Fall 11-2021

SILVER BOW CREEK/BUTTE AREA NPL SITE BUTTE PRIORITY SOILS OPERABLE UNIT

Pioneer Technical Services, Inc.

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

2021

Final

Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Quality Assurance Project Plan (QAPP) for Microbial Analysis and Biotreatability Study

Atlantic Richfield Company

Revision 0. November 2021

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for Microbial Analysis and Biotreatability Study

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Revision 0. November 2021

APPROVAL PAGE

Silver Bow Creek/Butte Area NPL Site
Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated
Quality Assurance Project Plan for Microbial Analysis and Biotreatability Study

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Butte Reduction Works Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site
Quality Assurance Project Plan for Microbial Analysis and Biotreatability Study

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ACRONYMS

Acronym	Definition	Acronym	Definition
%R	Percent Recovery	**OUR**	Oxygen Uptake Rate
%D	Percent Difference	**Pace**	Pace Analytical Services, LLC
°C	Degree Celsius	**PAH**	Polycyclic Aromatic Hydrocarbons
AECOM	AECOM Technical Services, Inc.	**PARCCS**	Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
ARAR	Applicable or Relevant and Appropriate Requirements	**PCB**	Polychlorinated Biphenyl
Atlantic Richfield	Atlantic Richfield Company	**PCP**	Pentachlorophenol
ATP	Adenosine Triphosphate	**PDI**	Pre-Design Investigation
BNSF	Burlington Northern Santa Fe (Railway)	**pH**	Potential Hydrogen
BOD	Biological Oxygen Demand	**PID**	Photoionization Detector
BPSOU	Butte Priority Soils Operable Unit	**Pioneer**	Pioneer Technical Services, Inc.
BRW	Butte Reduction Works	**ppb**	Parts per billion
BSB	Butte-Silver Bow	**PPE**	Personal Protective Equipment
CAR	Corrective Action Report	**ppm**	Parts per million
CD	Consent Decree	**Provectus**	Provectus Environmental Products
CFRSSI	Clark Fork River Superfund Site Investigation	**QA**	Quality Assurance
CLP	Contract Laboratory Program	**QAM**	Quality Assurance Manager
COC	Contaminant of Concern	**QAO**	Quality Assurance Officer
CPM	Contractor Project Manager	**QAPP**	Quality Assurance Project Plan
CRQL	Contract Required Quantitation Limit	**QC**	Quality Control
DEQ	Department of Environmental Quality	**RA**	Remedial Action
DM/DV	Data Management/Data Validation	**RBSL**	Risk-Based Screening Level
DO	Dissolved Oxygen	**RCRA**	Resource Conservation and Recovery Act
DQA	Data Quality Assessment	**RD**	Remedial Design
DQO	Data Quality Objective	**RFC**	Request for Change
EDD	Electronic Data Deliverable	**RPD**	Relative Percent Difference
EPA	Environmental Protection Agency	**SiO2**	Silicon Dioxide
EPH	Extractable Petroleum Hydrocarbons	**SOP**	Standard Operating Procedure
eV	electron volt	**SPLP**	Synthetic Precipitation Leaching Procedure
GPS	Global Positioning System	**SQL**	Structured Query Language
Hunter	Hunter Brothers Construction	**SRM**	Standard Reference Material
LCS	Laboratory Control Sample	**SSHASP**	Site-Specific Health and Safety Plan
LCSD	Laboratory Control Sample Duplicate	**T**	Duplicate Identification for Field Samples
LDS	Laboratory Duplicate Sample	**TOD**	Total Oxidant Demand
LMS	Laboratory Matrix Spike	**TPH**	Total Petroleum Hydrocarbons
LNAPL	Light Non-Aqueous Phase Liquid	**USCS**	Unified Soil Classification System
MB	Method Blank	**USGS**	US Geological Survey
MS	Matrix Spike	**VOC**	Volatile Organic Compound
MSD	Matrix Spike Duplicate	**VPH**	Volatile Petroleum Hydrocarbon
NRDP	National Resource Damage Program	**XRF**	X-Ray Fluorescence
ORP	Oxidation Reduction Potential		

1.0 INTRODUCTION

This Butte Reduction Works (BRW) Quality Assurance Project Plan (QAPP) for Microbial Analysis and Biotreatability Study (BRW Biotreatability QAPP) provides the sampling and analytical procedures and protocols necessary to conduct a bench-scale biotreatability study, including microbial analysis, as a part of the overall remedial design (RD) effort for the BRW Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site (Site).

As required by the Butte Priority Soils Operable Unit (BPSOU) Consent Decree (CD) (EPA, 2020a), soil and groundwater impacted with organic pollutants within the Site above Site-specific action levels must be properly managed in a manner that is consistent with the remedy. The bench-scale biotreatability study and associated characterization will advise appropriate Site-specific action levels for hydrocarbon-impacted soil by collecting data on the characteristics of the soil (hydrocarbon leachability, microbial activity, etc.). Additionally, if treatment of hydrocarbon-impacted soil is required as part of the remedial action (RA), the bench-scale biotreatability study will help identify the proper treatment option (i.e., chemical oxidation, landfarming, expedited natural attenuation under improved conditions, etc.) and advise the management plan for hydrocarbon-impacted soil.

This BRW Biotreatability QAPP includes the excavation of test pits within a specified area to provide a range of soil types and hydrocarbon-compound concentrations within the Site based on data collected from previous Site investigation work. Soil samples from each test pit will be collected and field tested to identify hydrocarbon compounds and contaminants of concern (COCs) throughout the Site. Soil samples will be collected and sent to specified laboratories for soil characterization analysis (e.g., hydrocarbon leachability, hydrocarbon-compound concentrations, metal concentrations, etc.), total oxidant demand (TOD) analysis, and bench-scale biotreatability with microbial analysis. Samples will be collected according to the schedule listed in Table 1 at the locations listed in Table 2, and Table 3 lists the applicable sample collection and holding times.

To detail the sampling and analytical procedures and methodologies for this work, this document includes the following information, as generally required in the U.S. Environmental Protection Agency (EPA) *Remedial Design/Remedial Action Handbook, EPA 540/R- 95/059* (EPA, 1995):

1. Site Background (Section 2.0).
2. Data Quality Objectives (DQOs) (Section 3.0).
3. Sample Process and Design (Section 4.0).
    - Preparation for Field Work (Section 4.1)
    - Sample Location and Frequency (Section 4.2).
    - Sample Designation (Section 4.3).
    - Sampling Equipment and Procedures (Section 4.4).
    - Sample Handling and Analysis (Section 4.5).
4. Quality Assurance (QA)/Quality Control (QC) (Section 5.0).
5. Assessment and Oversight (Section 6.0).

6. Health and Safety (Section 7.0).
7. Project Organization and Responsibilities (Section 8.0).
8. Data Validation and Usability (Section 9.0).

Supplemental information mentioned throughout the text is included in appendices A through E and includes operating procedures, field forms, field equipment manuals, data validation checklists, and corrective action form, respectively.

1.1 Objectives

The specific objectives under this BRW Biotreatability QAPP have been identified through the DQO process (Section 3.0). The primary objectives are to collect additional data regarding the soil characteristics (e.g., COC concentrations, hydrocarbon-compound concentrations, nutrients, microbial populations, hydrocarbon leachability, etc.) to help:

1. Estimate the biological degradation potential for the hydrocarbon-impacted soil.
2. Determine if high COC concentrations are impacting the microbial communities within the soil and possibly inhibiting the biodegradation process.
3. Understand the significance of other reduced species (e.g., iron, manganese, organic carbon, pyrite, and other sulfide minerals) in the soil sample that would consume the oxidant agent to a point where chemical oxidation would not be practicable as a treatment option.

Additionally, a secondary objective is to use the soil characterization data (nutrients, metal concentrations, and hydrocarbon leachability) collected during this work, along with additional data collected during previous Site investigation activities, to advise Site-specific action levels that will be protective of human health and the environment and guide the appropriate management (refer to Section 2.4) for hydrocarbon-impacted soil at the Site. Site-specific action levels will be determined in accordance with the Montana Risk-Based Corrective Action Guidance for Petroleum Releases (DEQ, 2018a).

To achieve these objectives, test pits will be excavated to gather soil samples for this study. Field testing will include photoionization detectors (PIDs), a Hanby Soil Test Kit, and an X-ray fluorescence (XRF) field unit. This field-testing equipment will be used to determine the appropriate interval to send samples for laboratory analysis (Table 3). Samples will be sent to Provectus Environmental Products (Provectus), Pace Analytical Services, LLC (Pace), and to AECOM Technical Services, Inc. (AECOM) to further identify soil characteristics (e.g., hydrocarbon leachability, hydrocarbon-compound concentrations, metals concentrations, etc.), microbial activity, and biological degradation potential for hydrocarbon compounds within the soil. Additional information on XRF limits, relevant operating procedures, and data validation equations is listed in Table 4, Table 5, and Table 6, respectively.

Some volatiles may be lost during the test pit excavations and sample mixing. To prevent the loss of volatiles during sampling, samples to be analyzed via the synthetic precipitation leaching procedure (SPLP) will be collected immediately following visual confirmation of anticipated soil

lithology, and the remaining volatile organic compound (VOC) samples will be prioritized for collection after the mixing of samples. The loss of volatiles through mixing of the soil is acceptable to meet the primary objectives of this work. Previous Site investigations have characterized the extent and concentrations of soil impacted with hydrocarbon compounds within the Site; therefore, this work is focused on the treatability of the soil within the Site and it is acceptable for some loss of volatiles during the sampling process to achieve this objective.

2.0 SITE BACKGROUND

Details of the Site, its history, and previous investigations are included in the *Butte Reduction Works (BRW) Smelter Area Mine Waste Remediation and Contaminated Groundwater Hydraulic Control Site Remedial Design Work Plan* (Atlantic Richfield, 2021a) and the corresponding Pre-Design Investigation (PDI) Work Plan included as an attachment to the remedial design work plan. These documents are working documents and will be updated as needed. Summaries relevant to the BRW Biotreatability QAPP are included in the sections below.

2.1 Site Description

The Site is in Butte, Montana, covers approximately 24 acres, and is located immediately west of Montana Street between Silver Bow Creek and the Burlington Northern Santa Fe (BNSF) Railway line (Figure 1 and Figure 2).

2.2 Site History

Beginning in 1885 to the time of this writing, the Site has been the location of multiple industrial operations including a copper smelter and a zinc concentrator, and it was also used by the Domestic Manganese and Development Company (Sanborn, 1943) and Rocky Mountain Phosphates, Inc. (GCM Services, Inc., 1991). The operations left behind a complex distribution of materials (including slag, tailings, manganese waste, demolition debris, foundations, and other historic structures) as well as impacted soil and groundwater.

In the center of the Site, there is an above-ground metal storage tank measuring approximately 90 feet in diameter. The tank is now empty but is thought to have been associated with the phosphate plant operation during the 1960s (GCM Services, Inc., 1991) and has been said to have previously stored petroleum hydrocarbons during the late 1900s (NRDP, 2016). The Site is also located near the following properties with recorded petroleum releases (Figure 2):

- 400 Oxford Street: Location of a leaking underground storage tank managed by the Montana Department of Environmental Quality (DEQ) in 1995 (DEQ, 2019).
- 1759 South Montana Street: Formerly the location of a Cenex Convenience Store. The site received reimbursement from the Petroleum Tank Release Compensation Board for Releases in 1990 and 2006 (DEQ, 2018b).

Additionally, Butte-Silver Bow (BSB) operated an asphalt plant at the Site from the mid-1990s to late 2020. Currently, BSB uses the Site to store materials. This complex history of activities has resulted in a complex distribution of materials within the Site (including slag, tailings,

manganese waste, demolition debris, foundations, and other historic structures) as well as soil and groundwater impacted with metals and hydrocarbons (Atlantic Richfield, 2021a).

2.3 Relevant Previous Investigations

2.3.1 Results from Phase I Site Investigation

Multiple investigations have been completed at the Site, including recent investigation activities, to identify impacted soil and groundwater throughout the Site. From August 2018 to March 2019, the initial Phase I Site Investigation took place according to the BRW Phase I QAPP (Atlantic Richfield, 2021b). The BRW Phase I QAPP was amended to include a request for change (RFC) for a Hydrocarbon Investigation, which took place December 2019 to February 2020, to further identify the hydrocarbon compounds that impact the soil and groundwater within the Site.

During both the initial Phase I Site Investigation and the Hydrocarbon Investigation, field personnel used two PIDs, a MiniRAE 3000 with a 10.6 electron volt (eV) lamp, and an UltraRAE 3000 with a 9.8 eV lamp to screen for the presence of hydrocarbons in the soil. Soil samples were collected if a positive PID reading was present and sent to Energy Laboratories in Helena, Montana, to be analyzed for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) fractionation with polycyclic aromatic hydrocarbons (PAH). Additionally, groundwater samples were collected from piezometers where soil samples had a positive PID reading during drilling activities.

During the Hydrocarbon Investigation, Pioneer Technical Services Inc. (Pioneer) constructed additional piezometers and test pits to capture the existence of light non-aqueous phase liquid (LNAPL) or determine if dissolved hydrocarbon concentrations in groundwater exceeded Risk-Based Screening Levels (RBSLs). Most hydrocarbon wells were installed near an existing piezometer that had a presence of hydrocarbon contaminates within the soil or groundwater during the initial Phase I Site Investigation. The general locations of unpaired piezometers were selected based on results from the initial Phase I Site Investigation and the groundwater contours shown on Figure 3.

Based on results from the Phase I Site Investigation, including the Hydrocarbon Investigation, there is both impacted soil and groundwater within the Site that exceed DEQ's RBSLs (DEQ, 2018a) (Figure 3). Groundwater results from the initial Phase I Site Investigation and the Hydrocarbon Investigation indicate that benzene concentrations are above the RBSLs in piezometers BRW18-PZ21, BRW19-HCW37, and BRW19-HCW38. Piezometers BRW18-PZ13 and BRW18-PZ18 contained concentrations of PAHs; specifically, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were at concentrations greater than RBSLs. Soil results from the initial Phase I Site Investigation and the Hydrocarbon Investigation include samples from BRW18-PZ18 and BRW18-PZ21 with concentrations that exceed RBSLs for VPH and EPH compounds and include high concentrations of PAHs. The Draft Final BRW PDI Evaluation Report (Atlantic Richfield, 2021c) provides additional detailed results from the Phase I Site Investigation.

2.3.2 Preliminary Results from Phase II Site Investigation

A Phase II Site Investigation began in March of 2020 and was completed in spring of 2021 in accordant with the Final Revised BRW 2021 Phase II QAPP (Atlantic Richfield, 2021d). This Phase II Site Investigation included collecting additional design data related to the groundwater and aquifer within the Site. Preliminary review of results from the Phase II Site Investigation indicated that there are no additional organic pollutant areas of concern from those already identified from the Phase I Site Investigation. Additionally, preliminary review of the results indicates that the concentrations of PAHs in piezometers BRW18-PZ13 and BRW18-PZ18 are below RBSLs. Once Site investigation activities are complete and the data are validated, results will be incorporated into a PDI Evaluation Report and submitted to Agencies for review.

2.3.3 2016 BRW Smelter Site Test Pit Report

In 2016 for the National Resource Damage Program (NRDP), Tetra Tech, Inc. conducted a test pit investigation and subsurface material sampling within the Site to characterize subsurface mine waste deposits, slag, impacted soil, and miscellaneous fill materials emplaced within the area. Thirty test pits were excavated, screened, and sampled. Of those 30 test pits, the presence of hydrocarbons was detected using a flame ionization detector in 6 test pits. Field technicians observed a hydrocarbon sheen on the groundwater surface in 4 test pits and an LNAPL layer on the groundwater surface in 1 test pit. The locations of the hydrocarbon observations are shown on Figure 4. Figures and tables with results, photographic logs, field sampling notes, and laboratory reports are included in the appendices of the BRW Smelter Site Draft Test Pit Report (NRDP, 2016).

2.4 BRW Remedial Action

The BRW RA includes removing tailings, waste, COC-impacted soil, and slag within the Silver Bow Creek 100-year floodplain reconstruction area to a depth to be determined during the RD activities. The conceptual RD will include the following additional elements:

- Removing waste (as defined by the BPSOU CD Waste Identification Screening Criteria [EPA, 2020a]) from the designated and approved 275-foot average width removal corridor (referred to herein as the waste removal corridor).
- Managing soil and groundwater within the Site impacted by organic pollutants as appropriate and in a manner that is complementary with the remedy. Organic pollutants (petroleum compounds, polychlorinated biphenyl [PCB], pentachlorophenol [PCP], and dioxins) are secondary concerns for the Site. Soil and groundwater within the Site that have been impacted by these pollutants above Site-specific action levels will be properly addressed/managed as part of the RA. However, additional remediation of the soil and groundwater impacted with organic pollutants (i.e., treatment of organic pollutant sources) is not required by the BPSOU CD (EPA, 2020a).
- Realigning Silver Bow Creek and constructing the bank-full channel and 100-year floodplain within the 275-foot average width waste removal corridor.

- Regrading and constructing caps over the waste left in place (e.g., tailings, slag, and impacted soil). Some slag walls will remain exposed on Site for cultural and historic preservation.
- Hydraulically managing COC-impacted groundwater from the Site to control discharge of COC-impacted groundwater to surface water and sediment in BPSOU generally and within the Site specifically.

As a result of the multiple industrial operations within and adjacent to the Site, there is a potential that there are areas within the Site where the soil and/or groundwater are impacted with organic pollutants (i.e., hydrocarbon compounds, PCP, PCBs, and dioxins), in addition to the COCs (i.e., arsenic, cadmium, copper, lead, mercury, and zinc) identified in the BPSOU CD (EPA, 2020a). However, based on existing Site data, the only organic pollutants of concern present at concentrations of potential concern are hydrocarbon compounds (Atlantic Richfield, 2021c). Therefore, this BRW Biotreatability QAPP focuses on soil impacted with hydrocarbon compounds.

As required by the BPSOU CD (EPA, 2020a), hydrocarbon-impacted soil and groundwater above Site-specific action levels must be properly managed in a manner that is consistent with the remedy. Figure 5 shows the general logic for managing hydrocarbon-impacted soil within the Site as part of the RA. Soil within the preliminary waste removal corridor that is impacted with hydrocarbon compounds above Site-specific action levels must be segregated and disposed of appropriately. Soil outside the preliminary waste removal corridor that is impacted with hydrocarbon compounds above Site-specific action levels must be managed in a way that is consistent with the Applicable or Relevant and Appropriate Requirements (ARARs) identified in the Draft Final Preliminary 30% Remedial Design Report for BRW Smelter Area (Atlantic Richfield, 2021e). Soil samples are necessary for both inside and outside the waste removal corridor since the waste removal corridor boundary is preliminary and since management of hydrocarbon-impacted soil is necessary both inside and outside the waste removal corridor.

To help determine appropriate Site-specific action levels and advise the proper management plan for hydrocarbon-impacted soil, additional information is needed on the characteristics of the soil, specifically on the soil's hydrocarbon leachability and microbial activity and biological degradation potential for hydrocarbon compounds within the soil. One of the concerns is that the microbial communities within the soil may be impacted by the elevated concentrations of metal COCs within the soil that may limit the hydrocarbon-compound biodegradation process. This BRW Biotreatability QAPP includes collecting samples from five sample areas within the Site with varying soil conditions that include hydrocarbon compounds and COC concentrations and submitting the samples for laboratory analyses to help estimate the biological degradation potential for the impacted soil.

3.0 DATA QUALITY OBJECTIVES

The DQO process is used to define the type of quality, quantity, purpose, and use of the data to be collected. The U.S. Environmental Protection Agency (EPA) developed a seven-step process to ensure the data collected during field activities are adequate to support the site-specific remediation plan. The DQOs were developed for this BRW Biotreatability QAPP according to

the EPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006). The seven-step process is outlined below.

Step 1: State the Problem
The purpose of this step is to describe the problem to be studied and so that the focus of the investigation will not be ambiguous.

Problem: As required by the BPSOU CD (EPA, 2020a), soil and groundwater impacted with organic pollutants within the Site above Site-specific action levels must be properly managed in a way that is consistent with the remedy. Soil within the preliminary waste removal corridor that is impacted with organic pollutants above Site-specific action levels must be segregated and disposed of appropriately. Soil outside the preliminary waste removal corridor that is impacted with organic pollutants above Site-specific action levels must be managed in a way that is consistent with the ARARs identified in the Draft Final Preliminary 30% Remedial Design Report for the BRW Smelter Area (Atlantic Richfield, 2021e).

Previous Site investigation work has identified hydrocarbon compounds as the primary organic pollutants of concern and has characterized the extents of the hydrocarbon-impacted material throughout the Site. However, additional information is needed to help determine the proper management and/or treatment for the soil impacted with hydrocarbon compounds. This also includes developing Site-specific action levels for hydrocarbon-impacted soil located outside of the waste removal corridor by better understating the potential leachability of hydrocarbon compounds from soil into groundwater.

Available Resources and Schedule: Pioneer is the contractor responsible for conducting the elements of the BRW Biotreatability QAPP under the direction of Atlantic Richfield Company (Atlantic Richfield). All personnel completing field work will be properly trained in how to perform their tasks. The laboratory(s) selected to analyze the soil and groundwater samples will be an Atlantic Richfield-approved laboratory(s). The BRW Biotreatability QAPP work must be completed by March 2021 to meet the current required design schedule for the RA. However, potential constraints could delay field work and/or the RD (Step 5) and will need to be addressed by Atlantic Richfield and Agencies if they occur.

Conceptual Model of Environmental Problem: The Site has a history of multiple industrial uses. As a result, there are accumulations of slag, tailings, demolition debris, and other impacted materials that may be a source of COCs and additional constituents of concern (e.g., manganese, trace elements, organic pollutants, etc.) to the underlying groundwater. A description on the Site history, previous investigations, and required RA is included in Section 2.0.

Planning Team: Section 8.0 includes a detailed description on the project organization and responsibilities.

Step 2: Identify Goals of the Study
This step identifies the principal questions that the study will attempt to resolve and what actions may result.

Principal Study Questions:

1. Are landfarming and/or chemical oxidation feasible treatment options for the hydrocarbon compounds within the soil at the Site?
    a. Are there other reduced species (i.e., iron, manganese, organic carbon, pyrite, and other sulfide materials) in the soil that would consume an oxidant agent to the point where chemical oxidation would not be practicable as a treatment option?
    b. Do elevated concentrations of metals notably affect the biological activity within the soil?
2. Based on the soil characteristics (e.g., nutrients, metal concentrations, hydrocarbon leachability, hydrocarbon-compound concentrations, etc.), what are the Site-specific action levels that would require management of hydrocarbon-impacted soil that is located outside the waste removal corridor?

Estimation Statement: The principal study questions will be answered by excavating at least five test pits; conducting field tests to determine the appropriate interval to be sent for laboratory analysis; and submitting split samples to Provectus, Pace, and AECOM to further identify soil characteristics (e.g., hydrocarbon leachability, hydrocarbon-compound concentrations, metals concentrations, etc.), microbial activity, and biological degradation potential for hydrocarbon compounds within the soil. The data collected will be used to :

1. Estimate the biological degradation potential for the hydrocarbon-impacted soil.
2. Determine if high COC concentrations are impacting the microbial communities within the soil and possibly inhibiting the biodegradation process.
3. Understand the significance of other reduced species (e.g., iron, manganese, organic carbon, pyrite, and other sulfide minerals) in the soil sample that would consume the oxidant agent to a point where chemical oxidation would not be practicable as a treatment option.

Additionally, the data will be used to advise Site-specific action levels that will be protective of human health and the environment and guide the appropriate management (Figure 5) for hydrocarbon-impacted soil at the Site. Site-specific action levels will be determined in accordance with the Montana Risk-Based Corrective Action Guidance for Petroleum Releases (DEQ, 2018a).

The data validation procedures detailed in Step 6 will ensure the data collected are usable for this intended purpose.

Step 3: Identify Information Inputs
The purpose of this step is to identify the informational variables that will be required to answer the principal study questions and determine which variables require environmental measures.

Types of Information Needed:

- Survey-grade Global Positioning System (GPS) location coordinates collected for test pits.
- Classification and lithology recorded for each test pit including Unified Soil Classification System (USCS) classification (Appendix B); visual estimate of rock content (2-inch plus fraction); color (as per Munsell color chart [Munsell, 2009]); depth to top and bottom of each lithological unit; presence or absence of soil staining, odor, nodules, organic matter, and/or groundwater; and depth to top and bottom of each sample collected for field testing and laboratory analysis.
- Sampling interval. Field testing results will be used to determine the appropriate interval for samples to be sent for laboratory analysis based on the anticipated soil conditions for sampling that are identified in Table 2:
    - Presence of hydrocarbons. The presence will be detected in the soil through visual screening (sight and/or smell) and with two types of PIDs. Visual and olfactory observations of suspected hydrocarbons will be confirmed with a Hanby Soil Test Kit prior to collecting a sample.
    - Concentrations of COCs in the soil will be confirmed with a XRF unit prior to collecting a laboratory sample for the bench-scale biotreatability study.
    - Results from the initial field screening will help determine the proper interval for samples to be sent to the laboratory for analysis to best match the anticipated soil conditions that are identified in Table 2, as determined by the Field Team Leader and Contractor Project Manager (CPM) in consultation with the Contractor Quality Assurance Officer (QAO) (refer to Section 8.0).
- Laboratory analysis for initial characterization of soil, a TOD analysis, and initial slurry analysis and subsequent microbial analysis to determine microbial activity. Dependent on the level of bacterial activity within the initial slurry analysis, an enhanced slurry analysis will also be conducted. Table 3lists samples that will be composited, homogenized, and split in the field by Pioneer. Samples will be sent to the respective laboratories:
    - Pace for the initial characterization analysis of each sample including general parameters, metals, and hydrocarbon compounds and general hydrocarbon leachability.
    - Provectus for the TOD analysis. Based on field screening and data collected from previous Site investigations, one sample from the test pit with the greatest concentration of high molecular weight hydrocarbons (i.e., one sample for the Site) will be sent to Provectus. At the conclusion of the TOD analysis, Provectus will submit a portion of the soil from each bench-scale reactor to Pace for a post-treatment analysis. The post-treatment analysis will include the following: total metals, hydrocarbon compounds (EPH, VPH, and PAH), and potential hydrogen (pH).
    - AECOM to complete each of the initial soil slurry analyses for a sample from each sample area. The oxygen uptake rate (OUR) and total and dissolved adenosine triphosphate (ATP) measurements will be performed to assess the microbial activity of the soil bacteria. Microbial analysis to quantify bacteria populations will be

subcontracted by AECOM to Microbial Insights to perform their CENSUS-qPCR method.

- Based on the results of the initial soil slurry analyses and TOD analysis, Atlantic Richfield will determine if additional slurry analyses are needed based on professional judgment.
    - Based on the results from the TOD analysis and initial slurry analysis, Atlantic Richfield will review results and determine if a sample of the post-treatment soil will be sent to the AECOM laboratory for a slurry analysis.
    - Based on the findings from the initial microbial analysis, an enhanced analysis may be performed to further characterize bacteria populations. If necessary, and at the direction of Atlantic Richfield, AECOM will perform the enhanced slurry study which will involve the addition of nutrients and an external carbon source as well as a longer incubation time to stimulate or enhance the microbial activity in an effort to gather additional information.

Sources of Additional Information:

- Phase I Site Investigation (BRW Phase I QAPP and RFC documents) (Atlantic Richfield, 2021b).
- Phase II Site Investigation (BRW Phase II QAPP) (Atlantic Richfield, 2021d).
- BRW PDI ER (Atlantic Richfield, 2021c).
- BRW Smelter Site Draft Test Pit Report (NRDP, 2016).

Applicable Limits/Thresholds:

- Waste Identification Screening Criteria (EPA, 2020a).
- Montana RBSLs (DEQ, 2018a).

Appropriate Sampling and Analysis Methods:

- Sampling and analysis methods are detailed in Table 3.
- All laboratory results will go through a Level 2 validation. The required quantification limit is listed in Table 3.

Step 4: Define the Boundaries

The purpose of this step is to define the spatial and temporal boundaries of this study.

Target Population: Test pits to be installed are listed in Table 2 and shown on Figure 3.

Specific Spatial Boundaries, Temporal Boundaries, and Other Practical Constraints: The projected boundary of this study is the Site (shown on Figure 3). Figure 3 includes the proposed sample areas for test pits, and the anticipated depth and soil conditions for each test pit are listed in Table 2. Locations of each sample area and anticipated depth and soil conditions were identified using previous investigation results. Actual soil sample location and depth will be determined using field screening to confirm the anticipated soil conditions listed in Table 2. Soil

samples are necessary from both inside and outside the waste removal corridor since the waste removal corridor boundary is preliminary, and since management of hydrocarbon-impacted soil is necessary both inside and outside the waste removal corridor.

Scale of Estimates to be Made: The sample results will be used to characterize the soil both inside and outside the waste removal corridor to help advise the management of the hydrocarbon-impacted soil within the Site.

General Spatial Boundaries, Temporal Boundaries, and Other Practical Constraints: Fieldwork will begin once Agency approval has been received. A proposed schedule is shown in Table 1. Work will be performed as weather conditions permit. Coordination with BSB will be required for each project task. Potential constraints that could delay fieldwork include adverse weather conditions, contractor availability, coordination with land managers/users, unforeseen challenges with the Covid-19 pandemic, or other unforeseen issues. Major project delays resulting from these constraints will be recorded in the field logbooks and reported to the Agencies.

Step 5: Develop the Analytical Approach
The purpose of this step is to specify the appropriate population parameters for making estimates.

Population Parameters:

- Soil characterization including general parameters, metals, and hydrocarbon compounds and general hydrocarbon leachability.
- Persulfate, sulfate, oxidation reduction potential (ORP), pH, and petroleum hydrocarbons will be measured multiple times during the bench-scale TOD analysis.
- The results of the analysis will include TOD, optimal tested oxidant, and pH adjusting amendment dose (if needed to adjust pH).
- The OUR and total and dissolved ATP measurements.
- Quantification of bacteria populations.

Specification of Estimator:

- Soil characterization results will be used to establish soil conditions prior to analysis and post-treatment. The goal is to characterize the soil that is being sent for the treatability testing and not to document the *in-situ* conditions of the soil.
- Additionally, a secondary objective is to use select soil characterization results (nutrient, metals concentrations, and hydrocarbon leachability) along with current Site data to advise Site-specific action levels that will be protective of human health and the environment and guide the appropriate management (Figure 5) for hydrocarbon-impacted soil at the Site. With the exception of the SPLP analysis results, which will be collected immediately after excavation, the hydrocarbon-compound analysis results from the BRW Biotreatability QAPP will not be used to advise Site-specific action levels since volatiles will be lost during excavation and mixing. Only analytical results that are not compromised with sampling procedures (i.e., metals and nutrient analyses) will be used.

- Persulfate, sulfate, ORP, pH, and petroleum hydrocarbons will be measured multiple times during the bench-scale TOD analysis to track how the reaction is progressing.
- The TOD, optimal tested oxidant, and pH adjusting amendment dose (if needed to adjust pH) from the TOD analysis will be used to understand the significance of other reduced species (e.g., iron, manganese, organic carbon, pyrite, and other sulfide materials) in the soil sample that would consume the oxidant agent to a point where chemical oxidation would not be practicable as a treatment option. (Section 4.5.3.2).
- The OUR and total and dissolved ATP measurements will be used to assess microbial activity and the potential for toxicity in soil bacteria. (Section 4.5.3.3).
- Quantification of bacteria populations provides a line of evidence for biodegradation of petroleum hydrocarbons and, thus, native bacteria metabolism. (Section 4.5.3.3).

Specific Action Levels: Field screening results will be used to select appropriate sample location and depth within each sample target area to collect samples for laboratory analysis. Anticipated soil depth and soil conditions are detailed in Table 2.

Step 6: Specific Performance or Acceptance Criteria
The purpose of this step is to define performance or acceptance criteria that the data collected will need to include.

All analytical data collected as part of this BRW Biotreatability QAPP will be validated to ensure that the data are suitable for the intended purpose. Specific data validation processes that will be followed to ensure analytical results are within acceptable limits are detailed in Section 9.0. Since this is a bench-scale study to determine the treatability of the hydrocarbon-impacted soil, the data collected from Pace will undergo Stage 2A Verification and the data collected from AECOM and Provectus will undergo Stage 1 Verification as defined in EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use (EPA, 2009). The data validation process will include evaluating analytical control limits and the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. If significant issues with the data are found, results will be discussed with the EPA.

Step 7: Develop the Plan for Obtaining the Data
The purpose of this step is to identify a resource-effective data collection design for generating data that are expected to satisfy the DQOs.

Section 4.0 describes the applicable data collection for this BRW Biotreatability QAPP. Procedures outlined in Section 4.0 are designed to ensure that the data will be of sufficient quality and quantity to answer the principal study questions outlined in Step 2 and to inform future activities in the area.

3.1 Measurement Performance Criteria for Data

Specific data validation processes ensure that analytical results are within acceptable limits. For work completed under this BRW Biotreatability QAPP, all data gathered will be checked to ensure they are usable for their intended purposes. Analytical control limits and the PARCCS

parameters of the data will be analyzed. If significant issues with any data are found, results will be discussed with EPA and Montana DEQ project managers. EPA, in consultation with Montana DEQ, will then decide if the total study error could cause them to make an incorrect decision. Using this approach, the probability of making an incorrect decision (i.e., either a false negative or positive) based on the information collected is considered small.

The PARCCS definitions are provided below along with the acceptance criteria for data collected. Equations for calculating precision, accuracy, and completeness are provided in Table 6.

Precision

Precision is the amount of scatter or variance that occurs in repeated measurements of a particular analyte. Acceptance or rejection of precision measurements is based on the relative percent difference (RPD) of the laboratory and field duplicates. For example, perfect precision would be a 0 percent RPD between duplicate samples (both samples have the same analytical result). For groundwater samples, the control limit of a RPD less than 20 percent will be used when sample results are greater than 5 times the Contract Required Quantitation Limit (CRQL). If either of the sample results are less than 5 times the CRQL, the control limit used will be a difference between sample results less than the CRQL. For soil samples, the control limit of an RPD less than 35 percent will be used when sample results are greater than 5 times the CRQL. If either of the sample results are less than 5 times the CRQL, the control limit used will be a difference between sample results less than 2 times the CRQL. This precision requirement is derived from the Clark Fork River Superfund Site Investigation (CFRSSI), Laboratory Analytical Protocol (ARCO, 1992a), the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020b), and the CFRSSI QAPP (ARCO, 1992b). Note that the Laboratory Reporting Limit in Table 6 will be used as the CRQL for data validation.

Accuracy

Accuracy is the ability of the analytical procedure to determine the actual or known quantity of a particular substance in a sample. Accuracy is assessed based on the percent recovery (%R) and percent difference (%D) of various laboratory QC samples. Perfect %R is 100% and perfect %D is 0% (the analysis result is exactly the known concentration of the QC sample). The laboratory control sample (LCS) and laboratory matrix spike (LMS) are used to measure accuracy, based on the %R of the LMS and LCS. An acceptable accuracy range for the %R of LMS and LCS is 80% to 120% in groundwater samples and 75% to 125% for soil samples. Additional laboratory QC samples may be used to assess accuracy as appropriate to the analytical method. Accuracy requirements for this project are derived from the EPA Contract Laboratory Program (CLP) Statement of Work for Inorganic Superfund Methods (EPA, 2016), the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020b), and the CFRSSI QAPP (ARCO, 1992b).

Representativeness

Representativeness is a qualitative parameter that is addressed through proper sampling program design. The sampling program is designed to obtain a sufficient number of samples that adequately represents the range of conditions present in the medium being sampled and specify suitable sampling methods and procedures. For this BRW Biotreatability QAPP, the CPM will

review the BRW Biotreatability QAPP to ensure that it is designed to collect the data and information necessary to meet the purpose of the study. The review will consider the volume, variability, and intended use of the data to ensure proper sampling methods and adequate spatial distribution of samples. After the data have been collected and analyzed, the Field Team Leader or CPM will review the data and qualitatively assess whether the data adequately represent the Site conditions and intended purpose of the study. Sample representativeness may also be evaluated using the RPDs for field duplicate sample results, if applicable.

Comparability

Comparability determines if one set of data can be compared to another set of data. Comparability will be assessed by determining if an EPA-approved analysis method was used, if bench-scale testing was conducted generally following published methods, if values and units were sufficient for the database, if specific sampling points can be established and documented, and if field collection methods are similar. All Standard Operating Procedures (SOPs) for this study are included in Appendix A. Analysis methods for each analytical group are listed in Table 3. The applicable analytical group for each sampling location is listed in Table 2.

Completeness

Completeness determines if enough valid data have been collected to meet the study needs. Completeness is assessed by comparing the number of valid sample results to the number of sample results planned for the study. Although not all the analytes measured in this sampling effort have completeness objectives outlined in the CFRSSI QAPP (ARCO, 1992b), the completeness target for this study is 95.0% or greater as designated in the CFRSSI QAPP.

Method Sensitivity

Method sensitivity is related to the method detection limits. The method sensitivity or lower limit of detection depends on several factors, including the analyte of interest, the method used, the type of detector used, matrix effects, etc. Appropriate methods must be selected with sufficient method sensitivity to accomplish the project's goals. Two methods are listed below.

XRF Analysis: The method sensitivity or lower limit of detection for XRF analysis depends on several factors, including the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement-spectral interferences. Example lower limits of detection for analytes of interest in environmental applications are listed in Table 4. These limits apply to a clean, spiked matrix of quartz sand (silicon dioxide) free of interelement-spectral interferences using long (100 - 600 second) count times. These sensitivity values are given for guidance only and may not always be achievable, because they will vary depending on the sample matrix, which instrument is used, and operating conditions.

Hanby Soil Test Kit: The method of sensitivity or lower limit of detection from the Hanby Soil Test Kit is 1 parts per million (ppm) to 1,000 ppm for total petroleum hydrocarbons (TPH) in soil samples. The Hanby Soil Test Kit will determine the hydrocarbon compound; however, additional samples will be sent for laboratory analysis (Table 3).

Laboratory Analysis: The method sensitivity for laboratory analyses is determined as part of the laboratory SOPs. The Laboratory Reporting Limit for each analyte is listed in Table 3. These detection limits will be reviewed as part of the data validation process.

4.0 SAMPLING PROCESS AND DESIGN

The BRW Biotreatability QAPP will include sampling and laboratory analysis that may consist of up to four parts: an initial characterization of soil, a TOD analysis, an initial soil slurry analysis, and possibly an enhanced slurry analysis. Composite soil samples will be collected from test pits from the anticipated depths and soil conditions (i.e., soil type, hydrocarbon-compound concentrations, and/or COC concentrations) (Table 2). With the exception of SPLP samples which will be collected immediately, the samples will be thoroughly mixed per SOP-S-06 (Appendix A) to ensure homogenized, aliquot split samples. Split samples will be sent to Pace for the initial characterization analysis, to Provectus for the TOD analysis, and to AECOM for the soil slurry analyses. The following subsections provide the procedures and protocols necessary to complete these tasks. The project schedule is included in Table 1.

4.1 Preparation for Fieldwork

The following tasks will be completed prior to conducting field activities.

4.1.1 Training

All field personnel will have a current certification for the 40-hour Occupational Safety and Health Administration Hazardous Waste Site and Emergency Response Training. Current certification records will be maintained at Pioneer headquarters at 1101 S. Montana Street in Butte, Montana.

In a project meeting held prior to fieldwork, all field personnel will review this BRW Biotreatability QAPP and receive any specified training. Field personnel will review sampling and monitoring procedures and requirements prior to field activities to ensure collecting and handling methods are completed according to the BRW Biotreatability QAPP requirements. Field personnel will be trained in how to properly use field equipment and complete activities according to field data collection SOPs in Appendix A.

The Field Team Leader will review the internal BRW Site-Specific Health and Safety Plan (SSHASP) with all field personnel prior to fieldwork to assess the Site's specific hazards and the control measurements put in place to mitigate these hazards. The BRW SSHASP review will cover all other safety aspects related to the Site including personnel responsibilities and contact information, additional safety requirements and procedures, and the emergency response plan.

The Field Team Leader will be responsible for training field personnel on how to calibrate field measurement instruments. The Field Team Leader will be experienced in the use and calibration of the equipment that will be used and responsible for training and overseeing the support staff. One hard copy of the current approved version of this BRW Biotreatability QAPP will be maintained for reference purposes in the field vehicle and/or field office. All field team

personnel will have access to electronic PDF format files of all documents pertaining to fieldwork.

4.1.2 Property Access

As Atlantic Richfield owns the property where the field activities will be performed, there are no property access tasks to be completed.

4.1.3 Utility Locates

Utility locates will be performed prior to any fieldwork and will follow BP Remediation Management Defined Procedures for ground disturbance in addition to applicable control measures addressed in the internal BRW SSHASP. Final utility locates for the work area will be completed by the performing authority prior to any ground disturbance activities. There is a possibility that test pit locations could shift once underground utilities are located throughout the Site.

4.2 Sample Location and Frequency

To help determine appropriate Site-specific action levels and define the proper management plan for hydrocarbon-impacted soil (both inside and outside the waste removal corridor), additional information is needed on the characteristics of the soil, specifically on the soil's microbial activity, the hydrocarbon's leachability from soil, and biological degradation potential for hydrocarbon compounds within the soil.

It is anticipated that five test pits will be excavated at the approximate sample areas shown on Figure 3 and described in Table 2. These sample areas were selected to provide a range of soil types and COC and hydrocarbon-compound concentrations within the Site based on data collected from the Phase I Site Investigation (Atlantic Richfield, 2021c) and preliminary results from the Phase II Site Investigation (Section 2.3). The anticipated soil type, general concentrations, and justification for each sample location and depth are described in Table 2.

The final number and locations of test pits will be determined by the Field Team Leader and CPM in consultation with the Contractor QAO. Considerations that will impact the decision on sampling locations include location of utilities, infrastructure and land use in the area due to ongoing BSB operations, safety concerns, and equipment access.

4.3 Sample Designation

A sample number system will be used to uniquely identify the project Site, the sample medium, and the specific sample location and depth interval. The sample identification number will be derived from the test pit number with the Site name followed by the sample interval enclosed in parentheses followed by the date. For example, a sample designated BRW21-TP75(1.5-3.2)-10072021 describes a sample from test pit BRW21-TP75 taken from a depth of 1.5-3.2 feet below existing grade on October 7, 2021. All measurements will be decimal feet. There will be

no blank spaces permitted in the identification. The following is an example of the sample numbering system:

Sample Number: **BRW21-TP75(1.5-3.2)-10072021**

Location/Year:	*"BRW21"* - BRW project area, collected in 2021.
Type:	*"TP"* - Test Pit
Location/Number:	*"75"* - Sample Location (corresponds with Test Pit ID No.). All sample locations will be plotted on the sampling maps.
Depth Interval:	*"(1.5-3.2)"* (upper limit-lower limit in feet).
Date:	*"10072021"* - sample collected on October 7, 2021.

For field duplicates, the depth interval will be replaced by "(T)." For example, a duplicate of BRW21-TP75(1.5-3.2)-10072021 would be BRW21-TP75(T)-10072021. Field duplicate samples will be recorded in the log or logbook, and the primary sample will be clearly indicated.

4.4 Sampling Equipment and Procedures

4.4.1 Equipment

Equipment used will include, but is not limited to, the following:

- Field logbook and pens.
- Field forms and references (Appendix B).
- USCS chart (ASTM D-2488) (Appendix B).
- Munsell color chart (Munsell, 2009).
- Measuring tape/wheel.
- XRF field unit – Niton^{TM} XL# Analyzer (XL3).
- Sieve.
- Portable heater or oven.
- Two PIDs - 9.8 eV and 10.6 eV lamps with humidity filter.
- Hanby Soil Test Kit.
- Digital camera and/or digital video camera.
- Sharpshooter shovels and spoons or disposable sampling spoons.
- Sample containers and labels.
- Chain of custody forms.
- Coolers.
- Decontamination equipment (pressure washer, tap water, dilute nitric acid, liquinox soap, decontamination containers, paper towels, scrub brushes, and spray bottles) (refer to SOP-DE-02 in Appendix A).
- Personal Protective Equipment (PPE).
- Resource-grade GPS unit.

Field equipment will be examined by the Field Team Leader or field team members to verify that it is in proper operating order prior to use. Equipment, instruments, tools, and other items

requiring preventive maintenance will be serviced and/or calibrated in accordance with the manufacturer's specified recommendations, as necessary. Field equipment will be cleaned (decontaminated) and safely stored between each use. Any routine maintenance recommended by the equipment manufacturer will also be performed and documented in field logbooks. Calibration of field equipment will be completed in the field at the beginning of each day and recorded in the field logbooks. Any equipment deficiencies or malfunctions during fieldwork will be recorded as appropriate in the field logbooks. The SOPs for the field equipment and PID units are in Appendix A and the manual for the Hanby Soil Test Kit is in Appendix C.

All supplies and consumables received for the project (e.g., sampling equipment, calibration standards, etc.) will be checked to ensure their condition is satisfactory, such as free of defects that would affect performance. The types of supplies and consumables needed to complete sampling activities are described in the relevant field SOPs (Appendix A). Inspections of field supplies will be performed by the Field Team Leader or field team members.

4.4.2 Procedures

Excavation of test pits will follow the general procedures in SOP-S-06 (Appendix A). Specific to this study, certain modifications to the SOP are described in this section.

4.4.2.1 Test Pit Excavation

Test pits will be excavated using the appropriate excavating equipment capable of collecting samples up to a maximum depth of 15 feet. During excavation of the test pit, the following limits will be observed:

- Test pits will be excavated using a track-mounted or rubber-tired excavator capable of excavating to a maximum depth of 15 feet. The type of excavation equipment used (e.g., excavator model number, bucket type, teeth type, etc.) as well as any modifications to the equipment (e.g., hydraulic modifications, counterweights, boom extensions, bucket thumbs, attachments, etc.) will be documented.
- Test pits will be excavated until the anticipated depth is reached, until the equipment hits refusal (i.e., cannot excavate through material), to the limits of the equipment (i.e., 15 feet), or other Site-specific limitations are encountered (e.g., sidewall stability becomes insufficient, etc.). The final depth of the test pit will ultimately be determined by the Field Team Leader and CPM in consultation with the Contractor QAO based on field conditions and results from previous investigations.
- Excavated materials will be stockpiled a minimum of 3 feet from the edge of the excavation.
- From the ground surface to a depth of 4 feet, 1 wall of the test pit will be prepared for evaluation if the desired sample interval does not exceed 4 feet. The test pit should have 1 vertical smooth wall for evaluation and 1 sloping or stepped wall for egress into and out of the test pit. Field personnel may only enter the test pit if a competent person (as identified in the corresponding Task Risk Assessment) has examined the test pit and determined it is safe to enter.

- No personnel will be permitted access to test pits deeper than 4 feet during performance of this work.
- If the depth of the test pit is greater than 6 feet, field personnel must maintain a 6-foot horizontal distance from the edge of the test pit unless they are wearing a safety harness and are appropriately anchored as identified in the Task Risk Assessment.
- Indicators of test pit stability will be documented in the corresponding Task Risk Assessment to establish protocols to cease excavation and safely backfill if a test pit becomes or appears to become unstable.
- Dewatering of test pits will not be conducted due to the considerations of impacted groundwater.

4.4.2.2 Logging

The classification and lithology of the test pit sidewalls will be logged, and the areas photographed and/or videoed. This will include a soil log of the test pit sidewall that lists USCS classification (Appendix B); visual estimate of rock content (2-inch plus fraction); color (as per Munsell color chart [Munsell, 2009]); depth to top and bottom of each lithological unit; presence or absence of soil staining, odors, nodules, organic matter, and/or groundwater; and bedrock depth (if encountered). All relevant observations will be recorded in a bound field logbook and on the forms included in Appendix B.

4.4.2.3 PID Screening Analysis

During excavation of the test pit, visual and olfactory observations (sight and/or smell), and two PIDs (9.8 eV and 10.6 eV lamps) will be used to identify sources of hydrocarbons. A slow sweeping motion will be used to detect petroleum compounds with the PIDs. The PIDs will be used to screen the soil within the test pit immediately after excavation (if it is safe to enter the pit) or the PIDs will be used to screen the soil immediately after it is excavated. If it has been determined that VPHs might be present, a combustible gas meter will be used to monitor the atmosphere for hazardous conditions. The combustible gas meter will be mounted on or near the excavator to monitor conditions near the test pit. If hazardous conditions are present, appropriate action will be taken by safety personnel.

4.4.2.4 Sampling and Analysis Procedures

Because the objective of this work is to gather data for soil with a range of hydrocarbon-compound and COC concentrations, field screening tools will be used to verify the soil conditions assumed from previous investigations. For each test pit, once the anticipated depth is reached the Field Team Leader will visually inspect the soil to determine if the anticipated lithological layer and soil type are present (Table 2).

If the visual inspection confirms the anticipated lithological layer and soil type are present, the Field Team Leader will immediately collect a sample for SPLP analysis in the required sample container(s) (Table 3). Additionally, samples will be collected for field screening following the general procedures below:

- Use 2 PIDs, one with a 9.8 eV lamp and another with a 10.6 eV lamp, to screen for any petroleum compounds via the headspace method. The procedures for using the PID units are summarized below, and additional detail is included in applicable user manuals. It is anticipated that a MiniRAE 3000 unit and a UltraRAE 3000+ unit will be used, or equivalent. The MiniRAE 3000 unit has a 10.6 eV lamp and can detect VOCs with ionization potentials below 10.6 eV (i.e., most VOCs) with a detection range of 0 to 15,000 ppm. The UltraRAE 3000+ unit has a 9.8 eV lamp and can detect VOCs with ionization potentials below 9.8 eV (e.g., benzene), with a detection range of 50 parts per billion (ppb) to 200 ppm for benzene.
    - Once the anticipated soil conditions are verified, a laboratory sample will be immediately collected for hydrocarbon compounds (Table 3) in the appropriate sample containers (i.e., two 4-ounce amber glass containers and one 8-ounce amber glass container). Additionally, the field team will immediately collect a sample in a ziplock bag with air space at the top above the sample (headspace) to allow testing using the headspace screening method.
    - For the headspace screening method, the sample is brought to room temperature, the sample is mixed or shaken depending on soil type to allow the contaminants to volatilize, and then the PID probe is inserted into the bag and the headspace concentration is measured and recorded.

- Use a Hanby Soil Test Kit (or similar test kit as determined by field personnel) to screen for hydrocarbon compounds. The detection limit for the Hanby Soil Test Kit ranges from 1 ppm to 100,000 ppm. The general procedures for using the field test kit are summarized below and additional detail is included in the user manual accompanying the test kit:
    - Weigh 5 grams of soil sample to be analyzed.
    - Place sample into beaker.
    - Add solvent to sample in beaker.
    - Stir or mix sample and solvent to form an extract.
    - Pour extract into test tube.
    - Add catalyst to test tube.
    - Shake test tube.
    - Compare test tube to color ID chart to determine presence of TPHs.

If another field test kit is used, the user manual for that unit will be followed.

- Use field XRF analyses as a guide to screen the soil for COC concentrations. The detection limits for the XRF are included in Table 4.
    - For the XRF analysis, use a Niton™ XL3 XRF Analyzer (XL3) and follow the procedures outlined in SOP-SFM-02 (Appendix A) as well as the XL3 user manual to ensure that the techniques employed are appropriate for the analytes of interest.
    - Collect samples in a ziplock bag and mix the soil.

- Dry the samples if conditions require it and deemed necessary by field personnel. If a portable heater or oven is used to dry samples, the sample will be dried while maintaining a temperature that does not exceed the boiling point of water (100 degrees Celsius [°C]).

Once field screening has been completed and the results confirm the anticipated soil conditions (i.e., soil type, hydrocarbon-compound concentrations, and/or COC concentrations) are present, a sample will be collected from the anticipated depth and soil conditions specified in Table 2. If the anticipated soil conditions are not present, the Field Team Leader and CPM in consultation with the Contractor QAO will determine the appropriate action, which may include excavating another test pit within the same area. If it becomes necessary to dig another test pit, Field Team Leader, CPM, and Contractor QAO will determine the intervals to send samples to the laboratory. At a minimum, one sample will be collected for laboratory analysis from each identified sample area (Figure 3).

Samples will be collected in accordance with the general procedures in SOP-S-06 (Appendix A). Samples will be collected using a disposable hand scoop or decontaminated shovel by scraping soil from the sidewall or collecting it from the appropriate excavated piles or from the excavator bucket. An appropriate sample volume will be collected to provide enough material for each required analysis (Table 3). Any large and/or coarse fragments greater than 0.5 inches will be removed from the sample. With the exception of SPLP samples which will be collected immediately, the samples will be thoroughly mixed per SOP-S-06 (Appendix A) to ensure homogenized, aliquot split samples. After the sample is thoroughly mixed, samples will be transferred to the appropriate sample containers, labeled, and immediately placed into the designated storage container (e.g., cooler).

Some volatiles may be lost during the excavation of the test pits and mixing of the samples. To prevent the loss of volatiles during sampling, SPLP samples will be taken immediately following visual confirmation of anticipated soil lithology and the remaining VOC samples will be prioritized for collection after the mixing of samples. The loss of volatiles through mixing of the soil is acceptable to meet the primary objectives of this work (i.e., to help estimate the biological degradation potential for the hydrocarbon-impacted soil, help determine if high COC concentrations are impacting the microbial communities within the soil and possibly inhibiting the biodegradation process, and help understand the significance of other reduced species in the soil sample that would consume the oxidant agent to a point where chemical oxidation would not be practicable as a treatment option). Previous Site investigations have characterized the extent and concentrations of soil impacted with hydrocarbon compounds within the Site; therefore, this work is focused on the treatability of the soil within the Site and it is acceptable for some loss of volatiles during the sampling process to achieve this objective.

No water samples will be collected for laboratory analysis; however, the potential hydrogen (pH), specific conductance, ORP, and dissolved oxygen (DO) of groundwater that enters the test pit will be tested in the field, if feasible. All field water testing results will be recorded in the field logbook. The field team will record the information on the Test Pit Log form provided in Appendix B. The field team will also record the resource-grade GPS coordinates of all test pits.

4.4.3 Standard Operating Procedures

This document references Pioneer SOPs for activities that outline specific procedures to safely complete tasks involved in this BRW Biotreatability QAPP. The SOPs applicable to the work are referenced in the appropriate sections throughout this report, are listed in Table 5, and included in Appendix A.

Depending on circumstances and needs, it may not be possible or appropriate to follow the SOPs exactly in all situations due to Site conditions, equipment limitations, and SOP limitations. When necessary to perform an activity that does not have a specific SOP, or when the SOP cannot be followed, existing SOPs may be used as a general guidance or similar SOPs (not listed in this report) may be adopted if they meet the project DQO. All modifications or adoptions will be approved by the Field Team Leader, CPM, and Contractor QAO and documented in the field logbook and/or the final project report, as appropriate.

4.4.4 Field Documentation

4.4.4.1 Field Logbook

To provide a permanent record of all field activities, field personnel will document all activities in a bound field logbook (refer to field SOPs in Appendix A). This will include a description of conditions during sampling activities. When field logbooks are used, each logbook will have a unique document control number, be bound, and have consecutively numbered pages. All entries will be in waterproof ink, and any mistakes will be lined out with a single line and initialed by the person making the correction. Whenever a sample is collected or a measurement is made, a detailed description of the sample location and any additional observations will be recorded. The GPS coordinates will be recorded when appropriate. Individual field team members may be responsible for required documentation based on specific tasks assigned by the Field Team Leader or CPM.

All significant observations, measurements, relevant data, and results will be clearly documented in the data log or the field logbook. At a minimum, the following will be recorded:

- A description of the field task.
- Time and date fieldwork started.
- Location and description of the work area including sketches, if possible, map references, and references to photographs and/or videos collected.
- Names and titles of field personnel.
- Name, address, and phone number of any field contacts or Site visitors (e.g., Agency representatives, auditors, etc.).
- Meteorological conditions at the beginning of fieldwork and any ensuing changes in the weather conditions.
- Details of the fieldwork performed and the field data sheets used.
- All field measurements made.

- Any field testing results.
- Personnel and equipment decontamination procedures.
- Deviations from the BRW Biotreatability QAPP or applicable field SOPs (Appendix A).

For each test pit the following entries will be made:

- Lithologic log of the test pit indicating material types, from and to depths, rock content, color, presence of water, etc.
- Depth intervals from the ground surface for each soil horizon and total depth of the test pit.
- Photograph or video of each test pit with a staff gage or tape measure for scale to document existing conditions. Include Site name ID in photograph or video using a white board or note pad.
- Abnormal occurrences, deviations from this BRW Biotreatability QAPP, or other relevant observations.

For any field sampling work the following entries will be made:

- Sample location and ID number.
- Sample type collected.
- Date and time of sample collection.
- Sample location description and designation, soil type and texture (e.g., sand, silt, etc.), grain size, and color (in the field).
- Split samples taken by other parties (Agencies, etc.). Note the type of sample, sample location, time/date, name of individual, individual's company, and any other pertinent information.
- Sampling method, particularly any deviations from the field SOPs (Appendix A).
- Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample (if any used in the field).
- Sample preservation (if used).
- Decontamination procedure (if used).
- Sample custody (where samples are stored/shipped and by whom).

The lithologic information for test pits will be transcribed into a spreadsheet or database that can be used with Strater® or other appropriate lithologic log software.

4.4.4.2 Field Photographs or Video

Photographs and/or video will be taken of sampling locations and field activities using a digital camera and/or digital video camera. Photographs or video should include a scale in the picture as well as a white board with relevant information (e.g., time, date, location, sample number, etc.). Additional photographs or video documenting Site conditions will be taken, as necessary.

Documentation of all photographs or video taken during sampling activities will be recorded in the bound field logbook or appropriate field data sheets (refer to field SOPs in Appendix A), and will specifically include the following for each photograph or video taken:

- Time, date, and location.
- Photograph or video number from the camera or video recorder.
- The identity of the person taking the photograph/video.
- Direction that the photograph was taken and description of the subject photographed.

The digital files will be placed with the electronic project files with copies of supporting documentation from the bound field logbooks.

4.5 Sample Handling and Analysis

4.5.1 Documentation and Shipping

Sample containers and holding times are listed in Table 3. All soil samples will be collected in the proper sample container. The sample ID, date/time, and depth interval of the sample will be written on the sample container with an indelible marker. Samples will be stored, handled, and packaged as described in Table 3. All procedures will strictly follow appropriate protocols and field SOPs in Appendix A. Chain of custody records will be kept with the samples and custody seals will be placed on the sample storage containers (coolers).

As applicable, samples will be either hand delivered or shipped via Federal Express or UPS to the appropriate laboratory under strict EPA chain of custody procedures. Samples will be shipped in appropriate containers that will prevent detrimental effects to the sample. A copy of the chain of custody record will accompany the samples during shipment and will serve as the laboratory request form. The chain of custody form will specify the type of analysis requested for each individual sample. The original form will be maintained with the field notes in the project records.

All samples not submitted to the laboratory will be archived or contained at the Site. If samples must be archived, they will be transported to the Pioneer field office at 244 Anaconda Road in Butte, Montana, or an alternate suitable location. When it is determined that the samples are no longer needed for analysis, the samples will be analyzed for proper disposal in accordance with SOP-DE-03 (Appendix A).

4.5.2 Chain of Custody

The SOP for chain of custody (SOP-SA-04) is in Appendix A. Maintaining the integrity of the sample from collection through data reporting is critical to the sampling and analytical program. This process includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. This documentation of the sample's history is referred to as chain of custody. A sample is under an individual's custody if it is in that

individual's physical possession, in view of the individual after taking possession, or secured by that individual so that no one can tamper with the sample.

The components of the field chain of custody (chain of custody form, labels, and custody seals) and laboratory chain of custody (chain of custody form, custody seals, and laboratory custody) are described in this section.

4.5.2.1 Chain of Custody Form

A chain of custody form will be completed and will accompany samples as appropriate. A standard form will be provided from each laboratory. The form will include the following information:

- Project code.
- Project name.
- Sampler's signature.
- Sample identification.
- Date sampled.
- Time sampled.
- Analysis requested.
- Remarks.
- Relinquishing signature, data, and time.
- Receiving signature, date, and time.

4.5.2.2 Custody Seals

Custody seals are used to detect unauthorized tampering with samples following sample collection up to the time of analysis. Custody seals will be applied to the shipping containers when the samples are not in the sampler's custody.

4.5.2.3 Laboratory Custody

Laboratory custody procedures will conform to procedures established for the EPA CLP (EPA, 2016). These procedures include the following:

- Designation of sample custodian.
- Correct completion of the chain of custody form, recording of sample identification numbers, and documentation of sample condition upon receipt.
- Laboratory sample tracking and documentation procedures.
- Secure sample storage.

The samples will be delivered to the laboratory for analysis in a timely manner to ensure the requested analyses can be performed within the specified allowable holding times. The sample will be hand delivered or addressed to a person in the laboratory who is authorized to receive samples (laboratory sample custodian).

4.5.3 Laboratory Analysis Methods

Laboratory analysis of samples collected will be performed by laboratories with established protocols and QA procedures that meet or exceed EPA guidelines. Instruments used by the laboratory will be maintained in accordance with the laboratory QA plan requirements and analytical method requirements. All analytical measurement instruments and equipment used by the laboratory will be controlled by a formal calibration and preventive maintenance program. The laboratory will keep maintenance records and make them available for review, if requested. Laboratory preventive maintenance will include routine equipment inspection and calibration at the beginning of each day or each analytical batch, per the laboratory internal SOPs and method requirements. Standard laboratory turnaround times will be requested.

Samples will be sent to Pace for the initial characterization analysis, to Provectus for the TOD analysis, and to AECOM for soil slurry analyses. The anticipated laboratory analytical methods and procedures for the four parts are detailed below and summarized in Table 3. The planned laboratory analysis approach may be altered by the CPM, in consultation with the Contractor QAO. Agencies will be notified of any significant changes to the laboratory analysis approach.

4.5.3.1 Initial Characterization

Soil samples collected from the test pits will be sent to Pace for the initial characterization analysis. The initial characterization will include analysis for the following: general parameters, metals, hydrocarbon compounds, and leachability of hydrocarbon compounds (Table 3). Standard laboratory turnaround ties will be requested.

4.5.3.2 Total Oxidant Demand Analysis

One soil sample will be sent to Provectus to complete the TOD analysis. The TOD analysis is routinely performed by treatability laboratories and technology vendors to provide a starting point on how much oxidant agent will be consumed over a certain period of time (ASTM, 2016 and Haselow et al., 2003).

The sample will be selected to target soil within the preliminary waste removal corridor with the greatest concentration of high molecular weight hydrocarbons based on field screening and data collected from previous Site investigations.

Provectus will test varying doses of two to three different oxidant agents to understand the significance of other reduced species (e.g., iron, manganese, organic carbon, pyrite, and other sulfide materials) in the soil sample that would consume the oxidant agent to a point where chemical oxidation would not be practicable as a treatment option. Provectus will set up bench-scale reactors and test their Provect-Ox line of chemical oxidant, activators, and buffers at a

range of concentrations. Persulfate, sulfate, ORP, pH, and petroleum hydrocarbons will be measured multiple times during the bench-scale tests to track how the reaction is progressing (Table 3). The results of the TOD analysis will include TOD, optimal tested oxidant, and pH adjusting amendment dose (if needed to adjust pH).

At the conclusion of the test, Provectus will submit a portion of the soil from each bench-scale reactor to Pace for a post-treatment analysis. The post-treatment analysis will include the following: total metals, hydrocarbon compounds (EPH, VPH, and PAH), and pH.

Based on the results from the TOD analysis and initial slurry analysis (described in Section 4.5.3.3), Atlantic Richfield will review results and determine if a sample of the post-treatment soil (i.e., soil that has undergone the TOD analysis) may be sent to the AECOM laboratory for a slurry analysis.

4.5.3.3 Initial Slurry Analysis

Soil samples will also be sent to AECOM to complete the initial soil slurry analyses. The general steps, provided by AECOM, for the soil slurry analyses are detailed below and generally follow published methods used to research the effects of metals toxicity on aerobic biodegradation or organic compounds (Olaniran et al., 2013 and Sobolev and Begonia, 2008.).

Upon receipt of the soil samples, AECOM will prepare a soil slurry for each composite soil sample. These soil slurries will consist of adding laboratory water (i.e., distilled deionized water) to each of the composite soil samples in 0.5-Liter glass media bottles. The target water to soil ratio will be 5:1 on a weight basis in order to promote mixing and increase contact among native bacteria, oxygen, hydrocarbons, and the native carbon and nutrients. Each soil slurry bottle will be capped with a porous foam plug to allow exchange of oxygen and carbon dioxide between the headspace and the room atmosphere.

The soil slurries will be mixed on a stir plate for 24 hours to establish a baseline level of biomass activity. At 24 hours, samples will be collected for measurements and analysis. The OUR and total and dissolved ATP measurements will be performed to assess the potential for toxicity in soil bacteria. The OUR indicates the rate of biomass respiration which is associated to overall biomass health and activity. The OUR will be measured on an aliquot from the soil slurry using a biological oxygen demand (BOD) bottle and a DO probe. Three OUR measurements will be performed after 24 hours of incubation for QC.

As it is responsible for transferring energy between electron donors (food source) and electron acceptors (oxygen), ATP is a key molecule for bacteria cell metabolism. The ATP can be measured as total and dissolved ATP. Dissolved ATP is an indication of bacteria cells that underwent lysis (death), and thus it is a measurement of inactive biomass. By measuring both total and dissolved ATP, the ATP measurements related to active biomass can be calculated (Active ATP equals the Total ATP minus Inactive [Dissolved] ATP). In addition, a biomass stress index factor can be obtained from these measurements. Both the absolute number of ATP counts (including total, active, or inactive ATP) and the stress index indicate the biomass health and can be used to make relative comparisons among the different soil slurries. The ATP will be

measured by taking a liquid sample from each soil slurry and processing it using the LuminUltra reactant kit and a luminometer. For each ATP measurement a duplicate measurement will be taken for QC. Additionally, the ATP standard will be used at the beginning and end of each batch and every 10 measurements to ensure the equipment is operating properly.

Microbial analysis to quantify bacteria populations will be subcontracted by AECOM to Microbial Insights to perform their CENSUS-qPCR method. The method amplifies the DNA gene that encodes for a biomarker target, in this case for total bacteria. The results are reported as bacteria cells/milliliter (for aqueous samples) or cells/gram (for soil samples). Approximately 10 grams of soil sample will be collected for microbial analysis. In addition to the total bacteria biomarker, functional genes related to the biodegradation of petroleum hydrocarbons will also be analyzed via CENSUS-qPCR. These will include the monooxygenase (almA) and alkane monooxygenase (alkB) genes, which encode for the enzymes responsible for short (C5-C16) and long (C20-C32) chain hydrocarbon compounds. The detection of these functional genes provides a line of evidence for biodegradation of petroleum hydrocarbons and, thus, native bacteria metabolism. Assay calibration, assay positive control, DNA extraction negative control, and assay negative control samples will be run during the analysis for QC.

4.5.3.4 Enhanced Slurry Study

Based on the findings from the initial microbial analysis, an enhanced analysis may be needed if results from the initial microbial analysis indicate the microbial activity is inadequate to quantify bacteria populations. The enhanced slurry study will stimulate or enhance the microbial activity to gather better results. If completed, the enhanced slurry study will be performed by AECOM. If performed, the enhanced microbial analysis will be similar to the initial analysis with the following exceptions:

- Nutrients, most likely salts containing nitrogen and phosphorus, and an external carbon source, such as diesel, will be added to the soil slurries when they are prepared. Nutrients and complex hydrocarbons, such as diesel, are necessary to stimulate the soil microbial activity for this study. Diesel was determined to be an appropriate external carbon source since previous Site investigation results indicated that EPHs, which are typically considered diesel range organics, are the primary concern with treatability of the soil within the Site. Therefore, diesel is expected to provide an appropriate food source for the microbial community.
- The soil slurries will go through a 2-week incubation period prior to selecting samples to submit for microbial analysis. During that 2-week incubation period, AECOM will sample the soil slurries 4 times to measure OUR and ATP.

As with the initial slurry study, Microbial Insights will be contracted by AECOM to perform their CENSUS-qPCR method to quantify bacteria populations. The CPM in consultation with the Contractor QAO will determine if the enhanced slurry study must be completed.

5.0 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

5.1.1 Field Quality Control Samples

Field QC samples are used to identify any biases from transportation, storage, and field handling processes during sample collection, and to determine sampling precision. The following quality samples only apply to the laboratory samples submitted to Pace for the initial characterization of soil. All field QC samples will be shipped with field samples to Pace per SOP-SA-01 in Appendix A. Brief descriptions of the field QC samples are provided below, along with when and how many are to be collected.

Field Duplicate
At least 1 field duplicate will be collected for this sampling event since it is anticipated that there will be less than 20 samples collected for analysis. If more than 20 samples are collected, additional field duplicates will be collected so that a minimum of 1 duplicate is collected for every 20 natural samples. A field duplicate is an identical, second sample collected from the same location, in immediate succession of the primary sample, using identical techniques. The duplicate sample will have its own sample number. Duplicate samples will be sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Both the primary sample and duplicate sample will be analyzed for identical chemical parameters by the laboratory. The analytical results of the primary and duplicate sample will be compared to determine sampling precision.

Temperature Blank
A temperature blank is a vial of water that accompanies the samples that will be opened and tested upon arrival at the laboratory to ensure that the temperature of the shipping container was less than 6 °C. One temperature blank is required for each cooler shipped to the laboratory.

Trip Blank
One trip blank is required per sampling event when VOC samples are collected. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory. A trip blank is only required for VOC sampling. A trip blank is prepared for field personnel by the contract laboratory staff prior to the sampling event and is shipped and stored in the same cooler with the investigative VOC samples throughout the sampling event. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks should be kept on ice in the cooler, along with the VOC samples, during the entire sampling run. They must be stored in an iced cooler from the time of collection, while they are in the sampling vehicle, until they arrive at the laboratory.

5.1.2 XRF Quality Control Samples

The XRF QC samples will be collected and used to assess the accuracy and precision of the XRF data. The XRF QC samples required are described below.

Energy Calibration Check
Field personnel will run a preprogrammed energy calibration check on the equipment at the beginning of each working day. If the individual believes that drift is occurring during analysis, that individual will run the energy calibration check. The energy calibration check determines whether the characteristic X-ray lines are shifting, which would indicate drift within the instrument.

Silicon Dioxide Standard
The silicon dioxide (SiO2) sample, as provided by Niton, is a "clean" quartz or silicon dioxide matrix that contains concentrations of selected analytes near or below the machine's lower limit of detection. These samples are used to monitor for cross contamination. Field personnel will analyze this sample at the beginning of each day, once per every 20 samples, and at the end of each day's analysis. The sample information will be recorded as "SIO2" on XRF field data sheets. This sample will also be analyzed whenever field personnel suspect contamination of the XRF aperture. Any elements with concentrations above the established lower limit of detection will be evaluated for potential contamination. If it is determined that the concentration is higher than that recorded at the start of the day, the probe window and the silicon dioxide sample will be checked for contamination. If it is determined that contamination is not a problem, and the concentration is significantly above the limit of detection, the sample result will be qualified by the XRF operator as 'J' estimated, and the problem recorded on the XRF field data sheet and in the logbook. If the problem persists, the XRF will be returned to Niton for calibration.

Calibration Verification Check Samples (Standards)
Calibration verification check samples help check the accuracy of the XL3 and assess the stability and consistency of the analysis for the analytes of interest. One to 3 (preferably) of the check samples will be analyzed at the start of each day, once per every 20 samples, and as the last analysis. Results for the check sample (standard reference material [SRM]) will be recorded on the individual XRF field data sheet and identified as a check sample. There are 3 Niton-provided SRM check samples: NIST 2709a- Joaquin Soil (2709), USGS SdAR-M2 (SRM created by the U.S. Geological Survey [USGS]), and a Resource Conservation and Recovery Act (RCRA) sample. There are also Niton-provided, machine-specific expected results for several elements for the check samples. Pioneer has refined the range of expected results for each SRM standard for each of the field XRF units in use. The measured values of a standard will be compared to the expected results. If a measured value falls outside this range, then the check sample will be reanalyzed. If the value continues to fall outside the acceptance range, this information will be noted on the XRF log. If any of the check sample results indicate that the XRF is not analyzing accurately, the XRF will be cleaned, turned off, and the energy calibration rerun. This information will be noted in the logbook and on the XRF field data sheet. The batch of samples analyzed prior to the unacceptable calibration verification check samples will be reanalyzed. If 1 standard continues to be outside of the expected range, it may indicate that the standard has been contaminated and needs replacing. If more than 1 standard is falling outside of the expected range, Niton will be contacted, and the machine may be returned for calibration.

Duplicate Samples
The XRF duplicate analysis of the same sample will be performed to assess reproducibility of field procedures and soil heterogeneity. To run a duplicate sample on the Niton XL3, field

personnel will remove the ziplock bag from the analytical stand, knead the ziplock bag once or twice, and replace it in the stand to be analyzed a second time. Duplicate samples will be recorded on the XRF field data form with a D designator in the sample identification number. A duplicate sample will be analyzed at the rate of at least 1 per 20 natural samples.

Replicate Samples
Field personnel will analyze an XRF replicate sample at the rate of at least 1 per 20 XRF samples. To run a replicate sample on the Niton XL3, once the primary sample analysis has been completed, the XRF is restarted to analyze the same sample a second time with the same soil in the XRF aperture without any remixing of the sample that is performed with duplicate analyses. Replicate samples help in assessing the stability and consistency of the XRF analysis. Replicate sample results will be recorded on the XRF field data form and designated with an R in the sample identification number.

5.1.3 Laboratory Quality Control Samples

Laboratory QC samples are introduced into the measurement process to evaluate laboratory performance and sample measurement bias. Laboratory QC samples can be prepared from environmental samples or generated from standard materials in the laboratory per the internal laboratory SOPs. The following laboratory QC samples only apply to the laboratory samples submitted to Pace for the initial soil characterization.

Method Blank
One method blank (MB) sample will be prepared and analyzed for this sampling event. The MB is laboratory deionized water that has gone through the applicable sample preparation and analysis procedure. Control limits vary based on the laboratory method performed and are contained in the applicable laboratory method and SOP. Failure will trigger corrective action and the blank will be reanalyzed. All samples will be footnoted with the appropriate flag to document contamination in the blank.

Laboratory Control Sample
A LCS will be prepared and analyzed for the applicable methods following the method required frequency with at least one associated with this sampling event for each applicable method. Control limits vary based on the laboratory method performed and are contained in the applicable laboratory method and SOP. Failure will trigger corrective action and the analysis will be terminated, the problem corrected, and the samples reanalyzed. If reanalysis of the samples fails, the samples will need to be re-digested and reanalyzed.

Matrix Spike/Matrix Spike Duplicate
Sufficient material will be supplied and the laboratory will be requested to perform at least one matrix spike (MS) and matrix spike duplicate (MSD) sample for parameters analyzed by SM 2320B, EPA 351.2, EPA 9056A, EPA 350.1, EPA 6010, EPA 6020, EPA 7471B, MTVPH, MTEPH, EPA 8270SIM, and EPA 8015 (Table 3). The control limits also depend on the method used and are contained in the applicable laboratory method and SOP. If the %R for the MS and MSD falls outside the control limits, the results are flagged as outside acceptance criteria along

with the parent sample. If the RPD exceeds the acceptance criteria, the MSD sample and associated parent sample will be flagged.

Laboratory Duplicate Sample
One laboratory duplicate sample (LDS) will be prepared and analyzed for this sampling event. A LCS and LCS duplicate (LCSD) pair or an MS and MSD sample pair may be used as the LDS. Control limits will vary based on the QC sample used. Failure will trigger corrective action and a single reanalysis of the respective failing QC sample is allowed. If the reanalysis is outside the acceptance criteria, the analysis must be terminated, the problem corrected, the instrument recalibrated, and the calibration re-verified.

5.2 Instrument/Equipment Testing, Inspection, Maintenance and Calibration

To ensure continual quality performance of all instruments and equipment, the testing, inspection, and maintenance activities will be performed and recorded as described in this section. All field and laboratory equipment will be operated, maintained, calibrated, and standardized in accordance with all EPA and manufacturer's recommended procedures.

Field Equipment
Field equipment will be examined to verify that it is in proper operating order prior to its first use. Equipment, instruments, tools, gages, and other items requiring preventive maintenance will be serviced and/or calibrated in accordance with the manufacturer’s specified recommendations, as necessary. Field equipment will be cleaned (decontaminated) and safely stored between each use. Any routine maintenance recommended by the equipment manufacturer will also be performed and documented in field logbooks. Calibration of field equipment will be completed in the field at the beginning of each day and recorded in the field logbooks. Any equipment deficiencies or malfunctions during fieldwork will be recorded as appropriate in the field logbooks. The SOPs for the field equipment are in Appendix A.

Groundwater Meter - Multi-Parameter Probe
The multi-parameter probe will be used to record water quality parameters from groundwater that enters the test pit as defined in previous sections and in the field equipment SOPs (Appendix A). Following proper safety protocols, a grab sample will be collected from the test pit and the multi-parameter probe will be submerged in the sample.

PID Unit
Screening for petroleum compounds will be conducted using 2 PIDs, one with a 9.8 eV lamp and another with a 10.6 eV lamp. The procedures for using the PID unit are included in Section 4.4.2.3 as well as in the applicable user manual. It is anticipated that a MiniRAE 3000 unit and an UltraRAE 3000+ unit will be used, or equivalent.

Hanby Soil Test Kit
The Hanby Soil Test Kit will be used to determine the hydrocarbon concentrations within the soil. The procedure identifies the aromatic compounds and provides a colorimetric identification of the concentration and types of contaminants present. A manual identifying the procedures for this kit is in Appendix C.

XRF Unit
The XRF analysis will be conducted using a Niton™ XL3 XRF Analyzer (XL3), and personnel will follow the procedures outlined in SOP-SFM-02 in Appendix A as well as in the XL3 user manual to ensure that the techniques employed are appropriate for the analytes of interest. Additional details on using the XRF are included in SOP-SFM-02.

5.3 Inspection/Acceptance of Supplies and Consumables

All supplies and consumables received for the project (e.g., sampling equipment, calibration standards, etc.) will be checked to ensure their condition is satisfactory, such as free of defects that would affect performance. The types of equipment needed to complete sampling activities are described in the relevant field SOPs (Appendix A). Inspections of field supplies will be performed by the Field Team Leader or field team members. The personnel at each laboratory (Section 8.1.2) will be responsible for inspecting laboratory supplies in accordance with the laboratory QA program.

5.4 Data Management Procedures

This section describes how the data for the project will be managed, including field and laboratory data. Data will be managed in accordance with the BPSOU Data Management Plan (Atlantic Richfield, 2017). The BRW Biotreatability QAPP quality records will be maintained by Atlantic Richfield. These records, in either electronic or hard copy form, may include the following:

- Project work plans with any approved modifications, updates, and addenda.
- BRW Biotreatability QAPP with any approved modifications, updates, addenda, and any approved corrective or preventive actions.
- Field documentation (including logbooks, data sheets, and photographs) in accordance with SOP-SA-05 in Appendix A.
- Chain of custody records in accordance with SOP-SA-04 in Appendix A.
- Field forms, which are provided in Appendix B.
- Laboratory documentation (results received from the laboratory will be documented in hard copy and in an electronic format).
- PDI Evaluation Report.

Hard copy field and laboratory records will be maintained in the project's central data file, where original field and laboratory documents are filed chronologically for future reference. These records will also be scanned to produce electronic versions. The electronic versions of these records will be maintained on a central Microsoft structured query language (SQL) server system that is backed up regularly. The data will be stored on the SQL server and a Microsoft Access database will be set up to access the data, which can then be exported to Excel, if necessary, for further graphing and interpretive analysis. Using a Microsoft-based software configuration is

widely accepted with support from Microsoft and allows for easy data sharing with most hardware configurations.

All field and laboratory data and supporting documentation will be subject to appropriate review to ensure the accuracy and completeness of original data records prior to uploading into the project database. Field data that have been reviewed and approved in a hard copy format will be entered into an electronic system to be uploaded to the project database. Laboratory electronic data deliverables (EDDs), provided in Microsoft Excel format and correlating PDF Level 4 data packages (simplified format), will be reviewed as part of the internal data review process. Following these review steps, field and laboratory electronic data files will be imported to the project database.

Standardized data import formats and procedures will be used to upload both field and laboratory data into the electronic database. Standardized parameter names, numerical formats, and units of measure will be applied to the original information to facilitate comparability across all data sets and within the database. Using these standardized formats will allow for quick and easy querying to retrieve data. Data can be retrieved by exporting into an Excel file and, because the data will be formatted with parameter names, easily made into a pivot table for data processing.

6.0 ASSESSMENT AND OVERSIGHT

Assessment and oversight of data collection and reporting activities are designed to verify that sampling and analyses are performed in accordance with the procedures established in this BRW Biotreatability QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits. Internal audits will be performed by Atlantic Richfield, their contractor, or a contracted laboratory consultant as necessary. External audits will be performed by EPA as necessary. Performance and system audits of field and laboratory data collection and reporting procedures are described in this section.

6.1 Field Activities Oversight

Oversight personnel will have the ability to inspect each soil boring and determine the appropriateness of the recorded data and ensure that the appropriate samples are collected. Copies of field logbook pages will be provided to oversight personnel as part of the PDI Evaluation Report.

Any deviations from this BRW Biotreatability QAPP will be brought to the attention of oversight personnel. If the deviation is first determined by oversight personnel, Atlantic Richfield and/or field representatives will be immediately notified. Reasons for such deviations will be recorded in the field logbook along with corrective actions to be implemented, if required. If oversight personnel request a deviation from the BRW Biotreatability QAPP, the deviation and the reasons for the deviation will be noted and then signed by the agency personnel.

6.2 Corrective Action Procedures

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-QC performance, which can affect data quality. Corrective action can occur during field activities, laboratory analyses, and data assessment.

Non-conforming equipment, items, activities, conditions, and unusual incidents that could affect data quality and attainment of the project's quality objectives will be identified, controlled, and reported in a timely manner. For this BRW Biotreatability QAPP, a non-conformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate in meeting the project's quality objectives. Corrective actions implemented by field personnel will follow appropriate field SOPs (Appendix A), as necessary.

Corrective action in the laboratory may occur prior to, during, and after initial analyses. A number of conditions such as broken sample containers, preservation or holding-time issues, and potentially high-concentration samples may be identified during sample log in or just prior to analyses. Corrective actions to address these conditions will be taken in consultation with the CPM (Section 8.0) and reported on a Corrective Action Report (CAR) form included in Appendix E, as necessary. In the event that corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted and concurrence will be obtained before the change is implemented.

If during sample analyses, the associated laboratory QC results fall outside of the project's performance criteria, the laboratory should initiate corrective actions immediately. If laboratory QC results are outside of the project specifications, the laboratory should take the appropriate corrective actions for the specific analytical method. Following consultation with laboratory analysts and section leaders, it may be necessary for the CPM to approve implementing a corrective action. These conditions may include dilution of samples, additional sample extract cleanup, or automatic reanalysis when certain QC criteria are not met. If the laboratory cannot correct the situation that caused the non-conformance and an out-of-control situation continues to occur or is expected to occur, then the laboratory will immediately contact the CPM and request instructions regarding how to proceed with sample analyses.

Completion of any corrective action should be evidenced by data once again falling within the project's performance criteria. If this is not the case, and an error in laboratory procedures or sample collection and handling procedures cannot be found, the results will be reviewed by the CPM and Field Team Leader in consultation with the Contractor QAO to assess whether reanalysis or re-sampling is required.

All corrective actions taken by the laboratory will be documented in writing by the Laboratory Project Manager and reported to the Field Team Leader and CPM. In the event that corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted and concurrence will be obtained before the change is implemented. All corrective action records will be included with the QAPP records.

6.3 Corrective Action During Data Assessment

During data assessment, the Contractor QAO could identify the need for corrective action. Potential types of corrective action include re-sampling by the field team, reanalyzing samples by the laboratory, or re-submitting Level 4 data packages with corrected clerical errors. The appropriate and feasible corrective actions will depend on the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded, etc.). If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted and concurrence will be obtained before the change is implemented. Corrective actions of this type will be documented by the Contractor QAO on a CAR and will be included in any subsequent reports.

6.4 Quality Assurance Reports to Management

After the study is complete, the Atlantic Richfield contractor will incorporate the results into the BRW PDI Evaluation Report summarizing and interpreting the sampling activities. The report will include the following:

- Summary of the work performed.
- Summary of the results.
- Summary of validated data (i.e., tables and graphics).
- Data validation reports and laboratory data reports.
- Narrative interpretation of data and results.
- Results of statistical and modeling analyses.
- Photographs documenting the work conducted.
- Conclusions and recommendations for RD, including design parameters and criteria.
- Recommendations for an additional phase(s) (if necessary).

The CPM and Contractor QAO are responsible for preparing the PDI Evaluation Report. All Site investigations will be incorporated into the report as the design progresses, and the report will be submitted in draft final form to EPA and Montana DEQ for review prior to the Intermediate 60% RD Report for the Site.

7.0 HEALTH AND SAFETY

All work completed by Pioneer and its subcontractor during execution of this BRW Biotreatability QAPP will be performed in accordance with all procedures outlined in the internal BRW SSHASP. Planned field activity for the BRW Biotreatability QAPP maintains the same types of activity in Phase III; therefore, the BRW SSHASP currently contains applicable hazards for this BRW Biotreatability QAPP. The BRW SSHASP may be updated to include unique hazards that materialize during field activities for work.

8.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The roles, duties, and responsibilities of personnel assigned to the BRW Biotreatability QAPP are provided below. An organizational chart showing the overall organization of the project team is detailed on Figure 6.

Atlantic Richfield Liability/Project Manager – Josh Bryson
The Atlantic Richfield Liability/Project Manager communicates directly to the Agencies on project matters, monitors the performance of the contractor(s), consults with the CPM and Contractor QAO on deficiencies and helps finalize resolution actions.

Atlantic Richfield Quality Assurance Manager (QAM) – David Gratson
The Atlantic Richfield QAM interfaces with the Atlantic Richfield Operations Project Manager on company policies regarding quality and has the authority and responsibility to approve specific QA documents including this BRW Biotreatability QAPP. Mr. Gratson is employed by Environmental Standards, Inc.

Contractor
Pioneer Technical Services, Inc. (Pioneer) is the contractor responsible for conducting the elements of the BRW Biotreatability QAPP under the direction of Atlantic Richfield.

Pioneer Contractor Project Manager (CPM) – Karen Helfrich
The CPM is responsible for scheduling all testing and sampling work to be completed and ensuring that the work is performed in accordance with the requirements contained herein. The CPM, or designated alternate, is also responsible for consulting with the specific project QA personnel regarding any deficiencies and finalizing resolution actions, maintaining the BRW Biotreatability QAPP, and verifying effective implementation of BRW Biotreatability QAPP requirements and procedures, including RFCs. This includes reviewing field and laboratory data and evaluating data quality.

Contractor Quality Assurance Officer (QAO) – Thomas Brown
The Contractor QAO is responsible for verifying effective implementation of BRW Biotreatability QAPP requirements and procedures, including reviewing field and laboratory data, and evaluating data quality. The Contractor QAO may conduct Site reviews and prepare Site review reports for the QAM. The Contractor QAO will have a direct line of communication to the QAM to ensure issues related to project QA are resolved. The Contractor QAO is also authorized to stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed QCs or approved methods and further work would make it difficult or impossible to obtain acceptable results.

Pioneer Field Team Leader – Kendra Jackson
The Field Team Leader ensures that the BRW Biotreatability QAPP and associated RFCs have been reviewed by all members of the field team and the BRW Biotreatability QAPP procedures are properly followed during field activities. The Field Team Leader will conduct daily safety meetings, assist in field activities, and document activities in the field logbook. The Field Team Leader is responsible for facilitating field activities and managing equipment and is responsible

for coordinating with the CPM and Contractor QAO regarding problem solving and decision making in the field. The Field Team Leader is responsible for technical aspects of the project and providing "on-the-ground" overviews of project implementation by observing Site activities to ensure compliance with technical project requirements and the BRW SSHASP. The Field Team Leader is responsible for identifying potential Integrity Management issues during field activities and reporting any issues to the Contractor QAO.

Safety and Health Manager – Tara Schleeman
The Safety and Health Manager is responsible for reviewing the BRW SSHASP with all members of the field team and updating it if necessary. The Safety and Health Manager will lead BRW Biotreatability QAPP applicable Task Risk Assessments and conduct the initial safety meeting prior to starting fieldwork. The Safety and Health Manager will monitor work crews' compliance with all Site safety and health requirements.

8.1.1 Subcontractors

One subcontractor will assist with the BRW Biotreatability QAPP. This company will subcontract to Pioneer and follow all health and safety protocols established by Pioneer to work on the Site. The subcontractor (below) was selected based on the unique skillset and specialized equipment:

Hunter Brothers Construction (Hunter) or an equivalent contractor. Hunter, or an equivalent contractor approved by Atlantic Richfield, will provide general services for test pit sampling activities, such as handling hydrocarbon-impacted soil and water and identifying the location of utilities prior to ground disturbance activities.

8.1.2 Laboratories

Three laboratories have been selected to provide analytical services: Provectus, Pace, and AECOM. These laboratories are required to generate and report high quality data that identify and define the physical and chemical characteristics of soil for environmental investigations, remediation activities, long-term monitoring programs, discharge compliance monitoring, and/or waste characterization under the purview of RCRA and Comprehensive Environmental Response, Compensation & Liability Act (CERCLA), referred to as Superfund. As such, analytical data must be accurately and precisely generated and reported in conformance with the applicable method "best industry standards." The selected laboratories will have QA personnel familiar with the approved QAPP and be responsible for reviewing final analytical reports, scheduling analyses, and supervising in-house custody procedures.

9.0 DATA VALIDATION AND USABILITY

Since this is a bench-scale study to determine the treatability of the hydrocarbon-impacted soil, the data collected from Pace will undergo Stage 2A Verification and Validation and the data collected from AECOM and Provectus will undergo Stage 1 Verification and Validation Manual as defined in *EPA Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (EPA, 2009).

9.1 Data Review, Verification, and Validation

This section describes the review, verification, and validation process for field data and laboratory data. The section also details laboratory data reporting requirements, which describe how results are conveyed to data users.

9.1.1 Data Review Requirements

Data review is performed by the data producer to ensure that the data have been recorded, transmitted, and processed correctly.

9.1.1.1 Field Data Review

Raw field data will be entered in field logbooks and/or field data sheets per appropriate field SOPs (Appendix A), and the data will be reviewed for accuracy and completeness by the Field Team Leader before the records are considered final. The overall quality of the field data from any given sampling round will be further evaluated during the process of data reduction and reporting.

Field data reduction procedures will be minimal in scope compared to those implemented in the laboratory setting. Field data review will include verification that any QC checks and calibrations, if necessary, are recorded properly in the field logbooks and/or data sheets and that any necessary and appropriate corrective actions were implemented and recorded. Such data will be written into the field logbook and/or data sheets immediately after measurements are taken. If errors are made, results will be legibly crossed out, initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. Later, the Field Team Leader will proof the field logbooks and/or data sheets to determine whether any transcription errors have been made by the field crew. If transcription errors have been made, the Field Team Leader and field crew will address the errors to provide resolution.

If appropriate, field measurement data will be entered into electronic files for import to the project database. Data entries will be made from the reviewed field data sheets or logbooks, and all data entries will be reviewed for accuracy and completeness before the electronic file is provided to the database manager. Electronic files of field measurement data will be maintained as part of the project's quality records.

9.1.1.2 Laboratory Data Review

Internal laboratory data reduction procedures will be according to each laboratory's quality management plan. At a minimum, paper records will be maintained by the analysts to document sample identification number and the sample tag number with sample results and other details, such as the analytical method used (e.g., method SOP #), name of analyst, the date of analysis, matrix sampled, reagent concentrations, instrument settings, and the raw data. These records will be signed and dated by the analyst. Secondary review of these records by laboratory personnel

will take place prior to final data reporting to Atlantic Richfield. The laboratory will appropriately flag unacceptable data in the data package.

9.1.2 Data Verification Requirements

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual specifications.

9.1.2.1 Field Data Verification

The Level A/B review, as described in the CFRSSI Data Management/Data Validation (DM/DV) Plan (ARCO, 1992c) and the CFRSSI DM/DV Plan Addendum (AERL, 2000), will be used in the verification process for field documentation related to samples collected for laboratory analysis.

The Level A criteria are:

- Sampling date.
- Sample team and/or leader.
- Physical description of sample location.
- Sample depth (soil).
- Sample collection technique.
- Field preservation technique.
- Sample preservation technique.
- Sample shipping records.

The Level B criteria are:

- Field instrumentation methods and standardization complete.
- Sample container preparations.
- Collection of field duplicates.
- Proper and decontaminated sampling equipment.
- Field custody documentation.
- Shipping custody documentation.
- Traceable sample designation number.
- Field notebook(s), custody records in secure repository.
- Complete field forms.

9.1.2.2 Laboratory Data Verification

The laboratory will prepare standard data packages for transmittal of results and associated QC information to Atlantic Richfield or its designee within a standard turnaround time, unless otherwise required.

Each data package from Pace will be accompanied by an EDD prepared by Pace. Additional laboratory QC data can be included in the EDD. The EDDs will be cross checked against corresponding data reports to confirm consistency in results reported in these two separate formats. This cross check will take place as part of the data verification process. AECOM will not provide an EDD as part of the data package.

The data packages from the laboratory will contain the following minimum information as applicable:

- A narrative addressing any anomalies encountered during sample analysis, and a discussion of any exceedances in the laboratory QC sample results.
- Analytical method references.
- Definition of any data flags or qualifiers used.
- Chain of custody documentation signed and dated by the laboratory to indicate sample receipt.
- Method detection limits and reporting limits.
- Analytical results for each field sample.
- QC sample results (as applicable).

9.1.2.3 Resolution of Deficiencies

Any deficiencies found during the verification process will be discussed with the data producer and may be resolved with a revised data package.

9.1.3 Data Validation Requirements

Data validation is the process of ensuring data are correct and useful. Data validation will be performed by qualified, independent data validation personnel, who are not associated with data collection or sampling responsibilities, and that have applicable training. The QC criteria used during the data validation process will follow the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020b), the National Functional Guidelines for Organic Superfund Methods Data Review (EPA, 2020c), the CFRSSI QAPP (ARCO, 1992b), the CFRSSI DM/DV Plan (ARCO, 1992c), the CFRSSI DM/DV Plan Addendum (AERL, 2000), laboratory-specific QC criteria, and/or method-specific criteria where applicable.

9.2 Verification and Validation Methods

The Level A/B Assessment checklists included in Appendix D are based on the CFRSSI DM/DV Plan Addendum (AERL, 2000) guidance.

Stage 1 verification and validation checks include an evaluation of the following, as applicable for each analytical method:

- Completeness of laboratory data package.
- Requested analytical methods performed.

Stage 2A verification and validation checks include an evaluation of the following, as applicable for each analytical method:

- Completeness of laboratory data package.
- Requested analytical methods performed.
- Holding times.
- Reported detection limits.
- Dilution factors.
- Method blanks.
- LCS and LCSD.
- MS samples and MSD samples.
- Laboratory duplicate samples.
- Field blanks.
- Field duplicates.
- Trip Blanks.
- Surrogates.

Stage 2A data validation for each laboratory data package will be documented on the data validation checklists in Appendix D.

Data qualifiers will follow those used in the National Functional Guidelines for Inorganic Superfund Methods Data Review (EPA, 2020b) and the National Functional Guidelines for Organic Superfund Methods Data Review (EPA, 2020c).

The Data Validator will be responsible for reviewing field documentation associated with sample collection, conducting the verification and validation of laboratory-produced data, and completing a data validation report, which will be reviewed by the CPM.

9.3 Reconciliation and User Requirements

The Data Quality Assessment (DQA) process described in the CFRSSI DM/DV Plan Addendum (AERL, 2000) and the Guidance for Data Quality Assessment EPA QA/G-9 (EPA, 2000) will be performed to determine whether project-specific DQOs have been satisfied. The DQA process consists of five steps that relate the quality of the results to the intended use of the data:

Step 1: Review DQOs and sampling design.
Step 2: Conduct preliminary data review.
Step 3: Select statistical test(s), as appropriate, to evaluate data quality.
Step 4: Verify assumptions.
Step 5: Draw conclusions about the quality of the data (data report will not include interpterion of results but will state conclusions regarding the quality of the results).

If, as a result of the DQA process, it is determined that data do not satisfy all DQOs, then corrective action(s) should be recommended. Corrective actions include, but are not limited to, revision of the DQOs based on the results of the study or collection of more information or data. It may be determined that corrective actions are not required or the decision process may continue with the existing data with recognition of the limitations of the data.

The PARCCS data quality indicators (Section 3.1) will be used when conducting the DQA. If the PARCCS assessment satisfies the project DQOs, then usability of the data will follow the enforcement/screening/unusable data categories as described in the CFRSSI DM/DV Plan (ARCO, 1992c):

1. Enforcement Quality (Unrestricted Use) Data. Enforcement quality data may be used for all purposes under the Superfund program including the following: site characterization, health and safety, Environmental Evaluation/Cost Analysis, remedial investigation / feasibility study, alternatives evaluation, conformational purpose, risk assessment, and engineering design.
2. Screening Quality (Restricted Use) Data. Potential uses of screening quality data, depending on their quality, include site characterization, determining the presence or absence of contaminants, developing or refining sampling and analysis techniques, determining relative concentrations, scoping and planning for future studies, engineering studies and engineering design, and monitoring during implementation of the response action.
3. Unusable Data. These data are not usable for Superfund-related activities.

Data that meet the Level A and Level B criteria and are not qualified as estimated or rejected during the data validation process are assessed as enforcement quality data and can be used for all Superfund purposes and activities.

Data that meet only the Level A criteria and are not rejected during the data validation process can be assessed as screening quality data. Screening quality data can be used only for certain activities, which include engineering studies and design. Data that do not meet the Level A and/or B criteria and/or are rejected during the data validation process are designated as unusable. The data are assigned one of the following qualifiers:

E = Enforcement quality. No qualifiers or U qualifier and meets Level A and B criteria.
S = Screening quality. J or UJ qualifier and/or meets only Level A criteria.
R = Unusable. R qualifier and/or does not meet Level A or B requirements.

Data that are only qualified as a result of the reported value lying between the laboratory reporting limit and the detection limit are also considered enforcement quality.

Enforcement/Screening Designation

	Meets Level A and B	Meets Level A	Does not Meet Level A or B
No qualifier, A, or U	E	S	R
J, J+, J-, or UJ	S	S	R
R	R	R	R

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FIGURES

TABLES

Appendix A.
Standard Operating Procedures

Appendix B.
Field Forms and Tables

Appendix C. Hanby Soil Test Kit Manual

Appendix D.
Data Validation Checklists

Appendix E.
Corrective Action Report