The samplers will be deployed by first attaching a reusable stainless-steel bottom weight to the tether and slowly lowering the weight and tether line into the well until the weight rests on the bottom of the well with the tether taut above it.

- The samplers will be allowed to equilibrate for at least 48 hours before being recovered. The tether will be secured at the top of the well by placing the well cap on the top of the well casing and over the tether, or by securing the tether to the J-plug well cap.

  The following procedure will be used to recover the samplers and collect the groundwater samples:

  - Retrieve the samplers from the well by pulling the tether up between 30 to 45 inches in one smooth motion. Continue pulling the tether upward until the sampler is at the top of the well. When retrieving the samplers, remove and process only one sampler at a time. The remaining samplers should be suspended in the well until they can be processed to isolate them from agitation, exposure to ambient weather conditions, and direct sunlight.

  - Puncture the sampler just below the check valve with the pointed end of the discharge tube. Collect the VOC samples by allowing the discharge to flow gently down the inside of laboratory-supplied 40-mL volatile organic analysis (VOA) vials pre-preserved with hydrochloric acid for laboratory analysis by EPA Method 8260B.

  - Properly label the sample containers and place the samples in coolers and chill to maintain the sample temperature at ≤6°C.

  - Samples will be sent to Energy and will be analyzed by EPA Method 8260B. All samples will be packaged and shipped in accordance with SOP-051-105 Sample Packaging and Shipping.

  - Decontaminate the reusable stainless-steel bottom weight and clip in accordance with SOP-051-209 Groundwater Sampling Using HydraSleeves™.

- If the EPA and DEQ, per Section IX, paragraph 26.a.(4) of the CD, or individual property owners request a split sample, they must supply all necessary sample bottles, supplies and materials required for sampling, as well as arrange for and pay for laboratory analyses of all split samples collected.

- After sampling each well, field parameters will be collected using low-flow purge techniques. Polyethylene tubing will be lowered into the well until the bottom of the tubing is located mid-well screen to collect field parameters. The tubing will then be connected to a 12-volt peristaltic pump so that groundwater is pumped directly into a flow-through cell. Field parameters will be recorded after the well has been purged, using low-flow purge techniques and measurements have stabilized.

- Field parameters will be measured using direct-reading instrumentation, such as a YSI 556 MPS or similar water quality meter. The water quality field parameters include pH, temperature, SC, ORP, and DO.

ATC will use low-flow sampling methods to collect the chemical oxidation bench-scale

treatability study groundwater samples described in the RDAWP according to the protocols and SOPs presented in the approved Groundwater Monitoring Work Plan (ATC, 2012c) and the approved Groundwater Monitoring Quality Assurance Project Plan (ATC, 2012d). The bench-scale treatability study groundwater sampling event will be conducted as soon as possible after the newly installed monitoring wells as part of the RDA have been developed and reach equilibrium.

Prior to collecting groundwater samples, an interface probe will be used to measure fluid levels and total depth of the well. The measurements will be recorded on the groundwater sampling field data sheet and if light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL) is detected while gauging the well, the depth to the measured liquid will also be recorded on the data sheet. Any observed LNAPL or DNAPL not detected by the gauge, will be noted on the data sheet and log book. Fluid levels will be measured first to the nearest 0.01 ft from the established measuring point.

A peristaltic pump will be used for all low-flow sampling. Prior to sampling, disposable polyethylene tubing will be placed in the well so that the bottom of the tubing is centered on the most contaminated zone, if known. If no, the tubing will be centered in the well's screened interval. The tubing will then be connected to the peristaltic pump so that groundwater is pumped directly into a flow-through cell. Field parameters will be measured using direct-read instrumentation, such as a YSI 556 MPS or similar water quality meter. Groundwater field parameters will consist of temperature, pH, dissolved oxygen (DO), oxidation-reduction potential (ORP) and specific conductance (SC). Samples will be collected once field parameters have stabilized as determined by field personnel. Water samples will be collected by disconnecting the down-hole tubing from the flow-through cell and reconnecting to the flexible silicon tubing on the peristaltic pump. Low-flow sampling will be conducted in accordance with SOP 051-201, Groundwater Sampling Using Low-Flow Methods, SOP 051-204 Measuring Fluid Levels, and SOP 051-205, Measuring Water Quality Field Parameters, located in Appendix A.

Reusable equipment used in the sampling of groundwater will be decontaminated per SOP 051-101 Equipment Decontamination – Organic Contamination, located in Appendix A. Disposable sampling equipment will be managed according to SOP 051-501 Management of Liquid Matrix Investigation-Derived Waste and SOP 051-505 Sampling of Solid Matrix Investigation-Derived Wastes (Appendix A).

Water generated during sampling activities will be drummed, treated and analyzed as indicated in Section 2.3.5.

2.3.2 Soil Sampling

Soil samples will be collected in accordance with ATC-SOP-051-301 Subsurface Soil Sampling: Well/Borehole Installation (Appendix A). A minimum of one soil sample will be collected from each proposed monitoring well and shallow well, offset location shown on Figure 4. The soil sample collected from each boring that exhibits the highest field screening total organic vapor (TOV) concentration or observed level of visual impact will be submitted for laboratory analysis. If none of the PID TOV measurements of field screening samples from a boring exceed 10 ppm, the soil sample collected from the middle of the sandy gravel unit will be submitted for laboratory analysis. More than one sample may be submitted from each boring, based on observations or field screening results. Only the samples collected from the pre-determined intervals described in Section 4.2.1 of the RDAWP, will be submitted for laboratory analysis.

Soil samples will be packed in iced coolers and transported to Energy using chain-of-custody (COC) procedures. The samples will be analyzed by EPA Method 8260B for VOCs. All samples will be packaged and shipping in accordance with SOP-051-105 Sample Packaging and Shipping.

2.3.3 Quality Control Sampling (B5)

As specified in Section 2.5, QC samples will be collected and submitted for laboratory analysis in accordance with ATC's SOP 051-103, Quality Assurance/Quality Control Sampling (Appendix A). Following is a list of the various QC sample types to be collected as part of the LSGPS OU2 activities:

- Duplicate samples,
- Equipment rinsate blanks, and
- Trip blanks.

Details of QC sampling are presented below in Section 2.5.

2.3.4 Decontamination and Equipment Rinsate Sampling (B2)

Decontamination procedures will be used in conjunction with safe-handling methods to prevent sample contamination, including minimizing contact with wastes and maximizing worker protection. Proper PPE will be used in accordance with the OU2-specific HASP (ATC, 2012b). All water derived from decontamination will be collected and temporarily stored on Soco-owned property as IDW. Personnel will decontaminate all reusable equipment before leaving OU2 to prevent off-site transport of contamination in accordance with ATC's SOPs 051-100, Equipment Decontamination – Inorganic Contamination or 051-101, Equipment Decontamination – Organic Contamination (Appendix A).

All reusable equipment will be decontaminated following each use. Equipment decontamination is not required when disposable equipment is used. Following decontamination of equipment, rinsate blanks will be collected at a frequency of one equipment blank per day, as described in Section 1.4.2.2.1. Equipment rinsate blanks are collected by pouring or running (pumping) clean water over or through the equipment following decontamination and into sample containers (i.e., VOA vials, see Section 2.3.5). Rinsate blanks will be submitted to Energy for VOC analysis according to EPA Method 8260B.

2.3.5 Management of Investigation-Derived Waste

Procedures for management of soil, liquid, and solid IDW are discussed below. Analytical methods are presented in Table 2-1.

2.3.5.1 Soil IDW

Solid matrix (soil) IDW will include soil cuttings from soil borings and will be handled in accordance with SOP-501 Management of Solid Matrix Investigation-Derived Wastes (Appendix A). Soil cleanup levels for the OU2 site are listed below in Table 2-2.

Table 2-2
LSGPS OU2 Soil Cleanup Levels

Chemical of Concern	Cleanup Level (mg/kg)
PCE	0.65
TCE	0.72
cis-1,2-DCE	4.90
VC	0.16

Source: EPA-MDEQ, 2005

Soil cuttings will be transferred to roll-off boxes located on Soco-owned property. Roll-off box(es) will be clearly labeled and identify the source of the containerized material.

Roll-off boxes and drums will be labeled using a weather-resistant paint pen or drum label with the following information:

- Source of the soil IDW.
- Type of material.
- Sampling identification(s).
- Date the container was filled and sealed.
- Point of contact with phone number.
- "Contents Pending Analysis" text.

One representative composite IDW soil sample will be obtained from each roll-off box, in accordance with SOP-505 Sampling of Solid IDW (Appendix A) for analysis by Resource Conservation and Recovery Act (RCRA) TCLP procedure (see Section 2.2) for characterization before disposal. Based on the results of previous investigations at the site, the TCLP extract will be analyzed VOCs to determine if the soil IDW exceeds the toxicity characteristic. Table 2-3 presents the maximum concentration of contaminants for toxicity characterization of hazardous wastes as specified in 40 CFR 261.24. Based on the results of analytical data, a waste determination will be made and IDW labeled and managed as either hazardous or non-hazardous.

If laboratory results indicate that COC concentrations in the IDW solids are below site-specific soil cleanup levels presented in Table 2-2, the solids can be disposed of on-site by spreading the solids over the ground surface, within the impacted area of Soco-owned property. IDW solids that do not meet site-specific soil cleanup levels will be characterized for off-site disposal at a municipal landfill licensed to accept the IDW solids as characterized, or at a transport, storage and disposal (TSD) facility licensed under RCRA. Any such IDW solids will be sampled and analyzed according to landfill or TSD facility characterization requirements. If off-site disposal is required, ATC will notify the EPA and DEQ with the location where the waste will be shipped, prior to shipment.

Table 2-3
TCLP Maximum Concentration Limits

U.S. EPA Hazardous Waste Number	Contaminant	CAS Number	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5
D005	Barium	7440-39-3	100
D018	Benzene	71-43-9	0.5
D006	Cadmium	7440-43-2	1
D019	Carbon Tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100
D022	Chloroform	67-66-3	6
D007	Chromium	7440-47-3	5
D023	o-Cresol	95-48-7	200.0[a]
D024	m-Cresol 65794-96-9	108-39-4	200.0[a]
D025	p-Cresol	106-44-5	200.0[a]
D026	Cresol	--	200.0[a]
D016	2,4-D	94-75-7	10
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13[b]
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8/1024-57-3	0.008
D032	Hexachlorobenzene	118-74-1	0.13[b]
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3
D008	Lead	7439-92-1	5
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10
D035	Methyl ethyl ketone (2-Butanone)	78-93-3	200
D036	Nitrobenzene	98-95-3	2
D037	Pentachlorophenol	87-86-5	100
D038	Pyridine	110-86-1	5.0[b]
D010	Selenium	7782-49-2	1
D011	Silver	7440-22-4	5
D039	Tetrachloroethene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400
D042	2,4,6-Trichlorophenol	88-06-2	2
D017	2,4,5-TP (Silvex)	93-72-1	1
D043	Vinyl Chloride	75-01-4	0.2

[a] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.
[b] Quantitation limit is greater than the calculated regulatory level. The quantitation limit, therefore, becomes the regulatory level.

-- No standard exists

CAS = Chemical Abstracts Service

CFR = Code of Federal Regulations

U.S. EPA = United States Environmental Protection Agency

= Contaminants of concern

2.3.5.2 Liquid IDW

Liquid matrix IDW will include liquids from decontamination procedures, monitoring well purging, and preparation of equipment rinsate blanks. IDW water generated during RDA activities will be managed in accordance with the Management of Liquid Matrix Investigation-Derived Wastes SOP 051-501 (Appendix A). Specifically, liquid IDW will be temporarily placed in a stock or polyethylene tank or drums then treated by air sparging and then will be further treated with a granulated activated carbon (GAC) filter in a storage area located on Soco-owned property. The treated IDW water will then be sampled in accordance with the Sampling of Liquid Matrix Investigation-Derived Wastes SOP 051-504 and the samples will be submitted to Energy for laboratory analysis of VOCs by EPA Method 8260B.

If laboratory results indicate the liquid IDW water treatment achieves the OU2 groundwater cleanup levels listed below in Table 2-4, the water will be surface discharged on Soco-owned property. If laboratory results from the liquid IDW treatment indicate the treatment did not achieve cleanup standards for VOCs, the EPA and DEQ will be notified that ATC intends to dispose of the liquid IDW off-site or propose an alternate treatment method, based on the constituent or constituents not meeting surface discharge standards. If off-site disposal is proposed, ATC will select a disposal facility based on the constituent or constituents that do not meet the discharge limits, and notify the EPA and DEQ with the location where the waste will be shipped, prior to shipment.

Table 2-4
LSGPS OU2 Groundwater Cleanup Levels

Chemical of Concern	Cleanup Level (µg/L)
PCE	5.0
TCE	5.0
cis-1,2-DCE	70.0
Vinyl chloride	2.0

Source: EPA-MDEQ, 2005

As discussed in ATC's Groundwater Monitoring Work Plan (ATC, 2012a) and the technical team meeting notes dated February 27, 2012, if the liquid matrix IDW achieved cleanup standards for surface discharge after air sparging, during the April 2012 sampling event, future post-treatment IDW samples will only be analyzed for VOCs. Liquid IDW from the April 2012 groundwater monitoring and sampling event was treated by air sparging and all constituents were below cleanup standards. Therefore, all future liquid matrix IDW will be sampled only for VOCs by EPA Method 8260B.

2.3.5.3 Solid Waste

Solid waste IDW, including PPE and disposable investigation equipment, that is generated throughout the monitoring activities will be placed in dedicated heavy duty plastic garbage bags or containers and will be disposed of at the Billings Regional Landfill, located in Billings, Montana, in accordance with the Management of Liquid Matrix Investigation-Derived Wastes SOP 051-501 and Management Of Solid Matrix Investigation Derived Wastes SOP 051-502 (Appendix A).

2.3.6 Sample Containers and Holding Times (B3)

The type and number of sample containers required for each sample type along with preservatives, shipping temperatures, and holding times are summarized below in Table 2-5.

Table 2-5
LSGPS OU2 RDA Laboratory Analytical Methods and Sample Requirements

Parameter	Matrix	Method No.	Sample Volume	Sample Container	Containers per Sample	Preservative	Shipping Temp	Holding Time
VOC	Water	8260B	40 mL	VOA vial	3	Hydrochloric acid	≤6°C	14 days
VOC	Soil	8260B	125 mL	Wide-mouth glass	1	Unpreserved	≤6°C	14 days
TCLP	Soil	1311	125 mL	Wide-mouth glass	1	Unpreserved	≤6°C	14 days

2.3.7 Other Monitoring

Monthly fluid level measurements will be collected from the Study wells for one year. The purpose of the monthly fluid measurements is to evaluate temporal groundwater levels in Study wells and to collect baseline water level data prior to pilot testing and remedy implementation. Additionally, the water level data will be used to evaluate potential interaction between Coulson Ditch and groundwater, if the ditch is returned to service.

Fluid level measurements will be collected in accordance with SOP 051-204 Measuring Fluid Levels (Appendix A). An interface probe will be used to measure fluid levels and total depth of each Study monitoring well. The measurements will be recorded on the Fluid Level Field Data Form (RDAWP Appendix E) and if LNAPL or DNAPL is detected while gauging the well, the depth to the separate phase liquid will also be recorded on the data sheet. Fluid levels will be measured to the nearest 0.01 ft from the established measuring point.

The monthly fluid level measurements data will be reported separately from the data collected as part of the RDA, after completion of the yearlong event. Fluid level measurements will be included in OU2 progress reports.

No other continuous monitoring, in-situ monitoring, or remote sensing is anticipated at this time. If needed in the future, these additional monitoring activities will be detailed in task specific sample and analysis plans (SAPs).

2.3.8 Field Measurements Methods and Equipment (B6)

The following field parameter measurements will be measured as part of RDA groundwater sample collection for the chemical oxidation bench-scale treatability study and the discrete interval multi-level sampling event:

- Depth to groundwater;
- Depth to LNAPL (if present);
- Depth to DNAPL (if present);
- Temperature;
- pH;
- DO;
- ORP; and/or
- SC.

An interface probe will be used to collect fluid level measurements and measurements will be made to the nearest 0.01 foot. A YSI® 556 MPS multi-probe meter or similar instrument will be used to measure water quality field parameters, following the manufacture's operating instructions. All measurements of groundwater samples, as specified in the RDAWP, will be made in accordance with ATC SOP 051-204 Measuring Fluid Levels, 051-205 Measuring Water

Quality Field Parameters, 051-201 Groundwater Sampling Using Low-Flow Methods, or 051-209 Groundwater Sampling Using HydraSleeves™ (Appendix A).

The following field parameter measurements will be measured as part of RDA soil sample collection for the chemical oxidation bench-scale treatability study and the boring/monitoring well installations:

- Total organic vapor (TOV)

A PID will be used to field-screened the soil samples for the presence of TOV headspace concentrations measured in parts per million by volume (ppm). All measurements of soil samples, as specified in the RDAWP, will be made in accordance with SOP-051-400 Organic Vapor Headspace Measurement.

2.3.9 Equipment/Supplies Inspections and Corrective Measures (B6)

ATC PMs have the primary responsibility for identifying the types and quantities of supplies and consumables needed to complete all tasks. When supplies are received, the field team members will inspect the condition of all supplies before they are accepted for use on a project. If an item is determined deficient, it will be noted and the item will then be returned to the vendor for replacement or repair.

When ordering sample bottles from an analytical laboratory, extra sample containers will be obtained in addition to the required number of samples in case of breakage or malfunction. If required, additional preservative may be acquired from the laboratory as well.

ATC field personnel will examine field measurement and sampling equipment used for field sampling to verify that they are in operating condition, prior to use in the field. If company owned field equipment needs immediate replacement, a similar piece of equipment may be rented from a local supplier for the sampling event. ATC field personnel will notify the PM, who will determine if the equipment should be sent in for repair and a replacement rented, or if a new piece of equipment should be purchased. Problems encountered and their resolution will be documented in the field logbook as discussed in Section 2.4.3.1.

Field corrective action procedures will depend on the type and severity of the finding. ATC classifies assessment findings as either safe or at-risk. At-risk behaviors are those that could lead to an employee exposure, incident, or property damage event and have a significant impact on data quality and that may require corrective action.

ATC project teams are required to respond to at-risk behaviors identified in field audits as discussed in Section 3.2.1. The PM and field team member(s) will meet to discuss any deficiencies and the appropriate steps to resolve each deficiency by:

- Determining when and how the problem developed;
- Assigning responsibility for problem investigation and documentation;
- Selecting the corrective action to eliminate the problem;
- Developing a schedule for completing the corrective action;

- Assigning responsibility for implementing the corrective action;
- Documenting and verifying that the corrective action has eliminated the problem; and
- Documenting the problem and corrective action.

In responding to the site audit, the project team will include a brief description of each deficiency, the proposed corrective action, the individual responsible for determining and implementing the corrective action, and the completion dates for each corrective action. The PM will monitor the status of all corrective actions.

The ATC PM is responsible for reviewing proposed corrective actions and verifying that those actions have been effectively implemented. The PM can require data acquisition to be limited or discontinued until the corrective action is complete and a deficiency is eliminated. The PM can also request the reanalysis of any or all data acquired since the system was last in operation to affirm the reliability of acquired data.

2.4 Sample Identification, Handling and Documentation (B3)

All samples will be identified and handled in accordance with the appropriate ATC SOP 051-104 Sample Documentation in Appendix A. The following sections provide details of how all samples are to be identified and handled and how sampling and sample handling procedures are to be documented.

2.4.1 Sample Identification (B3)

Each sample collected will be assigned a unique sample identification. The sample identification system is designed to be compatible with the existing database which includes results from previous investigations conducted at OU2. The sample numbering system allows each sample to be uniquely identified, and provides a means of tracking the sample from collection through analysis. Monitoring wells installed as part of the RDA, with the exception of replacement well MW125R, will be sequentially numbered beginning with MW400. The 400 series will indicate wells installed as part of the RDA. The four shallow offset wells installed within the delineated northwest source area will be identified similarly to the primary, fully penetrating monitoring well, but an “S”, indicating shallow, will be appended to the shallow well station identification. If other nested wells are installed, an “S” will be assigned to the shallow well, “I” for an intermediate screened well (if a well is screened at an intermediate depth) and “D” for a deep well screen. This naming convention will allow easily recognized, intuitive well and sample identification.

Each sample will be assigned a distinctive identification number with alpha characters indicating the station type followed by three numeric characters identifying the station number, followed next by two letters indicating the sample media type. For each sample location that is representative of a sample depth, numeric characters indicating the depth of the sample collected will follow the station number. Every sample location will receive a unique identification number yet to be identified. For a duplicate sample collected, the same unique identification will be followed with the exception of the series number 701 will be assigned to the duplicate sample, consistent with the existing program.

Possible station types include:

- SB - Soil Boring;
- MW - Monitoring Well;
- PZ - Piezometer; or
- IDW - Investigation-Derived Waste.

Possible sample media include:

- SB - Subsurface Soil;
- GW - Groundwater;
- HS - HydraSleeve™;
- RB - Equipment Blank;
- SM - Solid Matrix IDW; or
- LM - Liquid Matrix IDW.

ATC typically refers to rinsate blanks as equipment blanks. The abbreviation RB will be used as equipment blank sample identifiers to ensure consistency with historic equipment blank references in the database. The abbreviation TB will be used as trip blank sample identifiers.

Example sample identifications include:

- The first soil boring sample collected from three to four feet bgs: SB001SB-3-4;

- Soil boring sample collected from three to four feet bgs at new monitoring well MW400 location: SB400SB-3-4;

- Duplicate soil boring sample collected from three to four feet bgs at a new monitoring well MW400 location: SB400SB-3-4-701;

- Multi-level groundwater sample collected from monitoring well at interval 30 feet bgs: MW100HS-30;

- Duplicate multi-level groundwater sample collected from a monitoring well at interval 30 feet bgs: MW100HS-30-701;

- Due to historic samples, co-located soil sample for PT-02 collected from six to eight feet bgs: PT-2C-6-8;

- Since no additional historic co-located samples exist, to avoid confusion and data gaps in the naming convention, the remaining co-located soil samples collected from four to eight feet bgs: PZ-8B-4-8, PZ-10-4-8, PZ-11-4-8, PZ-19-4-8;

- The first solid matrix IDW sample: IDW001SM; or

- The first liquid matrix IDW sample: IDW001LM.

COCs concentrations in ambient air, sufficient to impact monitoring results, have not been measured at the site. Therefore, field blanks will not be collected during sampling field events.

2.4.2 Sample Labels (B3)

Each individual sample container will have affixed to it a label prepared by the sample collector with the following information legibly written in indelible ink:

- Project name and location;
- Sample identification number;
- Date and time of sample collection;
- Preservative used;
- Sample collector's initials; and
- Analysis required.

Pre-labeled sample containers may be used. If pre-labeled sample containers are used, the date and time of sample collection, the samplers initials, and any other information not included on the label will be filled out at the time of sample collection. Examples of sample labels can be found in Appendix D.

2.4.3 Field Documentation (B3)

Field activities will be documented by field personnel while on-site at OU2 in accordance with ATC's SOP 051-102 Field Forms (Appendix A). Collection of all samples will also be documented in accordance with ATC's SOPs, including chain-of-custody forms. All samples will be packaged and shipped in accordance with ATC's SOP 051-105 Sample Packaging and Shipping (Appendix A). Details of field activities documentation are discussed below.

2.4.3.1 Field Logbooks (B3)

Field personnel will use permanently bound field logbooks with sequentially numbered pages to record and document field activities. The logbook will list the site name and the PM. All field entries will be written in black or blue indelible ink. All corrections will be made utilizing a single line through the error, along with the date the correction was made, and the field personnel's initials. At a minimum, the following information will be recorded in the field logbook:

- Date and time of initiating field work;
- Name and affiliation of all OU2 on-site personnel or visitors;
- Weather conditions during the field activity;
- Summary of daily activities and significant events;

- Notes of conversations with coordinating officials;
- References to other field logbooks or forms that contain specific information;
- Equipment ID numbers, if relevant;
- Any field measurement made that is not recorded on a dedicated field form;
- Discussions of problems encountered and their resolution;
- Discussions of deviations from the RDAWP or other governing documents; and
- Description of all photographs taken.

ATC field personnel will use the appropriate field forms to record field activities in accordance with SOP 051-102 Field Forms (Appendix A).

2.4.3.2 Sample Documentation (B3)

In addition to the provisions for documents and records discussed in Section 1.6 of this RDAQAPP, ATC personnel will adhere to the following general guidelines for maintaining field documentation:

- Documentation will be completed in permanent blue or black ink;
- All entries must be legible;
- Errors will be corrected by crossing out with a single line and then dating and initialing the lineout; and
- Unused portions of pages will be crossed out, and each page will be signed and dated.

The ATC On-Site Field Supervisor is responsible for ensuring that sampling activities are properly documented.

2.4.3.3 Chain-of-Custody (B3)

ATC will use standard sample custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis in accordance with the appropriate ATC SOP 051-104 Sample Documentation (Appendix A). A sample will be considered to be in custody if one of the following statements applies:

- The sample is in a person's physical possession or view;
- The sample is in a secure area with restricted access; or
- The sample is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Chain-of-custody procedures provide an accurate written record that traces the possession of

individual samples from the time of collection in the field to the time of acceptance at the laboratory. Chain-of-custody records also will be used to document all samples collected and the analysis requested. Information that the field personnel will record on the chain-of-custody record includes:

- Project name and number;
- Sampling location;
- Name and signature of sampler;
- Destination of samples (laboratory name);
- Sample identification number;
- Date and time of collection;
- Number and type of containers filled;
- Analysis requested;
- Preservatives used (if applicable);
- Filtering (if applicable);
- Sample designation (grab or composite);
- Signatures of individuals involved in custody transfer, including the date and time of transfer;
- Airbill number (if applicable); and
- Project contact and phone number.

Chain-of-custody records that are initiated in the field will be signed by field personnel, and the airbill number (if necessary) will be recorded. The record will be placed in a waterproof plastic bag and taped to the inside of the shipping container used to transport the samples. Signed airbills will serve as evidence of custody transfer between field personnel and the courier, and between the courier and the laboratory. Copies of the chain-of-custody record and the airbill will be retained and filed by field personnel before the containers are shipped.

Laboratory chain-of-custody begins with sample receipt and continues until samples are discarded. The responsiblities of the laboratory custodian will be will conducted by the Samantha Rupe, laboratory project manager, but may also be designated to other competent individuals, as deemed appropriate by the laboratory project manager. The custodian will receive all incoming samples, sign the accompanying custody forms, and retain copies of the forms as permanent records. The laboratory sample custodian will record all pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature; or other relevant remarks), the sample identification numbers, and any unique

laboratory identification numbers for the samples. Once the sample transfer process is complete, the custodian is responsible for maintaining internal logbooks, tracking reports, and other records necessary to maintain custody throughout sample preparation and analysis. Examples of chain-of-custody and shipping airbill forms can be found in Appendix D.

2.4.4 Sample Packaging and Delivery (B3)

On November 14, 2012, the EPA provided written approval for the selection of Energy as an appropriate subcontractor to use as the contract analytical laboratory (Hoogerheide, 2012). Energy has a laboratory in Billings, Montana and soil and groundwater samples collected as part of the RDA for analysis by Energy will be delivered to the Billings, Montana Energy laboratory by ATC personnel.

Field personnel will follow sample shipment procedures provided in the Sample Packaging and Shipping SOP 051-105 (Appendix A). However, because RDA samples will be hand-delivered to a local laboratory (Energy), not all shipping procedures are necessary. The following procedures will be implemented for samples collected and hand-delivered for this project:

- The cooler will be filled with bubble wrap, sample bottles, and packing material. Sufficient packing material will be used to prevent sample containers from breaking during delivery. Enough ice will be added to maintain the sample temperature at ≤6ºC;

- The chain-of-custody records will be placed inside a plastic bag. The bag will be sealed and placed inside of the cooler. The laboratory will be notified if the sampler suspects that the sample contains any substance that would require laboratory personnel to take safety precautions; and

- When the cooler is hand-delivered to Energy, laboratory personnel will open the cooler and sign the chain-of-custody record to document transfer of samples.

Additionally, bulk soil and groundwater samples will be collected for the bench-scale treatability study and shipped for analysis in the Chemical Oxidation Laboratory at WSU. Field personnel will follow sample shipment procedures provided in the Sample Packaging and Shipping SOP 051-105. The following procedures will be implemented for samples collected and shipped for this project:

- The cooler will be filled with bubble wrap, sample bottles, and packing material. Sufficient packing material will be used to prevent sample containers from breaking during delivery. Enough ice will be added to maintain the sample temperature at ≤6ºC;

- The chain-of-custody records will be placed inside a plastic bag. The bag will be sealed and placed inside of the cooler and tape it to the inside lid of the shipping container. The laboratory will be notified if the sampler suspects that the sample contains any substance that would require laboratory personnel to take safety precautions;

- The shipping container will be closed and sealed using packing or fiberglass strapping tape; and

- The shipping label will be secured with the address, phone number, and return address clearly visible.

Samples will be shipped using standard, reliable carriers. All samples will be maintained in sealed containers under chain-of-custody procedures for the duration of shipping.

2.5 Quality Control Requirements (B5)

QC requirements ensure that the environmental data collected are of the highest standard feasible as appropriate for the intended application. OU2 QC requirements are provided in the following sections. Where applicable, QC checks will be strictly followed during the RDA through the use of replicate measurements, equipment calibration checks, and data verification by ATC field personnel. Field sampling precision and data quality will be evaluated through the use of field calibration checks, sample duplicates, equipment (rinsate) blanks, temperature blanks, and trip blanks. Sample duplicates provide precision information regarding homogeneity, handling, transportation, storage, and analysis. Equipment blanks will be used to ensure that proper decontamination procedures have been performed and that no cross contamination has occurred during sampling or transportation. Temperature blanks will be used to ensure that samples remain at the proper preservation temperature prior to analysis. Trip blanks will be used with VOCs samples to ensure that sample containers/samples have not been contaminated with VOCs during transportation or handling. If there is any discrepancy in the sample data, the ATC PM will be notified and, if deemed necessary, resampling will be performed.

Laboratory QAMs will be responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with method and laboratory specifications. Samples will be analyzed within their holding times. Internal laboratory duplicates and calibration checks are performed at a frequency of 5 percent, i.e., one of every 20 samples submitted for analysis per SDG. Other internal laboratory QA/QC may be performed if required by laboratory-specific QA/QC protocols.

The laboratory personnel will record all pertinent information concerning the samples, including the persons delivering the samples, the date and time received, sample condition at the time of receipt (sealed, unsealed, or broken container; temperature; or other relevant remarks), the sample identification numbers, and any unique laboratory identification numbers for the samples. Once the sample transfer process is complete, the laboratory is responsible for maintaining internal logbooks, tracking reports, and other records necessary to maintain custody throughout sample preparation and analysis. The Energy laboratory QA/QC manual is included in Appendix B.

2.5.1 Field Quality Control Requirements (B5)

Field sampling precision and data quality will be evaluated through the use of field calibration checks, sample duplicates, equipment (rinsate) blanks, liquid temperature blanks, and liquid trip blanks. Field calibration checks allow the assessment of field equipment sensitivity by checking the detection limits of direct-read field instruments. Sample duplicates provide precision information regarding homogeneity, handling, transportation, storage, and analysis. Equipment blanks will be used to ensure that proper decontamination procedures have been performed and that no cross contamination has occurred during sampling. Liquid temperature blanks will be used to ensure that samples remain at the proper preservation temperature prior to analysis (≤6°C). Liquid trip blanks will be used with groundwater samples to ensure that sample containers/samples have not been contaminated with VOCs during transportation or handling. If there is any discrepancy in the sample data, the ATC PM will be notified, who will then notify

EPA and DEQ. If deemed necessary, resampling will be performed.

All reusable equipment will be decontaminated following each use. Following decontamination of equipment, rinsate samples will be collected at a frequency of one sample per day. Equipment rinsate samples are collected by pouring or running (pumping) clean water through the equipment and into sample containers (i.e., VOA vials, see Section 2.3.6). Rinsate samples will be submitted to Energy for VOC analysis according to EPA Method 8260B.

2.5.2 Laboratory Quality Control Requirements (B5)

Samples will be analyzed within their sample holding times. The sample holding time refers to the length of time within which a sample remains representative of the environmental conditions of the matrix from which it was collected.

Internal laboratory duplicates and calibration checks are performed at a frequency of 5 percent, i.e., one of every 20 samples submitted for analysis per SDG. Other internal laboratory QA/QC may be performed if required by laboratory-specific QA/QC protocols.

LCSs will be prepared and analyzed at a frequency of 5 percent (one LCS for every 20 field samples) for liquid matrix samples.

Laboratory accuracy will also be evaluated by surrogate compound recovery where surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compounds are not expected to be found occurring naturally in the samples, but behave analytically similar to the compounds of interest. Consequently, surrogate compound percent recoveries provide information on the effect that the sample matrix exhibits on the accuracy of the analyses.

MS/MSD samples will be run at a frequency of 5 percent (one MS/MSD for every 20 field samples).

Laboratory QAMs will be responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with method and laboratory specifications. Internal laboratory duplicates and calibration checks are performed at a frequency of 5 percent, i.e., one of every 20 samples submitted for analysis per SDG. Other internal laboratory QA/QC may be performed if required by laboratory-specific QA/QC protocols.

Any control limits that are exceeded will be noted in laboratory reports, and if any of the QC acceptance criteria are exceeded results will be identified according as discussed in Section 4.2.

2.5.3 Instrument/Equipment Testing, Inspection, and Maintenance (B6)

Equipment testing, inspection, and maintenance will be engaged as preventative measures to reduce or eliminate delays in work. Major components of these preventative measures include establishing testing, inspection, and maintenance responsibilities and schedules for critical sampling and analysis equipment required for OU2. The laboratory QA/QC manual is included in Appendix B.

2.5.3.1 Field Instruments (B6)

All field equipment, including direct-read instruments such as water quality meters, will be stored, maintained, and used in accordance with the manufacturer's recommendations. All field equipment will be inspected for signs of physical damage or malfunction daily prior to use by field personnel. Any and all maintenance and repairs will be documented in equipment logs or field logbooks.

Direct-read field instruments will be calibrated as described in Section 2.6.1 in accordance with ATC SOP 051-205 Measuring Water Quality Field Parameters or SOP-400-Organic Vapor Headspace Measurement (Appendix A). Field instruments will be calibrated at least daily while in use. All field equipment will be inspected for signs of physical damage or malfunction daily prior to use by field personnel. Calibration records for field instruments will be maintained in logbooks.

Spare or replacement parts for all field measurement instruments and equipment are available directly through the manufacturers, or may be acquired from known, reliable retailers such as Geotech Environmental Equipment, Inc. of Denver, Colorado and TSD Technical Specialists, Inc. of Billings, Montana. Replacement equipment and parts will be acquired, if needed, in a timely manner to reduce or eliminate work delays. Replacement parts which are subject to frequent failure or which cannot be acquired from outside sources in a timely manner will be maintained in-house.

The ATC PM is responsible for ensuring that all instruments and equipment used by field personnel meet the project quality standards through testing, inspection, and maintenance. ATC field personnel are responsible for inspecting all field equipment for damage prior to use.

Any instruments or equipment found to be deficient of project quality standards will be replaced, repaired, or re-cleaned. Any replaced, repaired, or re-cleaned instruments or equipment will be subject to the same testing and rigors described above, including documentation, to determine if additional corrective action is required. Field equipment found to be in need of repair or replacement will be clearly labeled and removed from service until such repair or replacement can be made.

2.5.3.2 Laboratory Instruments (B6)

The laboratory will engage in routine preventative maintenance to minimize the malfunction of analytical instruments and equipment. All such instruments and equipment will be subject to routine preventative measures in accordance with the manufacturer's recommendations. Any and all maintenance and repairs will be documented in logbooks. Receipts for instrument and equipment maintenance performed by manufacturer personnel will also be filed and maintained. Lists of laboratory instruments and equipment are included in the laboratory QA/QC manual in Appendix B.

Laboratory instruments and equipment will be subject to standard calibration procedures, as described in the laboratory QA/QC manual in Appendix B, which are consistent with approved analytical methods. The laboratory will maintain calibration records for laboratory instruments and equipment.

The laboratory will acquire spare or replacement parts for laboratory instruments and equipment requiring non-major preventative or repair measures. Such measures will be performed by

qualified laboratory personnel. Major preventative or repair measures will be performed by the instrument or equipment manufacturer personnel.

Testing, inspection, and maintenance of laboratory instruments and equipment will be done on a schedule consistent with the manufacturer's recommendations or more frequently, as needed. Major repairs and maintenance will be performed by the instrument manufacturer, while routine preventative measures will be performed by qualified laboratory personnel.

Laboratory instruments and equipment found to be deficient of project quality standards will be clearly labeled and removed from service until repairs or replacement can be made. Every effort will be made to return the instrument or equipment to working order or analyze samples by an equivalent method within their holding times. Should this not be possible, alternate corrective measures will be considered and decisions made accordingly.

2.6 Instrument Calibration and Frequency (B7)

Calibration is the process of verifying and, if necessary, adjusting the measurements of measuring equipment to correct the measurements to known standards. Measuring equipment used in the field and laboratory will be subjected to a formal calibration program. Equipment of the proper type, range, accuracy, and precision to provide data compatible with the specified requirements and the desired results are required for OU2.

Equipment that fails calibration or becomes inoperable during use will be removed from service, segregated to prevent inadvertent use, and tagged to indicate the fault. Such equipment will be recalibrated and repaired to the satisfaction of the laboratory personnel or ATC field personnel, as applicable. Equipment that cannot be repaired will be replaced.

Records will be prepared and maintained for each piece of calibrated measuring and testing equipment to document that established calibration procedures have been followed. Records for ATC field equipment used for OU2 will be kept in the project files. Laboratories will maintain laboratory calibration records.

2.6.1 Field Instrument Calibration (B7)

ATC field personnel are responsible for the calibration of ATC field equipment, including water quality meters and PIDs, following the instrument manufacturer's calibration procedures. Field instruments will be calibrated at least daily while in use. It is the responsibility of ATC field personnel to determine if a higher frequency of calibration is warranted based on instrument use and COC contaminant levels encountered.

Instruments used to gather, generate, or measure field environmental data will be calibrated with sufficient frequency and in such manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications and in accordance with ATC SOP 051-205 Measuring Water Quality Field Parameters, and 051-400 Organic Vapor Headspace Measurement (Appendix A).

Calibration procedures will be documented in the field logbook and field sampling sheets. Documentation will include the following:

- Date and time of calibration;

- Identity of the person performing the calibration;
- Reference standard used, if applicable;
- Reading taken and adjustments to attain proper reading; and
- Any corrective action.

ATC field personnel will examine field measurement equipment used during field sampling to verify that they are in operating condition. The ATC On-site Field Supervisor will periodically audit the calibration and field performance of the field equipment to ensure that the system of field calibration meets the manufacturer's specifications. Equipment which at any time prior to or during use does not calibrate properly or which displays physical signs of damage will not be used. Any such equipment will be repaired or replaced as appropriate.

2.6.2 Laboratory Instrument Calibration (B7)

All laboratory instruments will be calibrated according to method-specific requirements, and it is the responsibility of the individual laboratory to ensure proper calibration. Each type of instrumentation and each analytical method have specific requirements for the calibration procedures, depending on the analytes of interest and the sample medium.

The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with method-specific requirements and EPA National Functional Guidelines (EPA, 2010 and 2008). The laboratory QAM will be responsible for ensuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory SOPs will be followed for corrective actions and preventative maintenance frequencies. Laboratory QC calibration procedures are included in laboratory-specific operations manual in Appendix B for Energy.

2.7 Data Quality Control Limits (B5)

Data quality control limits are established as acceptance criteria. The QA goal will be to have all samples and measurements representative of the media sampled. Field equipment will be checked for calibration as described in Sections 2.5.3.1 and 2.6.1. Table 1-5 (Section 1.4.2.8.1) identifies field (direct-read) instrument ranges and accuracies. For liquid matrix samples, the RPD between duplicate samples must be less than 25 percent. A calculated RPD of greater than 25 percent indicates that duplicate samples are not in agreement and signals problems with precision. Temperature blanks should indicate that samples are maintained at the proper preservation temperature prior to analysis (≤6°C). However, if samples are packaged and delivered immediately upon collection there may not be sufficient time for the sample temperatures to decrease to the proper holding temperature. In such cases details of such sampling, packaging and delivery activities will be disclosed to the laboratory at the time of sample delivery and all such activity will be documented by both ATC and laboratory personnel.

Equipment blanks and trip blanks should not contain detectable levels of COCs. Detection of COCs in either equipment blanks or trip blanks indicates potential cross contamination during sample collection, handling, or shipping. Samples will be analyzed within their holding times. Samples analyzed outside of their holding times may not be representative of the environmental

conditions of the matrix from which they were collected. Table 2-5 in Section 2.3.6 details required sample shipping temperatures and holding times.

Laboratory accuracy is assessed by evaluating the %R from LCS. Laboratory accuracy will also be evaluated by surrogate compound recovery where surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Table 1-3 (Section 1.4.2.4) details laboratory precision and accuracy criteria. Laboratory surrogate acceptance criteria are detailed in Table 1-4 (Section 1.4.2.4). The laboratory completeness goal is for 90 percent of the samples analyzed to be valid data.

Data exceeding project QC limits will be clearly identified as such in all documents. Corrective actions for equipment failure or malfunction are described in Sections 2.2.4 and 2.5.3.1. Steps to identify the cause of the QC limit exceedance and prevent its reoccurrence will be taken. Resampling and/or reanalysis may be performed, should data requirements necessitate such steps.

2.7.1 Data Quality Indicators and Measurement Criteria (B5)

All primary data will be evaluated in accordance with the following DQIs to ensure that DQOs are achieved: PARCCS. These DQIs are among those recommended by the EPA for data quality evaluation and measurement criteria (EPA, 2001a and 2001b).

2.7.2 Precision (B5)

Precision is the degree of agreement among repeated measurements of the same parameter under the same or similar conditions. Precision is reported as the RPD:

$$RPD\# \frac{|S - D|}{(S + D)/2} \times 100$$

where S is the original sample result, and D is the duplicate sample result.

2.7.2.1 Field Precision Objectives (B5)

Field precision will be assessed through the collection and analysis of field duplicate samples. RPDs will be calculated for the detected analytes from original and duplicate samples. A summary of duplicate samples to be collected, along with all other QC samples, is presented in Section 1.4.2.1.1. Field duplicate samples will be provided at a minimum frequency of one duplicate for every 20 original samples.

2.7.2.2 Laboratory Precision Objectives (B5)

Precision of laboratory analyses will be based upon the RPD between LCS and LCSD results. For liquid and solid matrix samples, LCS/LCSD analyses will be performed at a rate of 5 percent (one per 20 samples received by the laboratory). Laboratory precision acceptance criteria are presented in Section 1.4.2.4.

2.7.3 Accuracy (B5)

Accuracy is the extent of agreement between an observed or measured value and the accepted reference, or true, value of the parameter being measured.

2.7.3.1 Field Accuracy Objectives (B5)

The objective for accuracy of the field sample collection procedures is to ensure that samples are not affected by sources external to the sample, such as sample contamination by ambient conditions or inadequate equipment decontamination procedures. Sampling accuracy will be assessed by evaluating the results of equipment and trip blank samples for contamination.

A trip blank will consist of a laboratory-prepared sample of reagent-grade water. Trip blanks will accompany sample containers and be subjected to the same handling procedures as the field samples, but will not be opened and will be shipped back to the laboratory with the field samples. Trip blanks are required only when VOCs will be analyzed. Trip blanks will be submitted at the rate of one trip blank per shipping container containing field samples for laboratory VOC analysis. The trip blank samples will provide a measure of potential cross contamination of samples by VOCs during shipment and handling.

Equipment blanks will be collected by pouring or running clean water or distilled water over or through the field sampling equipment and collecting the rinsate in the proper analytical containers. Equipment blanks must be submitted to the laboratory with investigative samples and analyzed for the same parameters as the investigative samples. The minimum collection frequency is one equipment blank per day.

2.7.3.2 Laboratory Accuracy Objectives (B5)

Laboratory accuracy is assessed by evaluating the %R from LCS according to the following expression:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where: SSR = Spiked Sample Result
SR = Sample Result or Background
SA = Spike Added

LCSs will be prepared and analyzed at a frequency of 5 percent (one LCS for every 20 field samples) for liquid and solid matrix samples.

Laboratory accuracy will also be evaluated by surrogate compound recovery where surrogate compounds are added to each sample, standard, blank, and QC sample prior to sample preparation and analysis. Surrogate compounds are not expected to be found occurring naturally in the samples, but behave analytically similar to the compounds of interest. Consequently, surrogate compound percent recoveries provide information on the effect that the sample matrix exhibits on the accuracy of the analyses.

2.7.3.3 Laboratory Precision and Accuracy Summary (B5)

OU2 laboratory precision and accuracy criteria for EPA Methods 8260B are summarized in Table 1-3, and surrogate recovery acceptance criteria are summarized in Table 1-4 (Section 1.4.2.4).

2.7.4 Representativeness (B5)

Representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental conditions of OU2. It also reflects the ability of field personnel to collect samples and laboratory personnel to analyze those samples in such manners that the data generated accurately and precisely reflect the conditions at OU2.

2.7.4.1 Measures to Ensure Representativeness of Field Data (B5)

Representativeness will be achieved by ensuring that sampling locations are properly selected. Representativeness is dependent upon the proper design of the sampling program and will be accomplished by ensuring that this RDAQAPP, task-specific work plans, and SOPs are followed. The QA goal will be to have all samples and measurements representative of the media sampled.

2.7.4.2 Measures to Ensure Representativeness of Laboratory Data (B5)

Representativeness of laboratory data cannot be quantified. However, adherence to the prescribed analytical methods and procedures, including holding times, blanks, and duplicates will ensure that the laboratory data are representative.

2.7.5 Completeness (B5)

Completeness is defined as the measure of the quantity of valid data obtained from a measurement system compared to the quantity that was expected under normal conditions. Completeness is quantified according to the following expression:

$$\% \text{ Completeness} = \frac{\text{Number of Valid (usable) measurements}}{\text{Number of Measurements Planned}} \times 100$$

While a completeness goal of 100 percent is desirable, an overall completeness goal of 90 percent may be realistically achieved under normal field sampling and laboratory analysis conditions.

2.7.5.1 Field Completeness Objectives (B5)

Field personnel will take measures to ensure the integrity and validity of field samples. However, some samples may be broken during handling and transit. Therefore, field completeness goals for this project will be to have 90 percent of all samples to be valid data.

2.7.5.2 Laboratory Completeness Objectives (B5)

Laboratory completeness will be a measure of the quantity of valid data measurements and analyses obtained from all the measurements and analyses completed for the project. The laboratory completeness goal is for 90 percent of the samples analyzed to be valid data.

2.7.6 Comparability (B5)

The confidence with which one data set can be compared to another is a measure of comparability. The ability to compare data sets is particularly critical when a set of data for a specific parameter is compared to historical (secondary) data for determining trends.

To ensure comparability of field data, all samples will be consistently collected and properly handled in accordance with specific SOPs. Likewise, all samples will be consistently analyzed in accordance with the matrix-specific EPA methods.

2.7.7 Sensitivity (B5)

Sensitivity is the ability of a method or instrument to detect a parameter to be measured at a level of interest.

2.7.7.1 Field Data Sensitivity (B5)

The field data sensitivity requirement for OU2 is such that detection limits of direct-read field instruments used to measure field parameters are equal to or below the concentrations necessary for adequate characterization of the particular parameter. Field calibration checks will serve to assess field data sensitivity. For liquid matrix measurements, a YSI 556 MPS multi-probe meter or similar instrument will be used, and a MultiRAE PGM50-5P PID or similar instrument will be used for measuring organic vapors. The measurement ranges and corresponding accuracies for the parameters measured by these instruments are listed in Table 1-5 (Section 1.4.2.8.1).

2.7.7.2 Laboratory Data Sensitivity (B5)

The laboratory sensitivity requirement for OU2 is such that laboratory detection limits are equal to or below EPA/DEQ standards for all analytes in all matrices. Laboratory detection and RLs are summarized in Table 1-6 (Section 1.4.2.8.2).

2.8 Inspection/Acceptance of Supplies and Consumables (B8)

The ATC PM is responsible for ensuring that any and all consumables used by field personnel meet the project quality standards. ATC field personnel are responsible for maintaining a sufficient quantity of supplies and consumables for project activities. All supplies and consumables will be used and maintained in accordance with manufacturer recommendations and protocols. Any need for non-routine supplies and equipment will be discussed through consultation with the ATC PM. Laboratory-supplied supplies and consumables will be certified clean as an acceptance criterion.

Any supplies or consumables displaying physical signs of damage or malfunction, which are known or suspected of having been exposed to contaminants, or which have been stored or maintained under conditions not in accordance with the manufacturer recommendations will be

discarded and replaced. Sources for supplies and consumables will be identified prior to their need. Supplies and consumables will be acquired from known, reliable sources which will be documented. Supplies and consumables which are not available locally will be ordered in advance of their intended use to ensure that there are no delays in project field work.

2.9 Non-Direct Measurements (B9)

Non-direct measurements/data are data not generated directly as part of the RDA activities, and are referred to as secondary data in this RDAQAPP. If the future collection and/or use of secondary data is deemed necessary, a QAPP addendum will be issued. This addendum will detail the intended use, acceptance criteria, and selection rationale for the secondary data. All such secondary data will be evaluated as to their quality and usability, and any secondary data that do not meet the quality and usability standards of this RDAQAPP but determined necessary for RDA activities will be qualified (see Section 4.0) and identified accordingly in any documents in which such data are cited or referenced.

2.10 Data Management (B10)

Data generated during RDA field activities are recorded using field forms or field logbooks using hard copy or electronic media. These forms are reviewed for completeness and accuracy by the ATC On-Site Field Supervisor and by the ATC QAM and Database Manager (DM). Field documentation will meet the requirements of ATC's SOP 051-102 Field Forms and SOP 051-104 Sample Documentation (Appendix A).

Data from the field forms will be manually entered into the database and will undergo a peer review conducted by a project team within ATC. Management of all OU2 data is the responsibility of the ATC DM.

Data generated during laboratory analysis are recorded in hardcopy and as EDD after the samples have been analyzed. Laboratories will send the hardcopy and EDD records to the ATC DM, who will, in turn, send the deliverables to the ATC QAM. The ATC QAM will review the data deliverable for a given SDG. The data will then be validated and reviewed, and finally loaded, with the appropriate data qualifiers, into the existing Microsoft Access© database, which includes results from previous investigations conducted at OU2.

EDDs are required for all analytical results. An automated laboratory information management system will be used to produce the EDD. The laboratory will verify EDDs internally before they are issued. The EDD will correspond exactly to the hard-copy data. Results that should be included in all EDDs are as follows:

- Target analyte results for each sample and associated analytical methods requested on the chain-of-custody form;
- Method and instrument blanks and preparation and calibration blank results;
- Percent recoveries for the spike compounds in the MS, MSDs, blank spikes, and/or LCSs;
- Matrix duplicate results;

- All re-analysis, re-extractions, or dilutions reported, including those associated with samples and the specified laboratory QC samples;

- MRLs and MDLs; and

- Sample collection, extraction and analysis, hard copies of forms, data, and chain-of-custody forms should be filed in a secure storage area according to project and document control numbers.

Laboratory data packages and reports will be archived, and laboratories that generated the data will also archive hard-copy data. Electronic and hard copy data must be retained for a minimum of three and ten years, respectively, after final data have been submitted. Laboratories will use an electronic storage device capable of recording data for long-term, off-line storage. Raw data will be retained on an electronic data archival system.

ATC will maintain all laboratory and project reports and data for a period of ten years following certification of completion of all remediation activities at OU2. At the end of the retention period, ATC will offer the information to EPA and the DEQ prior to making any irretrievable decision to dispose of the data.

3.0 ASSESSMENT AND OVERSIGHT (GROUP C)

Performance and system audits will be completed to ensure that the field sampling activities and laboratory analyses are performed following the procedures established in this RDAQAPP, including the attached SOPs, and the RDAWP. The audits may be both internally and externally led, as further described below.

3.1 Technical Systems Audits (C1)

Generally, system audits are a qualitative measure of adherence to sampling QA measures overall, including sample collection handling, decontamination procedures, and recording requirements in the field, as well as sample receiving, log-in, and instrument operating records in the laboratory.

3.1.1 Field Data (C1)

An ATC On-Site Field Supervisor will be present at OU2 during all sampling activities and will provide the OU2 on-site supervision required during the project. The On-Site Field Supervisor will be in daily contact with the ATC PM, who will then review compliance with the project objectives and sampling protocol outlined in this RDAQAPP. Any anticipated modifications to the sampling or measuring procedures will be reported to the ATC PM and then to the EPA Project Manager and the DEQ Project Officer. ATC field personnel will document the modification in the field logbook.

3.1.2 Field Screening Instruments (C1)

Field instruments audits will be conducted to examine field equipment calibration and documentation of records; field instrument operation records; field measurement records; field sampling records, log books and field sampling forms; sample collection, handling, storage, and transportation procedures including organization and minimization of potential contamination sources; and chain-of-custody records and procedures.

3.1.3 Deliverable Review (C1)

Prior to submittal to the EPA and DEQ, all deliverable documents will undergo a peer review conducted by a project team within ATC. The documents will also be reviewed by the QAM. The ATC PM will provide final review of all deliverables and is ultimately responsible for ensuring the quality of such deliverables.

3.1.4 Laboratory Data (C1)

In addition, laboratory results will be reviewed for compliance against the DQO criteria for the level of reporting required. Laboratories will review data prior to submitting reports to ATC. ATC will review data in accordance with the verification and validation requirements specified in Section 4.0.

3.2 Performance Evaluation Audits (C1)

Field and laboratory audits will be performed as a quantitative measure of field sample collection and laboratory analyses quality.

3.2.1 Field Audits (C1)

The ATC PM and/or the ATC QAM or their designee may conduct periodic audits of field activities, as necessary. A field audit will be conducted within the first two days of drilling activities during the RDA. Field audits will include the following checklist:

- Review of field sampling records;
- Review of field measurement procedures;
- Examination of the application of sample identifications following specified protocols;
- Review of field instrument calibration records and procedures; and
- Review of sampling documentation, handling and packaging procedures.

After an internal audit is completed, a debriefing session will be held for participants to discuss the preliminary audit results. If no deficiencies or only minor deficiencies are identified, the audit is complete following the debriefing session. If significant deficiencies are identified, the auditor will prepare an audit evaluation report that includes observations of the deficiencies and the necessary recommendations for corrective actions.

A draft audit evaluation report will be provided to the ATC PM within ten days of completion of the field or system performance audit, and will be finalized no later than 30 days after the audit was performed. Nonconformance or deviation from the specifications presented in the manufacturer's SOPs, ATC's SOPs, and this RDAQAPP will be noted and will be addressed through corrective or preventative actions identified by the ATC QAM and project team with the approval of the ATC PM.

Upon request, the audit evaluation report and any associated proposed corrective or preventative actions will be forwarded to the EPA Project Manager along with a time frame for implementation of corrective actions. Follow up audits will be performed as necessary prior to completion of the project to ensure corrective actions have been implemented appropriately and completely by ATC field personnel.

External field audits are the responsibility of EPA Region 8. Field audits may be conducted at any time during the field operations and will be based upon the information presented in ATC's SOPs and/or the manufacturer's SOPs, and this RDAQAPP. These audits may or may not be announced at the discretion of the auditing agency.

3.2.2 Laboratory Audits (C1)

Internal and regulatory agency audits of laboratory performance and systems will be a regular part of the laboratory's QA program. Routine audits will be conducted by the laboratory's QAM or designee, and will consist of a review of the entire laboratory system and, at a minimum, include examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures, sample preparation and analysis, and instrument procedures.

To verify proper implementation of laboratory procedures and adherence to this RDAQAPP, EPA Region 8 may perform an external audit prior to or during this project. These audits may or

may not be announced and will be conducted at the discretion of the auditing agency. External audits will include, but may not be limited to, review of laboratory analytical procedures, laboratory internal audits, or submission of performance evaluation samples to the laboratory for analysis. If conducted, the laboratory audit will include a review of the following:

- Sample custody procedures;
- Sample disposal procedures and documentation;
- Calibration procedures and documentation;
- Completeness of data forms, notebooks, and other reporting requirements;
- Data review and validation procedures;
- Data reporting integrity and archiving;
- Data storage, filing, and record keeping procedures;
- QC procedures, tolerances, and documentation;
- Operating conditions of facilities and equipment;
- Documentation of training and maintenance activities;
- Systems and operations overview; and
- Security of laboratory automated systems.

Deficiencies and corrective action procedures will be clearly documented in the audit report.

3.3 Reports to Management (C2)

An ATC On-Site Field Supervisor will prepare QA reports and submit them to the ATC PM for review at the conclusion of the RDA, as necessary. The QA report will include, at a minimum, the following information:

- A list of all samples collected during the RDA;
- Descriptions of any deviations from ATC's SOPs, including the reason for the deviation and the resolution;
- Description of any deviations from this RDAQAPP, including the reason for the deviation and the resolution,
- Additional information relating to or having a significant impact on project quality or productivity, such as severe weather or staffing changes.

ATC will provide laboratory data and interim RDA updates to EPA and DEQ in project progress reports described above and required in the SOW (EPA/DEQ, 2011a). These reports will serve

to inform the EPA and DEQ of the project progress and any significant interim findings that have been identified.

4.0 DATA VALIDATION AND USABILITY (GROUP D)

This section describes the QA activities that will be performed to ensure that the collected data are scientifically defensible, properly documented, of known quality, and meet OU2 objectives. All analytical data collected for OU2 will be reviewed, verified and validated as described below.

4.1 Data Reduction (D1)

Field and laboratory data will be reduced as necessary in accordance with the provisions described below.

4.1.1 Field Data Reduction (D1)

Field data will be used as reported from the direct-read instruments, field notes, field sampling forms, and chain-of-custody records. All field water quality parameters will be entered into the project database after each sampling event. No further reduction of field data will be required.

4.1.2 Laboratory Data Reduction (D1)

The laboratory will reduce all analytical data (both screening and definitive) in accordance with the analytical methods, the laboratory SOPs, and the guidance presented in this RDAQAPP. Section 1.4.2 of this RDAQAPP provides equations that will be used by the laboratory to assess internal precision and accuracy.

4.2. Data Review (D1)

The laboratory will review internal data under the direction of the laboratory QAM. The laboratory will prepare and retain full analytical and QC documentation. Both screening and definitive data will be reviewed prior to release by the laboratory. In general, the laboratory data review will be conducted as described in the following paragraphs.

The bench analyst will conduct the initial data review based on established protocols specified in the laboratory SOPs, analytical method protocol, and project-specific data quality objectives. At a minimum, this review will include the following:

- An assessment of sample preparation and analysis procedures and documentation for accuracy and completeness;
- Assessments of whether the appropriate SOPs have been followed;
- An assessment of analytical results for accuracy and completeness;
- An assessment of whether QC samples are within established control limits and method blank data are acceptable; and
- An assessment of whether documentation is complete (that is, all anomalies in the preparation and analysis have been documented; out-of-control forms, if required, are complete; and holding times are documented).

The calculations used to evaluate precision and accuracy are defined in Section 1.4.2 of this RDAQAPP, along with the acceptance criteria for calibration, precision, and accuracy assessment.

When an analysis of a QC sample (blank, spike, duplicate/replicate, or similar) indicates that the analysis of that batch of samples is not in control, the analyst will immediately bring the matter to the attention of the appropriate designated QC staff (QAM, PM, section leader). This individual will determine whether the analysis can proceed, or if selected samples should be reanalyzed, or if specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria must be documented. A nonconformance report will be prepared for laboratory analysis out-of-control events that require documentation. ATC will be notified as soon as possible to determine appropriate corrective action for out-of-control events resulting in unacceptable data. Non-conformance report forms and out-of control analyses forms are specific to each laboratory, and are therefore not included with this RDAQAPP; laboratories will be required to submit these forms to ATC prior to submitting any samples for analysis.

After this review is complete, the analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer. This reviewer (department manager or QAM) will be responsible for review and approval of the analytical control documentation associated with each analytical batch, as well as any corrective action explanations provided by the analyst. This individual will also be responsible for determining whether the analytical data meet QC criteria established by the analytical methods and by this RDAQAPP, and for identifying QC problems that require further resolution. A permanent record of any corrective actions will be maintained in the laboratory files.

The laboratory QAM will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The laboratory QAM will also be responsible for reviewing final data reports for proper format and reporting consistency prior to releasing the reports to ATC. This review will include the following at a minimum:

- Laboratory name and address;
- Sample information (includes unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis);
- Analytical results, reported with an appropriate number of significant figures;
- Reporting limits reflecting dilutions, interferences, and corrections for dry weight as applicable;
- Method references;
- Appropriate QC results and correlations for sample batch traceability and documentation;
- Data qualifiers with appropriate references and narrative on the quality of results; and
- Confirmation that project-specific requirements have been met.

The laboratory QAM will also be responsible for qualifying any data that may be unreliable. Data qualifications will be based on the laboratory SOPs, the analytical method, and the principles in accordance with EPA guidelines (EPA, 2008).

4.3 Data Reporting (D1)

Laboratory data will be reported to ATC as EDDs and presented in a format that will facilitate data input, review, and evaluation. Tables, graphs, or figures will be used to present the data in associated project reports. The analytical data will be reported in a format organized to facilitate data validation.

4.4 Verification and Validation (D1 and D2)

Data verification is a process of evaluating the completeness, correctness, and contractual compliance of a data set against the method standard, SOP, or contract requirements. Data verification will be performed internally by the laboratory generating the data, and again upon receipt by the ATC QAM. Data verification may result in accepted, qualified, or rejected data (see data qualifiers in Section 4.4.4).

Data validation is an analyte-specific and sample-specific process that extends the qualification of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of specific data sets. Data validation criteria are based on the measurement performance criteria of this RDAQAPP. ATC will conduct EPA Stage 2B data validation on all laboratory data as discussed in Section 4.4.3. As with verification data, validation results are accepted, qualified, or rejected data (see data qualifiers in Section 4.4.4).

4.4.1 Verification and Validation Methods (D1 and D2)

This section describes the methods for evaluating the degree to which the collected data meet the project objectives, individually and collectively. ATC will estimate the potential effect that each deviation from this RDAQAPP may have on the usability of associated data items, its contribution to the quality of reduced and analyzed data, and its effects on the decision.

4.4.2 Data Verification (D1 and D2)

All field and laboratory data will undergo data verification to ensure that the data meet DQOs. All data will be qualified, as necessary, in accordance with established criteria as described in this section.

The ATC QAM will verify field data through reviews of data sets to identify inconsistencies or anomalous values. Any inconsistencies discovered will be resolved as soon as possible by seeking clarification from field personnel responsible for data collection. All field personnel will be responsible for following the sampling and documentation procedures described in the SOP 051-104 Sample Documentation (Appendix A) so that defensible and justifiable data are obtained.

Laboratory personnel will verify analytical data at the time of analysis and reporting, and through subsequent reviews of the raw data for any non-conformances to the requirements of the analytical method. Laboratory personnel will make a systematic effort to identify any outliers or errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in analysis,

transcription, or calculation will be clearly identified in the case narrative section of the analytical data package. The ATC QAM will verify that laboratory data sets are complete and meet DQOs.

Specific data verification procedures are described below.

4.4.2.1 Sampling Design (D1 and D2)

Each sample will be checked for compliance with the specifications, including type and location to ensure that measurements represent the actual environment at a given time and location. Any deviations will be noted by the ATC QAM and communicated to the EPA and DEQ.

4.4.2.2 Sample Collection Procedures (D1 and D2)

Sample collection procedures as specified in this RDAQAPP will be followed by ATC field personnel and verified by the ATC QAM. If field conditions require deviations, they will be discussed with the EPA and DEQ in advance. However, if any deviations are necessary but cannot first be discussed with the EPA and DEQ, such deviations will be noted by the ATC QAM and communicated to the EPA and DEQ by the ATC PM.

4.4.2.3 Sampling Handling (D1 and D2)

Deviations from the planned sample handling procedures will be noted on the chain-of-custody forms and in the field logbooks. Data collection activities will indicate the events that occur during sample handling affecting the integrity of the samples.

ATC field technical staff members will evaluate the sample containers and the preservation methods used and ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Checks on the identity of the sample will be made to ensure that the sample continues to be representative of its native environment as it moves through the analytical process.

4.4.2.4 Laboratory Analytical Procedures (D1 and D2)

Each sample will be verified to ensure that the procedures used to generate the data were implemented as specified. Data validation activities will be used to determine how seriously a sample deviated beyond the acceptance limit so that the potential effects of the deviation can be evaluated.

4.4.2.5 Quality Control (D1 and D2)

QC checks will be performed during sample collection, handling, and analysis. For each specified QC check, the procedures, acceptance criteria, and corrective action will be specified. During data validation, the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data will be documented.

4.4.2.6 Instrument Calibration (D1 and D2)

Calibration verification will be performed to ensure that calibrations:

- Were performed within an acceptable time prior to generation of measurement data;

- Were performed in proper sequence;
- Included the proper number of calibration points;
- Were performed using a standard that bracketed the range of reported measurement results; and
- Acceptable linearity checks and other checks to ensure that the measurement system was stable when calibration was performed.

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration will be flagged to alert data users (see data qualifiers in Section 4.4.4).

4.4.3 Data Validation (D1 and D2)

Validation will be completed on all laboratory data packages. All data will continue through the validation process and will be qualified in accordance with established criteria as discussed in this section. ATC will validate all laboratory data according to EPA Stage 2B guidelines for Superfund use (EPA, 2009), which will consist of validation checks for sample-related QC and instrument-related quality. This EPA Stage 2B process will consist of the specific baseline checks and described below.

- Documentation identifies the laboratory receiving and conducting analyses, and includes documentation for all samples submitted by the project or requester for analyses;
- Requested analytical methods were performed and the analysis dates are present;
- Requested target analyte results are reported along with the original laboratory data qualifiers and data qualifier definitions for each reported result and the uncertainty of each result and clear indication of the type of uncertainty reported if required;
- Requested target analyte result units are reported along with their associated uncertainty units if required;
- Required RLs for all samples are present and results at and below the required reporting limits are clearly identified, including sample detection limits;
- Sampling dates and times, date and time of laboratory receipt of samples, and sample conditions upon receipt at the laboratory, including preservation, pH and temperature where required by the laboratory method are documented;
- Sample results are evaluated by comparing sample conditions upon receipt at the laboratory (e.g., preservation checks) to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract;
- Requested methods (handling, preparation, cleanup, and analytical) are performed;

- Method dates (including dates, times and duration of analysis for radiation counting measurements and other methods, if needed) for handling, preparation, cleanup and analysis are present, as appropriate;

- Sample-related QC data and QC acceptance criteria (e.g., method blanks, surrogate recoveries, LCS recoveries, duplicate analyses, MS and MSD recoveries, serial dilutions, post digestion spikes, standard reference materials) are provided and linked to the reported field samples, including the field QC samples such as trip and equipment blanks;

- Requested spike analytes or compounds (e.g., surrogate, DMCs, LCS spikes, post digestion spikes) have been added, as appropriate;

- Sample holding times (from sampling date to preparation and preparation to analysis) are evaluated;

- Frequency of QC samples is checked for appropriateness (e.g., one LCS per 20 samples in a preparation batch);

- Sample results are evaluated by comparing holding times and sample-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract;

- Initial calibration data, e.g., initial calibration standards, initial calibration verification (ICV) standards, and initial calibration blanks (ICBs), are provided for all requested analytes and linked to field samples reported. For each initial calibration, the calibration type used is present along with the initial calibration equation used including any weighting factor(s) applied and the associated correlation coefficients, as appropriate. Recalculations of the standard concentrations using the initial calibration curve are present, along with their associated percent recoveries, as appropriate (e.g., if required by the project, method, or contract). For the ICV standard, the associated percent recovery (or percent difference, as appropriate) is present;

- Appropriate number and concentration of initial calibration standards are present;

- Continuing calibration data, e.g., continuing calibration verification (CCV) standards and continuing calibration blanks (CCBs) are provided for all requested analytes and linked to field samples reported, as appropriate. For the CCV standard(s), the associated percent recoveries (or percent differences, as appropriate) are present;

- Reported samples are bracketed by CCV standards and CCBs standards as appropriate;

- Method specific instrument performance checks are present as appropriate, e.g., tunes for mass spectrometry methods and instrument blanks;

- Frequency of instrument QC samples is checked for appropriateness (e.g., gas chromatography-mass spectroscopy (GC-MS) tunes have been run every 12 hours); and

- Sample results are evaluated by comparing instrument-related QC data to the requirements and guidelines present in national or regional data validation documents, analytical method(s) or contract.

Although not an EPA requirement, ATC will follow the 32 item checklist developed by the DEQ for data validation in their Data Validation Guidelines for Evaluating Analytical Data (DEQ, 2010), which is included in Appendix E.

4.4.4 Data Qualifiers (D1 and D2)

The following qualifiers will be used in the data quality review process for the LSGPS OU2 project in accordance with EPA National Functional Guidelines (EPA, 2008) to qualify any data that do not or may not meet the data quality and usability requirements of this RDAQAPP:

U: The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted detection limit for sample and method.

J: The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain QC criteria were not met, the concentration of the analyte was below the detection limit, or the RPD criterion was exceeded for field duplicates).

NJ: The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration.

UJ: The analyte was not detected at a level greater than or equal to the adjusted detection limit. However, the reported adjusted detection limit is approximate and may be inaccurate or imprecise.

R: The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

4.5 Reconciliation with User Requirements (D3)

After environmental data have been reviewed, verified, and validated in accordance with the procedures described above, the data must be further evaluated to determine whether project quality objectives have been met. To the extent possible, ATC will follow EPA's data quality assessment process to verify that the type, quality, and quantity of data collected are appropriate for their intended use as outlined by the EPA (2000b). The assessment process includes five steps: (1) review the data quality objectives and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data.

When the five-step assessment process is not completely followed because the data objectives are qualitative in nature, ATC may choose to systematically assess data quality and data usability. This assessment would include:

- A review of the sampling design and sampling methods to verify that these were implemented as planned and are adequate to support project objectives;

- A review of project-specific data quality indicators for precision, accuracy, representativeness, completeness, comparability, and quantitation limits (defined in Section 2.7) to determine whether acceptance criteria have been met;

- A review of project-specific DQOs to determine whether they have been achieved by the data collected; and

- An evaluation of any limitations associated with the decisions to be made based on the data collected. For example, if data completeness is only 85 percent compared to a project-specific completeness objective of 90 percent, the data may still be usable to support a decision, but at a lower level of confidence.

Any report or technical memorandum in which data for this project is reported will discuss any potential impacts of these reviews on data usability and will clearly define any limitations associated with the data.

In order to perform the data evaluation steps above, the reported data will be supported by complete data packages which include sample receipt and tracking information, chain-of-custody records, tabulated data summary forms, and raw analytical data for all field samples, standards, QC checks and QC samples, and all other project-specific documents that are generated.

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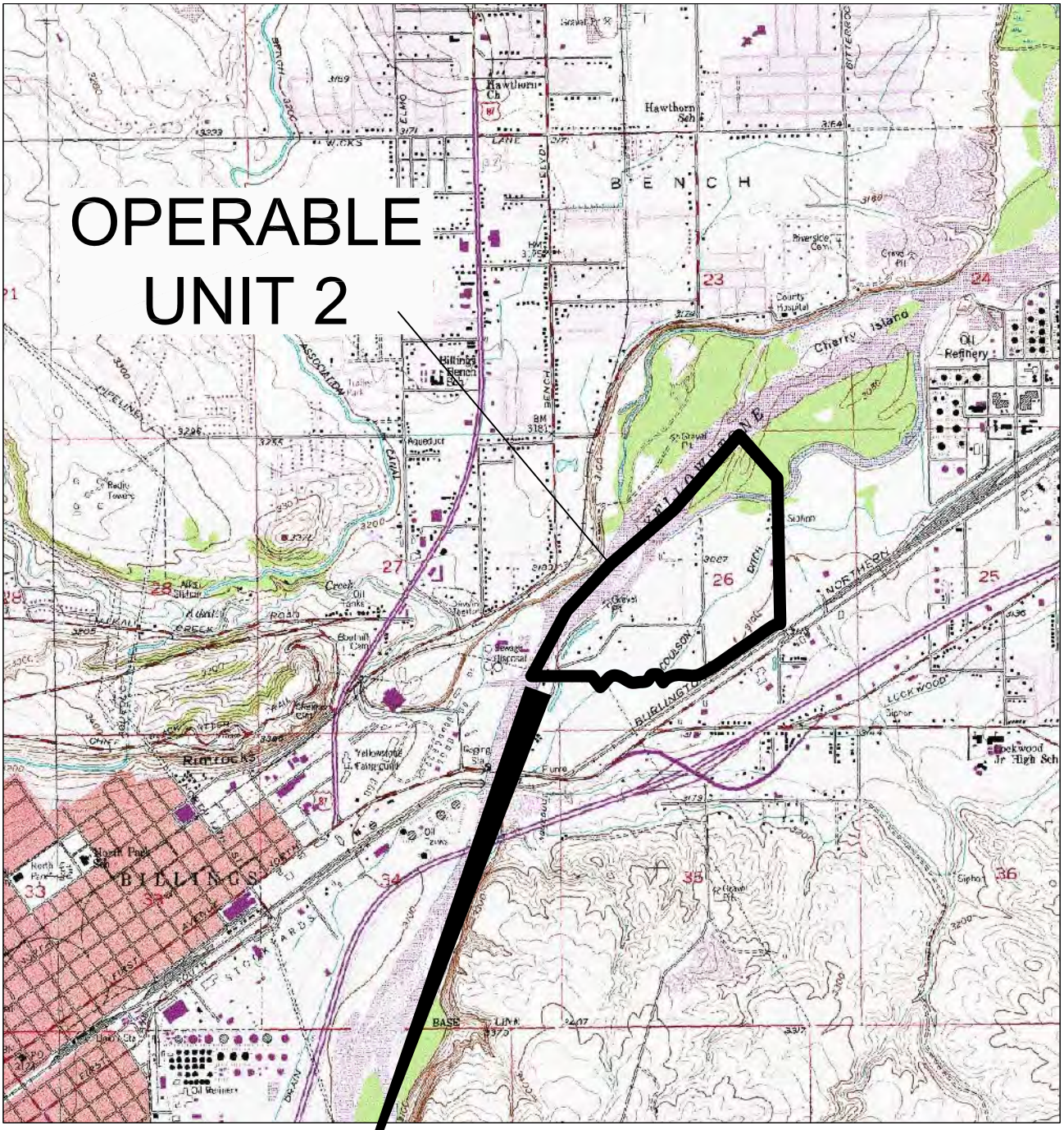
FIGURES



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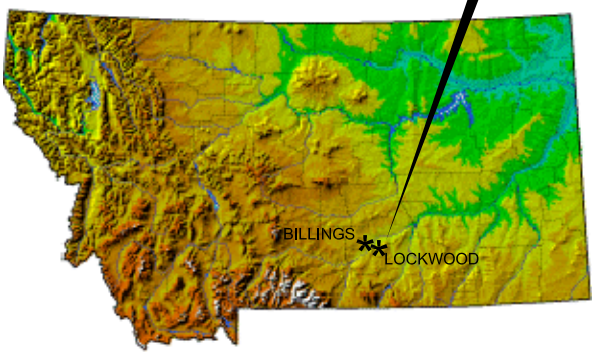

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SITE VICINITY MAP
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
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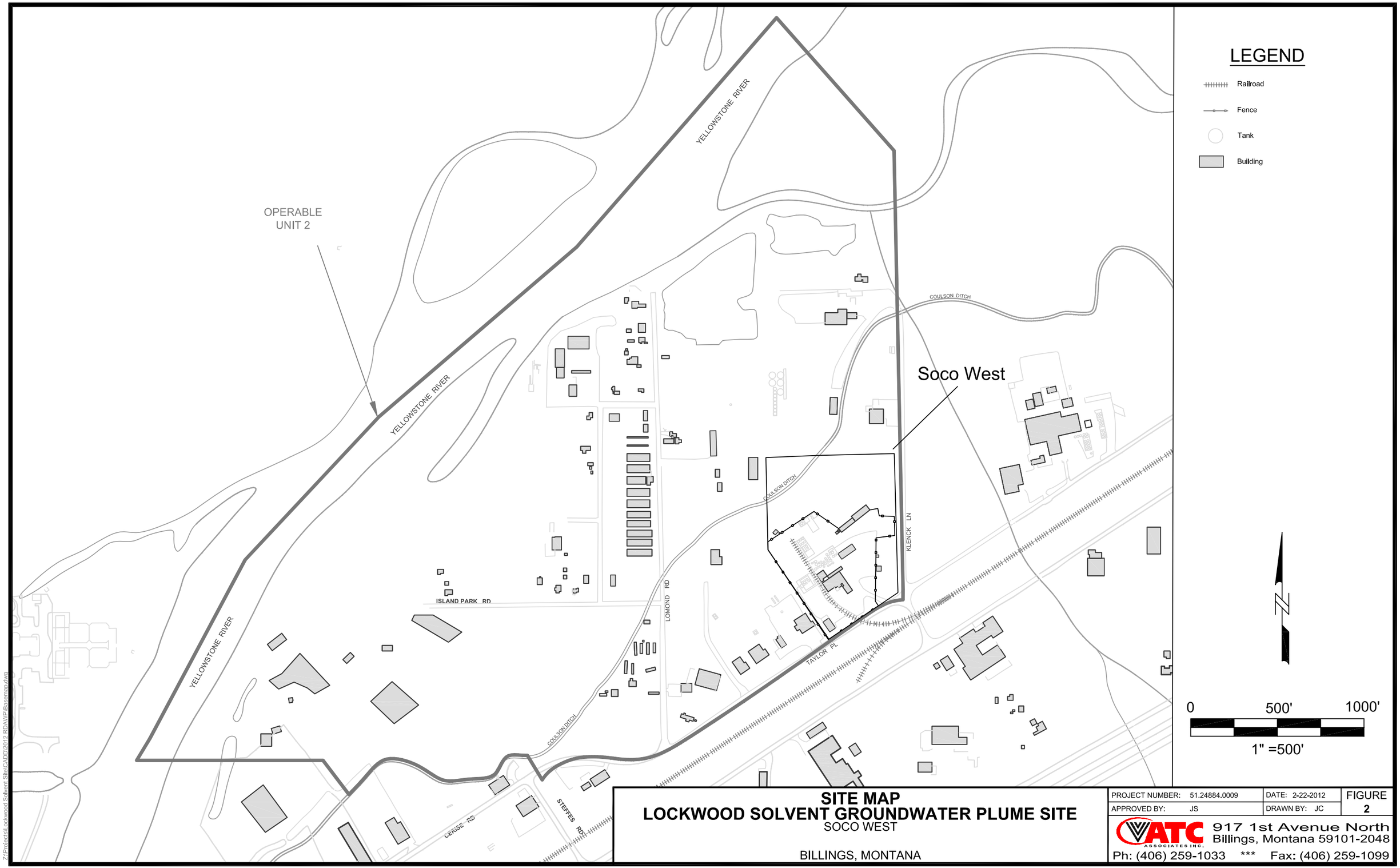
Billings, Montana

PROJECT NUMBER: 51.24884.0009		DATE: 11/21/2011	FIGURE
APPROVED BY: JS		DRAWN BY: JC	1

ATC ASSOCIATES INC.
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033 *** Fax: (406) 259-1099

Z:\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring Plan\Figure 1.dwg



SITE MAP
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0009		DATE: 2-22-2012	FIGURE
APPROVED BY: JS		DRAWN BY: JC	2

ATC ASSOCIATES INC.
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033 *** Fax: (406) 259-1099

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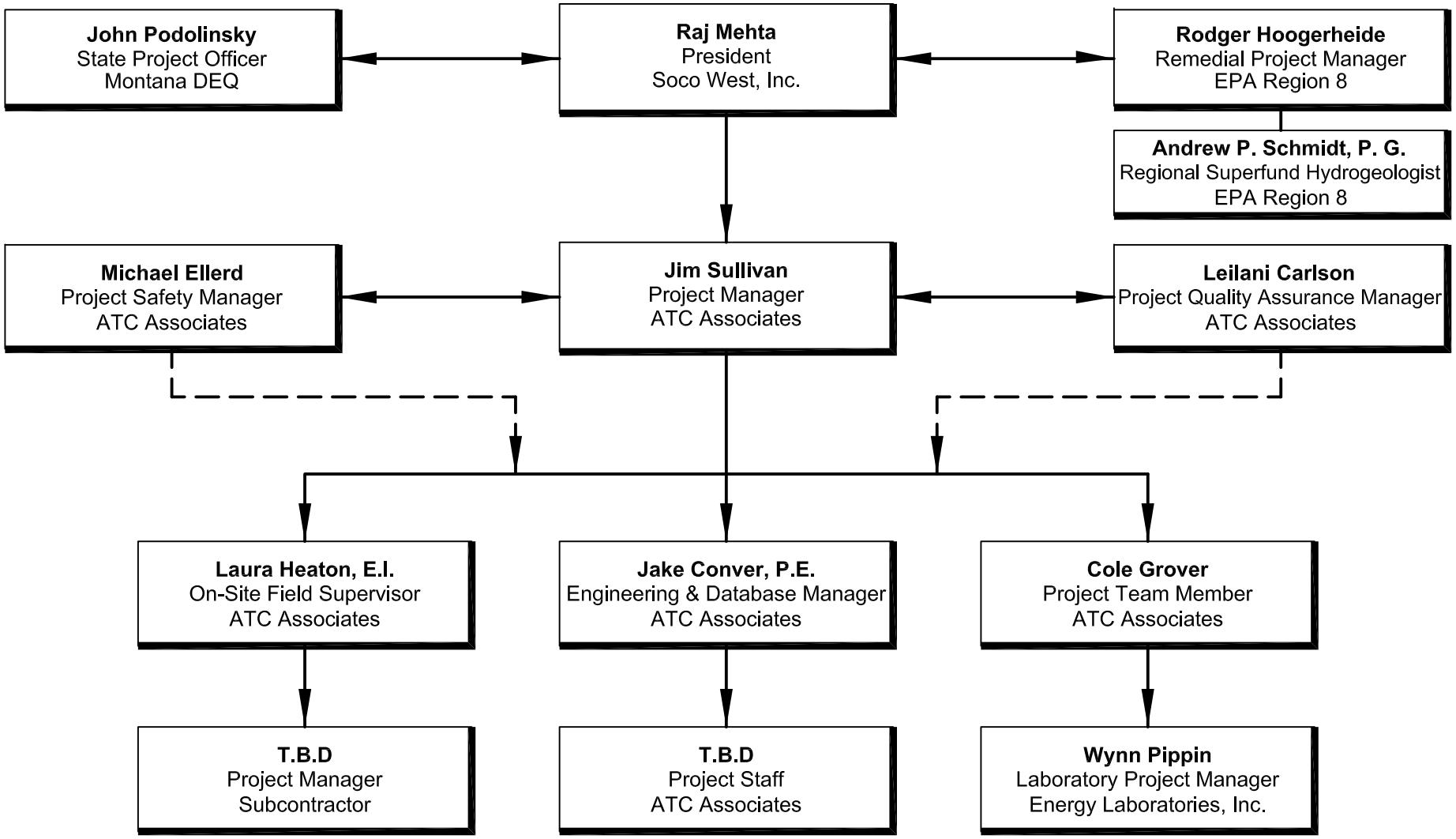


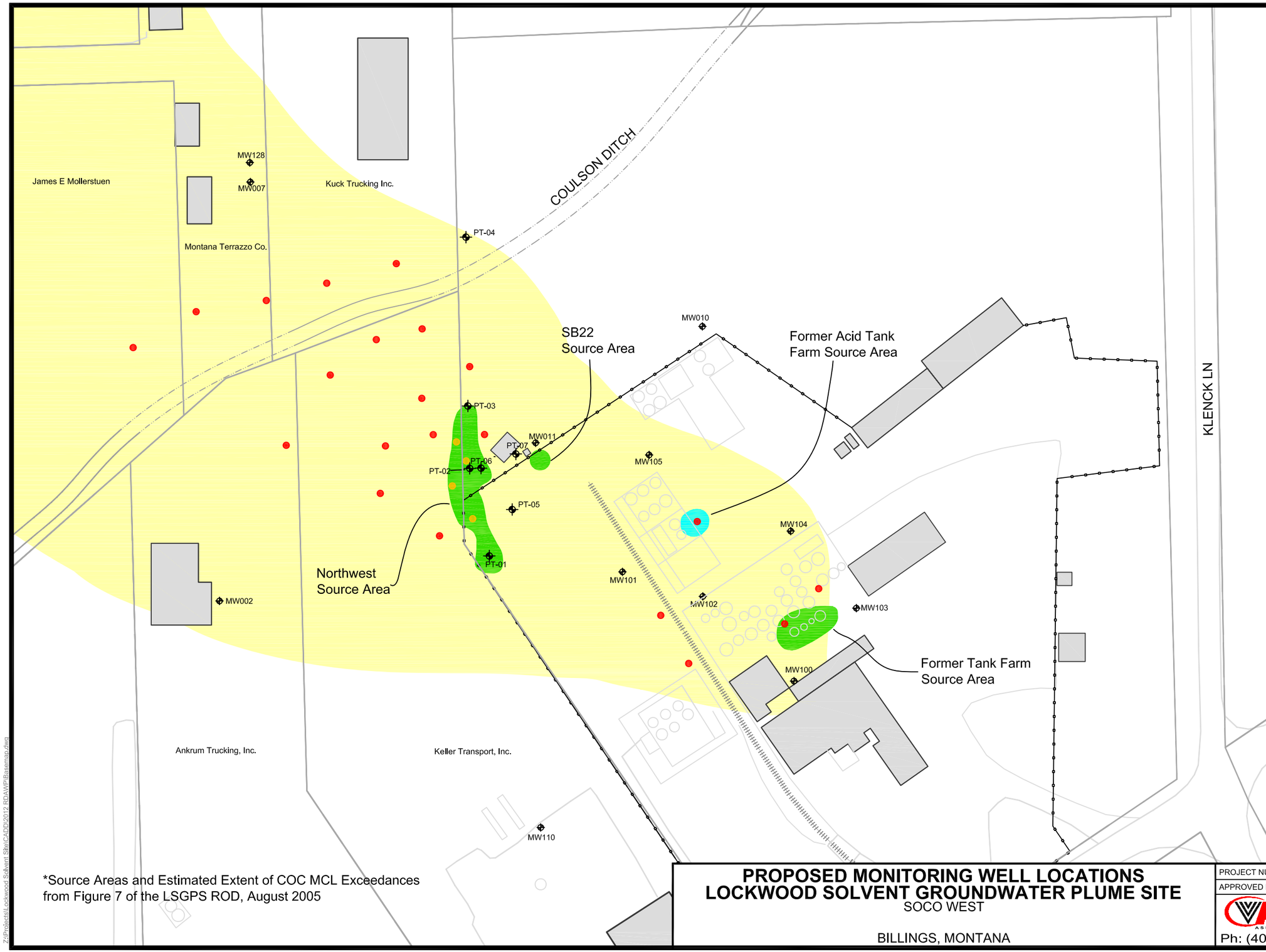
Project Organization Chart
OU2 Lockwood Solvent Groundwater Plume Site
SOCO WEST

Billings, Montana

PROJECT NUMBER: 51.24884.0001		DATE: 06-13-12	FIGURE
APPROVED BY: JS		DRAWN BY: JC	3

ATC ASSOCIATES INC.
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033 *** Fax: (406) 259-1099

S:\Projects\Lockwood Solvent Site\CADD\GroundWater Monitoring Plan\Figure 5.dwg



LEGEND

- Railroad
- Fence
- Property Boundary
- Former Tank Location
- Building
- Concrete/Asphalt Cover and Containment
- Estimated Extent of Dissolved Phase COC MCL Exceedance, April 2003
- Estimated Extent of Source Area Saturated Zone Soil
- Estimated Extent of Contaminated Vadose Soil Above Remediation Goals
- Monitoring Well Location
- Proposed Monitoring Well Location
- Proposed Monitoring Well Location with Co-Located Well Completed in Fine Grained Section Only

N

0 100' 200'

1" = 100'

*Source Areas and Estimated Extent of COC MCL Exceedances from Figure 7 of the LSGPS ROD, August 2005

PROPOSED MONITORING WELL LOCATIONS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0009		DATE: 6-13-2012	FIGURE
APPROVED BY: JS		DRAWN BY: JC	4

ATC ASSOCIATES INC.
917 1st Avenue North
Billings, Montana 59101-2048
Ph: (406) 259-1033 *** Fax: (406) 259-1099

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Appendix A

Standard Operating Procedures

Standard Operating Procedures

General

ATC-SOP-051-100	Equipment Decontamination – Inorganic Contamination
ATC-SOP-051-101	Equipment Decontamination – Organic Contamination
ATC-SOP-051-102	Field Forms
ATC-SOP-051-103	Quality Assurance/Quality Control Sampling
ATC-SOP-051-104	Sample Documentation
ATC-SOP-051-105	Sample Packaging and Shipping

Liquid

ATC-SOP-051-201	Groundwater Sampling Using Low-Flow Methods
ATC-SOP-051-204	Measuring Fluid Levels
ATC-SOP-051-205	Measuring Water Quality Field Parameters (Low-Flow, In-Situ, Ex-Situ, Surface Water)
ATC-SOP-051-209	Groundwater Sampling Using HydraSleeves™

Solid

ATC-SOP-051-301	Subsurface Soil Sampling: Well/Borehole Installation

Gas

ATC-SOP-051-400	Organic Vapor Headspace Measurement

Wastes

ATC-SOP-051-501	Management of Liquid Matrix Investigation-Derived Wastes
ATC-SOP-051-502	Management of Solid Matrix Investigation-Derived Wastes
ATC-SOP-051-504	Sampling of Liquid Matrix Investigation-Derived Wastes
ATC-SOP-051-505	Sampling of Solid Matrix Investigation-Derived Wastes

Monitoring Wells

ATC-SOP-051-600	Monitoring Well Installation and Development
ATC-SOP-051-601	Monitoring Well Abandonment

The purpose of this standard operating procedure (SOP) is to describe general decontamination procedures for field equipment in contact with vapor, soil, or water contaminated or potentially contaminated with inorganic elements or compounds. Reusable sampling equipment must be decontaminated between sample collection points. Field personnel must wear appropriate personal protective equipment (PPE) for decontamination procedures in accordance with site-specific health and safety plans (HASPs), but at a minimum personnel must wear eye protection, splash protect, and disposable nitrile gloves while decontaminating equipment at the project site.

Decontamination should be performed in areas so as to prevent cross-contamination of other field equipment. Decontamination is also to be performed in areas so as to avoid any exposure to the public and the area should be cordoned off, if necessary, to prevent public access. The following four-step procedure is to be followed to ensure thorough equipment decontamination:

1. Set up the decontamination zone upwind from the sampling area to reduce the chances of windborne contamination.
2. Visually inspect sampling equipment for contamination; use stiff brush to remove visible material.
3. The general decontamination sequence for field equipment includes: wash with Liquinox or an equivalent degreasing detergent; de-ionized water rinse; 10% dilute nitric acid rinse; de-ionized water rinse; rinse with sample water three times.
4. Clean the outside of sample container after filling sample container.

Sampling pumps and reusable tubing must be decontaminated internally by pumping wash solutions through the pump followed by appropriate rinses. The exterior of such equipment can be decontaminated using a high pressure washer with appropriate soap solution and clean water rinse. Unless prohibited or otherwise specified, decontamination rinse water can be surface applied for evaporation.

All disposable items (e.g., paper towels, gloves, etc) are to be deposited into a garbage bags and disposed of in a proper manner. Properly dispose of the wash water per provisions of the work plan. If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

Table 1 lists equipment and liquids necessary to decontaminate field equipment.

Table 1, Equipment List for Inorganic Decontamination

5-gallon plastic buckets	Liquinox (soap)
5-gallon plastic water-container	Hard bristle brushes
Deionized water	Garbage bags
10% HNO_3 solution	Nitrile gloves
Spray bottles	Paper towels

The purpose of this standard operating procedure (SOP) is to describe general decontamination procedures for field equipment in contact with vapor, soil, or water contaminated or potentially contaminated with organic compounds. Reusable sampling equipment must be decontaminated between sample collection points. Field personnel must wear appropriate personal protective equipment (PPE) for decontamination procedures in accordance with site-specific health and safety plans (HASPs), but at a minimum personnel must wear eye protection, splash protect, and disposable nitrile gloves while decontaminating equipment at the project site.

Decontamination should be performed in areas so as to prevent cross-contamination of other field equipment. Decontamination is also to be performed in areas so as to avoid any exposure to the public and the area should be cordoned off, if necessary, to prevent public access. The following three-step procedure is to be followed to ensure thorough equipment decontamination:

1. Wash equipment with Liquinox or an equivalent degreasing detergent to remove any and all contaminants.
2. Thoroughly rinse equipment with clean (tap) water
3. Rinse equipment a second time with de-ionized or distilled water rinse. A methanol rinse is optional depending on regulatory requirements, but the methanol rinse must be followed by an additional de-ionized or distilled water rinse.

Sampling pumps and reusable tubing must be decontaminated internally by pumping wash solutions through the pump followed by appropriate rinses. The exterior of such equipment can be decontaminated using a high pressure washer with appropriate soap solution and clean water rinse. Unless prohibited or otherwise specified, decontamination rinse water can be surface applied for evaporation.

All disposable items (e.g., paper towels, gloves, etc) are to be deposited into a garbage bags and disposed of in a proper manner. Properly dispose of the wash water per provisions of the work plan. If vehicles used during sampling become contaminated, wash both inside and outside as necessary.

Table 1 lists equipment and liquids necessary to decontaminate field equipment.

Table 1
Equipment List for Organics Decontamination

5-gallon plastic buckets	Liquinox or other degreasing detergent
Source of clean (tap) water	Hard bristle brushes
De-ionized or distilled water	Garbage bags
1-gallon container or spray bottle of 10% Methanol or pesticide grade acetone for organics	Nitrile gloves
	Spray bottles with de-ionized or distilled water
	Paper Towels

All pertinent field investigations and sampling information shall be recorded on a field form during each day of the field effort and at each sample site. The field supervisor shall be responsible for ensuring that sufficient detail is recorded on the field forms. No general rules can specify the extent of information that must be entered on the field form. However, field forms shall contain sufficient information so that someone can reconstruct all field activity without relying on the memory of the field crew. All entries shall be made in permanent ink. Each day's or site's entries will be initialed and dated at the end by the author.

At a minimum, entries on the field sheet or in field notebook shall include:

1. Date and time of starting work and weather conditions
2. Names of field supervisor and team members
3. Project name and type
4. Description of site conditions and any unusual circumstances.
5. Location of sample site, including map reference, if relevant
6. Equipment ID numbers, if relevant
7. Details of actual work effort, particularly any deviations from the field work plan or standard operating procedures
8. Field observations
9. Any field measurements made (e.g., pH)

For sampling efforts, specific details for each sample should be recorded using ATC Associates Inc. (ATC) standardized field forms. Surface water and groundwater field forms contain fill-in-the-blank type information in order that all pertinent information shall be recorded. In addition to the items listed above, the following information is recorded on field forms during sampling efforts:

1. Time and date samples were collected
2. Sample Name and type (natural, duplicate, QA/QC) of samples collected
3. Number and size of containers used to collect sample
4. Sampling method, particularly deviations from standard operating procedures

Strict chain of custody procedures shall be maintained with the field forms. Field forms shall remain with the field team at all times, while being used in the field. Upon completion of the field effort, photocopies of the original field forms will be made and used as working documents; original field forms shall be filed in the appropriate project file.

Quality Assurance/Quality Control (QA/QC) samples are submitted along with natural samples to provide supporting laboratory data to validate laboratory results. QA/QC samples are submitted blind, and do not have any unique identifying codes that would enable the lab or others to bias these samples in any way. Usually, the time or sampling location is modified in a way which will separate blank and standard samples from the rest of the sample train. QA/QC samples are identified only on field forms and in field notebooks. The following codes are typically used:

N - Natural Sample	Soil, water, air, or other of interest material from a field site
SP - Split Sample	A portion of a natural sample collected for independent analysis; used in calculating laboratory precision
D - Duplicate Sample	Two samples taken from the same media under similar conditions; also used to calculate precision
EB or RB– Equipment (Rinsate) Blank	Deionized water run through decontaminated equipment and analyzed for Blank residual contamination and deionized water contamination
BFS - Blind Field Standard	Certified materials of known concentration; used to determine laboratory accuracy
TB -Trip Blank	Inert material (deionized water or diatomaceous earth) included in sample cooler; sent by the lab, the sample is used to determine if contamination by volatiles is present during collection or shipping

In general, selected QA/QC samples will be inserted into the sample train within a group of twenty samples. Unless otherwise specified, QA/QC samples will be prepared in the field. Deionized water blanks will be collected from carboys and cubitainers used in the field. An exception to field preparation of QA/QC samples is the preparation of some blind field standards. Since the concentration of analytes in the sample is to be mixed according to specific manufacturer's instructions, field conditions may not provide the needed laboratory atmosphere. This is especially true for volatile organic compounds, which need to be prepared just before analyzing. Under these circumstances, standards will be shipped to the laboratory for preparation, keeping the concentration or manufacturer's QA/QC Lot Number as blind as possible.

The number and types of samples submitted for each group of natural samples will be determined by the project manager and others, including state or Federal agencies, and will be defined in the project work plan. Each field supervisor will be responsible for all QA/QC samples prepared by that crew.

Methods for computing data validation statements can be found in EPA documents.

Sample documentation is an important step to ensure the laboratory, project manager, and field personnel are informed of the status of field samples. Depending on the specifics required for each project, a number of forms will need to be filled out. Most sample documentation forms are preprinted carbonless triplicates, enabling copies to be filed or mailed from labs or offices. The forms will be completed by field personnel, who have custody of the samples. The office copy will be kept in the project file and subsequent copies sent to the laboratory, or other designated parties. The responsibility for the completion of these forms will be with each field supervisor. It is important that the field supervisor is certain field personnel are familiar with the completion process for filling out forms, and that the expected information is included.

Potential documents to be completed clearly in ink for each sample generated include:

1 Field Form
2 Chain-of-Custody
3 Custody Seal
4 Field Notebook or Field Notes

If working on Superfund activities, the following additional forms will also be prepared:

1 EPA Sample Tags
2 SAS Packing Lists
3 Sample Identification Matrix Forms
4 Organic Traffic Report (if applicable)
5 Inorganic Traffic Report (if applicable)

All environmental samples collected should be packaged and shipped using the following procedures:

PACKAGING

1. Label all sample containers with indelible ink (on the side, not on the cap or lid). Place labeled sample bottles in a high quality cooler containing an adequate amount of ice and/or frozen blue ice (appropriate for the season), making sure the cooler drain plug is taped shut.

2. Place the samples in an upright position and wrap the samples with absorbent, cushioning material for stability during transport. Samples should not be loose; the cooler should be able to withstand rough handling during shipment without sample breakage.

3. Fill out the appropriate shipping forms, and place the paperwork in a Ziploc® bag and tape it to the inside lid of the shipping container. Shipping forms usually include: 1) a chain-of-custody form, documenting the samples included in the shipment; 2) an analysis request form, specifying the laboratory analyses for each sample. If more than one cooler is used per chain of custody, put a photocopy in the other coolers and mark them as a copy.

4. Close and seal the cooler using fiberglass strapping tape.

5. Secure the shipping label with address, phone number, and return address clearly visible.

SHIPPING

Samples will be delivered by hand to analytical laboratory or shipped using standard, reliable carriers. All samples will be maintained in sealed containers under chain of custody procedures for the duration of shipping. Samples which are not delivered by hand to the analytical laboratory are subject to local, state, and federal regulations regarding shipping, as well as carrier-specific requirements. Consult the project manager for additional specific shipping procedures as necessary.

INTRODUCTION

The purpose of this standard operating procedure (SOP) is to provide a method that minimizes the amount of impact the purging process has on the groundwater chemistry during sample collection and to minimize the volume of water that is being purged and disposed. Low-flow refers to the velocity with which water enters the pump intake from the surrounding formation in the immediate vicinity of the well screen. This will take place by placing the pump intake within the screened interval and by keeping the drawdown at a minimal level (<0.33 feet) until water quality parameters have stabilized and sample collection is complete. The flow rate at which the pump will be operating will depend upon both hydraulic conductivity of the aquifer and the drawdown with the goal to minimize drawdown. The flow rate from the pump during purging and sampling will be at a rate that will not compromise the integrity of the analyte that is being sampled. The EPA recommends a starting flow rate of 0.2 to 0.5 liters per minute (Puls and Barcelona, 1996). In order to minimize the drawdown in the monitoring well a low-flow rate must be utilized.

SCOPE AND APPLICATION

Water quality indicator parameters and water levels must be measured during purging and prior to sample collection. Stabilization of the water quality indicator parameters in addition to monitoring water levels is a prerequisite to sample collection. The water quality indicator parameters measured include the following: pH, temperature, specific conductance (SC), oxidation-reduction potential (ORP), and dissolved oxygen (DO). In addition to the measurement of the above parameters, depth to water must be measured during purging.

EQUIPMENT

In order to obtain groundwater monitoring and sampling information, several pieces of equipment must be used. Field equipment may include:

Copy of project work plan
Water level indicator
Interface probe
Pumps and energy source
Polyethylene tubing
Flexible silicon tubing
Five-gallon bucket with volume intervals
Stop watch and calculator
Water quality meter
Decontamination materials
Sample bottles and preservative
Sample labels and chain-of-custody
Appropriate PPE and traffic controls
Tools
Air monitoring equipment, if needed
Five gallon buckets/55-gallon drums
Field forms/notebook
Well construction data
Field/water quality data from previous event
Well keys and map of well locations
Magnet
Ziplock® bags
Cooler and ice

PURGING AND SAMPLING PROCEDURES

The following describes purging and sampling procedures for the Low-Flow/ Minimal Drawdown method for the collection of groundwater samples.

Pre-Sampling Activities

1. Sampling locations must begin at the monitoring well with the least contamination, generally up-gradient or furthest from the site or suspected source, and then proceed systematically to the monitoring wells with the most contaminated groundwater. The level of groundwater contamination is determined by historical data.

2. Check and record the condition of the monitoring well for damage or evidence of tampering. Record the location, time, date and appropriate information in a field notebook or on the groundwater sampling field data sheet. Refer to Measuring Depth to Groundwater SOP-051-204.

3. Open protective well cover. If the protective cover is a flush mount, remove bolts and use a magnet to lift and remove the flush mount lid to avoid pinches. Unlock the padlock and remove compression cap. If the protective cover is a stick up, unlock the padlock, remove the cover, and remove the cap.

4. Don nitrile gloves.

5. Measure the fluid levels to nearest 0.01 feet relative to a reference measuring point on the well casing with an electronic water level indicator or interface probe, as specified in the project work plan, and record in logbook or groundwater sampling field sheet. If no reference point is found, measure relative to the top of the inner casing on the north side, then mark that reference point and note that location in the field logbook. Measure the depth to water a second time to confirm initial measurement; measurement should agree within 0.01 feet, if necessary re-measure again.

6. Decontaminate the measurement tape and indicator probe with a detergent and deionized or distilled water over a five gallon bucket. Return the water level indicator or interface probe to its clean protective casing.

7. Remove nitrile gloves.

8. Check the available well log or field information for the total depth of the monitoring well. Use the information from the depth of water in step four and the total depth of the monitoring well to calculate the volume of the water in the monitoring well or the volume of one casing. Record information in field logbook or groundwater sampling field sheet.

Purging and Monitoring Activities

1. Don new nitrile gloves.

2. Measure the water level (water level must be measured to nearest 0.01 feet) and record information on the groundwater sampling field sheet, leave water level indicator or interface probe in the monitoring well.

3. Thread the flow-through cell on to the probe module of the water quality field parameter meter.

4. If using a peristaltic pump, cut tubing to the appropriate length and lower tubing slowly (to minimize disturbance) into the well to the depth of the zone to be sampled as specified in the work plan. The tubing intake should be positioned such that it is at the zone of greatest impact, if known. If impact stratification is unknown, the tubing should be placed at mid-point in the saturated screened interval. Attach the tubing to flexible silicon tubing and connect the tubing to the peristaltic pump. Attach an effluent tubing line to the other end of the flexible silicon tubing. If using a submergible pump, cut tubing to the appropriate length and attach it to the pump. Lower the pump, safety cable, electrical line, and/or tubing slowly (to minimize disturbance) into the well to the depth of the zone to be sampled as specified in the work plan.

   Record the depth to the pump or tubing intake in the field logbook. If possible, keep the pump intake a minimum of two feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well.

5. Connect the down-hole tubing from the pump to the bottom port of the flow-through cell of the water quality meter. Connect an effluent line to the upper port of the flow-through cell. This ensures that flow is distributed evenly through the cell, eliminating dead zones of no flow along the sides of the cell.

6. Connect the effluent line from the flow-through cell to a purge water collection bucket. The purge water must be collected in buckets/drums during the purging and sampling of the monitoring well.

7. Connect the pump to the energy source. If a combustion type (gasoline or diesel-driven) generator is used it must be placed downwind of the sampling area.

8. Start pumping the well at a low flow rate (100 - 500 mL per minute). Check water level. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 feet. If drawdown is greater than 0.33 feet lower the flow rate. 0.33 feet is a goal to help guide with the flow rate adjustment. It should be noted that this goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience

9. Measure the discharge rate of the pump with a measuring device and a stop watch. Also, measure the water level and record both flow rate and water level on the groundwater sampling field sheet. Continue purging, monitoring, and recording water level and pump rates every three to five minutes during purging. Pumping rates should be kept at minimal flow to ensure minimal drawdown in the monitoring well.

   During the purging, a minimum of one tubing volume (including the volume of water in the pump) must be purged prior to recording water-quality indicator parameters. Monitor and record water-quality indicator parameters at three to five minute intervals. The water-quality field parameters include pH, temperature, SC, ORP, and DO.

   The stabilization criterion is based on three successive readings of the water quality field parameters; the following are the criteria which must be used:

Parameter	Stabilization Criteria
pH	± 0.1 standard units
Temp	± 1 degree Celsius (^{o}C)
SC	± 3%
ORP	± 10 millivolts (mV)
DO	± 0.3 milligrams per liter (mg/L)

Source: Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, EPA/542/S/02/001, May 2002

Once the criteria have been successfully met indicating that the water quality indicator parameters have stabilized, then sample collection can take place.

10. If a stabilized drawdown in the well can't be maintained at <0.33 feet, reduce the flow rate or turn the pump off (for 15 minutes) and allow for recovery.

Sampling Activities

1. Maintain the same pumping rate or reduce slightly for sampling (100 to 500 mL per minute) in order to minimize disturbance of the water column. Samples should be collected directly from the discharge port of the pump tubing. For samples collected for dissolved gases or Volatile Organic Compounds (VOCs) analyses, the pump's tubing needs to be completely full of groundwater to prevent the groundwater from being aerated as the groundwater flows through the tubing.

2. Disconnect the down-hole tubing from the flow-through cell.

3. Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the pre-preserved sample container.

   VOC samples will be collected by allowing the pump discharge to flow gently down the inside of laboratory-supplied 40 milliliter (mL) volatile organic analysis (VOA) vials pre-preserved with hydrochloric acid. When filling the VOAs, a meniscus must be formed over the mouth of the VOA to eliminate the formation of air bubbles and head space during capping. Turn the vial upside-down and check for air bubbles. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling the vial. If this has to be repeated more than twice, discard the sample and begin again with a new preserved vial.

4. Label each sample with the assigned sample identification, date, and time of sample collection on each vial. Wrap the vials in protective wrap and place in an iced cooler. Maintain a cooler temperature of ≤6°C.

5. Record the sample time on the sampling field data sheet. Also record the total volume of water purged from the well along with any other necessary information required on the sampling field

data sheet. Sign the sampling field data sheet and enter the necessary sample information on the chain of custody.

6. Close and lock the well.

7. Decontaminate the water quality field parameter sensors.

8. Properly dispose of the purge water per provisions of the work plan.

9. Place the used tubing, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

10. When all samples have been collected, carefully pack the cooler to avoid breakage of any samples during shipment. Sign the completed chain of custody and seal it in a resealable plastic bags (Ziploc® or equivalent) and place in the cooler. Add sufficient ice to the cooler to maintain a temperature of ≤6°C until the cooler arrives at the laboratory.

REFERENCES

EPA, 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, U.S. Environmental Protection Agency, EPA/542/S/02/001, May.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure, EPA/540/S-95/504, 12 pp.

INTRODUCTION

This standard operating procedure (SOP) is for measuring depth to groundwater in a flush-mount monitoring well or a stick-up monitoring well.

EQUIPMENT

Copy of project work plan
Paper towels
Water level indicator
Indelible pen
Five-gallon bucket
Decontamination materials
Field forms/notebook
Appropriate PPE and traffic controls
Well log(s)
Well keys
Magnet

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

1. Don safety glasses and other appropriate PPE. Set up any necessary traffic controls.

2. Identify the monitoring well.

3. Open protective well cover. If the protective cover is a flush mount, remove bolts and use a magnet to lift and remove the flush mount lid to avoid pinches. Unlock the padlock and remove compression cap. If the protective cover is a stick up, unlock the padlock, remove the cover, and remove the cap.

4. Don nitrile gloves.

5. Measure depth to groundwater to the nearest 0.01 ft from the established measuring point using an electronic water level indicator. Slowly lower the water-level indicator probe and measurement tape down the well so that it hangs freely. From the measuring point, record the depth to water and total depth of the well on field forms or in the logbook. Retract the water-level measurement tape.

6. Decontaminate water level measurement tape and indicator probe. Decontaminate the water level tape and probe with a detergent and deionized or distilled water over a five-gallon bucket. Generally, only that portion of the tape which enters the water table will need to be decontaminated. Return the water level indicator to its clean protective casing.

7. Remove nitrile gloves.

8. Properly dispose of the decontamination water per provisions set forth in the work plan.

9. Place the paper towels, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

10. Replace and lock the well cap and protective cover lid.

INTRODUCTION

This standard operating procedure (SOP) is for measuring water quality field parameters using a YSI 556 MPS or similar water quality meter. Water quality parameters include temperature, pH, specific conductance (SC), oxidation/reduction potential (ORP), and dissolved oxygen (DO). The manufacturer operation and maintenance manual shall be followed when operating or calibrating the meter. The meter shall be calibrated at least daily.

EQUIPMENT

Copy of project work plan
Water level indicator
Water quality meter
Interface probe
Calibration solutions
Submersible or peristaltic pump
Tubing
Power source
Safety cable
Five-gallon buckets
Field forms/log book
Well log(s)
Wrench and magnet
Paper towels
Indelible pen
Watch
Decontamination materials
Appropriate PPE and traffic controls
Well keys

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary. Solutions used for standardizing and calibrating will be checked prior to field mobilization to determine if the expiration dates have been exceeded. Any expired solution will be discarded appropriately and replaced with a new solution.

CALIBRATION

Make sure that the meter has been decontaminated with deionized water, the probe are not damaged or dirty, and wear nitrile gloves to avoid chemical exposure to your skin.

Turn on machine using the on/off key, and press the escape key to display the main menu.

pH

1. Use the arrow keys to highlight the pH calibration selection, and press enter.

2. Use the arrow keys to highlight 3 point calibration, and press enter. This process allows a pH buffer of 7.0, and two additional pH buffers to be calibrated (4.0 and 10.0).

3. Place a pre-measured, package of buffer solution (pH 7.0 buffer solution) into a clean, dry transport/calibration cup.

4. Ideally, before proceeding, rinse the pH sensor with a small amount of standard to clean the sensor and ensure that the sensor is not cross-contaminated from other calibration solutions.

5. Carefully immerse the end of the probe module into the solution. Ensure that the probe is fully immersed into the solution, and gently rotate and/or move the probe up and down to remove any bubbles from the pH sensor.

6. Screw the transport/calibration cup on the threaded end of the probe module, and securely tighten.

7. Use the keypad to enter the calibration standard value. Press enter after entering the value, and the meter will display the pH calibration screen.

8. Allow at least one minute for temperature equilibration before proceeding. When the pH reading shows no significant change for approximately 30 seconds, press enter, and the screen will indicate that the calibration has been accepted.

9. Upon completion of the calibration, rinse the probe module and sensors in distilled or deionized and dry.

10. Repeat the steps above using the additional two pH buffer solutions (i.e., 4.0 and 10.0).

Specific Conductance

1. Use the arrow keys to highlight the conductivity calibration selection, and press enter.

2. Use the arrow keys to highlight specific conductance, and press enter. The meter will display the conductivity calibration screen.

3. Place 55 ml of a conductivity standard solution (i.e., 2764 µS/cm) into a clean, dry transport/calibration cup.

4. Ideally, before proceeding, rinse the conductivity sensor with a small amount of standard to clean the sensor and ensure that the sensor is not cross-contaminated from other calibration solutions.

5. Carefully immerse the end of the probe module into the solution. Ensure that the probe is fully immersed into the solution past its vent hole, and gently rotate and/or move the probe up and down to remove any bubble from the conductivity cell.

6. Screw the transport/calibration cup on the threaded end of the probe module, and securely tighten.

7. Use the keypad to enter the calibration standard value, and be sure to enter the standard in mS/cm. Press enter after entering the value, and the meter will display the conductivity calibration screen.

8. Allow at least one minute for temperature equilibration before proceeding. When the conductivity reading shows no significant change for approximately 30 seconds, press enter, and the screen will indicate that the calibration has been accepted.

9. Upon completion of the calibration, rinse the probe module and sensors in distilled or deionized and dry.

Oxidation/Reduction Potential

1. Use the arrow keys to highlight the conductivity calibration selection, and press enter.

2. Use the arrow keys to highlight the ORP selection, and press enter. The meter will display the ORP calibration screen.

3. Place 30 ml of the ORP standard solution (i.e., 100 mVolts solution) into a clean, dry transport/calibration cup.

4. Ideally, before proceeding, rinse the ORP sensor with a small amount of standard to clean the sensor and ensure that the sensor is not cross-contaminated from other calibration solutions.

5. Carefully immerse the end of the probe module into the solution. Ensure that the probe is fully immersed into the solution, and move the probe up and down to remove any bubbles from the ORP sensor.

6. Screw the transport/calibration cup on the threaded end of the probe module, and securely tighten.

7. Use the keypad to enter the calibration standard value, and be sure to enter the standard in millivolts. Press enter after entering the value, and the meter will display the ORP calibration screen.

8. Allow at least one minute for temperature equilibration before proceeding. When the ORP reading shows no significant change for approximately 30 seconds, press enter, and the screen will indicate that the calibration has been accepted.

9. Upon completion of the calibration, rinse the probe module and sensors in distilled or deionized and dry.

Dissolved Oxygen

1. **Note: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.** After twenty minutes, press the escape key to display the main menu. Use the arrow keys to highlight the DO% calibration selection, and press enter.

2. The DO Barometric Pressure Entry Screen is displayed. Obtain the local, or regional barometric pressure from the local weather station.

3. Place approximately 1/8 of an inch of water into a clean, dry transport/calibration cup.

4. Place the probe module into the transport/calibration cup, and make sure that the DO and temperature sensors are not immersed in the water.

5. Screw the transport/calibration cup on the threaded end of the probe module, and engage only 1 or 2 threads to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the barometric pressure value, and be sure to enter the value in mmHg. Press enter after entering the value and the meter will display the dissolved oxygen calibration screen.

7. Allow at least ten minutes for temperature equilibration, and the air in the calibration cup to become saturated before proceeding. When the conductivity reading shows no significant change for approximately 30 seconds, press enter, and the screen will indicate that the calibration has been accepted.

8. Upon completion of the calibration, rinse the probe module and sensors in distilled or deionized and dry.

GENERAL PROCEDURES

1. Check to make sure meter is working, and batteries are in good condition prior to arriving at a site.

2. Don safety glasses and other appropriate PPE. Set up any necessary traffic controls.

3. Identify the monitoring well.

4. Calibrate water quality meter.

5. Open protective well cover. If the protective cover is a flush mount, remove bolts and use a magnet to lift and remove the flush mount lid to avoid pinches. Unlock the padlock and remove compression cap. If the protective cover is a stick up, unlock the padlock, remove the cover, and remove the cap.

6. Don nitrile gloves.

7. Measure fluid levels to the nearest 0.01 ft from the established measuring point using an electronic water level indicator or interface probe, as specified in the project work plan.

8. Decontaminate the measurement tape and indicator probe.

9. Remove nitrile gloves.

10. Calculate the height of the water column in the well. Calculate the thickness of non-aqueous liquid, if present. Calculate the volume of water to be purged from the well. Wells exhibiting measurable non-aqueous liquid will not be sampled.

Low-Flow

1. Calculate the length of tubing needed to reach the zone to be sampled as specified in the work plan.

2. Don new nitrile gloves.

3. Cut tubing to the appropriate length and attach it to the pump.

4. Lower the pump, safety cable, electrical line, and/or tubing slowly (to minimize disturbance) into the well to the depth of the zone to be sampled as specified in the work plan. Record the depth to the pump or tubing intake in the field logbook. If possible, keep the pump intake a minimum of two feet above the bottom of the well to minimize mobilization of particulates present in the bottom of the well.

5. Thread the flow-through cell on to the probe module of the water quality field parameter meter.

6. Connect the tubing from the pump to the water quality meter flow-through cell. Connect additional tubing to the flow-through cell discharge port and run the line into a five gallon bucket for purge collection.

7. Begin purging the monitoring well. Ensure the water quality probes are submerged in water at all times.

8. During purging, a minimum of one volume (including the volume of water in the pump) must be purged prior to recording water quality indicator parameters. Monitor and record water quality indicator parameters at three to five minute intervals or as appropriate. The stabilization criterion is based on three successive readings of the water quality field parameters. Once the criteria have been successfully met indicating that the water quality parameters have stabilized, then sample collection can take place. Field parameter measurements are considered satisfactorily stabilized when three consecutive readings, taken at three to five minute intervals, fall within the acceptable range listed in Table 1.

Table 1

Parameter	Stabilization Criteria
pH	± 0.1 standard units
Temp	± 1 degree Celsius (^{o}C)
SC	± 3%
ORP	± 10 millivolts (mV)
DO	± 0.3 milligrams per liter (mg/L)

Source: Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, EPA/542/S/02/001, May 2002

9. Record the required field parameters on the sampling field data sheet.

10. Disconnect the water quality meter before collecting a sample. Follow sample collection per the SOP for Groundwater Sampling Using Low-Flow Methods.

11. Decontaminate the water quality meter with DI water. Store probe in tap water to protect the sensors.

In-Situ

1. Don new nitrile gloves.

2. Based on depth to groundwater, measure required probe depth on the cable and mark desired location with tape.

3. Lower the water quality meter into the well until the probe is submerged and tape location reaches the top of the well casing. Ensure the water quality probes are submerged in water at all times.

4. Monitor and record on the sampling field data sheet the water quality indicator parameters once the parameters have stabilized.

5. Remove the water quality meter from the well.

6. Decontaminate the water quality meter with DI water. Store probe in tap water to protect the sensors.

7. Properly dispose of the decontamination water per provisions set forth in the work plan.

8. Place the used tubing, paper towels, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

Ex-Situ

1. Don new nitrile gloves.

2. Lower the bailer and cord very slowly until submerged into the water column to a depth corresponding to the approximate length of the bailer being careful not to agitate groundwater. Only allow the bailer to submerge to the point at which the top of the bailer is just submerged.

3. Very slowly extract the bailer from the water column being careful not to agitate groundwater. Decant the water in the bailer into a 5-gallon bucket through the top of the bailer. Do not allow the bailer to contact the bucket.

4. Place the bailer back into the well and slowly lower it to the water table and continue purging the well. Do not drop the bailer onto the water table; slowly lower the bailer to the water table and allow the bailer to slowly submerge into the water column to avoid agitation of groundwater.

5. Continue purging until one casing volume has been purged. At that point, decant water from the top one-third of the bailer into the transport cup or plastic disposable cup after decanting the water

in the lower two-thirds of the bailer into the purge water bucket through the ball valve on the bottom of the bailer. This can be done using the flow tip provided with the bailer or by pushing up the ball in the valve with a finger. Decant the remaining water in the bailer into the purge water bucket.

6. Place water quality meter probes into the transport cup and thread together. Immerse probe in sample so that all sensors are submerged. Move probe around in sample to displace any air bubbles. The probe should not be touching the sides of the container

7. Measure and record on the sampling field data sheet the required field parameters per the work plan of the water sample in the transport cup. Decant the water sample in the transport cup into the purge water bucket.

8. Continue purging the well until two casing volumes have been purged, then again measure and record the field parameters as described above.

9. Continue purging the well until three casing volumes have been purged, then again measure and record the field parameters as described above.

10. The stabilization criterion is based on three successive readings of the water quality field parameters. Once the criteria have been successfully met indicating that the water quality parameters have stabilized, then sample collection can take place. Field parameter measurements are considered satisfactorily stabilized when three consecutive readings, recorded following the purging of each casing volume, fall within the acceptable range listed in Table 1.

11. If stabilization of water quality parameters is not achieved by purging three casing volumes from the well, continue purging and collecting readings following each casing volume until water quality parameters are satisfactorily stabilized.

12. Following the stabilization of water quality parameters begin sample collection. Follow sample collection per the SOP for Groundwater Sampling Using Disposable Bailer Methods.

13. Decontaminate the water quality meter with DI water. Store probe in tap water to protect the sensors.

14. Properly dispose of the purge and decontamination water per provisions set forth in work plan.

15. Place the bailer, paper towels, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

16. Replace and lock the well cap and protective cover lid.

Surface Water

Water quality field parameters should be taken at the source. If it is not possible to measure the parameters at the source, collect a sample of the water in the transport cup or plastic disposable cup.

Direct Method

1. Don new nitrile gloves.

2. Lower the water quality meter into the surface water until the probe is submerged. Ensure the water quality probe sensors are submerged in water at all times.

3. Monitor and record on the sampling field data sheet the water quality indicator parameters once the parameters have stabilized.

4. Remove the water quality meter from the surface water body.

5. Following the stabilization of water quality parameters begin sample collection. Follow sample collection per the SOP for Surface Water Sampling.

6. Decontaminate the water quality meter with DI water. Store probe in tap water to protect the sensors.

7. Properly dispose of the decontamination water per provisions set forth in the work plan.

8. Place the used paper towels, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

Ex-Situ Method

1. Don new nitrile gloves.

2. Lower the transport cup or plastic disposable cup slowly until submerged into the water being careful not to agitate groundwater.

3. Slowly extract the cup from the water being careful not to agitate groundwater.

4. Place water quality meter probes into the transport cup and thread together. Immerse probe in sample so that all sensors are submerged. Move probe around in sample to displace any air bubbles. The probe should not be touching the sides of the container

5. Monitor and record on the sampling field data sheet the water quality indicator parameters once the parameters have stabilized.

6. Following the stabilization of water quality parameters begin sample collection. Follow sample collection per the SOP for Surface Water Sampling.

7. Decontaminate the water quality meter with DI water. Store probe in tap water to protect the

sensors.

8. Properly dispose of the decontamination water per provisions set forth in the work plan.

9. Place the used paper towels, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

MAINTENANCE

1. Store meter in its case during transport. Store probe immersed in tap water.

2. Check batteries before taking meter into the field. Carry spare batteries and screwdriver.

3. Inspect sensors regularly for cracks or other damage.

REFERENCES

EPA, 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers, Ground Water Forum Issue Paper, U.S. Environmental Protection Agency, EPA/542/S/02/001, May.

Puls, R.W. and M.J. Barcelona, 1996, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure, EPA/540/S-95/504, 12 pp.

INTRODUCTION

This standard operating procedure (SOP) provides guidelines for deployment, recovery, and quality assurance/quality control (QA/QC) associated with the use of HydraSleeve samplers for obtaining volatile organic compounds (VOCs) data results in groundwater monitoring wells.

Multiple samplers are deployed in groundwater monitoring wells to determine whether contaminant stratification is present and to locate the zone of greatest impacts, as well as long-term monitoring of VOCs. For the purposes of this SOP, it is assumed there is horizontal flow through the well screen and the quality of the water vertically within a well is representative of the groundwater in the aquifer directly adjacent to the screen at that location.

A site-specific Sampling and Analysis Plan (SAP) must be developed prior to groundwater sampling. The SAP should include the data quality objectives (DQOs), size of the samplers, the number and depth of samplers required at each well, and all QA/QC requirements.

EQUIPMENT

Copy of project work plan
Well log(s)
Water level indicator/interface probe
HydraSleeves
Suspension line or tether
Spring clip
Tether winding reel
Reusable stainless-steel weights and clips
Discharge tubes
Cable ties or stainless steel clamps
ID tags
Locking J-plugs/caps
Five gallon buckets
Plastic sheeting
Field sampling forms
Volatile Organic Analysis (VOA) sample vials and labels
VOA protective wrapping
HCl preservative
DI or distilled water
Chain of custody forms
Coolers and ice
Large plastic garbage bag(s)
Safety scissors
Watch
Indelible pen
Decontamination materials
Appropriate PPE and traffic controls
Well keys
Magnet

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

Overview

Attach the HydraSleeve samplers to a weighted tether and suspend from a J-plug well cap. The weight rests on the bottom of the well with the line taut above it. The size of the Hydrasleeve sampler and the particular depths where the samplers will be deployed will depend on the size and depth of the well and the DQOs specified in the SAP. Recover the HydraSleeve samplers a minimum of 48 hours after deployment, in accordance with the SAP or regulatory requirements. Retrieve the HydraSleeve samplers from the well and collect the enclosed water in preserved 40-

mL VOA vials for laboratory analysis.

Preliminary Procedures

1. Measure the correct amount of tether needed to suspend the HydraSleeve in the monitoring well so the weight will rest at the selected position in the well. Leave a few feet of excess tether at the top of the well to allow recovery of the sleeve.

2. Determine the length of screen to be sampled and the depths to deploy the samplers based on the well diameter, screen interval length and position, water level, and total depth at each monitoring well. In wells with a ten foot screen, up to three standard 30-inch samplers may be deployed in series evenly along the screen on a single tether.

   Measure the position of the samplers on the tether beginning from the bottom of well. Tethers with depth indicators marked in 1-foot intervals are available from the manufacturer. A weight will be attached to the end of the tether so that it rests on the bottom of the well with the line taut above it hanging from the J-plug well cap. Calculate the distance from the bottom of the well (or top of the sediment) to the desired interval to position the HydraSleeves.

3. Attach the samplers to the tether at both the top and bottom of the sleeve. Attach the tether at the top with a stainless-steel clip. Attach the tether at the bottom using a cable tie. If required in the work plan, attach the second sampler above the first and the third above the second.

   Alternatively, the first sampler can be attached to the tether as described above, a second attached to the bottom of the first using a short length of tether, and the third attached to the bottom of the second in the same manner, with the weight attached to the bottom of the third sampler.

4. The HydraSleeve samplers may be attached to the tether in the office or in the field prior to deployment as specified in the SAP.

HydraSleeve Assembly Procedures

1. Don nitrile gloves.

2. Remove the HydraSleeve from its packaging, unfold it, and hold it by its top.

3. Crimp the top of the HydraSleeve by folding the hard polyethylene reinforcing strips at the holes.

4. Attach the spring clip to the holes to ensure that the top will remain open until the sampler is retrieved.

5. Attach the tether to the spring clip by tying a knot in the tether. Alternatively, if not using a spring clip, attach the tether to one (NOT both) of the holes at the top of the Hydrasleeve by tying a knot in the tether.

6. Fold the flaps with the two holes at the bottom of the HydraSleeve together and slide the weight clip through the holes.

7. Attach a weight to the bottom of the weight clip to ensure that the HydraSleeve will descend to the bottom of the well.

8. Remove nitrile gloves.

HydraSleeve Deployment Procedures

1. Review the vendor HydraSleeve instructions.

2. Don safety glasses and other appropriate PPE. Set up any necessary traffic controls.

3. Inspect the well for damage or evidence of tampering, and record observations. Wells shall be locked at all times when not being sampled.

4. Open protective well cover. If the protective cover is a flush mount, remove bolts and use a magnet to lift and remove the flush mount lid to avoid pinches. Unlock the padlock and remove compression cap. If the protective cover is a stick up, unlock the padlock, remove the cover, and remove the cap.

5. Don nitrile gloves.

6. Plastic sheeting may be laid out on the ground at the sampling location to provide a contaminant free surface to assemble and prepare the samplers for deployment.

7. Measure the depth to fluid levels in accordance with the Measuring Fluid Levels SOP 051-204. Record the depth to water, non-aqueous fluid levels (if present), and total depth of the well on field forms or in the logbook. Decontaminate the measurement tape and indicator or interface probe.

8. If the samplers have not previously been assembled, attach enough weight to the bottom of the tether so it will rest on the bottom of the well with the line taut above it.

9. Attach a sample ID tag with a cable tie. This may be done in a clean environment prior to deployment if approved in the SAP. Clip off excess cable tie. Eliminate sharp points or ends of clamps, tags, or cable ties to decrease the potential for punctures or tears. Once all samplers are attached to the tether, attach the tether to the J-plug well cap.

10. Lower the weight and line into the well until the weight rests on the bottom of the well, or to the selected depth in the water column, and the line above the weight is taut. The sampler(s) should now be positioned at the selected depths.

    Check the depth by placing a knot or mark on the line at the correct distance from the top of the sampler to the top of the well casing and verify the mark aligns with the lip of the casing after deployment.

During installation, hydrostatic pressure in the water column will keep the self-sealing check valve at the top of the HydraSleeve closed, and ensure that it retains its flat, empty profile for an indefinite period prior to recovery.

Make sure that the HydraSleeve is not pulled upward at any time during its descent. If the HydraSleeve is pulled upward at a rate greater than 0.5 ft/second at any time prior to recovery, the top check valve will open and water will enter the HydraSleeve prematurely.

11. Secure the tether at the top of the well by placing the well cap on the top of the well casing and over the tether, or secure the tether to the J-plug well cap and secure the well. Leave a few inches of slack in the line to avoid pulling the sampler up as the cap is removed.
12. Allow a minimum of 48 hours of equilibration time following deployment of the Hydrasleves prior to their recovery.

<u>HydraSleeve Recovery Procedures</u>

1. Recover the HydraSleeve samplers following a minimum of 48 hours of equilibration time after deployment, in accordance with the SAP, manufacturer recommendations, and/or regulatory requirements, to allow groundwater in the screened interval to equilibrate.

2. Hold on to the tether while removing the well cap.

3. Secure the tether at the top of the well while maintaining tension on the tether (but without pulling the tether upwards).

4. Collect a fluid level measurement at the well. Compare the current water level to the deployment water level.

5. In one smooth motion, pull the tether up between 30” to 45” (36” to 54” for the longer HydraSleeve) at a rate of about 1 foot per second (or faster).

6. The motion will open the top check valve and allow the HydraSleeve to fill (it should fill in about 1 to 1.5 times the length of the HydraSleeve). This is analogous to coring the water column in the well from the bottom up. When the HydraSleeve is full, the top check valve will close. The weight of the HydraSleeve on the tether can be felt and it will begin to displace water. The closed check valve prevents loss of sample and entry of water from zones above the well screen as the HydraSleeve is recovered.

7. Continue pulling the tether upward until the HydraSleeve is at the top of the well. When retrieving the samplers, remove and process only one sampler at a time. The remaining samplers should be suspended in the well until they can be processed to isolate them from agitation, exposure to ambient weather conditions, and direct sunlight.

8. Once retrieved, examine the surface of the sampler for evidence of algae, iron or other coatings, and for tears. Note the observations on the field sample form. If there are tears, the sample should not be used.

9. Decant and discard the small volume of water trapped in the Hydrasleeve above the check valve by turning the sleeve over a five gallon bucket. Remove excess liquid from the exterior of the bag to minimize the potential for cross contamination or dilution of the sample.

Sample Collection

Sample collection should be done immediately after the HydraSleeve has been brought to the surface to preserve sample integrity. VOCs sample collection requires minimal disturbance of the sample to limit volatilization and therefore a minimal loss of volatiles from the sample.

1. Detach the sampler from the weighted line, if needed.

2. Remove the discharge tube from its sleeve.

3. Hold the HydraSleeve at the check valve.

4. Puncture the HydraSleeve just below the check valve with the pointed end of the discharge tube. Do not reuse the discharge tubes.

5. Discharge water from the HydraSleeve into the sample containers immediately using the following procedures:

   - Open the vial, set cap in a protected place, and collect the sample.
   - Allow the water to flow through the tube into the preserved VOA vials. Control the discharge from the HydraSleeve by either raising the bottom of the sleeve, by squeezing it like a tube of toothpaste, or both. Be sure the sample flow is laminar and no air bubbles are in the flow.
   - Create a convex meniscus on the top of the vial.
   - Check that the cap has not been contaminated and carefully cap the vial by placing the cap directly over the top and screwing down firmly. Do not over-tighten and break the cap or vial.
   - Invert the vial and tap gently. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling the vial. If this has to be repeated more than twice, discard the sample and begin again with a new preserved vial.
   - Record the deployment depth of the samplers on the label, the field sample form, and the chain of custody.

6. Continue filling sample containers until all are full. Place the samples in coolers and chill to maintain the sample temperature at $\leq 6^{o}$ C.

7. Unused water from the samplers can be discarded on the ground or containerized for proper disposal as specified in the SAP.

8. Decontaminate the reusable stainless-steel bottom weight and clip. The weight and clip may be reused after thorough cleaning.

9. Remove nitrile gloves.

10. Properly dispose of the decontamination water per provisions set forth in the work plan.

11. Place paper towels, nitrile gloves, tethers, and any other disposables in a plastic garbage bag for landfill disposal.

12. Replace and lock the well cap and protective cover lid.

Quality Assurance / Quality Control (QA/QC)

QA/QC sampling consists of sample duplicates, pre-deployment equipment blanks, and routine temperature and trip blanks.

Sample duplicates:

Duplicate samples will be collected at a minimum frequency of one per twenty samples and analyzed for VOCs. The natural sample is collected first, and then the duplicate sample is collected from the same sampler. Refer to the SAP for the specific requirements and a list of duplicate sample locations.

Pre-deployment equipment blank:

The pre-deployment equipment blank is a HydraSleeve that has been stored and transported from shipment through the last deployment of the sampling event and filled with DI or distilled water. After the last sampler deployment, the pre-deployment blank should be collected from the HydraSleeve sampler into VOA vials and submitted for analysis. Label the sample as a pre-deployment equipment blank. A minimum of one pre-deployment blank is required per event. Refer to the SAP for specific requirements. If more than one pre-deployment equipment blank is required, the locations of the associated HydraSleeve samplers must be noted on the field sampling forms.

Temperature and trip blanks:

There shall be one temperature blank and one trip blank per cooler.

Records and Documentation

The deployment depths for each sample should be identified in the sample name and be recorded on the field sample form and chain of custody.

Field data records must be documented while performing HydraSleeve sampling. As indicated above, special notations are required regarding the condition the HydraSleeves upon retrieval. This is critical to the validity of the data results. All observations shall be recorded on the field sample sheets or in the field notebook in permanent pen.

REFERENCES

GeoInsight, 2006, HydraSleeve™ Simple by Design Field Manual.

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McAlary, T. A. and J. F. Barker, 1987, Volatilization Losses of Organics During Ground-Water Sampling From Low-Permeability Materials, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 63-68.

Parsons, 2005, Results Report for the Demonstration of No-Purge Ground-Water Sampling Devices at Former McClellan Air Force Base, California; Contract F44650-99-D-0005, Delivery Order DKO1, U.S. Army Corps of Engineers (Omaha District), U.S. Air Force Center for Environmental Excellence, and U.S. Air Force Real Property Agency.

Robin, M. J. L. and R. W. Gillham, 1987, Field Evaluation of Well Purging Procedures, Ground-Water Monitoring Review, Vol. 7, No. 4, pp. 85-93.

DRILLING AND SOIL SAMPLING

Permits, Site Safety Plan, Utility Clearance

ATC Associates Inc. (ATC) obtains all the required permits, unless otherwise contractually directed. ATC prepares a site specific Health and Safety Plan (HASP) detailing site hazards, site safety and control, decontamination procedures, and emergency response procedures to be employed throughout the defined phase of work. At least 48 hours prior to drilling all underground utilities will be located by an authorized utility locating service. ATC attempts to locate all underground and aboveground utilities by site inspection (in conjunction with it's' subcontractors and knowledgeable site managers, if available), and review of site as-built drawings.

Drilling Equipment

All soil borings are drilled using equipment appropriate for site conditions, such as: air rotary, hollow-stem auger, sonic and direct push. If site conditions warrant and subsurface conditions permitting, the first five feet of each boring is advanced using a hand-auger or an air knife. All drilling equipment is inspected daily and maintained in safe working condition by the operator. All down-hole drilling equipment is decontaminated prior to arriving on site. Working components of the drill rig near the borehole, as well as augers and drill rods are thoroughly decontaminated between each boring location. All ATC drilling and sampling methods are consistent with ASTM Method D-1452-80 and local, state and federal regulations.

Soil Sampling and Lithologic Description

Whenever possible and approved by the appropriate regulatory agency, the borings to be drilled at a site are continuously sampled to obtain a complete lithologic description. If copper or zinc contamination is the subject of the investigation, stainless steel liners are used instead of brass. Additional soil samples may be collected based upon significant changes in lithology or in areas of obvious soil contamination. If applicable, the soil sampler and liners are cleaned with a Liquinox® solution and rinsed with tap water prior to each sampling event.

The samples are labeled, documented on a chain-of-custody form and placed in a cooler for transport to a state-certified analytical laboratory. Soil contained in remaining liners is removed for lithologic descriptions (according to the Unified Soil Classification System). Additional soil is screened for organic vapors by placing approximately 30 grams of soil in a sealed plastic bag or a glass jar sealed with aluminum foil. The bag or jar is left undisturbed for approximately 15 minutes, in the sun if possible. The headspace in the bag is accessed in a manner to minimize entry of outside air, and is tested for total organic vapor using a calibrated photo ionization detector (PID). . In addition, visual sheen tests will be conducted for each sample interval in conjunction with the PID screening to determine the possible presence (or absence) of source material. The results of the field screening are noted with the lithologic descriptions on the Field Exploratory Soil Boring Log.

On encountering an impermeable (clayey) layer three feet or more in thickness below a saturated permeable layer, where the impermeable layer is considered to be a possible confining layer for an underlying aquifer, drilling is halted until a decision to proceed is obtained from the project manager. This process minimizes the chance of introducing contamination to an underlying, clean aquifer.

Soil Waste Management

Soil cuttings are stockpiled on and covered with plastic sheeting to control runoff, or contained in 55-gallon D.O.T.-approved drums on site. Waste soil is sampled to chemically profile it for disposal, and hauled by a licensed waste hauler to an appropriate landfill or certified treatment facility. All waste stored on site is properly labeled at the time of production.

Soil Boring Abandonment

Soil borings which are not to be converted into monitor wells are sealed to the ground surface using neat cement, sand-cement slurry, or hydrated bentonite pellets or chips in accordance with federal, state and local regulations. Native soil may be used to fill the top two to three feet for cosmetic purposes, as permitted.

WELL INSTALLATION

Well Casing. Screen and Filter Pack Construction

Soil borings to be converted into single-cased monitor wells are a minimum of eight inches in diameter for 2-inch diameter wells, and a minimum of ten inches in diameter for 4-inch diameter wells. Monitor wells are constructed with schedule 40, threaded; polyvinyl chloride (PVC) casing unless site geochemistry or contamination necessitates an alternative regulatory agency approved material. The wells are constructed with factory-slotted screen and threaded end caps.

The screened interval is placed such that it extends approximately ten feet into the water bearing zone, and at least two feet above the expected maximum water level. The screened interval may extend less than two feet above the maximum water level, only to prevent intersection of the screened interval with the top of the confining layer of a confined aquifer, or where the water table is too shallow to allow this construction. A graded sand filter pack is placed in the annular space across the screened interval and extended approximately one to two feet above the screen, as site conditions permit, so as to prevent extension of the sand pack into an overlying water-bearing unit. The well screen slot size is the maximum size capable of retaining 90% of the filter pack. Typically, 0.010-inch screen is used where the formation is predominantly clay and/or silt or poorly graded fine sand. A 0.020-inch screen is used where the formation is predominantly well-graded or medium to coarse sand and/or gravel.

The filter pack grade (mean grain size) is selected according to native sediment type as follows: a) for poorly graded fine sand or silt/clay - 4 times the 70% retained grain size of the formation b)

for medium to coarse sand, gravel or well graded sediments - 6 times the 70% retained grain size. Since results of particle size analysis are not always available, ATC often selects screen size and filter pack on the basis of general site stratigraphy, and specifically the finest significantly thick layer of sediment to be screened.

Well Seal and Completion

A minimum two-foot seal of bentonite is placed above the sand pack and extended to near the ground surface. The bentonite seal is hydrated by either formation water or potable water. A watertight locking cap and protective traffic-rated, flush mount vault box is installed on top of each well situated within or near vehicle traffic areas, or where restricted by access agreements. Elsewhere, each well will be completed with a water tight cap and steel stick-up protective cover. Well construction details are presented on the Field Soil Boring Log sheet. Following completion of a well, ATC completes and submits, or ensures that the driller has sufficient information to complete and submit, the state-required Well Completion Report or equivalent document.

INTRODUCTION

This procedure is intended for field screening of volatile organic compounds (VOCs) in surface and/or subsurface soil samples collected as part of environmental investigations/assessments. A photoionization detector (PID) should be used for this procedure. Ensure that the lamp in the PID is of sufficient intensity to ionize all contaminants of concern.

EQUIPMENT

Photoionization Detector
Resealable plastic bags (Ziploc® or equivalent)
Field notes or sample logs
Decontamination materials

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

1. Place a small amount of soil into a Ziploc®or other suitable sealable plastic bag, seal tightly, then disaggregate the soil. Label the outside of the bag with the sample identification, depth, time, and date. When collecting samples where splits may be destined for laboratory analysis, collect laboratory samples in laboratory-supplied sample jars prior to collecting field screening samples to minimize the potential for loss of VOCs in laboratory samples.

2. Place the Ziploc® bag in a warm environment such as direct sunlight, on or in front of a vehicle heating vent, or in a slightly warm oven to promote volatilization of VOCs. The optimal temperature for volatilization is approximately 100°F. Allow the sample to sit for 15 minutes.

3. Place the bag on a clean work surface (plastic sheeting, etc.) upwind of any engine exhaust or VOC sources.

4. Insure that the PID has been properly calibrated prior to using. Follow the manufacturer's instruction and record the calibration on a calibration log, instrument maintenance book, or field book.

5. Open a small length of the plastic bag's zipper and insert the tip of the PID probe. Allow the meter to equilibrate, and then record the maximum measured concentration on the boring log or field book.

6. As necessary decontaminate the PID probe tip in accordance with the Equipment Decontamination SOP.

INTRODUCTION

This standard operating procedure (SOP) is for management of liquid matrix investigation-derived wastes (IDW) generated as a result of field sampling and characterization activities. The goal is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling or remediation, a project team member will select an area, preferably secure, for drum or tank storage in consultation with the on-site manager, if applicable. All drums used will be, as required, U.S. Department of Transportation (DOT) approved drums. Drums will not be stacked on top of each other and will be stored in rows not larger than two drums wide, with labels facing outward for identification. Decontamination fluids and other low-volume fluids may be temporarily stored and transported in five- gallon buckets with lids.

Different residual materials (e.g., water and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums or containers. Field screening will be used to drum materials with similar levels of contamination together, if possible.

EQUIPMENT

Storage tanks
DOT-approved drums
Drum liners
Funnels
Five gallon buckets and lids
Air sparge equipment
Weather-resistant paint pen
Granular activated carbon (GAC) unit

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

Residual Liquids

If it is determined that residual liquid such as water from well development and decontamination water must be containerized, it will be placed in a temporary holding tank or DOT-approved 55-gallon drums, as appropriate. The holding tank or drums will be sealed and labeled in accordance with labeling procedures. Liquids drums will contain removable bungs. Funnels will be used to prevent spillage when adding liquids to the drums.

Treatment and Sampling

The liquid matrix IDW temporarily placed in a tank or drum will then be treated on-site by air sparging. The treated IDW water will then be sampled in accordance with the Sampling of Investigation-Derived Wastes SOP 051-503, and the samples will be submitted for laboratory analysis per provisions defined in the work plan to evaluate the effectiveness of treatment. If laboratory results indicate the IDW water treatment achieves site-specific groundwater and surface water cleanup levels, the water will be surface discharged onsite. If the laboratory results indicate the IDW water treatment did not achieve cleanup standards, the IDW water will be further treated with a granulated activated carbon (GAC) filter, and the sampling and analysis process continued until IDW water quality meets groundwater and surface water cleanup levels. If laboratory results indicate the IDW water treatment then achieves the site-specific disposal criteria, the water will be surface discharged on-site.

If laboratory results do not indicate the IDW water treatment meets the surface discharge criteria, the disposal procedures listed below must be followed.

Disposal

Wastes that have been drummed based on field criteria will be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the nature of the source areas and the requirements of the disposal facility. IDW characterized or listed as hazardous waste will be disposed of in a manner consistent with all local, state, and federal guidelines.

Labeling

The holding tanks or drums will be labeled on the side using a weather-resistant paint pen. The following information will be included:

- Sampling location identification(s).
- Sampling area designation.
- Point of contact with phone number.
- Type of material.
    - GW - Groundwater from wells.
    - DW - Decontamination water.
    - DS - Disposables.
    - SO - Decontamination solvents.
- For drums containing liquids, indicate the approximate fill line on the outside of the drum. Do not fill more than two-thirds full with liquids.
- Range of field screening results and instrument type, if applicable.
- Date the tank or drum was filled and sealed.

PPE and Disposable Investigation Equipment

Non-hazardous IDW, such as personal protective equipment (PPE) and disposable investigation equipment will be disposed of at the Billings Regional Landfill, located in Billings, MT. PPE and disposable investigation equipment that is generated throughout the investigation activities shall be placed in dedicated heavy duty (minimum of 0.85 mil) plastic garbage bags or containers (e.g., drums). Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic garbage bags or containers by brushing off, or using small amounts of water to scrub off, gross potential contamination. PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as non-hazardous solid waste.

INTRODUCTION

This standard operating procedure (SOP) is for management of solid matrix investigation derived wastes (IDW) generated as a result of field sampling and characterization activities. The goal is to minimize the amount of waste generated while following applicable regulations. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to commencing sampling or remediation, a project team member will select an area, preferably secure, for drum or roll-off box storage in consultation with the on-site manager, if applicable. All drums used will be, as required, U.S. Department of Transportation (DOT) approved drums. Drums will not be stacked on top of each other and will be stored in rows not larger than two drums wide, with labels facing outward for identification.

Different residual materials (e.g., soil and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums. Field screening will be used to drum materials with similar levels of contamination together, if possible.

EQUIPMENT

DOT-approved 55-gallon drums
Roll-off boxes
Drum liners
PID
Drum labels
Weather-resistant paint pen
Plastic garbage bags

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

All residual waste must be placed in drums or roll-off boxes. IDW-filled drums or roll-off boxes will be transported to the secure staging area on-site. The IDW- filled drums or roll-off boxes must be sampled to determine the appropriate type of disposal facility.

Residual Soil

Soil cuttings and excess samples must be placed in DOT-approved drums or roll-off boxes. They will be sealed and labeled in accordance with labeling practices.

Disposal

Wastes that have been drummed based on field criteria may be sampled for laboratory analysis to determine the appropriate type of disposal facility. The number of samples collected will depend on the homogeneity of the drummed material, the nature of the source areas, and the requirements of the disposal facility. IDW characterized or listed as hazardous waste will be disposed of in a manner consistent with all local, state, and federal guidelines.

Labeling

Drums will be labeled on the side using a weather-resistant paint pen or drum label. The following information will be included:

- Sampling location identification(s).
- Sampling area designation.
- Point of contact with phone number.
- Type of material.
    - OB - Overburden soil and cuttings.
    - DS - Disposables.
    - BR - Bedrock cuttings.
    - SO - Decontamination solvents.
- Range of field screening results and instrument type, if applicable.
- Date the drum was filled and sealed.

PPE and Disposable Investigation Equipment

Non-hazardous IDW, such as personal protective equipment (PPE) and disposable investigation equipment will be disposed of at the Billings Regional Landfill, located in Billings, MT. PPE and disposable investigation equipment that is generated throughout the investigation activities shall be placed in dedicated heavy duty (minimum of 0.85 mil) plastic garbage bags or containers (e.g., drums). Potentially contaminated PPE or disposable investigation equipment will be decontaminated prior to placement in the plastic garbage bags or containers by brushing off, or using small amounts of water to scrub off, gross potential contamination. PPE and disposable investigation equipment that have been decontaminated, if warranted, are considered refuse and do not require characterization prior to disposal as non-hazardous solid waste.

INTRODUCTION

This standard operating procedure (SOP) is for the sampling of liquid matrix investigation-derived wastes (IDW) in order to characterize them for disposal. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to sampling and characterizations, IDW liquids will be drummed or stored in temporary holding tanks on-site. Different residual materials (e.g., water and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums or containers.

EQUIPMENT

Field log book or field sheets
Sample vials/bottles
Nitrile gloves
5-gallon buckets with lids
Resealable plastic bags: Ziploc® or equivalent
Polyethylene sheeting
Weather-resistant paint pen
Coolers with ice
Peristaltic pump and energy source
Polyethylene tubing
Flexible silicon tubing
Safety scissors
Plastic garbage bags
Traffic controls

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

IDW requires sampling and characterization prior to disposal.

IDW Liquids

Prior to sampling and characterization, IDW liquids are stored on-site in DOT-approved drums or held in temporary holding tanks for treatment by air sparge and/or granular activated carbon (GAC) filtration. Liquids generated as IDW must be characterized by collecting one post-treatment sample from each drum or temporary holding tank. Samples are collected using a peristaltic pump.

The following steps outline the basic procedures for the sampling and characterization of IDW liquids.

- Don safety glasses. Set up any necessary traffic controls.
- Prepare vial/bottle labels with the following information: date, project identification, sample identification, laboratory analysis and preservative.
- Don nitrile gloves.

- Place plastic garbage bag or sheeting on the ground adjacent to drum or tank, if required.

- Add preservative as required to vials/bottles.

- For the peristaltic pump, cut new, clean polyethylene tubing to the appropriate length and lower tubing into the drum or holding tank. Attach the tubing to approximately eight to ten inches of flexible silicon tubing and connect the silicon tubing to the peristaltic pump. Attach an effluent polyethylene tubing line to the other end of the flexible silicon tubing.

- Connect the effluent line to a purge water collection bucket or the purge water drum or tank. The purge water must be collected in buckets/drums during the sampling of the IDW liquids.

- Connect the pump to the energy source. If a combustion type (gasoline or diesel-driven) generator is used it must be placed downwind of the sampling area.

- Start pumping the purge water at a low flow rate (100 - 500 mL per minute). Samples should be collected directly from the discharge port of the pump tubing. For samples collected for dissolved gases or volatile organic compounds (VOCs) analyses, the pump's tubing needs to be completely full of IDW water to prevent the IDW water from being aerated as the IDW water flows through the tubing.

- Fill all sample containers with minimal turbulence by allowing the IDW water to flow from the tubing gently down the inside of the pre-preserved sample container.

- VOC samples will be collected by allowing the pump discharge to flow gently down the inside of laboratory-supplied 40 milliliter (mL) volatile organic analysis (VOA) vials pre-preserved with hydrochloric acid. When filling the VOAs, a meniscus must be formed over the mouth of the VOA to eliminate the formation of air bubbles and head space during capping. Turn the vial upside-down and check for air bubbles. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling the vial. If this has to be repeated more than twice, discard the sample and begin again with a new preserved vial.

- After filling all sample bottles, dry the bottles with a paper towel and write the time of sample collection on each vial. Wrap the bottles in protective wrap and place in the iced cooler. Maintain a cooler temperature of ≤ 6°C prior to shipping.

- Record the sampling time on the sampling field data sheet. Also record the total volume of purge water the sample was collected from along with any other necessary information required on the sampling field data sheet. Sign the sampling field data sheet and enter the necessary sample information on the chain of custody.

- Properly dispose of the purge liquid, per provisions of the work plan, by returning it to the IDW drums or holding tank until sample analysis results are received.

- Place the tubing, paper towels, nitrile gloves, and any other disposables in the plastic garbage bag for landfill disposal.

- Change nitrile gloves prior to sampling any additional drums or tanks of IDW liquid.

- When all samples have been collected, carefully pack the cooler to avoid breakage of any samples during shipment. Sign the completed chain of custody and seal it in a Ziploc® plastic bag and place in the cooler. Add sufficient ice or freezer packs to the cooler to maintain a cooler temperature of ≤ 6°C until the cooler arrives at the laboratory.

INTRODUCTION

This standard operating procedure (SOP) is for the sampling of solid matrix investigation-derived wastes (IDW) in order to characterize them for disposal. Field personnel should review and understand all applicable federal, state, and local regulations regarding IDW. Regulations may prohibit disposal of certain IDW on-site.

Prior to sampling and characterizations, IDW soils will be field screened visually and using a PID to store materials of similar contamination together. These units of similarly contaminated soil will be known herein as IDW soil units. IDW soils will be placed in drums, roll-off boxes or stockpiled on, and covered with, polyethylene sheeting on-site. Different residual materials (e.g., soil and disposable PPE/investigation equipment) will not be drummed together, but will be placed in separate drums or containers.

EQUIPMENT

Field log book or field sheets
Sample jars/bottles
Sample labels and chain-of-custody
Nitrile gloves
Camera
Trowel or shovel
Resealable plastic bags- Ziploc® or equivalent
PID, if needed
Hand auger
Stainless steel spoon and bowl
Indelible pen
Coolers with ice
Plastic garbage bags
5-gallon buckets with lids
Decontamination materials

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

IDW requires sampling and characterization prior to disposal.

IDW Soil

Prior to sampling and characterization, IDW soils are stored in DOT-approved drums or roll-off boxes.

Soils generated as IDW must be characterized by collecting one composite sample from each IDW soil unit before they can be disposed of. Five to eight sub-sample composite points are collected for each IDW soil unit per composite sample. Each sub-sample composite point must be collected from the same depth below the surface of the stored soil. This depth is typically 6-inches below the soil surface to minimize the effects of volatilization on soil contaminants. To accomplish this, the top 6 inches of soil is removed from the surface in each sub-sample composite point location with a decontaminated trowel or shovel. A hand auger is used to extract each sub-sample composite point sample, placing them in a decontaminated steel bowl or sample container with minimum head space. The sub-sample composite point samples are then mixed thoroughly to ensure homogenization prior to filling the sample jars. Sample jars are to be filled

with soil and compacted by hand to ensure that the jars are as full as possible while still allowing the application of the lid without it buckling or cracking.

The following steps outline the basic procedures for the sampling and characterization of IDW soils.

- Don nitrile gloves and safety glasses.
- Identify sub-sample composite point locations and illustrate them on a diagram of the IDW soil unit.
- Using a trowel or shovel, remove the top 6 inches of soil from the composite point location.
- Using a hand auger, collect the composite point sample and place it in a steel bowl or sample container with minimum head space. For volatile organic characterization, sub-samples of equal proportions will be transferred directly from each IDW waste container to the sample container with minimum head space for laboratory analysis. For all analyses other than VOCs, individual grab samples will be transferred into a sample bowl for homogenizing.
- Repeat the above for each sub-sample composite point.
- Mix the sub-sample composite point samples thoroughly to ensure homogenization.
- Fill soil sample jars as fully as possible, while ensuring that the lid can be applied without buckling or cracking.
- Label sample jars. Wrap the jars in protective wrap and place in the iced cooler. Maintain a cooler temperature of ≤6°C prior to shipping.
- Fill out field sheets and or log book.
- Change nitrile gloves and decontaminate all sampling equipment prior to commencing sampling of any additional IDW soil units.
- When all samples have been collected, carefully pack the cooler to avoid breakage of any samples during shipment. Sign the completed chain of custody and seal it in a Ziploc® plastic bag and place in the cooler. Add sufficient ice to the cooler to maintain a cooler temperature of ≤ 6°C until the cooler arrives at the laboratory.

INTRODUCTION

This standard operating procedure (SOP) establishes guidelines for specifying, assessing and documenting well installation and development. Well development is the process by which foreign materials and solids are removed from the screen filter pack or open hole, allowing water to flow freely into the well. This process is accomplished by moving water through the well screen or borehole into and out of the surrounding material. Well development serves four principal purposes:

- Removes materials that have built up in the openings of the screen or borehole during the well drilling and installation process.
- Removes fine materials from the side of the borehole that result from the drilling procedures (e.g., drilling mud).
- Increases hydraulic conductivity of the filter pack and adjacent geologic materials by removing fine materials.
- Stabilizes the fine materials that remain in the vicinity of the well, thereby retarding their entry into the well.

The benefits are increased yield and reduced suspended solids.

For drilling and soil sampling procedures, follow the Sub-Surface Soil Sampling: Well/Borehole Installation SOP.

EQUIPMENT

Copy of project work plan
Field logbook and forms
Well keys
Interface probe
Five gallon buckets (2 minimum)
Calculator
Disposable bailer or pump
Surge block
Tubing or bailer cord
Safety scissors
Plastic garbage bags
Watch
Indelible pen
Decontamination materials
Appropriate PPE and traffic controls

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

Well Installation

Well Casing. Screen and Filter Pack Construction

Soil borings to be converted into single-cased monitor wells are a minimum of eight inches in diameter for 2-inch diameter wells, and a minimum of ten inches in diameter for 4-inch diameter wells. Monitor wells are constructed with schedule 40, threaded; polyvinyl chloride (PVC) casing

unless site geochemistry or contamination necessitates an alternative regulatory agency approved material. The wells are constructed with factory-slotted screen and threaded end caps.

The screened interval is placed such that it extends approximately ten feet into the water bearing zone, and at least two feet above the expected maximum water level. The screened interval may extend less than two feet above the maximum water level, only to prevent intersection of the screened interval with the top of the confining layer of a confined aquifer, or where the water table is too shallow to allow this construction. A graded sand filter pack is placed in the annular space across the screened interval and extended approximately one to two feet above the screen, as site conditions permit, so as to prevent extension of the sand pack into an overlying water-bearing unit. The well screen slot size is the maximum size capable of retaining 90% of the filter pack. Typically, 0.010-inch screen is used where the formation is predominantly clay and/or silt or poorly graded fine sand. A 0.020-inch screen is used where the formation is predominantly well-graded or medium to coarse sand and/or gravel.

The filter pack grade (mean grain size) is selected according to native sediment type as follows: a) for poorly graded fine sand or silt/clay - 4 times the 70% retained grain size of the formation b) for medium to coarse sand, gravel or well graded sediments - 6 times the 70% retained grain size. Since results of particle size analysis are not always available, ATC often selects screen size and filter pack on the basis of general site stratigraphy, and specifically the finest significantly thick layer of sediment to be screened.

Well Seal and Completion

A minimum two-foot seal of bentonite is placed above the sand pack and extended to near the ground surface. The bentonite seal is hydrated by either formation water or potable water. A watertight locking cap and protective traffic-rated, flush mount vault box is installed on top of each well situated within or near vehicle traffic areas, or where restricted by access agreements. Elsewhere, each well will be completed with a water tight cap and steel stick-up protective cover. Well construction details are presented on the Field Soil Boring Log sheet. Following completion of a well, ATC completes and submits, or ensures that the driller has sufficient information to complete and submit, the state-required Well Completion Report or equivalent document.

Well Development

The most common methods used to develop monitoring wells consist of surging and bailing, surging and pumping, or combinations of these.

Visually inspect the well to ensure that it is undamaged, properly labeled and secured. Any observed problems with the well head should be noted in the field notebook and reported to the Project Manager.

Unlock the well and measure fluid levels using the interface probe. Record the depth to water, non-aqueous fluid levels (if present), and total depth of the well on field forms or in the logbook. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi x(\frac{d}{2})^2 \text{ x } (h_1 - h_2) \text{ x } 7.48 = \text{gallons per cased well volume}$$

where:

π = 3.14 (dimensionless)
d = inside diameter of well casing (in feet)
h_1 = depth of well from top of casing (in feet)
h_2 = depth to water from top of casing (in feet)

The depth to the bottom of the well should be sounded and then compared to the completion form or diagram for the well. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Instead report the conditions to the Project Manager and obtain approval to continue or cease well development activities.

Begin development by first gently surging followed by bailing or pumping. This is then continued with alternate surging and bailing or pumping. At no time should the surge block be forced down the well if excessive resistance is encountered. During development, the bailer should not be allowed to free-fall or descend rapidly such that it becomes lodged in the casing or damages the end cap or sediment trap at the bottom of the well.

Continuously monitor the discharge from the well. Development is considered complete when approximately 10 well volumes of water have been removed and exhibits low turbidity (low particulate discharge) and ideally specific conductivity, pH, and temperature have stabilized over the final three casing volumes of development. For slow recharging wells, well development is considered complete upon removal of the minimum of three well volumes. Record the volume removed.

Obtain and record water level and total depth measurements at the completion of development. Complete documentation of the well development event. At a minimum the record must contain:

- Project name and number;
- Well identification number;
- Well depth, casing size, and completion date;
- Method of development;
- Volume of water removed;
- Water levels (including the time of measurement);
- Physical description of the water (e.g., discoloration, turbidity, odor, etc.) and solids removed from the well;

Decontaminate the interface probe. Collect and appropriately transport and dispose of water removed from the well in accordance with criteria listed in project-specific work plans and regulatory requirements. Place the used bailers, tubing, nitrile gloves, and any other disposables in a plastic garbage bag for landfill disposal.

Allow the well to recover for at least 24 hours prior to sampling.

INTRODUCTION

This standard operating procedure (SOP) establishes guidelines and procedures for field personnel to use in the supervision of groundwater monitoring well abandonment activities. Additional specific well abandonment procedures and requirements may be provided in project work plans. Well abandonment is the process of formally destroying the well such that it may never be used again. Well abandonment generally consists of two basic methods:

- Abandoning the well in-place; or
- Drilling the well out.

The exact type of methodology that is used at a site is dependent upon specific regulatory requirements. Abandoning the well in place consists of cementing the sand pack, well screen and casing in place, usually with a cement bentonite grout. The grout is commonly pumped through a pipe inside the well. At certain sites the regulators may require perforating the casing across low permeability zones, excess sand pack interval, and/or intervals of poor cement seal. The grouting is then conducted in successive stages across the perforated intervals. In other instances, the regulatory agencies may require in-place abandonment be conducted using pressure grouting techniques.

Drilling the well out is most commonly conducted using a hollow stem auger. The auger size is selected so that the inside diameter of the augers is slightly greater than the well casing and screen. The auger is then centered over the casing with the center plug and pilot bit removed, or a small guide plug inserted in the casing. The cement seal, bentonite seal, and sand pack is then drilled out with the augers as they are advanced or washed over the well casing and screen. Once the cement seal, bentonite seal, and sand have been drilled out and circulated to the surface, the well casing and screen are then pulled from the hole. The remaining boring is then usually sealed with a cement grout.

The above methodologies also commonly incorporate the removal of the well head and surface completion materials down to a pre-specified depth. The surface is then sealed and a permanent marker or monument may also be emplaced at the surface. Any of the above methodologies are effective in rendering the wells inoperable and preventing them from becoming conduits for enhanced vertical transport.

EQUIPMENT

Copy of project work plan
Field notebook
Well abandonment log
Water level indicator
Disposable bailer or pump
Bailer Cord
Safety scissors
Decontamination materials
Indelible pen
Appropriate PPE and traffic controls

All equipment and materials shall be inspected for damage prior to traveling to the site and replaced if necessary.

GENERAL PROCEDURE

Abandonment procedures to be used at a particular site must incorporate project specific regulatory requirements. Consequently, project work plans will identify the following:

- Abandonment objectives;
- Monitoring wells to be abandoned;
- Applicable site-specific regulatory requirements for monitoring well abandonment; and,
- Specific procedures for well abandonment beyond those covered in this SOP.

Pre-Abandonment Activities

The abandonment of monitoring wells should be done in compliance with applicable state and local regulations. Permits should be obtained from the county, or any other agency which requires one, prior to well abandonment. It is advisable to compile a well abandonment plan to be included in the project work plans for use by the well-site geologist/engineer and the driller. The procedures for the abandonment within the plan should be consistent with the above applicable regulatory requirements. The plan should be reviewed by the field crew prior to the abandonment of a well.

Certain information may be required to appropriately complete the plans and is important in planning and ensuring that effective abandonment of the well will be completed. This information may include the following:

- The subsurface lithology/soil types in the immediate vicinity of the well, as derived from the boring, soil core and/or borehole geophysical logs compiled from the particular well;
- The well condition information based upon historical or operations records (including sample collection forms) and previous inspection activities;
- The well construction information, including type and diameter of casing and well screen, and depths, composition and thicknesses of sand packs, bentonite seals and cement seals; and past analytical results of groundwater samples collected from the well.

In-Place Well Abandonment Activities

This section describes basic requirements for abandoning (cementing) monitoring wells in place.

Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well. Obtain a measurement of the total depth of the well and compare to the existing well construction information. If granular material (e.g., sand pack, formation sediment, etc.) is believed present inside the well based upon the sounding, a bailer may be run to bottom to attempt to ascertain the type of debris. The granular well debris should then be removed from the well by bailing, pumping or other appropriate techniques.

If the condition of the well casing is suspect or of concern, it may be advisable to run a video log of the well, if it has not already been done. However, judgment and caution will need to be exercised to prevent sticking the camera inside the well during the video logging.

Upon completion of the perforating, the screen interval and sand pack is then grouted with cement grout. The type and composition of the grout mixture will be specified in the abandonment and/or

project work plans. The grout will be emplaced as required by the abandonment and/or project work plans. The remainder of the well casing and the perforated intervals are then grouted in successive stages as specified in the abandonment and/or project work plans.

If the well is abandoned in-place without perforating, the well is sealed with cement grout after any necessary brushing and cleaning. The type and composition of the grout mixture will be specified in the abandonment and/or project work plans.

While grouting the well, special care should be used to restrict the flow of groundwater into the well if subsurface pressure producing the flow is significant. During the grouting process, the personnel performing the task should be supervised to assure that potentially contaminating material (oil, grease, or fuels from gloves, pumps, hoses, et. al) does not enter the grout mix and that personnel are properly wearing personal protective equipment as specified in the Health and Safety Plan.

Quantities of grout used are to be recorded in the field notebook. It should be verified that the volume of the grout placed during destruction operations equals or exceeds the volume to be filled and sealed. This is to help determine whether the well has been properly destroyed and that no jamming or bridging of the grout has occurred.

The final well surface disposition should be completed as stated in the abandonment and/or project work plans.

Any problems or unusual conditions observed during the entire abandonment process should be recorded in the field notebook. A well abandonment log should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

Well Removal Abandonment Activities

This section describes basic requirements for monitoring well abandonment by drilling the well out. As hollow-stem auger drilling techniques are most commonly employed, they will be described in this section.

Upon initiation of abandonment, conduct equipment and debris removal activities. If the condition of the well casing or screen is suspect (e.g. parting is suspected), a video log may be run inside the well. If parting of the casing or screen is evident, drilling the well out may not be feasible and abandoning the well in-place may need to be considered as a more viable option.

For drilling out the well, the site should be prepared and the rig centered over the well per the project work plans. The lead auger is positioned such that it will wash over the well casing during drilling. A small guide plug may then be positioned through the inside of the auger and into the casing. The cement seal and sand pack are then drilled out by advancing the augers and adding auger joints to the drill string. Drilling should be conducted following procedures specified in the project work plans.

Once the targeted total depth is reached, the hole is cleaned by circulating out all cement, sand pack and cuttings by spinning the augers. The well casing is then removed using casing jacks, drill line or other appropriate methods. If the casing is disconnected during removal, it is advisable to suspend and hold the casing with slips. Care should be taken to prevent the remaining casing

from falling back into the hole. The remaining boring is then sealed following procedures specified above and the abandonment and/or project work plans. The final well surface disposition should be completed as stated in the abandonment and/or project work plans.

Any problems or unusual conditions observed during the entire abandonment process should be recorded in the field notebook. A well abandonment log should also be completed for the well during and upon completion of abandonment activities to provide appropriate documentation.

Records generated as a result of implementation of this SOP will be maintained in the project file.

Appendix B

Energy Laboratories, Inc. Quality Assurance Manual (CD)

Appendix C

Laboratory Analytical Methods (CD)

Appendix C-1: EPA Method 8260B
Appendix C-2: EPA Method 1311

Appendix D

Sample Labels and Forms

ENERGY LABORATORIES

www.energylab.com

Client: _____

Sample ID: _____

Date Collected: _____

Time Collected: _____

☐ Filtered ☐ Non-Filtered

ENERGY LABORATORIES

www.energylab.com

CUSTODY SEAL · CUSTODY SEAL · CUSTODY SEAL

Date: _____

Signature: _____

Chain of Custody and Analytical Request Record

Page _____ of _____

PLEASE PRINT- Provide as much information as possible.

Company Name:	Project Name, PWS, Permit, Etc.	Sample Origin State:	EPA/State Compliance: Yes ☐ No ☐
Report Mail Address:	Contact Name: Phone/Fax:	Email:	Sampler: (Please Print)
Invoice Address:	Invoice Contact & Phone:	Purchase Order:	Quote/Bottle Order:

Special Report/Formats – ELI must be notified prior to sample submittal for the following:

☐ DW
☐ GSA
☐ POTW/WWTP
☐ State: _____
☐ Other: _____
☐ A2LA
☐ EDD/EDT (Electronic Data)
Format:_____
☐ LEVEL IV
☐ NELAC

Number of Containers
Sample Type: A W S V B O
Air Water Soils/Solids
Vegetation Bioassay Other

ANALYSIS REQUESTED

SEE ATTACHED

Normal Turnaround (TAT)

R U S H

Contact ELI prior to **RUSH** sample submittal for charges and scheduling – See Instruction Page

Comments:

Shipped by:

Cooler ID(s):

Receipt Temp _____ °C

On Ice: **Yes** **No**

Custody Seal Y N
Intact Y N
Signature Match Y N

SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)	Collection Date	Collection Time	**MATRIX**														
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

LABORATORY USE ONLY

Custody Record MUST be Signed

Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Relinquished by (print):	Date/Time:	Signature:	Received by (print):	Date/Time:	Signature:
Sample Disposal: Return to Client: _____ Lab Disposal: _____			**Received by Laboratory:**	Date/Time:	Signature:

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested.
This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report.
Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

FedEx Express **US Airbill**

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Form ID No. 0200

Sender's Copy

1 From *Please print and press hard.*

Date

Sender's FedEx Account Number

Sender's Name

Phone ( )

Company

Address

Dept./Floor/Suite/Room

City State ZIP

2 Your Internal Billing Reference OPTIONAL

First 24 characters will appear on invoice.

3 To

Recipient's Name

Phone ( )

Company

Recipient's Address

We cannot deliver to P.O. boxes or P.O. ZIP codes.

Dept./Floor/Suite/Room

Address

To request a package be held at a specific FedEx location, print FedEx address here.

City State ZIP

Ship and track packages at fedex.com

Simplify your shipping. Manage your account. Access all the tools you need.

4a Express Package Service *Packages up to 150 lbs.*

- ☐ FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.
- ☐ FedEx First Overnight — Earliest next business morning delivery to select locations.* Saturday Delivery NOT available.
- ☐ FedEx 2Day — Second business day.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

FedEx Envelope rate not available. Minimum charge: One-pound rate.

* To most locations.

4b Express Freight Service *Packages over 150 lbs.*

- ☐ FedEx 1Day Freight* — Next business day.** Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx 2Day Freight — Second business day.** Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- ☐ FedEx 3Day Freight — Third business day.** Saturday Delivery NOT available.

* Call for Confirmation:

** To most locations.

5 Packaging

- ☐ FedEx Envelope*
- ☐ FedEx Pak* — Includes FedEx Small Pak, FedEx Large Pak, and FedEx Sturdy Pak.
- ☐ FedEx Box
- ☐ FedEx Tube
- ☐ Other

* Declared value limit $500.

6 Special Handling Include FedEx address in Section 3.

- ☐ SATURDAY Delivery — NOT Available for FedEx Standard Overnight, FedEx First Overnight, FedEx Express Saver, or FedEx 3Day Freight.
- ☐ HOLD Weekday at FedEx Location — NOT Available for FedEx First Overnight.
- ☐ HOLD Saturday at FedEx Location — Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Does this shipment contain dangerous goods? One box must be checked.

- ☐ No
- ☐ Yes — As per attached Shipper's Declaration.
- ☐ Yes — Shipper's Declaration not required.
- ☐ Dry Ice — Dry ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging.

☐ Cargo Aircraft Only

7 Payment *Bill to:* Enter FedEx Acct. No. or Credit Card No. below.

- ☐ Sender — Acct. No. in Section 1 will be billed.
- ☐ Recipient
- ☐ Third Party
- ☐ Credit Card
- ☐ Cash/Check

FedEx Acct. No. / Credit Card No.

Exp. Date

Total Packages	Total Weight	Total Declared Value†
		$ .00

†Our liability is limited to $100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

FedEx Use Only

8 NEW Residential Delivery Signature Options If you require a signature, check Direct or Indirect.

- ☐ No Signature Required — Package may be left without obtaining a signature for delivery.
- ☐ Direct Signature — Anyone at recipient's address may sign for delivery. *Fee applies.*
- ☐ Indirect Signature — If no one is available at recipient's address, anyone at a neighboring address may sign for delivery. *Fee applies.*

520

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RETAIN THIS COPY FOR YOUR RECORDS.

Appendix E

Montana Department of Environmental Quality
Data Validation Guidelines for Evaluating Analytical Data

Montana Department of Environmental Quality
Data Validation Guidelines for Evaluating Analytical Data
(updated August 5, 2010)

This document was assembled by the Montana Department of Environmental Quality Site Response Section (DEQ) to formalize technical direction for conducting data validation. Data validation is a standardized review process for judging the analytical quality and usefulness of a discrete set of chemical data and is necessary to ensure that data of known and documented quality are used in making environmental decisions.

While these guidelines are generally used by DEQ, there may be circumstances that warrant a higher level of data validation review and DEQ reserves the right to require additional validation. For investigations where XRF or other field screening equipment is used, an evaluation including the comparison and correlation of field screening data to laboratory confirmation data must be also be included in the data validation discussion (please see DEQ's frequently asked questions at http://deq.mt.gov/StateSuperfund/FrequentlyAskedQuestions.mcpx for specifics associated with the use of XRF equipment and data collection/evaluation).

A separate data validation report must be completed for each sample batch/group. A brief summary of this validation report and the usability of the data should be included in the text of the project report with the validation report included as an appendix. The data validation should include an assessment of data using the precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters:

Precision: The degree of mutual agreement between individual measurements of the same property under similar conditions.

- Combined field and laboratory precision is evaluated by collecting and analyzing field duplicates and then calculating the variance between the samples, typically as a relative percent difference (RPD). Laboratory analytical precision is evaluated by analyzing matrix spike/matrix spike duplicate (MS/MSD) samples and using the results to calculate an RPD.

Accuracy: The degree of agreement between an analytical measurement and a reference accepted as a true value.

- The accuracy of a measurement system can be affected by errors introduced by field contamination, sample preservation, sample handling, sample preparation, and analytical techniques. Analysis of MS/MSD samples, laboratory control spikes (LCS) or blank spikes, surrogate standards, and method blanks are typically used to calculate the percent recovery (%R) for evaluating accuracy.

Representativeness: The degree to which sample data accurately and precisely represent the characteristics of a population, variations in a parameter at a sampling point, or an environmental condition that they are intended to represent.

- Typically, representative data will be obtained through careful selection of sampling locations and analytical parameters; proper collection and handling of samples; and through use and consistent application of established field and laboratory procedures. Evaluation of field and laboratory blank samples for presence of contaminants can be useful in evaluating representativeness of sample results.

Completeness: A measure of the percentage of project-specific data that is valid.

- Valid data are obtained when samples are collected and analyzed in accordance with quality control (QC) procedures outlined in the SAP, and when none of the QC criteria that affect data usability are exceeded. Once data validation is complete, the number of useable sample results is divided by the total number of sample results planned for the investigation to determine the percent completeness. A completeness goal should be developed for each project (i.e., 100% completeness for residential samples to ensure that all properties requiring sampling are sampled).

Comparability: Expression of the confidence with which one data set can be compared with another.

- Comparability of data is achieved by consistently following standard field and laboratory procedures and by using standard measurement units in reporting analytical data.

DATA VALIDATION REPORT

1. Please provide the following information at the beginning of the data validation report:
   - Project name
   - Name and Date of approved Quality Assurance Project Plan (QAPP), Sampling and Analysis Plan (SAP), or other applicable document
   - Laboratory Name
   - Laboratory Project ID
   - Sample Matrix
   - Sample Start and End Dates
   - Parameters Included (e.g., volatile organic compounds using EPA Method 8260)
   - Date Validated
   - Name of Validator

2. Please include a description of the data validation criteria used. These data validation criteria should be outlined in the appropriate QAPP, SAP, or other applicable document. ***For example:***

   - *USEPA Contract Laboratory Program (CLP) National Functional Guidelines (NFG) for Superfund Organic Methods Data Review, USEPA-540-R-08-01, June 2008; with additional reference to USEPA CLP NFGs for Organic Data Review, EPA 540/R-99-008, October 1999*
   - *USEPA CLP NFGs for Inorganic Superfund Data Review, EPA 540R-10-011, January 2010.*
   - *USEPA Region 1 Laboratory Data Validation Function Guidelines for Evaluation of Organic Analysis, December 1996.*

3. Please include a table or list identifying all samples evaluated in this validation report. Please provide the associated laboratory sample identification numbers if different than the project sample ID/name.

4. Please include a description of the acceptability and usability of the data, including any qualified data Please explain data qualification flags or any other notes used by the laboratory. Please identify and explain any exceptions (i.e., rejected data) to the acceptability and usability of the data. Also include a cross reference where data qualified by the laboratory is discussed. ***For example:*** *Based on a data validation review, the data are acceptable as delivered with the exceptions noted below as rejected data. Data qualified by the laboratory are discussed in Section #2 [of the project report].*

5. Please include a description of the data qualifiers used during this validation. ***For example***: *J - estimated concentration; UJ – estimated reporting limit (for non-detect results); or R - rejected, data not usable.*

6. Does the laboratory case narrative note any nonconformance issues with the analytical data? Please identify the nonconformance issues.

7. Were sample chain-of-custody (CoC) forms complete? Please describe. ***For example:*** *The CoC records from field to laboratory were complete, and custody was maintained as evidenced by field and laboratory personnel signatures, dates, and times of receipt.*

8. Were detection limits in accordance with the project requirements? If applicable, discuss how this relates to method selection, screening levels, and matrix interference. Please explain, and include discussion of how this affects the data.

9. Were the requested analytical methods in compliance with project requirements (i.e., QAPP, SAP)? If not, please explain, and include discussion of how this affects the data.

10. Were samples received in good condition within method specified requirements? Please explain any exceptions, and how sample condition may affect the results. ***For example:*** *Sample collected and listed on CoC; however, lab noted sample not received in shipment. No qualification necessary.*

11. Were samples analyzed within method specified or technical holding times? Please explain any exceptions, and how this may affect the results.

12. Were reported units appropriate for the associated sample matrix/matrices and method(s) of analyses? Please explain.

13. Do the laboratory reports include all constituents requested to be analyzed on the CoC or under the QAPP, SAP, or other applicable document? Please explain.

14. Was there indication from the laboratory that the initial or continuing calibration verification results were within acceptable limits? Please explain. ***For example:*** *Initial and continuing calibration data were not included as part of this data set; however, these data are assumed to be acceptable as the laboratory did not note any calibration results that were outside of QC limits.*

15. Was the total number of method blank samples prepared equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? Please explain.

16. Were laboratory blank samples free of analyte contamination? Please explain, and include discussion of how this affects the data. ***For example:*** *The method blank samples were reported to be free of analyte contamination with the following exceptions: MADEP VPH - the analyte naphthalene was detected at 0.0256 mg/Kg in the method blank prepared for batch X. As naphthalene was not detected in the associated samples, no qualification of data was required.*

17. Was the total number of matrix spike samples prepared equal to at least 5% of the total number of samples, or analyzed as required by the method? Please include a discussion of the project samples used to prepare the MS and MSD samples, if applicable. Please explain, and include discussion of how this affects the data. ***For example:*** *The total number of MS/MSD samples was equal to at least 5% of the total number of samples for each analysis and batch, with the exception of pesticides by Method 8081A batch X, where the laboratory indicated with a MNR1 qualifier that sufficient sample volume was not available to perform matrix spikes. These data were evaluated using other laboratory QC data. Additionally, no matrix spike samples were analyzed for percent dry solids as it is not required by the method.*

18. Please include a discussion of the project samples used to prepare the MS and MSD samples, if applicable.

19. Were MS/MSD percent recoveries and MS/MSD relative percent difference (RPDs) within data validation or laboratory QC limits? Please explain, and include discussion of how this affects the data.

20. Was the reference material used for the laboratory control standard (LCSs) the correct matrix and concentration? Please explain, and include discussion of how this affects the data.

21. Was the total number of LCSs samples analyzed equal to at least 5% (1 in 20) of the total number of samples, or analyzed as required by the method? ***For example:*** *The frequency requirements for laboratory quality control samples (1/20) were met.*

22. Were LCSs prepared in the same way as the associated samples? Please explain, and include discussion of how this affects the data.

23. Were LCS/LCSD percent recoveries and LCS/LCSD RPDs within laboratory QC limits? Please explain, and include discussion of how this affects the data.

24. Were surrogate recoveries within laboratory QC limits? Please explain and include a discussion of how this affects the data. ***For example:*** *In sample A, the surrogates 2-fluorobiphenyl and 2-bromonaphthalene were recovered outside the laboratory QC limits of 40-140% at 143% and 151%, respectively. As a result, the detection for the analyte C19-C36 aliphatic hydrocarbons was qualified as J in this sample due to possible high bias.*

25. Were the number of equipment, trip, or field blanks collected equal to at least 10% of the total number of samples, or as required by the project requirements, QAPP, or SAP? Please explain, and include discussion of how this affects the data.

26. Were the trip blank, field blank, and/or equipment blank samples free of analyte contamination? Please explain, and include discussion of how this affects the data.

27. Were the field duplicates collected as required by the project requirements, QAPP or SAP? Please explain, and include discussion of how this affects the data. Also, please provide a summary or a table identifying primary and duplicate sample pairs.

28. Were field duplicate RPD values within data validation QC limits (generally soil 0-50%, water 0-30%, or air 0-25%, or otherwise specified in the QAPP/SAP)? Please explain, and include discussion of how this affects the data.

29. Were laboratory duplicate RPD values within laboratory-specified limits? Please explain, and include discussion of how this affects the data.

30. If any data was qualified, please provide a data qualification summary or table that includes the analyte, sample ID, laboratory ID, laboratory result, validator qualifier, and reason for qualification (and include how data is affected/biased). ***For example:***

Analyte	***Sample ID***	***Laboratory ID***	***Laboratory Result***	***Validator Qualifier***	***Reason for Qualification***
C5-C8 Aliphatic Hydrocarbons	*All Samples*	*Lab-01 through Lab-14*	*Detects and Non-Detects*	*J for detections or UJ for non-detections*	*The RPD for the MS/MSD or LCS/LCSD was greater than the acceptable difference indicating poor repeatability. The MS and/or MSD recovery(ies) were below the acceptable limits indicating possible matrix interference.*
Benzene	*All Samples*	*Lab-01 through Lab-14*	*Detects and Non-Detects*	*J for detections or UJ for non-detections*	*The RPD for the MS/MSD or LCS/LCSD was greater than the acceptable difference indicating poor repeatability. The MS and/or MSD recovery(ies) were below the acceptable limits indicating possible matrix interference.*

31. If DEQ collected split samples, explain how those results compare to the natural sample.

32. Please provide any other general comments or other observations.