REVISED ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
SAMPLING AND ANALYSIS PLAN AND FIELD SAMPLING 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:

Cardno ATC
917 1st Avenue N., Suite 3
Billings, Montana 59101
(406) 259-1033

July 9, 2014
Revision 0

Cardno ATC Project No. 051.24884.0001

Cardno ATC
Shaping the Future

REVISED ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
SAMPLING AND ANALYSIS PLAN AND FIELD SAMPLING PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

and

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

APPROVAL

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's compliance with the terms of this Consent Decree shall be signed by an authorized representative of Soco.

Raj Mehta Soco West, Inc. President	07/09/2014 Date

REVISED ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
SAMPLING AND ANALYSIS PLAN AND FIELD SAMPLING PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

Prepared for:

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

and

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

REVIEWS AND APPROVALS

Roger Hoogerheide
EPA Remedial Project Manager

7/15/14
Date

Richard Sloan
DEQ Project Officer

7/16/14
Date

James Sullivan
Cardno Project Manager

07/09/2014
Date

TABLE OF CONTENTS

Section **Page**

APPROVAL i
REVIEWS AND APPROVALS ii
ACRONYMS AND ABBREVIATIONS iii
DISTRIBUTION LIST v
REVISION TRACKING TABLE vi
1.0 INTRODUCTION 1
1.1 Overview 1
1.2 Remedial Design Assessment Objectives 1
1.3 Work Plan Organization 1
1.4 Site Description 2
1.5 Agency Oversight 2
2.0 SCOPE OF WORK 3
2.1 Remedial Design Assessment Sampling Rationale 3
3.0 FIELD INVESTIGATION AND PROCEDURES 6
3.1 Pre-Assessment Activities 6
3.1.1 Site Access 6
3.1.2 Utility Clearance 6
3.2 Field Data Generation And Acquisition 6
3.2.1 Borings/Monitoring Wells 6
3.2.2 Bench-Scale Treatability Study Sample Collection 11
3.2.3 Low-Flow Groundwater Sampling 13
3.2.4 Monitoring Well MW125 Abandonment and Replacement 14
3.2.5 Monitoring Well Location Survey 15
3.3 Decontamination 15
3.4 Management of Investigation-Derived Waste 15
3.4.1 Soil IDW 15
3.4.2 Liquid IDW 16
3.4.3 Solid Waste 17
3.5 Sample Documentation and Shipment 17
3.5.1 Field Documentation 17
3.5.2 Sample Identification 18
3.5.3 Sample Labels 20
3.5.4 Sample Documentation 20
3.5.5 Chain-of-Custody 20
3.5.6 Sample Packaging and Shipment 21
3.6 Sample Containers, Preservation and Holding Times 22
3.7 Quality Control 22
3.7.1 Field Quality Control Samples 22
3.7.2 Laboratory Quality Control 23
3.8 Field Variances 24
3.9 Health And Safety 24
3.10 Sample Containers, Preservation and Holding Times 24
3.11 Analytical Methods 24
4.0 REPORTING 25
4.1.1 Bench-Scale Treatability Study Report 25
5.0 SCHEDULE 26
6.0 REFERENCES 27

TABLE OF CONTENTS (Continued)

TABLES

Table 1 ROD Cleanup Standards
Table 2 Groundwater Monitoring and Sampling Summary
Table 3 Maximum Concentration of Contaminants for Toxicity Characteristic
Table 4 Summary of Liquid and Solid Matrix Samples
Table 5 Sample Container, Holding Time, and Preservative Requirements
Table 6 Bench-Scale Treatability Sample Requirements
Table 7 Quality Control Samples for Precision and Accuracy

FIGURES

Figure 1 Site Vicinity Map
Figure 2 Site Map
Figure 3 Hydrogeologic Cross Section A-A'
Figure 4 Proposed Monitoring Well Locations
Figure 5 Summary of SVE System and PCE Recovery
Figure 6 Proposed Location of Monitoring Well MW125

APPENDICES

Appendix A Field Forms
Appendix B MW125 Well Log

ACRONYMS AND ABBREVIATIONS

ATC	ATC Associates Inc.
bgs	Below ground surface
Cardno	Cardno ATC
cis-1,2-DCE	Dichloroethene
CSM	Conceptual site model
CD	Remedial Design/Remedial Action Consent Decree
CHP	Catalyzed hydrogen peroxide
COC	Contaminant of concern
DEQ	Montana Department of Environmental Quality
DNAPL	Dense non-aqueous phase liquid
DO	Dissolved oxygen
Energy	Energy Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
GMWP	Groundwater Monitoring Work Plan
HASP	Health and safety plan
HSA	Hollow stem auger
IDW	Investigation-derived waste
ISCO	*In-situ* chemical oxidation
LSGPS	Lockwood Solvent Groundwater Plume Site
LNAPL	Light non-aqueous phase liquid
mg/kg	Milligrams/kilogram
MQAPP	Groundwater Monitoring Quality Assurance Project Plan
MRL	Method reporting limit
NAD83	North American Datum of 1983
NPL	National Priorities List
OU2	Operable Unit 2
ORP	Oxidation-reduction potential
PCE	Tetrachloroethene (perchloroethene)
PID	Photoionization detector
PPE	Personal protective equipment
ppm	Parts per million
PVC	Polyvinyl chloride
QA	Quality assurance
QAM	Quality Assurance Manager
QC	Quality control

ACRONYMS AND ABBREVIATIONS (Continued)

RAOs	Remedial action objectives
RCRA	Resource Conservation and Recovery Act
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
ROD	Record of Decision
SC	Specific conductivity
Soco	Soco West, Inc.
SOP	Standard operating procedure
SOW	Statement of Work
SVE	Soil vapor extraction
TCE	Trichloroethene
TCLP	Toxicity characteristic leaching procedure
TOV	Total organic vapor
TSD	Transport, storage and disposal
USCS	Unified Soil Classification System
VOC	Volatile organic compound
VC	Vinyl chloride
WSU	Washington State University
µg/L	Micrograms/liter

DISTRIBUTION LIST

The following individuals will receive a copy of this Revised Addendum 01 to the RDAWP 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 W. 15th Street, Suite 3200
Helena, MT 59626
(406) 457-5031

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

Richard Sloan
Remedial Project Officer
Remediation Division
Montana Department of Environmental Quality
P.O. Box 200901
Helena, MT 59620
(406) 841-5046

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

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

Catherine LeCours
Project Manager
Pacific Western Technologies, Ltd.
54 North Last Chance Gulch, Suite 213
Helena, MT 59601
(406) 422-5495

REVISION TRACKING TABLE
REVISED ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
BILLINGS, MONTANA

Revision Number	Date	Section Revised	Changes/Comments	Revised Page Color

1.0 INTRODUCTION

1.1 OVERVIEW

This Revised Addendum 01 (Addendum 01) to the Remedial Design Assessment Work Plan (RDAWP) (Cardno, 2013b) has been prepared by Cardno ATC (Cardno [formerly ATC Associates Inc.]), on behalf of Soco West, Inc. (Soco) for Operable Unit 2 (OU2) of the Lockwood Solvent Groundwater Plume Site (LSGPS) near Billings, Montana. Addendum 01 incorporates EPA and DEQ's comments, dated June 13, 2014. The location of the LSGPS is shown on Figure 1. This Addendum 01 to the RDAWP 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), in accordance with the requirements of the October 3, 2011 Remedial Design/Remedial Action Consent Decree (CD) for Operable Unit 2 (EPA/DEQ, 2011b), and the Remedial Design Work Plan (RDWP) (ATC, 2012c). The purpose of this addendum is to collect additional data, following the initial phase of the remedial design assessment (RDA) activities. All work performed under this addendum will be performed in accordance with the Remedial Design Assessment Quality Assurance Project Plan (RDAQAPP), included in the RDAWP (Cardno, 2013a and 2013b).

In general, the RDA will be conducted between the former tank farm area on the Soco property and the area immediately north of Coulson Ditch (Figure 2). This subset of OU2 is referred to as the Study Area. This Study Area encompasses all known source areas in OU2.

1.2 REMEDIAL DESIGN ASSESSMENT OBJECTIVES

A complete list of RDA objectives is included in the RDAWP (Cardno, 2013b) and is not repeated here. Several of the RDA objectives include:

- Evaluate the nature and extent of contaminants of concern (COCs) within the vadose zone and saturated-zone between the tank farm area and north of Coulson Ditch;
- Identify the location(s) 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, in the former tank farm areas;
- Determine the lithology, including depth to bedrock, in the former tank farm areas; and
- Determine if the fine-grained section in the northwest source area is a large contributor to the downgradient dissolved phase plume.

1.3 WORK PLAN ORGANIZATION

This Addendum 01 is organized into six sections and two appendices. Sections 2.0 through 6.0 and the contents of the appendices are described briefly below.

Section 2.0 Scope of Work - Presents the proposed scope of work for the addendum activities.

Section 3.0 Field Investigation and Procedures - Details the activities, field work and procedures to be implemented as part of field data collection during the Addendum 01 activities.

Section 4.0 Reporting - Summarizes the data reporting.

Section 5.0 Schedule - Presents the addendum schedule.

Section 6.0 References - Presents the references used in preparing this addendum.

Appendix A - Presents the field forms for addendum activities.

Appendix B - Presents the MW125 well log.

1.4 SITE DESCRIPTION

The LSGPS encompasses approximately 580 acres located on the outskirts of Billings, Montana and consists of chlorinated solvent contamination in soils and groundwater. The United States Environmental Protection Agency (EPA) proposed the LSGPS for placement on the National Priorities List (NPL) in May 2000 and listed the LSGPS on December 1, 2000. The primary COCs for OU2 are the following volatile organic compounds (VOCs): tetrachloroethene (perchloroethene or PCE); trichloroethene (TCE); *cis*-1,2-dichloroethene (*cis*-1,2-DCE); and vinyl chloride (VC). Concentrations of these COCs in groundwater and source area soils can be compared to the performance (remediation goal) standards as specified in the ROD (EPA/DEQ, 2005) and provided in Table 1.

Figure 1 shows the general location of OU2 of the LSGPS, and Figure 2 is a map of OU2. 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. 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). OU2 consists of residential and light industrial commercial facilities.

A complete site history, including physical settings, summary of previous investigations, and a conceptual site model (CSM) of the Study Area is detailed in the RDAWP (Cardno, 2013b). Three principal hydrogeologic units have been identified in the Study Area during previous investigations: a silty clay and silty sand unit, a sand and gravel unit, and bedrock. These units are displayed graphically in a southeast-northwest oriented cross-section as shown on Figure 3.

1.5 AGENCY OVERSIGHT

Agency field oversight may be conducted during all field activities associated with this project as indicated in Section IX, paragraph 26.a.(1) of the CD (EPA/DEQ, 2011b). All oversight personnel will be briefed by the Cardno On-Site Field Supervisor prior to conducting oversight activities. Additionally, the EPA and Montana Department of Environmental Quality (DEQ) may obtain samples from the activities at OU2, as described in Section 3.0.

2.0 SCOPE OF WORK

Data collection activities will be conducted in a manner consistent with the procedures set forth in the standard operating procedures (SOPs) included in the RDAQAPP (Cardno, 2013a). Field investigation activities will be performed in accordance with the ROD (EPA/DEQ, 2005), SOW (EPA/DEQ, 2011a), and in accordance with the requirements of the CD for OU2 (EPA/DEQ, 2011b). Likewise, all work performed under this addendum to the RDAWP will be performed in accordance with the OU2 Health and Safety Plan (HASP), appended to Cardno's RDWP, dated March 30, 2012 (ATC, 2012c).

2.1 REMEDIAL DESIGN ASSESSMENT SAMPLING RATIONALE

The scope of work for the Addendum 01 activities includes the installation of ten borings to be completed as nested groundwater monitoring wells and collection of groundwater samples for laboratory analysis. Figure 4 indicates the general areas where the nested monitoring wells will be installed in the Study Area. In general, nested wells will be installed using hollow stem auger (HSA) or sonic drilling methods, as discussed below, at ten locations, and completed vertically at two depths at each location: 1) in the five feet above bedrock (deep) and 2) in the five feet at the top of the sandy gravel unit (intermediate). These nests, with two monitoring wells per nest, will be 2-inch diameter wells with both wells of each nest completed in a single borehole screened in the deep (designated with a "D") and intermediate (designated with an "I") depths of the water column. The purpose of the nested wells is to evaluate the location of source material and assess how it is contributing to the dissolved phase plume. Nested well construction and screening intervals may be adjusted in the field, based on observations of the borings/cores. Additional borings or wells may be installed to further delineate impacts, based on findings during the field investigation.

As determined during the installation of RDA monitoring wells MW400 through MW407 and MW410 through MW413 in May 2013, elevated temperatures that sonic drilling methods can create were not encountered, and are not expected to be an issue for future soil sample collection in OU2. Therefore, either sonic or HSA drilling methods may be used during Addendum 01 activities. The drilling method used will be selected at the time of drilling based on cost and subcontractor availability

The following initial-phase RDA activities detailed in the RDAWP, which were not completed during the May 2013 drilling event, are also planned during Addendum 01 field activities, as summarized below (Cardno, 2013b).

Cardno will install the remaining initial-phase RDA nested monitoring wells MW408 and MW409 on the Keller Transport, Inc. (Keller) property, as shown on Figure 4. These two locations (MW408 and MW409) will each include a monitoring well nest containing three monitoring wells. The three monitoring wells in each nest will be 1-inch diameter wells with all three wells of each nest completed in a single borehole. Two of those wells will be screened in the sandy gravel section including the deep (designated with a "D") and intermediate (designated with an "I") depth wells and the third well (shallow) in each nest will be completed in the saturated, fine-grained section intersecting the water table (designated with an "S").

Additionally, five soil borings will be advanced within the northwest source area to collect soil samples as near as possible to the location and interval where soil samples previously were collected. The co-located soil samples will be collected adjacent to five "PT" wells and/or "PZ" piezometers in the northwest source area, as shown on Figure 5. The purpose of the co-located soil samples is to generally evaluate changes in soil COC concentrations since the

original samples were collected. Because of the inability to sample at the precise location that historic samples have been collected, and given the inherent heterogeneities in soil samples, the data will be used in a qualitative manner to evaluate soil vapor extraction (SVE) effectiveness.

Soil and groundwater samples will also be collected from the northwest source area and former tank farm source area for the bench-scale treatability study. Soil sample locations will be determined in the field, contingent upon the ability to access the area due to vegetation, access to the Keller property, and structures and SVE infrastructure located on Soco-owned property. Groundwater samples for the bench-scale treatability study will be collected from monitoring wells PT-02 and MW420-I or MW423-I, as shown on Figure 4.

Furthermore, replacement monitoring well MW125R will also be installed, as shown on Figure 6, during Addendum 01 field activities.

The data collected during Addendum 01 activities 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 remedial action objectives (RAOs).

The following scope of work has been developed based on the objectives presented in Section 1.2:

- Install and develop monitoring well nests in eleven locations in the Study Area as shown on Figure 4 and detailed in Section 3.2.1;
    - Field-screen soil cuttings or cores for the presence of organic vapors using a photoionization detector (PID); and
    - If separate phase liquid is suspected, based on visual screening or organic vapors concentrations in sections of the boring/core during boring installation, Scarlet Red® dye kits will be used to determine if separate phase organic liquids are present.
- Conduct one groundwater sampling event, using low-flow procedures, to evaluate vertical stratification of dissolved phase COCs and infer the location of source mass contributing to the dissolved phase plume. The groundwater sampling event will involve collection of groundwater samples from the separate intervals of the water column from monitoring wells MW001, MW007, MW010, MW011, MW100 through MW105, PT-01 through PT-07, MW400 through MW413, and MW420 through MW429, as detailed in Section 3.2.3;
- Collect at least one soil sample co-located with each of the following five “PT” wells or “PZ” piezometers in the northwest source area: PT-02, PZ-08, PZ-10, PZ-11, and PZ-19, as shown on Figure 5. Soil samples will be collected at the same depth as previous soil samples collected during the installation of the “PT” wells or “PZ” piezometers listed in Section 3.2.1, to evaluate potential changes in soil COC concentrations over time;
- Collect soil and groundwater samples from the sandy gravel section and the fine grained section of the northwest source area, as well as from the saturated section of the former tank farm area for *in-situ* chemical oxidation (ISCO) bench-scale testing at Washington

State University (WSU) to evaluate the effectiveness of ISCO treatments at OU2, as discussed in Section 3.2.2;

- Survey, excavate, and attempt to locate and properly abandon monitoring well MW125;
- Install and develop replacement well MW125R;
- Survey the monitoring wells after installation; and
- Collect monthly water level measurements from the Study Area wells for one year. The Study Area wells will include all monitoring wells installed during the RDA (MW400 series), "PT wells" (PT-01 through PT-07), MW100 through MW105, MW010, MW011 and MW007 (Figure 4). Based on the first two months of fluid level measurements collected, the number of well locations gauged may be revised.

3.0 FIELD INVESTIGATION AND PROCEDURES

The following sections describe in detail the proposed sampling and analysis activities that will be conducted to achieve RDA goals and implement the scope of work.

3.1 PRE-ASSESSMENT ACTIVITIES

3.1.1 Site Access

In order to implement the scope of work presented in this addendum, access to one non-Soco-owned property will be necessary. The owners/properties include:

- Keller Transport, Inc.

If unexpected impacts are encountered during the monitoring well installation activities, EPA and DEQ will be notified and additional wells may be installed in an attempt to collect additional data. An EPA or DEQ representative will be available during the installation of the wells on the Keller property to ensure timely field changes can be made.

3.1.2 Utility Clearance

All underground utilities will be located and marked prior to beginning intrusive field activities. If necessary, a private utility locator will be used. No overhead utilities are expected to be encountered during drilling operations.

3.2 FIELD DATA GENERATION AND ACQUISITION

3.2.1 Borings/Monitoring Wells

In order to implement the scope of work of this addendum, the following soil borings and/or completions will be used.

<u>Monitoring Wells</u>:

- Install new monitoring wells in ten locations in the Study Area as listed in Table 2 and shown on Figure 4. All ten of these locations (MW420 through MW429) will include a monitoring well nest containing two monitoring wells. The ten nests of two wells per nest will consist of 2-inch diameter monitoring wells with both wells of each nest completed in a single borehole with screen intervals in the deep (designated with a “D”) and intermediate (designated with an “I”) depths of the water column. Boreholes for all of these wells will be advanced using either HSA or sonic drilling methods. No soil samples are planned to be collected during this phase of the RDA. Opportunistic soil samples may, however, be collected during installation of these monitoring wells if unexpected impacts are encountered during the monitoring well installation activities;

- Install new monitoring wells in two locations on the Keller property as shown on Figure 4. These two locations (MW408 and MW409) will include a monitoring well nest containing three monitoring wells. The two nests with three monitoring wells per nest will be 1-inch diameter wells with all three wells of each nest completed in a single borehole. Two of those wells will be screened in the sandy gravel section including the deep (designated with a “D”) and intermediate (designated with an “I”) depth wells and the third well (shallow) in each nest will be completed in the saturated, fine-grained section intersecting the water table (designated with an “S”); and

- Install replacement well MW125R, as discussed in detail in Section 3.2.4.

Soil Borings:

- Five soil borings will be advanced using a HSA or sonic drill rig within the delineated northwest source area to collect soil samples as near as possible to the location and interval where soil samples previously were collected. The purpose of the co-located soil samples is to generally evaluate changes in soil COC concentrations since the original samples were collected. Because of the inability to sample at the precise location that historic samples have been collected, and given the inherent heterogeneities in soil samples, the data will be used in a qualitative manner to evaluate SVE effectiveness. The five soil samples to be collected include:

    - PT-02, 6 – 8 ft below ground surface (bgs);
    - PZ-08, 4 – 8 ft bgs;
    - PZ-10, 4 – 8 ft bgs;
    - PZ-11, 4 – 8 ft bgs; and
    - PZ-19, 4 – 8 ft bgs.

    The location of the PT and PZ sample locations are shown on Figure 5. Following collection of the soil samples the soil boreholes will be abandoned.

If unexpected impacts are encountered during any monitoring well or soil boring installation activities, EPA and DEQ will be notified and additional wells may be installed in an attempt to collect additional data. An EPA or DEQ representative will be available during well installation to ensure timely field changes can be made.

Prior to drilling, the proposed boring locations shown on Figures 4 and 5 will be marked in the field with an EPA and/or DEQ representative participating. If any of the proposed boring locations are not accessible, an appropriate alternate location will be selected in the field and will be documented in the field log book and the field log book will be signed by the appropriate EPA and/or DEQ representative approving the change. After intrusive activities are complete, locations of all monitoring wells and borings will be surveyed as discussed in Section 3.2.5.

3.2.1.1 Boring Installation and Soil Sampling

As described above, all underground utilities will be located prior to advancing boreholes to ensure the locations are sufficiently clear of underground utilities. In the event that borehole positions have to be adjusted, the positions will be adjusted to the minimal extent necessary to adequately clear utilities and still maintain, to the extent possible, the locations shown on Figure 4. No overhead utilities are expected to be encountered during drilling operations.

Soil borings proposed to be completed as monitoring wells will be advanced using a HSA or sonic drilling rig. No soil sampling is planned during boring installation for the monitoring wells. However, opportunistic soil samples may be collected during installation of these monitoring wells if unexpected impacts are encountered during the monitoring well installation activities. If soil samples are collected, sampling activities will be conducted according to the protocols and SOPs presented in the RDAQAPP (Cardno, 2013a).

Boring Installation for RDA Monitoring Wells:

- Field personnel will log each sample interval and complete a lithologic log for each boring in general accordance with ASTM Method D 2488-90. Samples will be described according to the Unified Soil Classification System (USCS), including color, consistency, moisture content and evidence of impacts or sheen. Additionally, each interval will be visually screened for the presence of separate phase product;

- Representative soil samples will be collected from each continuous core/sample interval for field screening. A portion of each core/interval will be immediately transferred into a re-sealable plastic bag and sealed, labeled, and exposed to direct sunlight for approximately 10 to 15 minutes to allow for the volatilization of organic vapors. Following equilibration, the soil samples will be field-screened for the presence of organic vapors by inserting the probe of a PID into the headspace of each field screening sample bag. The total organic vapor (TOV) headspace concentrations will be measured in parts per million by volume (ppm) for each sample and recorded on the boring logs (Appendix A). Additional field screening may be conducted if any obvious change in the core is observed, such as change in lithology, staining, or suspected presence of dense non-aqueous phase liquid (DNAPL). The additional field screening may include collection of multiple samples from the same core for screening purposes or the use of Sudan IV dye, if DNAPL is suspected;

- If separate phase liquid is suspected, based on visual screening or organic vapors concentrations in sections of the core during boring installation, Scarlet Red® dye kits will be used to determine if separate phase organic liquids are present. If DNAPL is suspected, a jar shake test will be performed in accordance with SOP-051-305, Field Screening for DNAPL in Soil Using Scarlet Red®, included in the RDAQAPP, by placing a soil matrix sample in a clear sample container with Scarlet Red® and warm water, capping and vigorously shaking the sample container, followed by visual inspection. DNAPL products will be indicated by red beads/globules of color in, or on top, of the soil. The jar shake test results will be noted on the lithologic log;

- If sonic drilling methods are used, continuous soil cores will be extruded into plastic sleeves and placed in wooden core boxes for storage. The core boxes will be stored on Soco-owned property for future reference;

- If investigation-derived waste (IDW) soil cuttings are generated during drilling, the cuttings will be containerized in drums or roll-off boxes in accordance with SOP-051-501 Management of Solid Matrix Investigation-Derived Wastes. Any well development/purge liquid collected also will be properly contained and managed in accordance with SOP-051-501 Management of Liquid Matrix Investigation-Derived Wastes. IDW solids and liquids will be managed as discussed in Section 3.4; and

- Soil samples, if collected, will be packed in iced coolers and transported to Energy Laboratories, Inc. (Energy) using chain-of-custody procedures. The samples will be analyzed by EPA Method 8260B for VOCs. All samples will be packaged and shipped in accordance with SOP-051-105 Sample Packaging and Shipping included in the RDAQAPP (Cardno, 2013a).

Soil borings for the collection of co-located “PZ” and “PT” soil samples will be advanced using a HSA or sonic drilling rig. Soil sampling activities will be conducted according to the protocols and SOPs presented in the RDAQAPP (Cardno, 2013a).

Boring Installation for Co-Located Samples:

- Co-located “PZ” and “PT” soil samples will be collected at the locations and depths specified in Section 3.2.1. Soil samples will be placed in laboratory-supplied sample containers in accordance with SOPs presented in the RDAQAPP (Cardno, 2013a). Soil samples will be packed in iced coolers and transported to Energy using chain-of-custody procedures. The samples will be analyzed by EPA Method 8260B for VOCs. All samples will be packaged and shipped in accordance with SOP-051-105 Sample Packaging and Shipping included in the RDAQAPP.

Per Section IX, paragraph 26.a.(4) of the CD, if the EPA, DEQ, 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 and pay for laboratory analyses of all split samples collected. However, there is a limited amount of soil available during boring installation and there may be an insufficient volume to collect soil for PID readings, laboratory samples, and split samples.

3.2.1.2 Monitoring Well Installation

- Following boring installation, borings for monitoring wells MW408, MW409, and MW420 through MW429, will be completed as monitoring well nests. The monitoring wells will be installed and completed in accordance with SOP-051-301 Subsurface Soil Sampling Well/Borehole Installation and SOP-051-606 Nested Monitoring Well Installation and Development, included in the RDAQAPP (Cardno, 2013a). The nested well configuration will be as follows: ten nested monitoring wells consisting of two monitoring wells per nest (MW420 through MW429) and two nested monitoring wells consisting of three monitoring wells per nest (MW408 and MW409) at various locations in the Study Area, as shown on Figure 4.

- Monitoring wells MW408 and MW409 will be constructed using 1-inch diameter, Schedule 40 PVC threaded casing and 0.010 inch slotted screen. These two wells were originally proposed during the first phase of RDA data collection. Due to access issues, they were not installed at that time. For consistency purposes, they are being completed similar to the original RDA wells. However, none of the other wells being installed as part of the Addendum 01 scope of work will be completed in the fine grained section, because the low permeability of the interval prevented the development and purging of the fine grained section wells prior to sampling. Given this information, it is believed that the fine grained section may act as a source of COCs to groundwater, but that horizontal flow of COC impacted groundwater in the fine grained section is extremely limited. The riser and screen length will be determined in the field based on total boring depth and field observations. Typically, five feet of screen will be used to complete each monitoring well. These two monitoring well nests containing three wells per nest will be 1-inch wells with all three wells completed in a single borehole. Two of those wells will be screened in the sandy gravel section including the deep (designated with a “D”) and intermediate (designated with an “I”) depth wells and the third well (shallow) in each nest will be completed in the saturated, fine-grained section intersecting the water table (designated with an “S”).

- Monitoring wells MW420 through MW429 will be constructed using 2-inch diameter, Schedule 40 polyvinyl chloride (PVC), threaded casing and 0.010 inch slotted screen. The riser and screen length will be determined in the field based on total boring depth and field observations. Typically, five feet of screen will be used to complete each monitoring well. The ten monitoring well nests containing two wells per nest (MW420 through MW429) will be 2-inch diameter monitoring wells with both wells completed in a single borehole. The screen intervals for these well nests containing two wells will be in the deep (designated by a 'D") and intermediate (designated with an "I") depths of the water column. A shallow well interval will not be installed on the monitoring wells MW420 through MW429. The shallow well intervals previously installed during the RDA had low permeability and yielded insufficient water to be developed or purged prior to collecting groundwater samples.

- In the deep completions, the filter pack will consist of 20-40 mesh silica sand placed from the bottom of the screened interval to one-foot above the top of the screen. Filter packs will be emplaced from six-inches below the bottom of the screen to one-foot above each nested screen to account for settling and prevent bentonite from entering the well-screens. In these nested completions, two to three wells will be completed in each boring. Bentonite chips will be placed in the annular space vertically between the screened intervals to prevent vertical communication between the nested wells. The remainder of the borehole will be filled with hydrated bentonite chips to form the annular seal. The volume of material placed in the borehole to form the filter pack, annular seal, and surface seal will be documented on the well completion log (Appendix A).

- Material specifications and completion depths will be recorded during well construction and recorded on the well completion log (Appendix A).

- Surface completions for monitoring wells MW408 and MW409 installed on the Keller property, will be completed as flush-mount surface completions. Surface completions for monitoring wells MW420 through MW424, MW426, MW427, and MW429 may consist of a 2- to 3-foot steel stickup casing with a cap and locking lid (Figure 4). If wells cannot be completed as stickups, they will be completed as flush-mount surface completions, including steel protective covers mounted in concrete and locking j-plugs. Monitoring wells MW425 and MW428 will be completed as flush-mount surface completions (Figure 4).

- Groundwater samples will be not be collected during boring or well installation. A groundwater sampling event will be conducted after the new wells are installed, developed, and reach equilibrium, as described in Section 3.2.3.

- Monitoring well MW125R will be installed as discussed in Section 3.2.4 (Figure 6). Monitoring well MW125R will be constructed using 2-inch diameter schedule 40 PVC casing and 0.010 slotted screen. The total depth for MW125R will be approximately 28.5 ft bgs and a ten foot screen will be set at the top of bedrock or across the water table. The screening decision will be made at the time of well installation and in consultation with EPA. The screen will be set to intersect the lithology with the appearance of the highest permeability. DNAPL is not suspected to be present in the area where MW125R is to be installed, based on historic PCE concentrations in groundwater samples collected from MW125 and other nearby monitoring wells. . Completion may consist of a 2- to 3-foot stickup casing with a locking lid. The well log for MW125 is included in Appendix B.

3.2.1.3 Well Development

Monitoring wells installed as part of Addendum 01 activities will be developed after installation to remove silt and other fine-grained sediments that may accumulate within the monitoring well during installation and to ensure good communication between the well and aquifer. Development will be accomplished using one or more techniques, including surging, bailing and pumping in accordance with SOP-051-600 Monitoring Well Installation and Development and SOP-051-606 Nested Monitoring Well Installation and Development, included in the RDAQAPP (Cardno, 2013a). Well development will not occur until the monitoring well construction materials have been allowed to properly set (generally ~48 hours). Development is considered complete when approximately 10 well volumes of water have been removed and purge water visually exhibits low turbidity (low particulate discharge) and, ideally, specific conductivity (SC), pH, and temperature have stabilized. For slow recharging wells, well development is considered complete upon removal of the minimum of three well volumes. The Remedial Design Assessment Report (RDAR) will describe the development methods used.

Water generated during well development activities will be containerized, treated and analyzed as described in Section 3.4.

3.2.2 Bench-Scale Treatability Study Sample Collection

A chemical oxidation bench-scale treatability study will be conducted to evaluate the effectiveness of potential ISCO treatments in reducing COC concentrations in soil and groundwater samples collected from OU2, as detailed in the RDAWP (Cardno, 2013b). Dr. Richard J. Watts, Ph.D., P.E., Professor of Civil and Environmental Engineering at WSU, has been selected to conduct the ISCO bench-scale treatability study. Dr. Watts will conduct the treatability study at the Chemical Oxidation Laboratory at WSU using soils and groundwater collected from the Study Area to evaluate the effectiveness of the different ISCO reagents and to provide additional data necessary for developing a pilot test program. Based on the literature review and discussions with Dr. Watts, Fenton's reagent (catalyzed hydrogen peroxide or CHP), permanganate, and ozone were selected for treatability testing as part of the RDA as described in the RDAWP (Cardno, 2013b).

The study has been developed to evaluate the effectiveness of two different ISCO treatments as well as evaluate potential dosing estimates. As part of the study, samples will be collected from the source area where the highest levels of PCE have been measured in soil and groundwater ("worst case") as well as composite samples from selected areas within the defined source areas ("average source area"). The purpose for collecting the two types of samples is to evaluate the variability of PCE concentrations within the source area and how it may affect ISCO dosing requirements. In all cases, field screening will be used to identify the most highly impacted portion of the cores and the samples will be collected from that section of core. This applies to both discrete and composite samples and "worst case" and "average source area" samples. The bench-scale treatability testing will be conducted in three parts at the laboratory. Part 1 will involve treating northwest source area samples using CHP and permanganate, Part 2 will consist of treatment of a former tank farm area sample using CHP and permanganate, and Part 3 will involve evaluating optimum ozone treatment rates for northwest source area soils and groundwater. The ozone bench scale study will not be conducted until the field application of the ISCO treatment. The field ISCO implementation will likely change the contaminant and other organic material in the area substantially. Therefore, the ozone bench scale study will be conducted after the *in situ* ISCO treatment and stabilization of the aquifer and contaminant conditions. All treatability testing will be conducted in duplicate to address possible variability in

the results. The complete procedures described in the RDAWP will be conducted on each of the samples (Cardno, 2013b).

A total of four soil samples will be collected for ISCO treatability sampling; three from the northwest source area and one from the former tank farm area. Two kilograms of soils and two liters of groundwater (unpreserved) will be collected for each of the samples and shipped to the Chemical Oxidation Laboratory for testing.

A description and location of the four samples is presented below.

Part 1: Northwest Source Area Treatability Study:

Northwest source area, sandy gravel, "worst case" – This "worst case" sample will be collected from the sandy gravel unit during the installation a boring that will be installed immediately downgradient of monitoring wells PT-02 and PT-06 (Figure 4). Based on historic soil and groundwater data, this area of the northwest source area exhibits the highest level of COC impacts.

Northwest source area, sandy gravel, "average source area" – This average source area sample will be a composite soil sample collected from the sandy gravel unit during the installation of three other soil borings to be installed in the northwest source area. This composite sample is intended to represent average source area conditions in the sandy gravel unit for ISCO bench-scale treatability testing purposes.

Northwest source area, fine-grained, "average source area" – This average source area sample will be a composite soil sample collected from the saturated fine-grained section during the installation of the four soil borings to be installed in the northwest source area. This sample is intended to represent average source area conditions in the saturated fine-grained section for ISCO bench-scale treatability testing purposes.

In addition to the soil samples, three corresponding groundwater samples will be collected from monitoring well PT-02 (Figure 4), for use in Part 1 of the bench-scale treatability study. Two liters of groundwater (unpreserved) is necessary for each of the samples. The groundwater samples intended for use in the bench-scale treatability study will be collected using low-flow purging and sampling methods according to the protocols and SOPs presented in the approved Groundwater Monitoring Work Plan (GMWP) (ATC, 2012a, 2012f) and the approved Groundwater Monitoring Quality Assurance Project Plan (MQAPP) (ATC, 2012b, 2012g). The bench-scale treatability study sample requirements including sample containers to be used and sample volumes required are presented in Table 6.

Part 2: Former Tank Farm Source Area Treatability Study

Former tank farm area, sandy gravel, "average" – This average source area sample will be a soil sample collected from the sandy gravel unit within the delineated tank farm source area, during installation of monitoring wells MW420 or MW423 (Figure 4). This sample is intended to represent average source area conditions in the sandy gravel unit of the former tank farm area for ISCO bench-scale treatability testing purposes. Representative soil samples will be collected from soil borings proposed to be completed as monitoring wells MW420 and MW423 for field screening and for possible laboratory analysis. A portion of each core/interval will be immediately containerized for laboratory

use and an additional portion will be immediately transferred into a re-sealable plastic bag to allow for the volatilization of organic vapors, as described in Section 3.2.1.1. The core/interval that exhibits the highest TOV headspace concentrations will be submitted for laboratory use in the bench-scale treatability study.

In addition to the soil sample, a corresponding groundwater sample will be collected from the intermediate monitoring well, i.e. MW420-I or MW423-I (Figure 4), for use in Part 2 of the bench-scale treatability study. Two liters of groundwater (unpreserved) is necessary for the sample. The groundwater sample will be collected using low-flow purging and sampling methods according to the protocols and SOPs presented in the approved GMWP (ATC, 2012a, 2012f) and the approved MQAPP (ATC, 2012b, 2012g). The bench-scale treatability study sample requirements including sample containers to be used and sample volumes required are presented in Table 6.

The locations of the four borings in the northwest source area and the single boring in the former tank farm area for both Parts 1 and 2 of the bench-scale treatability study will be determined in the field. An EPA or DEQ representative will be available during the installation of the borings to consult on the locations selected. The locations of the borings in the northwest source area will be dependent upon vegetation, access to the Keller property, and structures and SVE infrastructure located on Soco-owned property.

Two kilograms of soil are necessary for each of the bench-scale treatability study soil samples described above. Soil borings will be advanced using a sonic drill rig. It is anticipated that sufficient soil for the treatability samples will be recovered.

3.2.3 Low-Flow Groundwater Sampling

Addendum 01 activities will include a groundwater sampling event, using low-flow procedures, to sample the new monitoring wells installed as part of this phase of the RDA (MW408, MW409, and MW420 through MW429), existing RDA wells (MW400 through MW407 and MW410 through MW413) and existing monitoring wells (MW001, MW007, MW010, MW011, MW100 through MW105, and PT-01 through PT-07). The purpose of sampling event is to evaluate potential vertical stratification of dissolved phase COCs and use that data to infer the location of source mass contributing to the dissolved phase plume.

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 DNAPL is detected while gauging the well, the depth to, and thickness of, 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 centered in the well's saturated 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 SC. Samples will be collected once field parameters have stabilized as determined by field personnel. Groundwater samples will be collected from the peristaltic pump by disconnecting the tubing from the flow-through cell. Low-flow sampling and fluid level measurements will be conducted

in accordance with the protocols and SOPs 051-201, Groundwater Sampling Using Low-Flow Methods, 051-204 Measuring Fluid Levels, and 051-205, Measuring Water Quality Field Parameters presented in the approved GMWP (ATC, 2012a, 2012f) and the approved MQAPP (ATC, 2012b, 2012g).

Reusable equipment used in the sampling of groundwater will be decontaminated per SOP-051-101 Sample Equipment Decontamination – Organic Contamination, located in the RDAQAPP (Cardno, 2013a). Disposable sampling equipment will be managed according to SOP-051-501 Management of Liquid Matrix Investigation-Derived Waste (Cardno, 2013a).

Water generated during sampling activities will be drummed, treated and analyzed as indicated in Section 3.4.

Per Section IX, paragraph 26.a.(4) of the CD, if the EPA, DEQ, 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 and pay for laboratory analyses of all split samples collected.

3.2.4 Monitoring Well MW125 Abandonment and Replacement

Monitoring well MW125 was damaged in 2006 and has not been located or sampled in the interim, as discussed in the RDAWP (Cardno, 2013b). MW125 will be replaced during the addendum activities. The replacement well will be designated MW125R and will be sampled during the semi-annual groundwater monitoring and sampling program as part of the plume delineation and stability monitoring.

Replacement well MW125R will be offset from the original MW125 to the northeast along the Yellowstone River so that it is nearer the center of the PCE plume, as shown on Figure 6. Replacement well MW125R will be completed similarly to the damaged well and will be constructed with 2-inch diameter, Schedule 40 PVC casing and 0.010 slotted screen, in accordance with SOP-051-600 Monitoring Well Installation and Development, included in the RDAQAPP (Cardno, 2013a). The well log for MW125 is included in Appendix B. The total depth for replacement well MW125R will be approximately 28.5 ft bgs and a ten foot screen will be set at the top of bedrock or across the water table. The screening decision will be made at the time of well installation and in consultation with EPA. The screen will be set to intersect the lithology with the appearance of the highest permeability. DNAPL is not suspected to be present in the area where MW125R is to be installed, based on historic PCE concentrations in groundwater samples collected from MW125 and other nearby monitoring wells.
Completion may consist of a 2- to 3-foot stickup casing with a locking lid; bollards may be placed around the competed wells to provide protection from vehicular traffic or the well may be completed as a flush-mount well. A well completion log will be created for the newly installed MW125R and will be provided in the RDAR. Soils and water generated during well installation and development activities will be containerized, and managed as described in Section 3.4.

Well abandonment activities will include a survey and excavation in an attempt to locate and properly abandon MW125. If located, the damaged MW125 will be abandoned in accordance with Montana Administrative Code 36.21.670 and SOP-051-601 Monitoring Well Abandonment, presented in the RDAQAPP (Cardno, 2013a). The abandoned well will be filled with sealing material (bentonite) to within three feet of the surface to prevent vertical movement of groundwater in the bore hole. Any remaining hole will be filled with unimpacted or clean naturally occurring soils. If possible, the casing will be removed. In the event that the damaged

well is located and the casing cannot be removed, it shall be cut off or driven downward so that the top of the casing is at least three feet bgs. Land surface will be restored to a like condition of the surrounding surface area.

3.2.5 Monitoring Well Location Survey

The north side of the PVC casing of all newly installed monitoring wells will be notched and marked with an indelible marker as the measuring point location. The measuring point of all monitoring wells will be surveyed by a licensed surveyor or a professional engineer registered in the State of Montana. Survey results will provide an accuracy of plus or minus 0.1 foot horizontally. The horizontal datum for coordinates will be the State Plane North American Datum of 1983 (NAD83) HARN Coordinate System which references a nearby USGS, or equivalent, horizontal control mark. The vertical elevation of all measuring points will have an accuracy of 0.01 foot.

3.3 DECONTAMINATION

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 included in the RDWP (ATC, 2012c). All water derived from decontamination will be collected and temporarily stored on Soco-owned property as liquid IDW. Personnel will decontaminate all reusable equipment (core barrels and soil sampling equipment) between boring or sampling locations and before leaving OU2 to prevent off-site transport of contamination in accordance with SOP 051-101, Sample Equipment Decontamination – Organic Contamination, included in the RDAQAPP (Cardno, 2013a).

All reusable sample equipment will be decontaminated following each use. Equipment decontamination is not required when disposable equipment is used. New tubing will be used for the collection of each groundwater sample. Because none of the equipment that comes in contact with groundwater samples will be decontaminated and re-used, rinsate blanks will not be collected during the groundwater sampling event.

3.4 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

IDW will be generated during the Addendum 01 activities including, but not limited to, soil and liquid IDW. All IDW generated will be transported to Soco-owned property and properly stored before disposal, treatment or shipment for off-site disposal.

3.4.1 Soil IDW

If sonic drilling methods are used, continuous soil cores generated will be extruded into plastic sleeves and placed in wooden core boxes for storage. The cores will be stored on Soco-owned property for future reference.

Solid matrix IDW will include soil cuttings from soil borings and will be handled in accordance with SOP-051-501 Management of Solid Matrix Investigation-Derived Wastes, included in the RDAQAPP (Cardno, 2013a). Solid matrix IDW generated from HSA drilling methods, if used, co-located soil samples, or bench-scale treatability study samples will be transferred to roll-off boxes or drums located on Soco-owned property as discussed in the RDAWP (Cardno, 2013b).

Roll-off boxes or drums will be clearly labeled and will identify the source of the containerized material. IDW containers 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; and
- "Contents Pending Analysis" text.

One representative composite IDW soil sample will be obtained for soil IDW in accordance with SOP-505 Sampling of Solid Matrix Investigation-Derived Wastes for analysis by Resource Conservation and Recovery Act (RCRA) toxicity characteristic leaching procedures (TCLP) for characterization before disposal (Cardno, 2013a). Based on the results of previous investigations at the site, the TCLP extract will be analyzed for VOCs to determine if the soil IDW exceeds the toxicity characteristic. Table 3 presents the maximum concentration of contaminants for toxicity characterization of hazardous wastes as specified in 40 CFR 261.24. Table 4 provides a summary of estimated IDW characterization samples. Based on the results of analytical data, a waste determination will be made and soil 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 1, the solids will 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, Cardno will notify the EPA and DEQ of the proposed location where the waste will be shipped, prior to shipment.

3.4.2 Liquid IDW

Liquid matrix IDW will be temporarily stored in drums or polyethylene tanks, and treated by air sparging in a storage area located on Soco-owned property. The treated IDW water will then be sampled in accordance with SOP-051-504 Sampling of Liquid Matrix Investigation-Derived Wastes, included in the RDAQAPP (Cardno, 2013a), and the samples will be submitted to Energy for laboratory analysis of VOCs using EPA Method 8260B to evaluate the effectiveness of treatment. If laboratory results indicate the IDW water treatment achieves the OU2 Soco-owned property disposal criteria discussed in the RDAQAPP, the water will be surface discharged on Soco-owned property (Cardno, 2013a).

If laboratory results from the IDW sample indicate the treatment did not achieve cleanup standards for VOCs, the EPA and DEQ will be notified that Cardno intends to dispose of the liquid IDW off-site or propose an alternate treatment method, based on the constituent which did not meet surface discharge standards. If off-site disposal is proposed, Cardno will select a disposal facility based on the constituent or constituents that do not meet the discharge limits, and will notify the EPA and DEQ of the location where the waste will be shipped, prior to shipment.

3.4.3 Solid Waste

Non-hazardous IDW, such as PPE and disposable investigation equipment that is generated throughout the investigation 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, included the RDAQAPP (Cardno, 2013a).

3.5 SAMPLE DOCUMENTATION AND SHIPMENT

Documentation is critical for evaluating the success of any environmental data collection activity. The following subsections describe field documentation and sample handling procedures, including sample identification and labeling, documentation, chain-of-custody, and shipping. All documentation will be conducted in accordance with the RDAQAPP (Cardno, 2013a).

3.5.1 Field Documentation

Recording of notes on field data sheets or in a field log book will follow SOP-051-102 Field Forms, included in the RDAQAPP (Cardno, 2013a). Field personnel will use permanently bound field log books to record and document field activities. The field log book will list the project name, the names of subcontractors, and the project manager. 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 log book:

- Date and time of starting work and weather conditions during the field activity;
- Name and affiliation of all 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;
- Field observations; and
- Any field measurements made (e.g., pH), description of any photographs taken, etc. that are not recorded on project or task specific field data sheets.

The field team will also use the various field forms included in Appendix A of this addendum to record field activities.

3.5.2 Sample Identification

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 the LSGPS. 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 Addendum 01 activities with the exception of replacement well MW125R and Keller wells MW408 and MW409, will be sequentially numbered beginning with MW420. The 400 series indicate wells installed as part of the RDA. For nested wells, an “S” will be assigned to the shallow well, an “I” will be assigned to the intermediate screened well and “D” for a deep well screen (i.e.; the intermediate depth well at the MW420 location will be identified as MW420-I). This naming convention is consistent with previous naming conventions and 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 by the depth interval, if applicable, and 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. 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
- PT - Monitoring Well
- PZ - Piezometer
- IDW - Investigation-Derived Waste

Possible depth intervals include:

- S - Shallow
- I - Intermediate
- D - Deep

Possible sample media include:

- SB - Subsurface Soil
- GW - Groundwater
- RB - Equipment Blank
- SM - Solid Matrix IDW
- LM - Liquid Matrix IDW
- TB - Trip Blank

Example sample identifications include:

- Low-flow groundwater sample collected from an intermediate monitoring well: MW420-I.

- Duplicate low-flow groundwater sample collected from an intermediate monitoring well: MW420-I-701.

- Due to two historic samples previously collected, PT-02A and PT-02B, this third co-located soil sample for PT-02 collected from six to eight feet bgs: PT-02C-6-8.

- Due to two historic samples previously collected, PZ-8A and PZ-8B, this third co-located soil sample for PZ-8 collected from four to eight feet bgs: PZ-8C-6-8.

- Due to historic samples previously collected, the remaining co-located soil samples collected from four to eight feet bgs: PZ-10B-4-8, PZ-11B-4-8, and PZ-19B-4-8.

- The first equipment rinsate blank collected during soil sampling: RB001.

- The first solid matrix IDW sample: IDW001SM.

- The first liquid matrix IDW sample: IDW001LM.

- The first trip blank included in the first sample container: TB001.

COCs in ambient air have not been measured at the LSGPS in sufficient concentrations to impact monitoring results. Therefore, field blanks will not be collected during sampling field events. As described in Section 3.7.1.2, rinsate blanks will not be collected during the groundwater sampling event.

The bench-scale treatability study soil and groundwater samples will be named as follows:

Part 1: Northwest Source Area Treatability Study:

- The “worst case” northwest source area sandy gravel unit soil sample: NWSA-SG-WC-SB.

- The groundwater sample collected from PT-02 for the northwest source area sandy gravel unit “worst case” sample: NWSA-SG-WC-GW.

- The “average source area” northwest source area sandy gravel unit composite soil sample: NWSA-SG-A-SB.

- The groundwater sample collected from PT-02 for the “average source area” northwest source area sandy gravel unit sample: NWSA-SG-A-GW.

- The “average source area” northwest source area saturated fine-grained composite soil sample: NWSA-FG-A-SB.

- The groundwater sample collected from PT-02 for the “average source area” northwest source area saturated fine-grained unit sample: NWSA-FG-A-GW.

Part 2: Former Tank Farm Source Area Treatability Study

- The “average source area” former tank farm source area sandy gravel unit soil sample from MW420 or MW423: MW420-SB or MW423-SB.

- The corresponding groundwater sample collected from monitoring well MW420-I or MW423-I for the “average source area” former tank farm source area sandy gravel unit sample: MW420-I or MW423-I.

3.5.3 Sample Labels

A sample label will be affixed to all sample containers. The label will be pre-printed and/or completed with the following information written in indelible ink:

- Project name;
- Sample identification number;
- Date and time of sample collection;
- Preservative used; and
- Analysis required.

If pre-printed bottle labels are used, at a minimum, the date and time of sample collection will be written on the sample containers.

3.5.4 Sample Documentation

Documentation during sampling is essential to ensure proper sample identification. Cardno personnel will adhere to the following general guidelines for maintaining field documentation:

- Documentation will be completed in permanent blue or black ink;

- All entries will be legible;

- Errors will be corrected by crossing out the error 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 Cardno field team members are responsible for ensuring that sampling activities are properly documented.

3.5.5 Chain-of-Custody

Cardno will use standard sample custody procedures to maintain and document sample integrity during collection, transportation, storage, and analysis in accordance with the Sample Documentation SOP-051-104, included in the RDAQAPP (Cardno, 2013a). 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;
- 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);
- 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 by field personnel before the containers are shipped.

3.5.6 Sample Packaging and Shipment

In general, field personnel will follow sample shipment procedures provided in the Sample Packaging and Shipping SOP-051-105, included in the RDAQAPP (Cardno, 2013a). However, because some 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 for this project and hand-delivered to a local laboratory:

- 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 laboratory will be notified if the sampler suspects that the sample contains any substance that would require laboratory personnel to take safety precautions.

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

Samples collected for the bench-scale treatability samples will be shipped for analysis to 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 bench-scale treatability 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.

3.6 SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

The type of sample containers to be used for each analysis, the sample volumes required, the preservation requirements, and the maximum holding times for sample extraction and analysis are presented in Table 5 for soil and groundwater assessment samples and samples of IDW. The bench-scale treatability study sample requirements are presented in Table 6.

3.7 QUALITY CONTROL

Cardno will assess the quality of field data through regular collection and analysis of field quality control (QC) samples in accordance with the RDAQAPP (Cardno, 2013a). Laboratory QC samples will also be analyzed in accordance with the RDAQAPP referenced analytical method protocols to ensure that laboratory procedures and analyses are conducted properly and that the quality and usability of the data is known.

3.7.1 Field Quality Control Samples

QC samples are collected in the field and analyzed to check sampling and analytical precision, accuracy, and representativeness. The following section discusses the types and purposes of

field QC samples that will be collected for this project. Table 7 presents the types and frequency of collection of field QC samples.

3.7.1.1 Field Duplicates

Field duplicate samples are collected at the same time and from the same source and then submitted as separate samples to the laboratory for analysis. Field duplicates will be collected at a frequency of one per 20 samples (five percent) for VOC samples during the soil and groundwater sampling events. The frequency of one per 20 samples (five percent) is sufficient for the intended data usage for delineation of soil and groundwater impacts. Samples will be assigned a unique sample identification number that is blind to the laboratory.

3.7.1.2 Equipment Blank Samples

Equipment blank (rinsate) samples demonstrate whether decontamination procedures are effective in removing contaminants from the field sampling equipment. The presence of contamination in equipment rinsate samples indicates that decontamination procedures were not effective, allowing for the possibility of cross-contamination. Equipment rinsate samples will be collected during soil sampling at a frequency one per day for VOC soil samples. An equipment rinsate is a sample collected after a sampling device is subjected to standard decontamination procedures. Water will be poured over or through the decontaminated sampling equipment, such as a core barrel, into a sample container and sent to the laboratory for analysis. De-ionized or distilled water will be used for organic parameters. Equipment rinsate samples will be sent blind to the laboratory. During data validation, the results for the equipment rinsate samples will be used to qualify data or to evaluate the levels of analytes in the field samples collected on the same day.

Because none of the equipment that comes in contact with groundwater samples will be decontaminated and re-used, equipment rinsate blanks will not be collected during groundwater sampling events.

3.7.1.3 Trip Blanks

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.

3.7.1.4 Temperature Blanks

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 temperature blank will be used by the sample custodian to check the temperature of samples upon receipt.

3.7.2 Laboratory Quality Control

Energy's quality assurance manager (QAM) is responsible for ensuring that the laboratory's data precision and accuracy are maintained in accordance with method and laboratory

specifications. Details of all requirements for laboratory QC are presented in the RDAQAPP (Cardno, 2013a).

3.8 FIELD VARIANCES

As conditions in the field may vary, it may become necessary to implement minor modifications to sampling as presented in this addendum. When appropriate, the EPA and DEQ will be notified and a verbal approval will be obtained before implementing the changes. Any deviations or variances to the approved Addendum 01 will be documented in the field log books and the RDAR. If the revision is a substantive change, a revision to the addendum will be issued.

3.9 HEALTH AND SAFETY

All work performed under this addendum will be performed in accordance with the LSGPS OU2 HASP, appended to the RDWP (ATC, 2012c). The HASP contains emergency contact information and directions to the hospital, as well as potential hazards that may be encountered. All personnel working on-site at OU-2 must review and sign the HASP. The RDAWP lists the health and safety training requirements for Cardno personnel who work on-site at OU2 (Cardno, 2013b). Copies of Cardno's health and safety training records are maintained in project files in Cardno's Billings, Montana office.

3.10 SAMPLE CONTAINERS, PRESERVATION AND HOLDING TIMES

The type of sample containers to be used for each analysis, the sample volumes required, the preservation requirements, and the maximum holding times for sample extraction and analysis are presented in Table 5 for soil, groundwater, and IDW samples. The type of sample containers to be used, the sample volumes required, and the preservation requirements, for the bench-scale treatability study are presented in Table 6.

3.11 ANALYTICAL METHODS

Groundwater samples collected will be analyzed by Energy for VOCs according to EPA Method 8260B (see RDAQAPP for method details). The Method Reporting Limit (MRL) for all COCs is 0.5 micrograms/liter (µg/L), which is below the Performance Standards, as published in the ROD for the respective COC (EPA/DEQ, 2005). Soil samples collected will be analyzed by Energy for VOCs according to EPA Method 8260B (see RDAQAPP for method details). The MRLs for all VOCs in solid media are compound-specific, and range from 0.01 milligrams/kilogram (mg/kg) to 0.09 mg/kg, which are below the site Performance Standards, as published in the ROD for the respective COC (EPA/DEQ, 2005).

Additionally, soil and groundwater samples will be collected from OU2 for the bench-scale treatability study to be conducted in the Chemical Oxidation Laboratory and analyzed as discussed in Section 3.2.2.

4.0 REPORTING

Data will be submitted to EPA and DEQ upon receipt for decision-making purposes. Additional phases of data collection may be conducted based on these data. The results of all phases of the RDA activities will be incorporated into an RDAR and submitted to the EPA and DEQ for review and approval, as discussed in the RDAWP (Cardno, 2013b).

4.1.1 Bench-Scale Treatability Study Report

A final bench-scale treatability study report will be provided by Dr. Watts describing the methodology used for the bench-scale ISCO treatability study, a listing of all results, discussion of the results, assessment of effectiveness or ineffectiveness of the ISCO reagents, and recommendations for scale-up and transferring the bench-scale treatability results to the field for OU2. The results of the bench-scale treatability study will be evaluated and the results incorporated into the RDAR or, based on agreement with EPA, the results may be published as a stand-alone document.

5.0 SCHEDULE

The drilling is currently scheduled for the summer of 2014, pending approval of this Addendum 01 to the RDAWP and the drilling subcontractor's schedule. Future RDA field activities (e.g., well development and low-flow sampling) will occur as appropriate for the data objectives of each field event and as allowed by personnel schedules and weather.

6.0 REFERENCES

ATC, 2012a. Groundwater Monitoring Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Billings, Montana, March 12.

ATC, 2012b. Groundwater Monitoring Quality Assurance Project Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Billings, Montana, March 12.

ATC, 2012c. Remedial Design Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Billings, Montana, March 30.

ATC, 2012d. Remedial Design Assessment Quality Assurance Project Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Billings, Montana, August 3.

ATC, 2012e. Remedial Design Assessment Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Billings, Montana, August 3.

ATC, 2012f. Groundwater Monitoring Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, Revision 1, ATC Associates Inc., Billings, Montana, December 14.

ATC, 2012g. Groundwater Monitoring Quality Assurance Project Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, Revision 1, ATC Associates Inc., Billings, Montana, December 14.

ATC, 2012h. Remedial Design Assessment Quality Assurance Project Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, Revision 1, ATC Associates Inc., Billings, Montana, December 14.

ATC, 2012i. Remedial Design Assessment Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, ATC Associates Inc., Revision 1, Billings, Montana, December 14.

Cardno, 2013a. Remedial Design Assessment Quality Assurance Project Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, Revision 2, Cardno ATC, Billings, Montana, April 24.

Cardno, 2013b. Remedial Design Assessment Work Plan, Operable Unit 2, Lockwood Solvent Groundwater Plume Site, Billings, Montana, Cardno ATC, Revision 2, Billings, Montana, April 24.

EPA/DEQ, 2005. Record of Decision, Lockwood Solvent Groundwater Plume Site. U.S. Environmental Protection Agency, Helena, Montana, and Montana Department of Environmental Quality, Helena, Montana, August.

EPA/DEQ, 2011a. Statement of Work for Remedial Design and Remedial Action in Operable Unit 2 at the Lockwood Solvent Ground Water Plume Superfund Site. U.S. Environmental Protection Agency, Helena, Montana, and Montana Department of Environmental Quality, Helena, Montana, June.

EPA/DEQ. 2011b. Remedial Design/Remedial Action Consent Decree, Operable Unit 2, Lockwood Solvent Ground Water Plume Superfund Site. U.S. Environmental Protection Agency, Helena, Montana, and Montana Department of Environmental Quality, Helena, Montana, October 3.

Watts, R.J., A.L. Teel, 2005. Chemistry of modified Fenton's Reagent (Catalyzed H2O2 Propagations—CHP) for In Situ Soil and Groundwater Remediation. J. Environ. Eng. 131, 612–622.

Watts, R.J., A.L. Teel, 2006. Treatment of Contaminated Soils and Groundwater Using ISCO. Pract. Period. Hazard. Toxic Radioact. Waste Manage, 10, 2–9.

TABLES

TABLE 1
ROD CLEANUP STANDARDS
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Contaminant	Cleanup Standards	
	Groundwater (µg/L)	Source Area Soil (mg/kg)
Tetrachloroethene	5.0	0.65
Trichloroethene	5.0	0.72
cis-1,2-Dichloroethene	70.0	4.90
Vinyl chloride	2.0	0.16

Source: EPA/MDEQ, 2005

TABLE 2
GROUNDWATER MONITORING AND SAMPLING SUMMARY
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

	Well Location ID	Well Interval	Well Diameter (Inch)	Estimated Number of Groundwater Samples	Monthly Fluid Level Measurements (12 Months)
Proposed Wells	MW408	S	1 (Nested)	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW409	S	1 (Nested)	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW420	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW421	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW422	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW423	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW424	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW425	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW426	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW427	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW428	I	2 (Nested)	1	X
		D	2 (Nested)	1	X
	MW429	I	2 (Nested)	1	X
		D	2 (Nested)	1	X

Notes:
Monthly fluid level measurements will not be initialed until all RDA wells are installed and developed.
Based on the first two months of fluid level measurements collected, the number of well locations gauged may be revised.
S - Shallow
I - Intermediate
D - Deep

TABLE 2 (CONTINUED)
GROUNDWATER MONITORING AND SAMPLING SUMMARY
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

	Well Location ID	Well Interval	Well Diameter (Inch)	Estimated Number of Groundwater Samples	Monthly Fluid Level Measurements (12 Months)
Existing Wells	MW001	-	2 (Existing)	1	-
	MW007	-	2 (Existing)	1	X
	MW010	-	2 (Existing)	1	X
	MW011 (Offset from MW411)	I	2 (Existing)	1	X
	MW100	-	2 (Existing)	1	X
	MW101	-	2 (Existing)	1	X
	MW102	-	2 (Existing)	1	X
	MW103	-	2 (Existing)	1	X
	MW104	-	2 (Existing)	1	X
	MW105	-	2 (Existing)	1	X
	PT-01	-	2 (Existing)	1	X
	PT-02	-	2 (Existing)	1	X
	PT-03	-	2 (Existing)	1	X
	PT-05	-	2 (Existing)	1	X
	PT-04	-	2 (Existing)	1	X
	PT-06	-	4 (Existing)	1	X
	PT-07	-	2 (Existing)	1	X
	MW400	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW401	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW402	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW403	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW404	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW405	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW406	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW407	S	2	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW410	S	1 (Nested)	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW411 (Offset from MW011)	S	2	1	X
		D	2	1	X
	MW412	S	1 (Nested)	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	MW413	S	1 (Nested)	1	X
		I	1 (Nested)	1	X
		D	1 (Nested)	1	X
	Total Estimated Number of Groundwater Samples Including Proposed and Existing Wells:			78	

Notes:
Monthly fluid level measurements will not be initialed until all RDA wells are installed and developed.
Based on the first two months of fluid level measurements collected, the number of well locations gauged may be revised.
S - Shallow
I - Intermediate
D - Deep

TABLE 3
MAXIMUM CONCENTRATION OF CONTAMINANTS FOR TOXICITY CHARACTERISTIC (40 CFR 261.24)
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

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

TABLE 4
SUMMARY OF LIQUID AND SOLID MATRIX SAMPLES
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Parameters	Estimated Number of Samples	Estimated Number of Equipment Rinsate (at 1 per day)	Estimated Number of Duplicates (at 5%)[a]	Estimated Total Number of Samples
Liquid	VOCs	78	0	4	82
Solid	VOCs	5	1	1	7
Liquid – IDW	VOCs	2	0	0	2
Solid – IDW[b]	VOCs	1	0	0	1

Notes:
a. Each cooler containing samples for VOC analysis will also include one trip blank. Trip blanks are required only when VOCs will be analyzed. All sample coolers will contain a temperature blank.
b. Estimated using a single roll-off box.
IDW Investigation-derived waste
VOCs Volatile organic compounds
See Table 6 for the Bench-Scale Treatability Sample Requirements.
The estimated number of samples is based on collection of groundwater samples from the separate intervals of the water column from monitoring wells MW001, MW007, MW010, MW011 (included with MW411), MW100 through MW105, PT-01 through PT-07, MW400 through MW413, and MW420 through MW429.

TABLE 5
SAMPLE CONTAINER, HOLDING TIME, AND PRESERVATIVE REQUIREMENTS
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Parameter	Method No.	Sample Volume	Sample Container	Containers per Sample	Preservative[A]	Shipping Temp	Holding Time[B]
	Organic Sample Analyses							
Liquid	VOCs	8260B	40 mL	VOA vial	3	HCl	≤6°C	14 days
Solid	VOCs	8260B	125 mL	Wide mouth glass	1	None	≤6°C	14 days
Investigation-Derived Waste Analyses								
Liquid	VOCs	8260B	40 mL	VOA vial	3	HCl	≤6°C	14 days
Solid	VOCs	SW-846 Methods 1311 TCLP and 8260B for VOCs	125 mL	Wide mouth glass	1	None	≤6°C	14 days

Notes:
A. HCl Hydrochloric acid
B. The number refers to the maximum number of days from sampling to analysis.
≤ Less than or equal to
°C Degrees Celsius
mL Milliliter

TABLE 6
BENCH-SCALE TREATABILITY SAMPLE REQUIREMENTS
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

Matrix	Sample Volume per Sample	Sample Container	Preservative	Shipping Temp
Part 1: Northwest Source Area Treatability Study				
Liquid	2 L	Amber glass	None	≤6°C
Solid	2 kg	Wide mouth glass with minimum headspace	None	≤6°C
Part 2: Former Tank Farm Source Area Treatability Study				
Liquid	2 L	Amber glass	None	≤6°C
Solid	2 kg	Wide mouth glass with minimum headspace	None	≤6°C

Notes:

See Section 3.2.2 and Figure 4.

Part 1: Northwest Source Area Treatability Study:

- Northwest source area, sandy gravel, "worst case" – Collect "worst case" sample from sandy gravel unit during installation of boring installed immediately downgradient of monitoring wells PT-02 and PT-06.
- Northwest source area, sandy gravel, "average source area" – Collect average source area composite soil sample from sandy gravel unit during installation of three other soil borings to be installed in the northwest source area.
- Northwest source area, fine-grained, "average source area" – Collect average source area composite soil sample from saturated fine-grained section during installation of four soil borings to be installed in the northwest source area.
- Collect three corresponding groundwater samples from monitoring well PT-02. Two liters of groundwater (unpreserved) is necessary for each sample.

Part 2: Former Tank Farm Source Area Treatability Study

- Former tank farm area, sandy gravel, "average" – Collect average source area soil sample from sandy gravel unit of soil borings proposed to be completed as monitoring wells MW420 and MW423 within delineated tank farm source area. A portion of each core/interval will be immediately containerized for laboratory use and an additional portion will be transferred into a re-sealable plastic bag to allow for the volatilization of organic vapors, as described in Section 3.2.1.1. The core/interval that exhibits the highest TOV headspace concentrations will be submitted for laboratory use in the bench-scale treatability study.
- Collect corresponding groundwater sample from intermediate monitoring well MW420-I or MW423-I. Two liters of groundwater (unpreserved) is necessary for the sample.

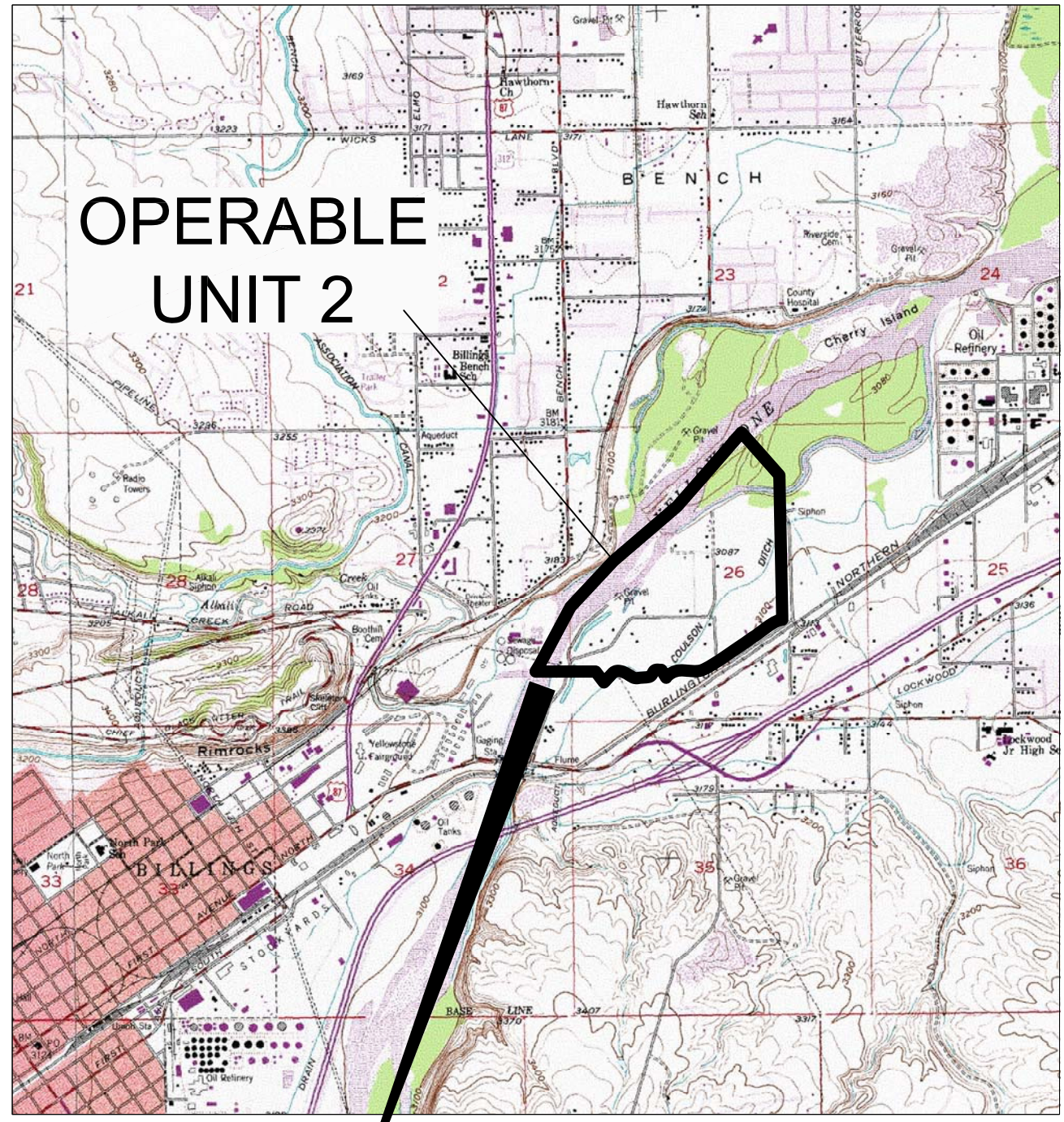
TABLE 7
QUALITY CONTROL SAMPLES FOR PRECISION AND ACCURACY
ADDENDUM 01
REMEDIAL DESIGN ASSESSMENT WORK PLAN
OPERABLE UNIT 2
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

QC Type	Precision	Accuracy	Frequency
Field QC	Field Duplicate RPD	Equipment Rinsate Blank	Field Duplicate = 1 per 20 samples Equipment Rinsate = 1 per day soil sampling[A]
Laboratory QC	LCS/LCSD RPD MS/MSD RPD Field Duplicate RPD	Method Blanks LCS or Blank Spikes MS/MSD %R Surrogate Standards %R Internal Standards %R	Method Blank = 1 per 20 samples LCS or Blank Spikes = 1 per 20 samples MS/MSD = 1 per 20 samples Every Sample Every Sample

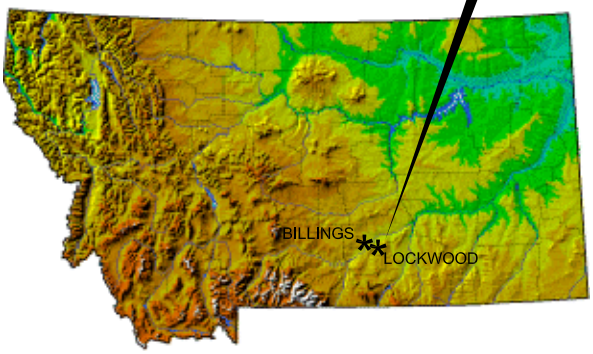
Notes:

A.	Equipment rinsate blank collected only during soil sampling. No equipment rinsate blanks collected during the groundwater sampling event.
%R	Percent recovery
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate
MS/MSD	Matrix spike/matrix spike duplicate
QC	Quality control
RPD	Relative percent difference

FIGURES



REF: USGS 7.5 MINUTE SERIES (TOPOGRAPHIC)
BILLINGS WEST AND BILLINGS EAST
CONTOUR INTERVAL: 20FEET



N

1000 0 2000

1"=2000'

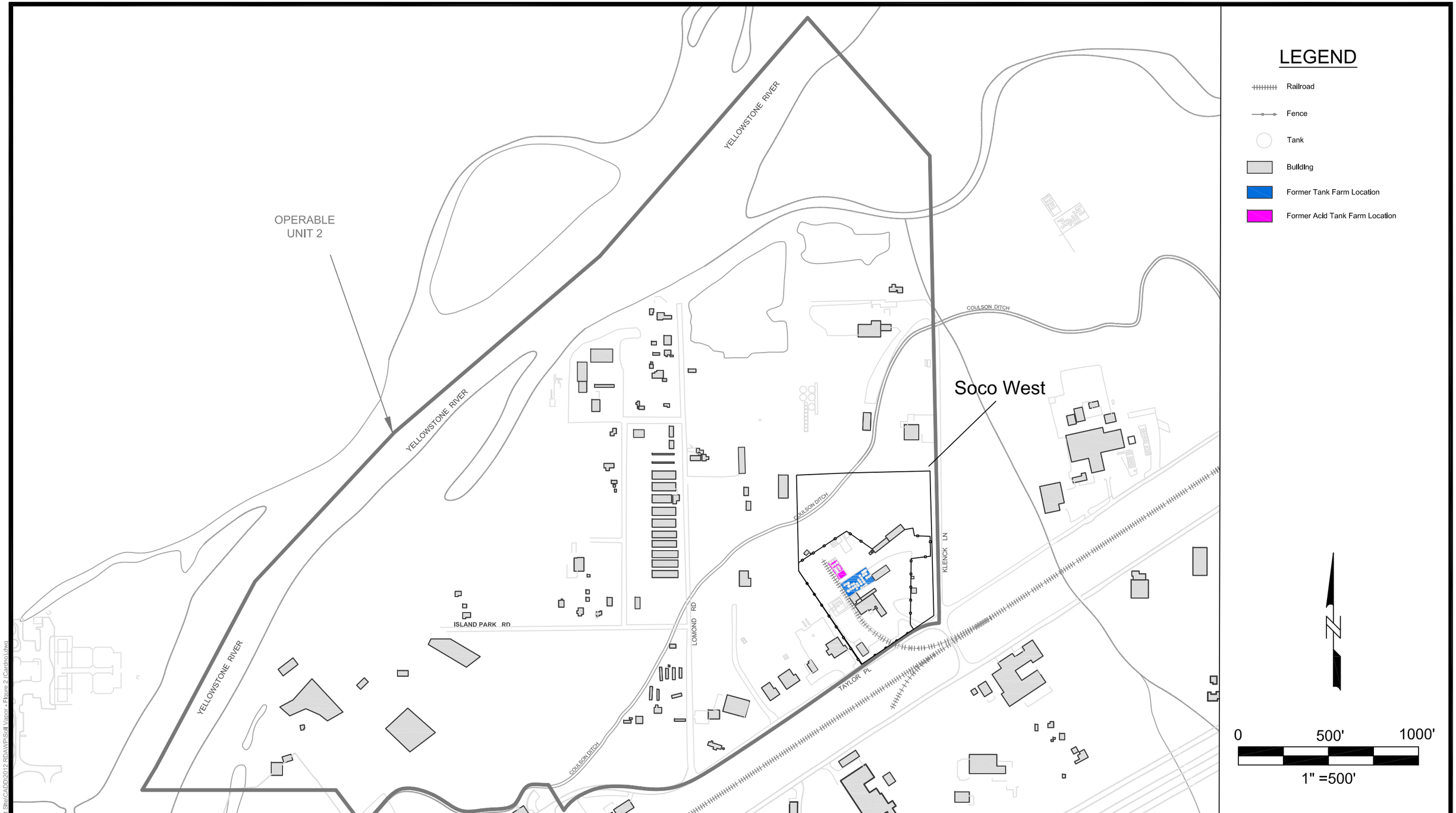
SITE VICINITY MAP
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

Billings, Montana

PROJECT NUMBER: 51.24884.0001		DATE: 12/23/2013	FIGURE
APPROVED BY: JS		DRAWN BY: JC	1

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDAWP\Soil Vapor - Figure 1 (Cardno).dwg



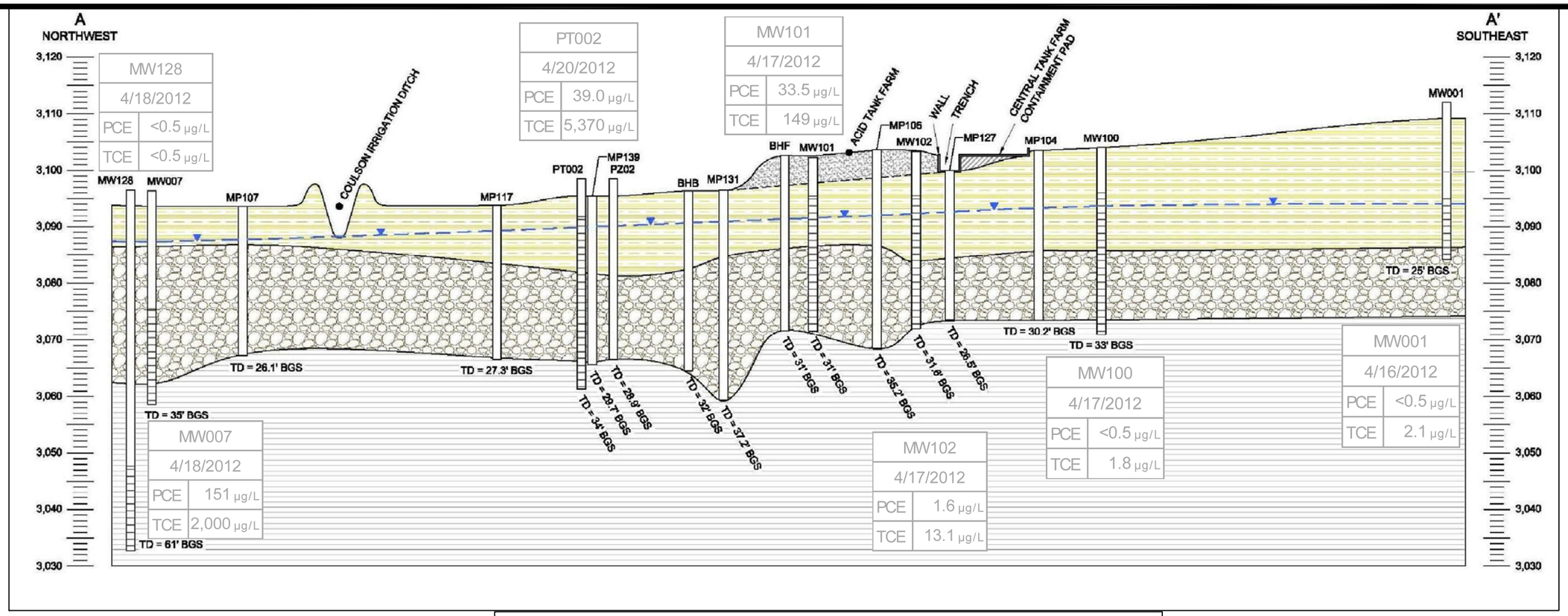
SITE MAP
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

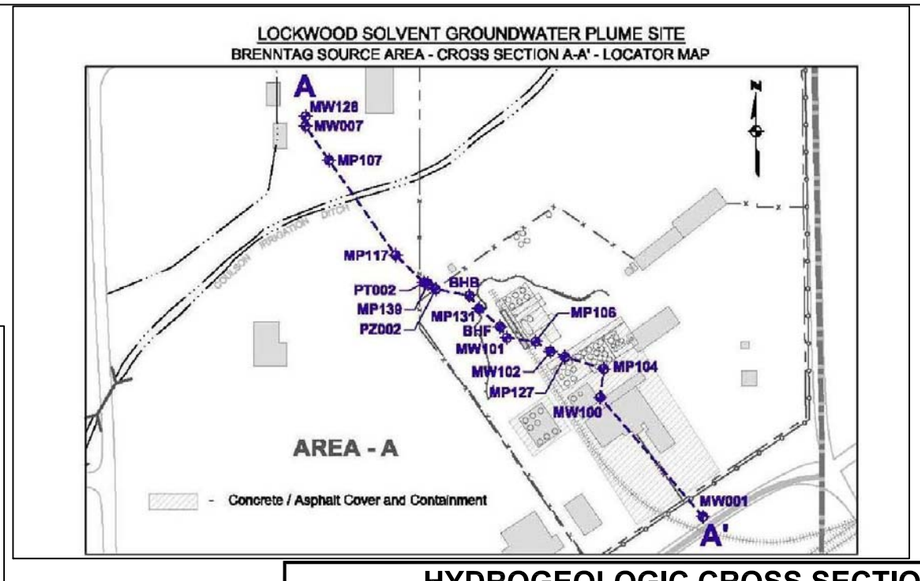
BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 10-31-2012	FIGURE 2
APPROVED BY: JS		DRAWN BY: JC	

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDAWP\Soil Vapor - Figure 2 (Cardno).dwg



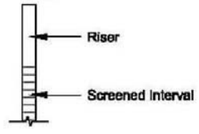


Legend

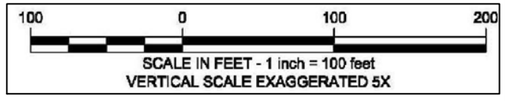
TD	-	Total Depth
BGS	-	Below Ground Surface
	-	Groundwater Level
	-	Compacted Fly Ash
	-	Fill
	-	Silty Clay / Silt / Fine Sand
	-	Sand With Gravels
	-	Bedrock

Elevations Listed in Feet Above Mean Sea Level

Well - Boring Detail



*Adapted from Figure 2-2, Final Feasibility Study Report, July 6, 2004



HYDROGEOLOGIC CROSS SECTION A-A'
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

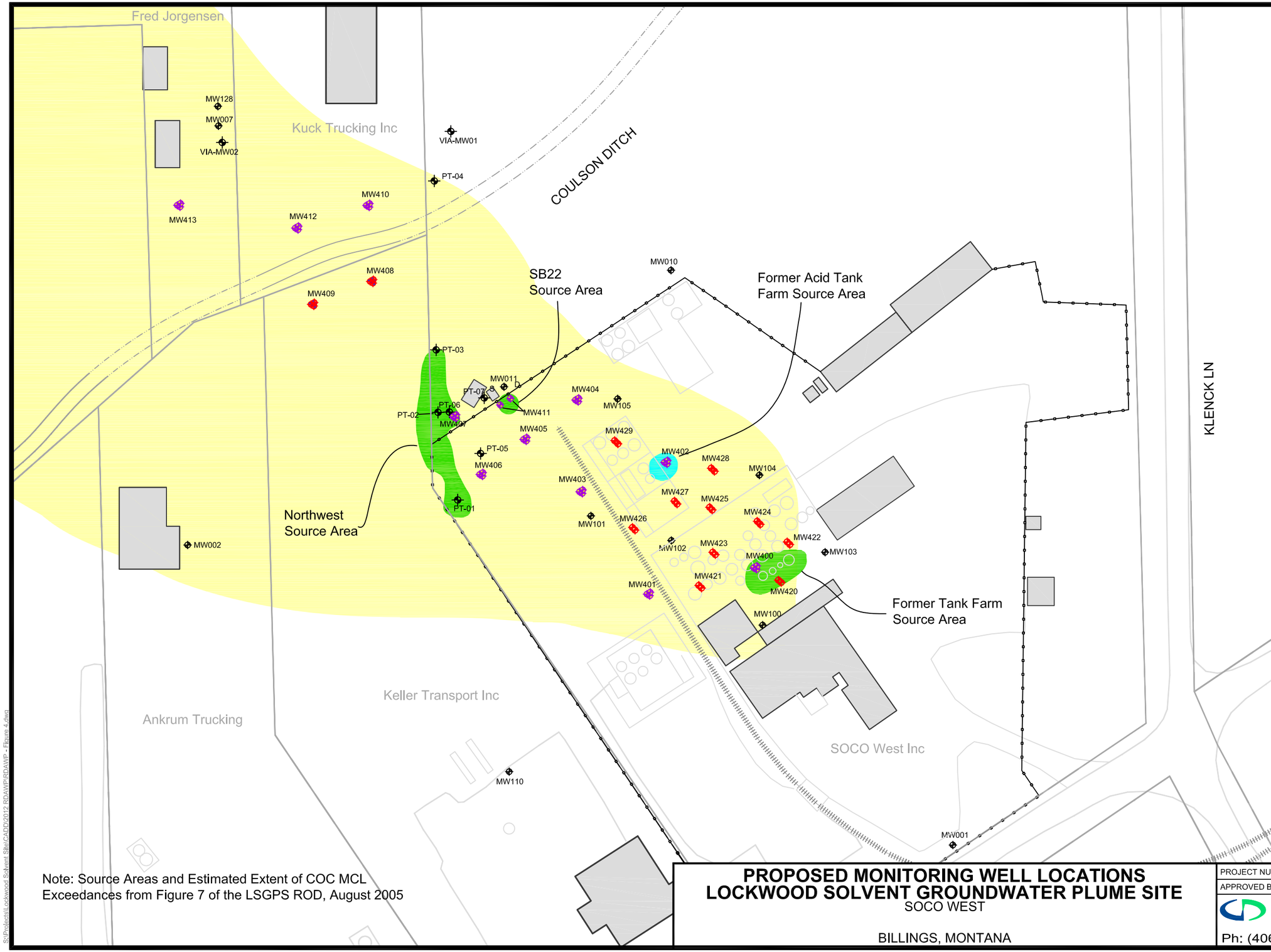
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 12-24-2013	FIGURE
APPROVED BY: JS		DRAWN BY: JC	3

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDA\WP\RDA\WP - Figures 2, 4, 5, 7 and 11.dwg



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

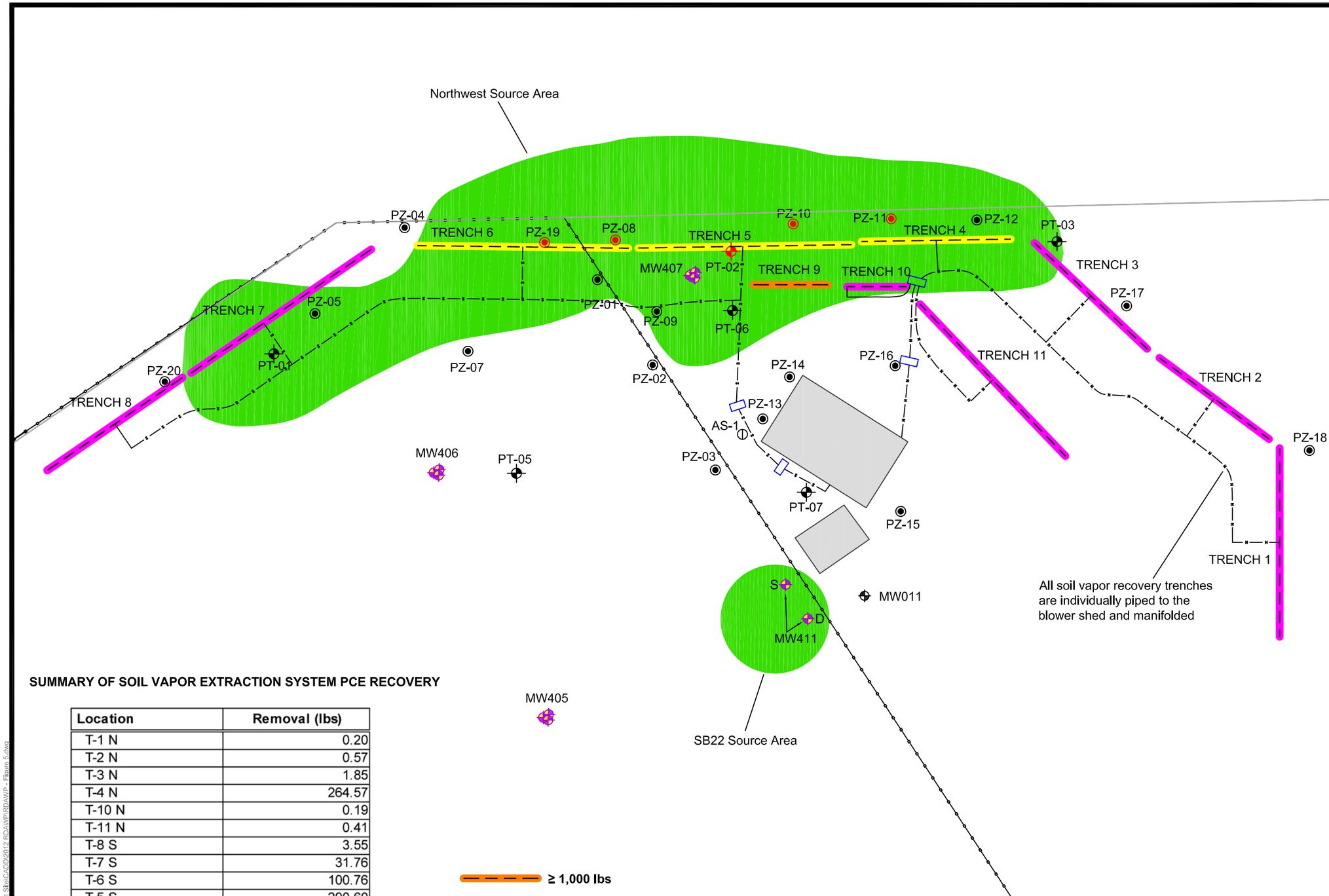
PROPOSED MONITORING WELL LOCATIONS
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001		DATE: 9-12-2013	FIGURE 4
APPROVED BY: JS		DRAWN BY: MHF	

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDAWP\RDAWP - Figure 4.dwg



LEGEND

- Railroad
- Fence
- Property Boundary
- Building
- Estimated Extent of Contaminated Vadose Soil Above Remediation Goals
- Monitoring Well Location
- Piezometer
- Ozone Sparge Point
- Monitoring Well Clusters with Shallow, Intermediate, and Deep Intervals
- S Shallow Monitoring Well Location
- D Deep Monitoring Well Location
- Proposed co-located soil sampling location. See Section 4.2.1 of the RDAWP for sample depth collection.
- N Conveyance Piping

0 20' 40'

1" = 20'

SUMMARY OF SOIL VAPOR EXTRACTION SYSTEM PCE RECOVERY

Location	Removal (lbs)
T-1 N	0.20
T-2 N	0.57
T-3 N	1.85
T-4 N	264.57
T-10 N	0.19
T-11 N	0.41
T-8 S	3.55
T-7 S	31.76
T-6 S	100.76
T-5 S	290.60
T-9 S	1147.38
Total Removal	**1841.85**

*Source Areas from Figure 7 of the LSGPS ROD, August 2005

- ≥ 1,000 lbs
- ≥ 100 to <1,000 lbs
- < 100 lbs

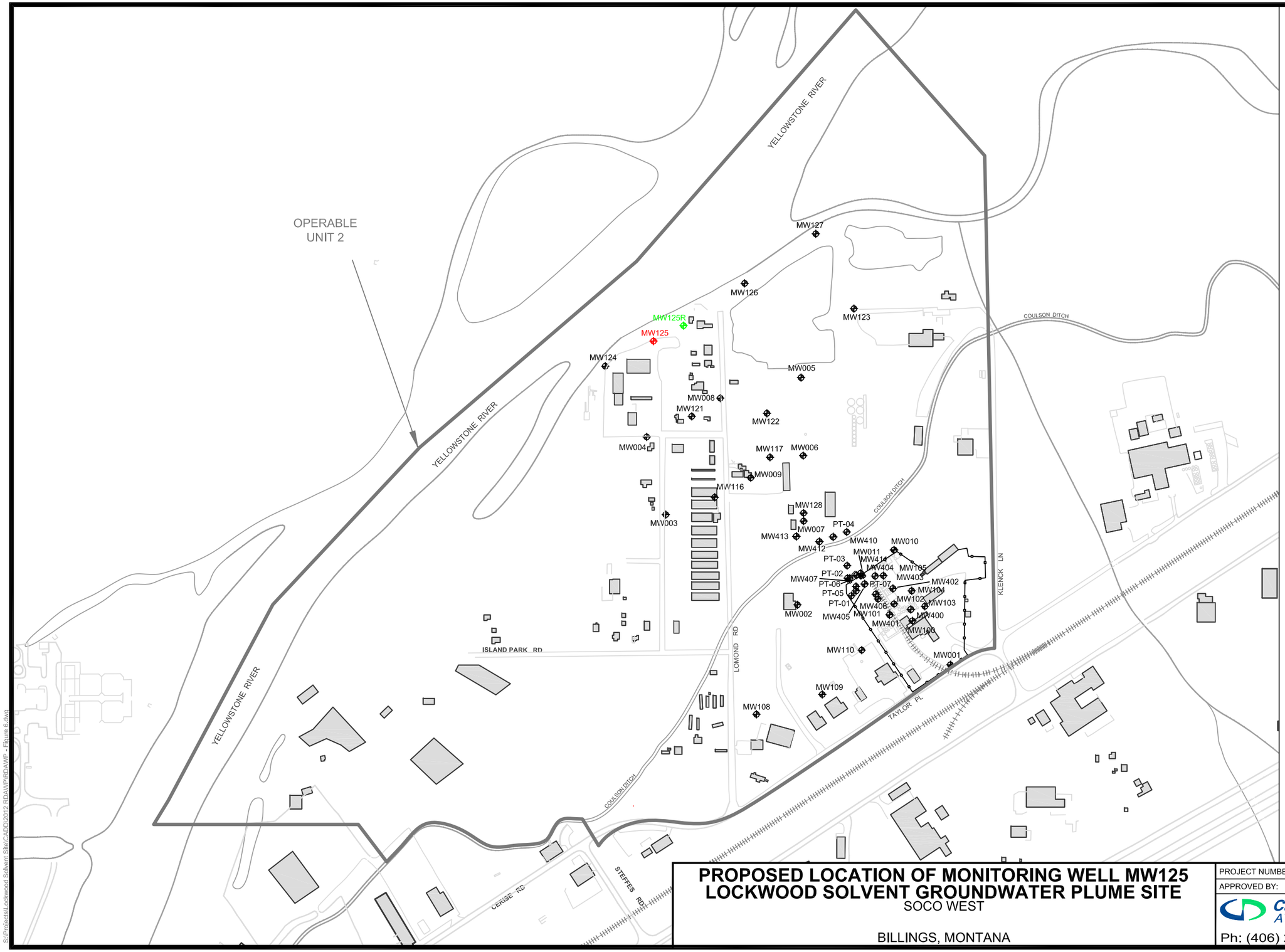
SUMMARY OF SOIL VAPOR EXTRACTION SYSTEM AND PCE RECOVERY
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE
SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001	DATE: 08-15-2012	FIGURE
APPROVED BY: JS	DRAWN BY: JC	5

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDAWP\RDAWP - Figure 5.dwg



LEGEND

- Railroad
- Fence
- Tank
- Building
- Monitoring Well Locations
- Destroyed Monitoring Well Location
- Proposed Monitoring Well Location

N

0 500' 1000'

1" =500'

PROPOSED LOCATION OF MONITORING WELL MW125
LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

SOCO WEST

BILLINGS, MONTANA

PROJECT NUMBER: 51.24884.0001	DATE: 12-24-2013	FIGURE
APPROVED BY: JS	DRAWN BY: MF	6

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

S:\Projects\Lockwood Solvent Site\CADD\2012 RDAWP\RDAWP - Figure 6.dwg

Appendix A

Field Forms

Tailgate Safety Meeting Form
Borehole Lithologic Log and Well Construction Diagram
Water Quality Meter Calibration Log
Low-flow Groundwater Sampling Field Data Sheet
Fluid Level Field Data Form
Monitoring Well Development Log
Chain of Custody and Analytical Request Document

Cardno ATC
Shaping the Future

Appendix 07-01
Tailgate Safety Meeting Form

Site Name & Number: _____

Cardno ATC Project Number: _____

Work Being Performed: _____

Date & Time of Meeting: _____

Name of Presenter: _____

NOTE: On the initial day of the project, the Project Manager or designee should conduct a visual inspection of the project site prior to the Tailgate Safety Meeting. This inspection should include a review of project site equipment, hazards, and specific job tasks, activities or operations to be performed for that day. These specific items must be covered during the Tailgate Safety Meeting. For subsequent days, any changes to the site or operations must be covered in the Tailgate Safety Meeting. In addition, "Task-Specific" Job Safety Analysis (JSA) for the tasks/activities at the project site must be integrated into the HASP and Tailgate discussions.

Itemize the Specific Topics Discussed (if more space is needed use the back of this page):

❑ Are all employees okay? ❑ Are all employees physically able to perform their job duties? ❑ "Shared Learning" items?
❑ Has PPE been checked? ❑Emergency evacuation area identified? ❑ Asked for Sub interactions or questions?

❑ **Client Requirements** - By checking the box to the left, the Presenter of the Tailgate Meeting acknowledges that all Client-specific requirements have been completed for both Cardno ATC and Subcontractor employees.

Participants (if needed, list additional participants on back of this page):

Print Name	Signature	Company	Date

A Tailgate Safety Meeting must be conducted and documented at the beginning of each workday when two or more Cardno ATC employees and/or Subcontractor representatives are present on site. Employees, client representatives and subcontractors who arrive at the site after the Tailgate Safety Meeting has been conducted must be briefed on the topics and acknowledge by signing this form. The JSA must be completed at the beginning of each day when one or more Cardno ATC employees and/or subcontractor representatives are present on a site.

Cardno ATC
917 1st Avenue North
Billings, MT 59101
Telephone: (406) 259-1033
Fax (406) 259-1099

Borehole Lithologic Log and Well Construction Diagram

Well Name:

CLIENT NAME:	**PROJECT NAME:**	**BOREHOLE NAME:**
DATE STARTED:	**FIELD GEOLOGIST:**	**DATE FINISHED:**
LEGAL LOCATION:	**CONTRACTOR:**	**CHECKED BY:**
GROUND SURFACE ELEVATION:	**DRILLER:**	**EASTING:**
GROUNDWATER ELEVATION:	**DRILLING METHOD:**	**NORTHING:**
TOTAL DEPTH DRILLED:	**CASING STICKUP:**	**TOTAL DEPTH CASED:**

ELEV. (ft)	DEPTH (ft)	▽ Depth Water Encountered During Drilling: LITHOLOGIC DESCRIPTION	USCS	SAMPLE	PID	Blows	Recovery	WELL CONSTRUCTION DIAGRAM	WELL DESCRIPTION
	0								
	5								
	10								
	15								
	20								
	25								
	30								
	35								
	40								

Total Depth:

Cardno ATC

Water Quality Meter Calibration Log

Project Name: **Date:**

Weather:

Instrument: **Calibrated By:**

Serial Number:

Initial Calibration **Barometric Pressure (mm HG):**

Parameter	Standard	Units	Temperature (°C)	Pre-Calibration Reading	Post-Calibration Reading
pH	7	s.u.			
	4	s.u.			
	10	s.u.			
Specific Conductance		µS/cm			
		mS/cm			
Dissolved Oxygen		%			
		mg/L			
ORP		mV			

Post Field (Drift) Calibration **Barometric Pressure (mm HG):**

Parameter	Standard	Units	Temperature (°C)	Pre-Calibration Reading	Post-Calibration Reading
pH	7	s.u.			
	4	s.u.			
	10	s.u.			
Specific Conductance		µS/cm			
		mS/cm			
Dissolved Oxygen		%			
		mg/L			
ORP		mV			

Notes:

Cardno ATC

GROUNDWATER SAMPLING FIELD DATA SHEET

PROJECT NAME: LSGPS DATE: ___/___/_____ WELL NO. _____

PROJECT NUMBER: 051.24884.0001 TEMPERATURE: _____ °F or °C

FIELD PERSONNEL: _____ WEATHER: _____

FIELD MEASUREMENTS:

A. LNAPL Level below top of casing/piezometer: _____ FT. LNAPL Thickness: _____ FT.

B. Static Water Level (SWL) below top of casing/piezometer: _____ FT.

C. DNAPL Level below top of casing/piezometer: _____ FT. DNAPL Thickness: _____ FT.

D. Total Depth of well (TD) from top of casing/piezometer: _____ FT.

E. Height of Water Column in casing (h = TD - SWL): _____ FT.

F. **Useful approximate Purge Volumes (PV) per foot of water column for common casing sizes:**

		3 Well Vols.	5 Well Vols.				
2" diameter	=	0.5 gals/ft	0.82 gals/ft	x	feet of water_____	=	_____PV (gallons)
4" diameter	=	2.0 gals/ft	3.25 gals/ft	x	feet of water_____	=	_____PV (gallons)
6" diameter	=	4.4 gals/ft	7.35 gals/ft	x	feet of water_____	=	_____PV (gallons)

PURGING METHOD: Peristaltic Pump DURATION: _____ minutes

OBSERVATIONS:

Time	Volume Removed (gal)	Color	Sheen	Temp (°C)	pH	Conduct (uS/cm)	ORP (mV)	DO (mg/L)

Total Volume of Water Purged From Well: _____ gallons

Purge Water Stored/Disposed of Where/How: _____

SAMPLES COLLECTED: Depth to Water at time of sample collection: _____

Sample Number(s)	Time	Number/Size of Container(s)	Preservative	Analysis
		3 – 40 mL VOA Vials	HCl	8260B

COMMENTS: Tubing set at ~ ft below TOC.

Casing Capacities:
1-inch hole……..0.041 gal/lin.ft.
2-inch hole.....0.16 gal/lin ft.
4-inch hole.....0.65 gal/lin ft.

Signature:_____

Cardno ATC
Fluid Level Field Data Form

Date: ____________________ Field Personnel: ____

Weather: ____________________ Temperature: ____________________ ^{o}F or ^{o}C

Well Number	Depth to Fluid (ft)			Total Depth (ft)
	LNAPL	Water Level	DNAPL	

CARDNO ATC
MONITORING WELL DEVELOPMENT LOG

Project Name:	Start Date:	Weather: Temp: °F	
Project Number	End Date:	Well No.:	
Field Personnel:		Well Diameter: inch	
Static Water Level:	Initial Well Depth: ft.	Screen Interval: ft.	
Stick-up Height: ft.	Total Depth Well Installed: ft.	Screen Length: ft.	
Total Purged Volume: gal.	Final Well Depth: ft.	1 Well vol.: gal.	10 Well vol.: gal.
General Comments (e.g., presence of NAPL):		General Development Method(s):	

Time	Method	Pumping Rate (gpm)	Volume Purged (gal)	Temp. (ºC)	pH	Spec. Cond. (µS/cm)	Turbidity (Visual Observation)	Comments (e.g., clarity of water, success of development)

Well Casing Capacities: 1-inch well = 0.0410 gal/lin ft. 2-inch well = 0.163 gal/lin ft. 4-inch well = 0.653 gal/lin ft.

TOC – Top of casing

Bgs – below ground surface

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.

Appendix B

MW125 Well Log

LOCKWOOD SOLVENT GROUNDWATER PLUME SITE

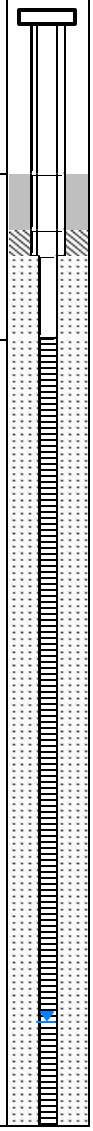
YELLOWSTONE COUNTY

MONTANA

LOG OF BOREHOLE

Borehole/Well ID: MW125

Elevation (+/- AMSL)	Depth (ft bgs)	Lithologic Symbol/ Recovery	Lithologic Description	Headspace PID Reading	Soil Sample ID/ Sample Interval	Monitoring Well Completion
3096.0, 3095.0, 3094.3	-3, -2, -1		Ground Surface			
3094.0, 3093.0, 3092.0, 3091.0	0, 1, 2, 3		***No Samples***		No Samples Collected	
3090.0, 3089.0	4, 5		***Sand*** Light brown, very fine, dry, well sorted , no stain or odor.	0		
3088.0, 3087.0, 3086.0	6, 7, 8		***No Samples***			
3085.0, 3084.0	9, 10		***Sandy Gravel*** Sub-angular to sub-rounded in coarse sand, no odor or staining	0		
3083.0, 3082.0, 3081.0	11, 12, 13		***No Samples***			
3080.0, 3079.0	14, 15		***Sandy Gravel*** As above, so stain or odor	0		
3078.0	16, 17		***No Samples***			



DRILLING DATE: 7-10-02
DRILLING METHOD: HSA
BOREHOLE DEPTH (ft bgs): 28.5
TOTAL WELL DEPTH (ft btoc): 28.5
LOGGED BY: J. Faubion
CLIENT: MDEQ
PROJECT NO.: S1176-10RIRPRT

BOREHOLE DIAMETER (in.): 8.25
WELL CASING DIAMETER (in.): 2.0
TOC ELEVATION (ft AMSL): 3097.26
GROUND ELEVATION (ft AMSL): 3094.35
DRILLING CO.: SK Geotechnical
WATER LEVEL (ft btoc): 15.43 (10/28/02)
GROUNDWATER ELEV (ft AMSL).: 3081.83

Tetra Tech EM Inc.
7 West 6th Avenue, Suite 612
Helena, Montana
(406)442-5588

LOCKWOOD SOLVENT
GROUNDWATER PLUME SITE
YELLOWSTONE COUNTY
MONTANA

LOG OF BOREHOLE

Borehole/Well ID: MW125

Elevation (+/- AMSL)	Depth (ft bgs)	Lithologic Symbol/ Recovery	Lithologic Description	Headspace PID Reading	Soil Sample ID/ Sample Interval	Monitoring Well Completion
3077.0						
3076.0	18					
3075.0	19		***Gravel*** Coarse, sub-rounded			
3074.0	20		***No Samples***			
3073.0	21					
3072.0	22					
3071.0	23					
3070.0	24		***Sandy Gravel*** Coarse, sub-angular to sub-rounded with sand matrix			
3069.0	25		***No Samples***			
3068.0	26					
3067.0	27					
3066.0	28		***Bedrock*** Sandstone gray	0		
3065.0	29		End of Log			
3064.0	30					
3063.0	31					
3062.0	32					
3061.0	33					
3060.0	34					
3059.0	35					
3058.0	36					
	37					

DRILLING DATE: 7-10-02
DRILLING METHOD: HSA
BOREHOLE DEPTH (ft bgs): 28.5
TOTAL WELL DEPTH (ft btoc): 28.5
LOGGED BY: J. Faubion
CLIENT: MDEQ
PROJECT NO.: S1176-10RIRPRT

BOREHOLE DIAMETER (in.): 8.25
WELL CASING DIAMETER (in.): 2.0
TOC ELEVATION (ft AMSL): 3097.26
GROUND ELEVATION (ft AMSL): 3094.35
DRILLING CO.: SK Geotechnical
WATER LEVEL (ft btoc): 15.43 (10/28/02)
GROUNDWATER ELEV (ft AMSL).: 3081.83

Tetra Tech EM Inc.
7 West 6th Avenue, Suite 612
Helena, Montana
(406)442-5588