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Draft Final 2022 Residential Metals Abatement Program (RMAP) Quality Assurance Project Plan (QAPP) (Non-Residential Parcels)

Pioneer Technical Services, Inc.

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

Draft Final

2022 Residential Metals Abatement Program (RMAP)
Quality Assurance Project Plan (QAPP)
(Non-Residential Parcels)

Butte-Silver Bow County

and

Atlantic Richfield Company

Revision 1 - June 13, 2022

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Quality Assurance Project Plan (QAPP)
(Non-Residential Parcels)

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Revision 1 - June 13, 2022

APPROVAL PAGE

2022 Quality Assurance Project Plan for BPSOU Residential Metals Abatement Program (Non-Residential Parcels) Silver Bow Creek/Butte Area NPL Site

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Plan is effective on date of approval.

DISTRIBUTION LIST

Quality Assurance Project Plan for
BPSOU Residential Metals Abatement Program
(Non-Residential Parcels)
Butte Area NPL Site

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DOCUMENT MODIFICATION SUMMARY

Modification	Author	Version	Description	Date
0	Jesse Schwarzrock	Draft	Issued for Agency Review	05/12/22
1	Jesse Schwarzrock	Draft Final	Issued for Agency Review	06/13/22

LIST OF ACRONYMS

Acronym	Definition	Acronym	Definition
Agencies	U.S. Environmental Protection Agency and Montana Department of Environmental Quality	**LBP**	Lead-based paint
ASA	American Society of Agronomy	**LCS**	Laboratory Control Sample
Atlantic Richfield		**LMS**	Laboratory Matrix Spike
bgs	Below Ground Surface	**MDL**	Method Detection Limit
BHRS	Butte Hill Revegetation Specifications	**mg/kg**	milligram per kilogram
BPSOU	BPSOU Butte Priority Soils Operable Unit	**ml**	milliliters
BSB	Butte-Silver Bow	**MS**	Matrix Spike
CAR	Corrective Action Report	**MSD**	Matrix Spike Duplicate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act,	**NPL**	National Priorities List
CFRSSI	Clark Fork River Superfund Site Investigations	**pdf**	Portable document format
CLP	Contract Laboratory Program	**QA**	Quality Assurance
COC	Contaminant of Concern	**QAPP**	Quality Assurance Project Plan
DEQ	Montana Department of Environmental Quality	**QC**	Quality Control
DMP	Data Management Plan	**QMP**	Quality Management Plan
DQA	Data Quality Assessment	**RL**	Reporting Limit
DQO	Data Quality Objectives	**RMAP**	Residential Metals Abatement Program
DSR	Data Summary Report	**ROD**	Record of Decision
EBL	Elevated Blood Lead	**RPD**	relative percent difference
EDD	Electronic Data Deliverable	**SAP**	Sampling Analysis Plan
EPA	U.S. Environmental Protection Agency	**SOP**	Standard Operating Procedure
ESD	Explanation of Significant Differences	**SOW**	Statement of Work
ft^2	square feet	**SQL**	Structured Query Language
GIS	Geographical Information System	**SRM**	Standard Reference Material
HAZWOPER	Hazardous Waste Operations and Emergency Response	**SSHASP**	Site-Specific Health and Safety Plan
HEPA	High Efficiency Particulate Air	**SSSA**	Soil Science Society of America, Inc.
HUD	U.S. Housing and Urban Development	**UAO**	Unilateral Administrative Order
IC	Institutional controls	**USDA**	U.S. Department of Agriculture
ICIAP	Institutional Controls Implementation and Assurance Plan	**XRF**	X-ray fluorescence
ICP-AES	Inducted Coupled Plasma Atomic Emission Spectroscopy	**°C**	degrees Celsius

Acronym	Definition	Acronym	Definition
ISM	Incremental Sampling Methodology	**µg/m^3**	Micrograms per cubic meter
ICP-MS	Inductively-Coupled Plasma Mass Spectrometry	**µm**	micron
ISWP	Individual Site Work Plan		

1.0 INTRODUCTION

The Butte-Silver Bow (BSB) *Multi-Pathway Residential Metals Abatement Program Plan (RMAP) Plan* (BSB and Atlantic Richfield Company, 2020) (hereafter referred to as the Program) is designed to mitigate exposure of residents of the Butte Priority Soils Operable Unit (BPSOU), the larger Butte community as a whole and rural residential development within the Silver Bow Creek/Butte Area Superfund Site to sources of arsenic, lead, and mercury contamination. The current Program boundary (depicted as the 2020 RMAP Area Boundary) is shown on Figure 1. Medical monitoring is conducted as a sister program to evaluate the effectiveness of the Program.

The contamination may originate from both mining-related (waste rock, tailings, aerial emissions) and non-mining-related sources. The potential sources of arsenic, lead, and/or mercury exposure addressed in the Program include lead, arsenic, and total mercury present in soil. The Program uses remediation and abatement of contaminated properties and community awareness and education to ensure its effectiveness.

The Program requires systematic sampling of residential soil within the BPSOU. For areas outside of BPSOU but within the 2020 RMAP Area boundary shown on Figure 1, a test-by-request campaign will be implemented in place of a systematic sampling approach to identify sampling efforts and potentially necessary remedial work. The Program also requires systematic sampling of playground and play areas (e.g., schools and parks) within the 2020 RMAP Area (see Figure 1). This QAPP addresses soil sampling of non-residential parcels (schools, parks, non-residential daycares) that fall under the RMAP umbrella. Interior assessments and sampling of these non-residential structures will be addressed through forthcoming QAPP revisions. Additionally, a separate QAPP will be prepared to support the assessment of residential RMAP parcels/properties.

The Program contains additional institutional control (IC) measures regarding education, outreach, and tracking programs related to remedial activities at residential properties, as further described in the *BPSOU Institutional Controls Implementation and Assurance Plan* (ICIAP) (Atlantic Richfield Company, 2019).

1.1 Purpose

The BPSOU Quality Management Plan (QMP) (Atlantic Richfield Company, 2016) provides guidance to ensure quality environmental data collected for the BPSOU meet requirements mandated by the U.S. Environmental Protection Agency (EPA). The purpose of this Quality Assurance Project Plan (QAPP) is to provide guidance for future RMAP sampling and analyses of non-residential properties (e.g., schools, parks, and non-residential daycares) and to describe the quality assurance/quality control (QA/QC) policies and procedures to be used during these efforts. The current Program boundary (depicted as the 2020 RMAP Area Boundary) is shown on Figure 1. This QAPP functions as the Program sampling and analysis plan (SAP) for all future non-residential sampling activities. A separate QAPP is being developed to address residential RMAP parcels (including residential daycares and commercial properties containing living space).

This QAPP has been composed of standard recognized elements referenced in the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA, 2001); the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA, 2006a); and the *EPA Region 8 Quality Assurance Document Review Crosswalk checklist* (EPA, 2016), which is provided in Attachment A. This QAPP includes the following four key elements:

- Program management and organization (Section 2.0).
- Measurement and data acquisition (Section 3.0).
- Reclamation material (Section 4.0).
- Assessment and oversight (Section5.0).
- Data review and usability (Section 6.0).

The sections below provide the project elements and include details for planning, sampling, and analyses within the Program areas. Sections in this QAPP expand on or reference information in other site-wide documents and present project-specific requirements.

2.0 PROGRAM MANAGEMENT AND ORGANIZATION

This section addresses Program and project administrative functions as well as project background, objectives, and documentation requirements for sampling and analyses activities on each project site within the Program area. Project personnel roles are described below. Responsibilities of personnel in each of these roles are described below.

2.1 Agency Oversight

The EPA and Montana Department of Environmental Quality (DEQ) (the Agencies) are responsible for project oversight, review, and approval of all Program generated sampling data and subsequent site-specific remediation plans. The EPA Remedial Project Manager is Nikia Greene, and the DEQ Project Officer is Daryl Reed.

The Agencies also review sampling results above action levels listed in Table 1 and project completion reports.

2.2 Atlantic Richfield Company

Atlantic Richfield Company (Atlantic Richfield) provides Program funding through an Allocation Agreement between BSB and Atlantic Richfield. The Atlantic Richfield Liability Manager, Mike Mc Anulty, must authorize all reclamation activities under the Program. An Atlantic Richfield project representative or designated alternate may complete a site walk-through and assist with site-specific work plan approval of all reclamation projects prior to implementation.

At this time, it is anticipated that Atlantic Richfield will elect to self-perform portions of the RMAP sampling and analyses work in consultation with BSB representatives.

2.3 Butte-Silver Bow County Department of Reclamation and Environmental Services

Butte-Silver Bow is responsible for notifying qualifying property owners of potential exposure within the property, obtaining property owner access (Attachment B) to conduct sampling and abatement (as needed), maintaining all Program data, and coordinating abatement activities. Key individuals comprising the BSB Department of Reclamation and Environmental Services are shown on Figure 2. The Program project team responsibilities are described below.

Director – Eric Hassler
The Director will oversee all activities throughout the department and is responsible for maintaining the official approved QAPP and for ensuring that the work is performed in accordance with the requirements contained herein. The Director is also responsible for consulting with the Assistant Director regarding any project deficiencies and resolutions.

Assistant Director – Julia Crain
The Assistant Director will perform various coordinating responsibilities across operable units while assisting with data related activities.

Manager, Human Health/RMAP Division - Chad Anderson
The Human Health/RMAP Division Manager will coordinate all RMAP activities and oversee division crews and staff. Furthermore, the Manager is responsible for verifying effective implementation of QAPP requirements and procedures and scheduling sampling work to be completed. This includes reviewing field and laboratory data and evaluating data quality. The Manager will also complete a site walk-through, prepare a site-specific work plan for approval of all reclamation projects prior to implementing, and provide project oversight.

The Manager will also be responsible for the oversight of field team laborers during abatement activities to complete the duties listed below:

- Scheduling sampling work to be completed.
- Managing requests for property access, tracking the status of access requests, and maintaining copies of completed agreements received from property owners (refer to Section 2.9.1 and 3.1).
- Ensuring completed agreements are photocopied, scanned, and the electronic version stored on a hard drive.
- Ensuring a copy of the individual access agreement is included in the project record files.
- Ensuring that all team members have reviewed the QAPP and the QAPP procedures are properly followed during field activities.
- Conducting daily safety meetings, assisting in field activities, and documenting activities in the field logbook or appropriate field collection device.
- Coordinating field activities and managing equipment.
- Solving problems and making decisions in the field.
- Managing technical aspects of the project.

- Maintaining an on-the-ground overview of the project tasks by observing site activities.
- Ensuring compliance with technical project requirements and the Site-Specific Health and Safety Plan (SSHASP).
- Identifying issues during field activities and reporting all issues to the RMAP Coordinator.

Data Management Division/Quality Assurance Manager – Abigail Peltomaa
The Data Management Division Manager assumes the role of Program QA Manager and is responsible for the data management and QA/QC of all field data, reviewing and maintaining laboratory data packages, compiling an annual Data Summary Report (DSR), maintaining quality records (as described in Section 2.9.7), and reporting final remediated property requirements to the Agencies.

2.4 Analytical Laboratory

All laboratories contracted to work on Program projects must ensure that the laboratory's QA personnel are familiar with this QAPP and are performing the analytical and QC work as specified per laboratory methods and this QAPP. Laboratory QA personnel are responsible for reviewing final analytical reports produced by the laboratory, coordinating the laboratory analyses schedule, and supervising in-house chain of custody procedures.

2.5 Problem Definition and Background

Contamination of properties described herein may originate from both mining-related (waste rock, tailings, aerial emissions) and non-mining-related sources. The potential sources of arsenic, lead, and/or mercury exposure addressed in the Program include arsenic, lead, and total mercury in soil.

Assessment is needed to determine remediation or abatement requirements if non-residential parcel soil (schools, parks, or non-residential daycares) exceeds solid media action levels.

This QAPP was developed in response to the Agencies *2006 BPSOU Record of Decision* (BPSOU ROD) (EPA, 2006b) and *Explanation of Significant Differences* (ESD) to the *2006 Butte Priority Soils Operable Unit Record of Decision* (EPA, 2011a). The ESD modified the soil sampling depth from 0 to 2 inches to the depth intervals discussed in Section 3.2; changed the soil removal from a minimum depth of 18 inches to the minimum depth of 12 inches or to the soil bedrock interface if less than 12 inches; and extended the project schedule to accommodate expansion of the Program.

This QAPP was also developed in response to the Agencies *2020 Unilateral Administrative Order Amendment* (UAO Amendment) *for "Partial Remedial Design/Remedial Action Implementation and Certain Operation and Maintenance at the Butte Priority Soils Operable Unit/Butte Site"* (EPA Docket No. CERCLA-08-2011-0011) (EPA, 2020a). The UAO Amendment expanded the RMAP boundary (see Figure 1) and also expanded the Program to include schools, parks, and daycare facilities.

Program representatives will provide results of monitoring and sampling data to the Agencies and notify property owners of necessary abatement (as needed).

2.6 Project Description and Schedule

The Program is designed to mitigate exposure of residents of the BPSOU and Expanded Area to sources of arsenic, lead, and mercury contamination.

In 2020, the Program was expanded to perform sampling within the 2020 RMAP Area boundary provided on Figure 1. Specific exclusion areas are also identified on Figure 1. Sampling outside of the BPSOU but within the expanded boundary will be performed on a test-by-request basis.

Components of the Program include environmental sampling and remediation, long-term tracking and data management, and education and outreach. Medical monitoring is conducted as a sister program to the Program. The long-term tracking and data management ensures properties will be sampled, evaluated, and remediated, if necessary. The long-term tracking and data management will be continued for the life of the Program. The data management will be described in the BPSOU *Final Data Management Plan (DMP)*[1].

The Program includes systematic sampling for additional specific areas within the 2020 RMAP Area such as parks and play areas, schools, and non-residential daycares. Program eligibility is described in the *Revised Final Multi-Pathway Residential Metals Abatement Program (RMAP) Plan* (BSB and Atlantic Richfield Company, 2020).

The objectives of this QAPP are as follows:

1. Provide consistent means and methods of non-residential parcel (schools, parks, and non-residential daycares) soil sampling and analyses associated with the Program sampling activities and ensure compliance with performance standards. Interior assessment/sampling of these parcels will be addressed under forthcoming QAPP revisions.
2. Describe the requirements for sample collection and analyses.
3. Provide data to identify and mitigate potentially harmful exposure to sources of arsenic, lead, and mercury.

2.6.1 Project Schedule

Environmental assessment of schools, non-residential daycare facilities, playgrounds, and play areas soil and vegetated areas will begin in 2021 with the goal of completing as much sampling and subsequent remediation work as possible prior to the start of the 2021-2022 academic calendar year. A systematic schedule to complete environmental assessments of structures and properties presently used as schools, playgrounds, and play areas will be proposed annually. The annually proposed schedule will account for the results of previously completed environmental assessments, provision of access, and the availability of Program resources to implement and oversee subsequent environmental assessments and remediation, if required.

[1] The BPSOU Final Data Management Plan is currently being developed by Atlantic Richfield Company and will be submitted at a later date.

Environmental assessment of playgrounds and play areas within designated parks will be coordinated with the entity responsible for their management (e.g., BSB Parks and Recreation).

2.7 Quality Objectives and Criteria

This section discusses the internal QC and review procedures used to ensure that all data collected for this project are of known quality. The Data Quality Objectives (DQOs) were developed in accordance with EPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA, 2006a). The DQOs are statements that define the type, quality, quantity, purpose, and use of data to be collected. The EPA developed a seven-step process to establish DQOs to help ensure that data collected during a field sampling event are adequate to support reliable site-specific decision making (EPA, 2001 and EPA, 2006a). The sections below outline the QAPP DQOs.

2.7.1 Data Quality Objectives

The DQO process specifies project decisions, the data quality required to support those decisions, specific data types needed, data collection requirements, and analytical techniques necessary to generate the specified data quality. The process also ensures justification of the resources required to generate the data. The DQO process consists of seven steps of which the output from each step influences the choices that will be made later in the process:

- Step 1: State the Problem.
- Step 2: Identify the Goals of the Study.
- Step 3: Identify the Information Inputs.
- Step 4: Define the Boundaries of the Study.
- Step 5: Develop the Analytic Approach.
- Step 6: Specify Performance or Acceptance Criteria.
- Step 7: Develop the Plan for Obtaining Data.

During the first six steps of the process, the planning team develops decision performance criteria that will be used to develop the data collection design. The final step of the process involves developing the data collection design based on the information from the other steps. The following provides a brief discussion of these steps and their application to this sampling effort.

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

Describing the problem. Properties in Butte and within the Expanded 2020 RMAP Area (see Figure 1) have the potential to be contaminated by historical mining activities and related contaminants. The proximity of properties to mining wastes and operations may have resulted in contamination of non-residential properties such as schools, parks, and non-residential daycare facilities.

The presence of contaminants and exposure pathways, related and non-related to historical mining activities, may result in a health-based risk to users of non-residential properties.

Establishing the planning team. Project personnel, roles, and responsibilities are detailed in Sections 2.1 through 2.3 of this document.

Describing the conceptual model of the potential hazard. Historical surface and underground mining activities resulted in the presence of contaminants in soil around Butte due to waste dumping and deposition of aerial emissions from smelters/mills. Other, non-mining sources have also resulted in contamination in some areas. People may contact contaminated soil at non-residential properties through pathways such as dermal contact and incidental ingestion; for example, children playing at a park may have skin contact with exposed soil, some of which could be ingested through hand to mouth transfer. When people contact contaminated soil, they may be exposed to contaminants, which could pose a health risk if concentrations are above health-protective concentrations, such as action levels. In order to investigate this problem, data quantifying contaminant concentrations will need to be collected, compared to the appropriate project action levels, and used for remedial decision making.

Identifying available resources, constraints, and deadlines. Atlantic Richfield Company (Section 2.2) and Butte-Silver Bow (Section 2.3) will provide necessary project resources (financial and staffing) to properly implement the program. Project schedule details are provided in Section 2.6 and 2.6.1.

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

Key elements/questions. The Program requires that all area schools, parks, and non-residential daycare facilities within the BPSOU be sampled and assessed. The goal is to use best efforts to obtain access to all applicable properties within the expanded 2020 RMAP Area (see Figure 1) that have not previously been sampled in accordance with current methodology to complete outdoor assessments. Exterior soil sampling is addressed by this version of the QAPP. Interior assessments/sampling are addressed under the Final *RMAP QAPP (Non-Residential Parcels – Indoor Dust)* (BSB and Atlantic Richfield Company, 2022).

Specifying the primary question. The primary question to be addressed is the following:

Are soil concentrations of arsenic, lead and/or mercury at non-residential properties present at levels that may pose a risk to human health (e.g., above the action levels)?

Determining alternative actions. Possible alternative actions are as follows:

- Take no action – If all analyte concentrations are below the appropriate project action level.
- Complete Additional Sampling – If more information is needed to characterize a property and support remedial decision-making. One example that may warrant additional sampling is if variability in initial sampling results indicates the potential presence of sub-areas with unique characteristics.
- Complete Remedial Action – If an analyte concentration is above the appropriate project action level. Remedial action would consist of soil removal and disposal at an Agency approved repository followed by backfill with Agency approved borrow material.

Specifying the decision statement. The decision statement is as follows:

- Determine whether Remedial Action (soil removal) is required.

Step 3: Identify the Information Inputs - *The purpose of this step is to identify the informational variables that will be required to resolve the decision statements and determine which variables require environmental measurements.*

Identifying the type of information that is needed to resolve the decision statement. Arsenic, lead, and mercury concentrations should be determined through sampling soil from non-residential RMAP properties (schools, parks, and non-residential daycare facilities). The goal of soil sample collection and analysis is to obtain a reliable estimate of the average concentration of a contaminant of concern (COC) in soil over a specified area where exposure may occur for comparison to the appropriate action level for that area. The relationship between the average COC concentration and the action level provides the input needed to resolve the decision statements outlined in Step 2 in order to determine whether abatement is required for non-residential RMAP soil.

Information regarding the land use of the different areas within the parks and schools should inform the sampling design for each area. Five primary land uses have been identified for non-residential RMAP properties. These land use categories help inform the approach for sampling each property, and include:

Land Use Category #1: playground areas.

Land Use Category #2: highly accessible areas/barren sports fields.

Land Use Category #3: maintained grass areas/grass sports fields.

Land Use Category #4: low access areas/low maintenance areas/open space.

Land Use Category #5: flower/vegetable gardens.

Land use information should be used to make decisions about the appropriate sampling methodology, sample count/density, and depth intervals to be sampled for each area, and to identify action levels that are protective of the specified land uses.

Sample coordinates and depth intervals should also be documented so that sample results are linked to specific locations and depths to inform remediation decisions. If chips from building exterior lead based paint (LBP) are identified in a sampled area, this should also be documented as it is likely to influence lead concentrations in soil.

Identifying the number of variables to be collected. Arsenic, lead, and mercury concentrations should be determined for each sample collected.

Identifying the appropriate Action Levels. For Butte, there are no school- or park-specific soil action levels. Therefore, the basis of the existing soil action levels (as presented in the BPSOU ROD) was reviewed to determine which type of action level is likely to be the most applicable and adequately protective level to employ in making cleanup decisions for the schools and parks. The non-residential soil action level for lead (2,300 milligrams per kilogram [mg/kg]) has historically been applied to address waste rock dumps and source areas, which are different from the types of materials expected at schools or parks. The recreational soil action level for arsenic (1,000 mg/kg) was developed based on a dirt-bike riding scenario, which is an activity that is quite different from anticipated use of school property and of many parks. There is no non-residential soil action level for mercury.

Based on a review of the basis of the soil action levels, the residential soil action levels should be employed in evaluating the soil sampling results for the schools. The application of the residential action levels is conservative for a school scenario; however, use of more conservative action levels is appropriate, especially considering the school setting and community sensitivity to childhood exposures. The use of the residential action level in making cleanup decisions is consistent with what has been done historically for Butte parks. Additionally, residential soil action levels are also being used for the Anaconda Smelter site when making cleanup decisions for schools.

The BPSOU residential action levels (Arsenic – 250 mg/kg, Lead – 1,200 mg/kg, Mercury – 147 mg/kg) will be utilized for all work completed under this QAPP (see Table 1).

Identifying appropriate sampling and analysis methods. Multiple sampling strategies (discrete, incremental, composite, etc.) should be considered for potential use on this project. Given the large areas contemplated for this project, exclusive discrete sampling may not be the most appropriate option given its common deficiencies including poor spatial coverage, inadequate sample density, or data that cannot be used to statistically represent the entire area of interest with a reasonable level of confidence. In addition to having been used historically within the National Priorities List (NPL) Site and on the RMAP project specifically, composite sampling is the recommended approach for sampling residential parcels provided in EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA, 2003). For consistency and comparability with previous RMAP and NPL Site sampling results, composite sampling may be the most appropriate sampling method for the project.

While incremental sampling is a type of composite sampling, it would represent a change from current sampling practices within the Silver Bow Creek/Butte Area NPL Site. As such, a change could create issues surrounding consistency and comparability with previous RMAP and NPL Site sampling results. However, incremental sampling may be the preferred approach for some land uses, such as certain areas of some parks. Incremental sampling is an increasingly popular approach because it can provide better coverage and produce more consistent, reproducible, and statistically robust estimates of the mean compared to traditional approaches (e.g., discrete sampling). Incremental sampling is well-suited to meet the goals of estimating a reasonably unbiased estimate of the mean COC concentration and reducing decision errors for some areas within nonresidential properties (e.g., large field areas within parks where soil is not exposed at the surface).

X-ray fluorescence (XRF) has been used historically to analyze arsenic and lead concentrations in Butte soils. This method provides a quick output that can be used for immediate decision making. However, it is less sensitive than laboratory analytical methods and cannot be used for mercury analysis. Because samples must be packaged and shipped to a laboratory for mercury analysis, it may be more practical to have all three metals analyzed by the laboratory via inorganic analyses. Inorganic analyses data from an analytical laboratory can also be validated. If inorganic analyses are used, expedited laboratory analysis (5 to 7 business day turn around on data and level 2 data packages and 10 to 12 business day turn around on data and level 4 data packages) and data validation (7 business day turn around after data packages are received) options should be investigated in order to achieve the project assessment and remediation goals.

Step 4: Define the Boundaries of the Study - *The purpose of this step is to define the spatial and temporal boundaries of the problem.*

Specifying the target population. The 2020 RMAP/Program area (see Figure 1) addressed under this QAPP will include the exterior soil of schools, parks, and non-residential daycares. Interior assessments and sampling of these properties are addressed under the *Final RMAP QAPP (Non-Residential Parcels – Indoor Dust)* (BSB and Atlantic Richfield Company, 2022). Because of differences in potential soil exposures with depth and for consistency and comparability with previous RMAP sampling, soil should be sampled separately from discrete depth intervals. For example, EPA recommends sampling soil from the 0- to 2-inch depth interval to assess contact by most activities of children, while some activities may result in contact with deeper soil, and vegetable gardens, which have been observed at some schools in the 2020 RMAP/Program area may involve digging up to 2 feet. Exterior soil sampling should be conducted at multiple depth intervals (including 0 to 2 inches, 2 to 6 inches, and 6 to 12 inches) to assess potential health risks under different land uses and to obtain data that are comparable to those from previous sampling efforts. Flower/vegetable garden components should be sampled at additional depth intervals of 12 to 18 inches and 18 to 24 inches.

For some areas within park properties, fewer depth intervals may be appropriate to characterize the top 12 inches of soil, depending on the sample collection methodology. For

large uniform areas of maintained grass where soil is not exposed at the surface, where broad recreational use is expected to occur, and where no contact with subsurface soils is expected, the 2- to 6-inch and 6- to 12-inch depth intervals could be combined to estimate the average concentration in the 2- to 12-inch interval of soil present beneath a grassy or landscaped surface. This may be particularly relevant at properties such as parks where there are large grassy areas used for recreational purposes. For these types of areas, the 0- to 2-inch interval of soil is the key priority in assessing potential exposures (i.e., soils in the 0- to 2-inch depth interval are most likely to be contacted) and sampling from 2 to 12 inches is primarily to support remedial action design. In this scenario, exterior soil sampling should be conducted at two depth intervals (including 0 to 2 inches and 2 to 12 inches).

Description of what constitutes a sampling unit. Sampling units should be defined based on land use information. Sampling unit extents are defined as the maximum area to be sampled to support decision-making for each of the five specified land-use categories identified for non-residential RMAP properties (see Step 3). The EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA, 2003), previous RMAP QAPP, and procedures for sampling schools in nearby Anaconda were reviewed to inform sampling unit extents appropriate for each land use type. The recommendations below were developed consistent with EPA recommendations, other RMAP sampling efforts, and sampling of schools where similar types of contamination are present. In the event of a composite sampling design, these recommended sampling unit extents should inform development of the sampling plans for each property.

Land Use Category #1 (playground areas): 6,250 square feet.

Land Use Category #2 (highly accessible areas/barren sports fields): 9,375 square feet.

Land Use Category #3 (maintained grass areas/grass sports fields): 10,890 square feet.

Land Use Category #4 (low access areas/low maintenance areas/open space): 21,780 square feet.

Land Use Category #5 (flower/vegetable gardens): 3,125 square feet.

Many parks are likely to have continuous vegetative cover, such as grass or landscaping, as well as consistent land use, across the entire property or large portions of the property. For such areas, falling into Land Use Category #3 and/or #4, incremental sampling may be the preferred approach to characterize the average concentration of a COC in soil over the potential exposure area. Using this approach, multiple replicate samples, each consisting of numerous increments, are collected across the sampling unit. In the event of an incremental sampling design, the following recommended sampling unit extents should inform development of the sampling plans for each property area to be sampled using the incremental sampling methodology. For portions of parks falling into Land Use Category #3 (maintained grass areas/grass sports fields) or #4 (low access areas/low maintenance areas/open space), with large uniform areas of maintained grass/vegetation where soil is not exposed at the surface, where broad recreational use is expected to occur, and where soil is

not exposed at the surface and no contact with subsurface soils is expected, a maximum incremental sampling unit extent of 440,000 square feet (or 10.1 acres), with a minimum sampling density of 1 increment per 4,400 square feet, is recommended.

Time frame for collecting data and making the decision. The temporal boundaries of the school investigation include the time from when evaluation and sampling actions begin at each property to the time these actions are completed. No temporal variability in soil concentrations is expected, so the sampling effort should be primarily dictated by when it is easiest to conduct sampling, meaning when no snow is present and when school facilities are not in use (i.e., summer). School sampling should be completed prior to when school starts in the fall. Outreach meetings should be conducted with each school to better understand individual schedule restraints (summer activities/camps, construction projects, etc.). Similarly, no temporal variability in soil concentrations is expected for the park and play area investigations, so the sampling effort should be primarily dictated by when it is easiest to conduct sampling, meaning when no snow is present (i.e., summer). Outreach meetings should be conducted with affected Stakeholders to better understand individual schedule restraints (summer activities/camps, construction projects, etc.).

Specifying the scale for decision making. For the non-residential RMAP properties, the sampling unit extent for each land use category should be specified as the maximum area for decision-making by land use type to ensure that any location where arsenic, lead, or mercury concentrations are above health-protective action levels is remediated. Some properties may have multiple land uses and more than one sampling unit. By setting the decision unit (DU) equal to the sampling unit, decisions to remediate can be made for subareas of a property, rather than on a property-wide basis, and any subarea with analyte concentrations above action levels can be addressed even if property-wide removal is not warranted. For DUs comprising open, grassy areas of a park where the land use is homogeneous and recreational, and soil is not exposed at the surface, incremental sampling may be the preferred approach. Sufficient numbers of increments and replicates should be collected across the extent of the incremental sampling unit to achieve the coverage necessary to support decision making (see Step 6 for additional discussion of confidence and tolerance for decision errors, and Section 2.7.2 for discussion of replicates and data quality). For homogenous, open grassy areas with recreational use where soil is not exposed at the surface, such as portions of the parks included in this QAPP, replicates consisting of a pre-determined number of increments (which will be documented and Agency approved through the submittal and approval of park-specific Field Sampling Plans [FSPs], see examples in Figures 3 and 4) will be collected to provide data of sufficient quality to achieve the project objectives. For the areas of parks where incremental sampling is applicable, the following criteria will be used to select the appropriate number of increments to be collected for each replicate:

- Incremental sampling area less than 3 acres: 30 increments.
- Incremental sampling area ranging from 3 to 10.1 acres: between 30 and 100 increments, to be determined on a park-specific basis and informed by the layout of unique park features. The minimum sampling density will be 1 increment per 4,400 square feet.

In some cases, initial results for a sampling unit/DU may indicate a need for additional sampling to further characterize all or part of a property. In such cases, it may make sense to adjust the DU to include multiple smaller sampling units, or to evaluate smaller sampling units as individual DUs. Additional sampling requirements and the associated determination of sampling and DUs should be specified on a property-specific basis, as initial investigation results inform refinement of the conceptual model for a property and described in detail in a property-specific FSP. A general decision framework is outlined in Step 7.

Step 5: Develop the Analytic Approach - *The purpose of this step is to define the parameters of interest and integrate any previous DQO inputs into a single statement that describes a logical basis for choosing among alternative actions.*

Identification of the population parameters most relevant for making inferences and conclusions on the target population. Arsenic, lead, and mercury concentrations should be measured for each sampling unit as determined by analysis of each corresponding soil sample collected. The true average concentration is the population parameter of interest to make inferences and conclusions for each DU.

Specifying the theoretical decision rule. The theoretical decision rule is as follows.

- If the analyte concentration measured in the sampling unit (i.e., the average concentration within each composite sampling DU for either arsenic, lead, or mercury) exceeds the appropriate Residential Action Level detailed in Table 1, then the soil from the corresponding sampling area will be removed using conventional equipment (such as backhoes, small Bobcat-type loaders, and hand tools) and transported to the Butte Mine Waste Repository using dump trucks.
- If the average analyte concentration measured in the incremental sampling DU exceeds the appropriate Residential Action Level detailed in Table 1, and additional sampling is not warranted, then the soil from the corresponding sampling area will be removed using conventional equipment (such as backhoes, small Bobcat-type loaders, and hand tools), and transported to the Butte Mine Waste Repository using dump trucks.
- If the average analyte concentration measured in the incremental sampling DU exceeds the appropriate Residential Action Level detailed in Table 1, and more information is needed to characterize a property or area of a property and support remedial decision-making, the proposed plan for additional sampling will be described in a property specific FSP using the decision framework presented in Step 7.

Step 6: Specify Performance or Acceptance Criteria - *The purpose of this step is to identify baseline conditions, limits, and ranges for decisions and consequences of decision errors.*

The decision question identified in Step 2 is: Are soil concentrations of arsenic, lead, and/or mercury at non-residential properties present at levels that may pose a risk to human health (e.g., above the action levels)? In this case, the baseline (null) condition for each DU is that the average analyte concentration in soil is above the action level, and the alternative condition is that there is not an exceedance. Because this is a decision question, the potential exists for decision error to occur due to variability and uncertainty in the data. Potential decision errors

include Type I (false rejection of the baseline condition) and Type II (false acceptance of the baseline condition) errors. In the context of the RMAP non-residential sampling decision question, a Type I error would mean concluding that the arsenic, lead, or mercury concentrations in soil are below the action level when it is actually above the action level. Consequences of this type of error include leaving soil in place that contains a metal at concentrations above the action level, resulting in a potential risk to human health. A Type II error would mean determining that the arsenic, lead, or mercury concentration in soil is above the action level when in fact it is not. Consequences of this type of error include unnecessary soil removal and increased costs.

Because the goal of the RMAP is to protect human health, the tolerance for making a Type I error is lower than the tolerance for making a Type II error. Therefore, a sampling design and analysis method that minimizes the potential for Type I decision errors should be selected. Due to the potential for work to occur over more than one season and the need to make decisions on a property-by-property basis, the experiment-wise error rate will likely be difficult to assess, and efforts should be made to reduce the Type I error rate at the DU, rather than at the project-wide level.

When discrete sampling methods are used and the resulting population of sample data representing each DU are compared to a standard using hypothesis testing, the chance of making a Type I error can be reduced by setting a lower significance level (α) (i.e., a lower Type I error rate). The chance of making a Type II error is reduced by setting a higher statistical power (β). The significance level and power can be raised or lowered to control the probability of each type of error depending on the tolerance for each. With this type of approach, there is a set tolerance for reaching a conclusion (the action level is or is not exceeded) that is correct for most, but not all, values in a population. Typically, the probability of a Type I error is lower than that of a Type II error; for example, a significance level of 5% (0.05 probability of a Type I error) and a power of 80% (0.2 probability of Type II error) are often selected. It can be difficult to obtain the sample size needed to achieve a much higher statistical power due to limitations such as the area available for sampling and associated analytical costs.

For the non-residential RMAP program, the tolerance for Type I decision errors is lower than that for Type II errors. Instead of addressing the decision question through hypothesis testing using a population of discrete samples collected across a non-residential property or area of a property (i.e., setting the DU as the combination of numerous discrete sampling units), the DU can be reduced to equal the sampling unit to maximize the potential to find an exceedance where present (i.e., to lower the Type I error rate). If each sample result is compared individually to the action level, this reduces the chance of concluding that the average COC concentration in the DU is below the action level when it is not.

A composite sampling design is a good option to support the goal of reducing Type I error potential by limiting the size of the DU to the extent of the sampling unit. The EPA handbook states that, "*the overall goals of the sampling effort are to estimate an average soil concentration for risk assessment purposes and to provide information to determine the scope of required cleanup actions"*(EPA, 2003). The composite sampling method is intended to better approximate potential average exposure to a receptor while moving across an area, rather than remaining at a single spatial point which is less likely to occur. Therefore, collecting a composite sample to

estimate the average concentration of each analyte in soil across the extent of each sampling unit is a preferable approach compared with collecting a discrete sample from one location within each area.

Similarly, the incremental sampling method is a type of composite sampling that uses multiple increments to obtain a sample representing the average concentration across the area covered by the sample. Multiple replicates are collected to obtain a reproducible estimate of the average. A 95% upper confidence limit (UCL) on the average of replicate concentrations is calculated to reduce the likelihood of underestimating the mean. A 95% UCL is often selected to meet a significance level of 5%, as this parameter is associated with a high level of confidence (95%) that the true mean will be equal to or less than the UCL, provided the data are of sufficient quality to meet the specified confidence level. Estimating a 95% UCL to represent the average COC concentration for comparison to the action level provides similar information as setting the Type I error rate at 5% in a one-sided, one-sample hypothesis test, and is a good option for the non-residential RMAP program given the low tolerance for Type I decision errors. A minimum of 3 replicate samples would be needed to compute a 95% UCL on the mean.

In addition to lowering the potential for Type I errors, study error should be minimized through proper training of the field sampling team, sample documentation and handling, the use of appropriate analytical methods that achieve method detection limits below the action levels, analysis of field and analytical QC samples, analysis of precision, accuracy, and other measurement performance criteria (described in detail in Section 2.7.2), and data validation. Decisions should be made using data that meet the performance and acceptance criteria; if these criteria are not met, corrective action steps should be taken.

Step 7: Develop the Plan for Obtaining Data - *The purpose of this step is to develop an optimized plan to complete the task.*

Selecting the sampling design. The data collection scheme is designed to ensure that the information will be of sufficient quality and quantity to determine the component(s) of individual schools, parks, and non-residential daycares requiring remedial action (and the depth to which remedial action is required). The information and outputs generated in Steps 1 through 6 of the DQO process informed selection of the optimized approach for soil sampling and analyses at non-residential RMAP properties described in this final step of the process.

The RMAP sampling plan generally follows the EPA's *Superfund Lead-Contaminated Residential Sites Handbook* (EPA, 2003) composite sampling design (with one composite collected per yard component representing an exposure area that would be remediated). For this reason and because this approach supports the goals of obtaining average concentrations of arsenic, lead, and mercury across each sampling unit and minimizing the potential for Type I errors (i.e., falsely concluding that the average concentration is not above the action level when it actually is), the schools program is designed to also rely on composites that reflect portions of exposure areas. Arsenic, lead, and mercury concentrations will be determined through composite samples collected from non-residential RMAP properties (schools, some parks or portions of parks, and non-residential daycare facilities). The goal of

composite soil sample collection and analyses is to obtain a reliable estimate of the average concentration of a COC in soil over a specified area where exposure may occur, for comparison to the appropriate action level for that area.

For some portions of parks (i.e., those portions with a continuous grass/turf cover, where similar recreational exposures are assumed, contaminant concentrations are expected to be relatively homogeneous, and soil is not exposed at the surface), the incremental sampling methodology, a variation of composite sampling, will be used to obtain a reliable estimate of the average concentration of a COC in soil over the specified exposure area. Where the incremental sampling methodology is applied, the true average COC concentration will be estimated as the 95% UCL on the average of replicate concentrations for each DU.

For each property or portion of a property where composite samples are collected, sampling unit extents will be defined based on land use types identified at the property, based on the recommendations described in Step 4. Land use should also inform the number of composite subsamples to be collected across each sampling unit. For consistency with the RMAP and with EPA guidance, the same information used to determine appropriate sampling unit extents for each land use category (EPA's lead handbook, previous RMAP sampling, and Anaconda schools sampling) also informs determination of subsample counts recommended for each land use-specific composite sampling unit. Details of the extent and number of subsamples to be collected from each area of a non-residential property, based on land use within that area, are provided in Table 1 and in Section 3.2. Exterior composite soil sampling will be conducted at multiple depth intervals (0 to 2 inches, 2 to 6 inches, and 6 to 12 inches) for all five land use categories. Flower/vegetable garden components (Category #5) will be sampled at additional depth intervals of 12 to 18 inches and 18 to 24 inches.

For those portions of parks where incremental samples are collected, sampling and DU extents will also be defined based on land use. As described in Step 4, separately characterizing the 0- to 2-inch depth interval is necessary to estimate average constituent concentrations in surface soil with which receptors are most likely to have contact, while decisions about remedial actions are typically made across the 0- to 12-inch interval. Extending the subsurface depth interval to 10 inches (i.e., 2 to 12 inches) will support overall decision-making while maintaining the separate characterization of the most likely exposure interval. Exterior soil sampling will be conducted at two depth intervals (0 to 2 inches and 2 to 12 inches) for those portions of parks where the incremental sampling methodology is used (i.e., large uniform areas of maintained grass where soil is not exposed at the surface, where broad recreational use is expected to occur, and where no contact with subsurface soils is expected). Further incremental sampling details are provided in Table 1 as well as in Section 3.3.

Consistent with prior sampling programs, samples will be sieved to the less than 250 micrometers (µm) fraction, reflecting the fine fraction of soil most likely to adhere to children's hands. More recent EPA guidance (EPA OLEM Directive 9200.1-128) requires sieving to less than 150 µm based on studies that show lead enrichment in very fine soil fractions (e.g., less than 63 µm). There are no data adequate to predict if the less than 150 µm fractions might be detectably enriched as compared with the less than 250 µm fraction. In

light of this uncertainty, EPA has agreed with use of the less than 250 µm fraction for the 2021/2022 sampling program while a particle size enrichment demonstration study is planned and conducted.

Based on the assessment of the limitations and benefits of potential sample analyses options completed in Step 3, laboratory analyses were identified as the preferred approach for measurement of arsenic, lead, and mercury concentrations in composite and incremental soil samples. Arsenic and lead concentrations will be determined per EPA Method 6010 (inductively-coupled plasma atomic emission spectroscopy [ICP-AES]) or EPA Method 6020 (inductively-coupled plasma mass spectrometry [ICP-MS]). Mercury concentrations will be determined per EPA Method 7471B (Manual Cold-Vapor Technique). The detection limits associated with these methods are expected to be well below the applicable Action Levels (see Table 1).

Decision units will be set equal to the sampling unit. As described in Step 4, initial incremental sampling/DUs may need to be divided to comprise more sampling units. If initial results lead to additional sampling, either the composite or incremental sampling methodology or a combination may be most appropriate depending on the unique scenario guiding decisions at a particular park. Such property-specific determinations would be based on changes to the conceptual model of the property resulting from initial incremental sampling results, and details would be provided in property-specific FSPs using the general decision framework outlined below.

The relationship between the average COC concentration and the action level provides the input needed to resolve the decision statements outlined in Step 2 to determine whether abatement is required for non-residential RMAP soil. For each composite sampling DU, the decision question (*Are soil concentrations of arsenic, lead, and/or mercury at non-residential properties present at levels that may pose a risk to human health (e.g., above the action levels)?*) will be addressed by comparing the composite soil sample result from each sampling unit to the corresponding action level. Each sampled depth interval within the area covered by a composite sample will be considered a separate sampling unit.

For areas of parks where incremental samples are collected (i.e., large uniform areas of maintained grass where soil is not exposed at the surface, where broad recreational use is expected to occur, and where no contact with subsurface soils is expected), the decision question will be addressed by comparing the 95% UCL of replicate sample results for each DU to the corresponding action level. The 95% UCL will be calculated using the ITRC's *Incremental Sampling Methodology (ISM) Calculator (v. 3.0, August 2020) for Calculating 95% UCL with ISM Data*. The ISM calculator uses two methods suitable for calculating 95%UCLs using as few as three replicate samples: the Student's t-method for normally distributed datasets, and the Chebyshev method for datasets that do not fit a normal distribution. The calculator recommends selection of a 95% UCL from these two values for each sampling unit, based on variability in the dataset. The calculator also recommends an overall 95% UCL for a DU comprised of multiple sampling units; in this case, sampling units are weighted by area, volume, or depth interval to calculate the overall 95% UCL for the DU. When the DU is set equal to the sampling unit, the decision question (*Are soil concentrations of arsenic, lead and/or mercury at non-residential*

properties present at levels that may pose a risk to human health (e.g., above the action levels)?) will be addressed by comparing the 95% UCL recommended by the ISM calculator for each DU to the corresponding action level. As with composite sampling, each sampled depth interval within the area covered by an incremental sample will be considered a separate DU. When a property-specific decision has been made to combine sampling units for a larger DU, as outlined in a property-specific FSP, the decision question will be addressed by comparing the overall 95% UCL recommended by the ISM calculator for the larger DU to the corresponding action level.

Three alternate actions were identified in Step 2: take no action, complete remedial action, and complete additional sampling. The decision framework through which incremental sampling results will inform selection of each alternate action is described below.

- Take no action: This action will be selected if the 95% UCL is below the action level.
- Complete remedial action: This action will be selected if the 95% UCL is above the action level, and the following condition is met:
    - The total incremental sampling area is less than 1 acre.
- Complete additional sampling: This action will be selected if the conditions specified above for the first two alternative actions (take no action or complete remedial action) are not met, and an evaluation of site conditions and data indicate that additional sampling will be informative for decision-making.

  Additional sampling may include separating the initial DU into multiple sampling/DUs for additional incremental sampling, identifying separate DUs for composite sampling, and/or collecting an additional replicate sample from the incremental sampling DU. The design of additional sampling will be dependent on specific conditions in the DU, as generally described below.

    - If review of available information about potential contaminant sources, visual cues, or other relevant information indicates that a portion of the incremental sampling area has unique characteristics that warrant separate evaluation, additional sampling may be completed. The DU may be separated into multiple sampling/DUs for additional incremental sampling, or composite sampling may be used to characterize the unique sub-area(s).
    - If variability is low [i.e., the Coefficient of Variation (CV) of increments (with adjustment as calculated in the ITRC ISM UCL calculator) is less than 1.5] and all replicate concentrations are less than the action level or if variability is moderate to high (i.e. the adjusted CV of increments is greater than or equal to 1.5), collection of an additional replicate may reduce the width of the confidence interval and better inform cleanup decisions. If these conditions are met, an additional replicate may be collected from the incremental sampling DU.
    - While high variability is not expected for most parks, if sampling results indicate strong disagreement among replicates, then additional increments may be needed to properly characterize the DU. Separating the area into multiple sampling/DUs for additional incremental sampling, or composite sampling, may be suitable alternatives depending on the park's layout or other characteristics.

Details on how the design should be implemented together with contingency plans for unexpected events. Soil sampling shall be implemented per the guidelines provided in Sections 3.2 and 3.3. 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. Corrective action procedures are outlined in Sections 5.1 and 5.2. Any unexpected/unplanned events not specifically addressed by this QAPP will be discussed with Agency personnel and addressed through forthcoming QAPP revisions.

Specifying the Quality Assurance and Quality Control procedures. Sufficient data quality will be achieved through the field and laboratory quality control measures (Sections 3.7 and 3.9, respectively) including the use of appropriate sample collection, handling, and chain of custody procedures and laboratory analytical methods, quality control sample analysis (field and laboratory), assessment of the performance criteria described in Section 2.7.2, following the corrective action procedures detailed in Sections 5.1 and 5.2, and analytical data validation (Section 6.0).

2.7.2 Measurement Performance Criteria for Data

Measurement performance criteria are established by defining acceptance criteria and quantitative or qualitative goals (e.g., control limits) for precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) of measurement data. The definitions of precision, accuracy, representativeness, comparability, completeness, and sensitivity are provided below. Acceptance limits are detailed in Section 3.6.2 for each measurement performance criteria. Equations for calculation of precision, accuracy, and completeness are provided in Table 2. Additional QC acceptance criteria are provided in Table 3.

Precision

Precision is the amount of scatter or variance that occurs in repeated measurements of a particular analyte. Precision is assessed using the relative percent difference (RPD) between a primary sample result and its paired field or laboratory duplicate sample result (for field and laboratory precision, respectively). For example, perfect precision would be a 0% RPD between the primary sample result and its paired field or laboratory duplicate sample result (both samples have the same analytical result). For these sampling events, precision will be assessed based on laboratory prepared and field duplicate sample analysis.

Precision for incremental sampling will be determined by the collection of three replicate samples in each DU, each containing the same number of sample increments. These replicate samples will be collected in the same grid location, separated into approved depths, and the sample increments will be thoroughly field homogenized before being shipped to the laboratory. A percent relative standard deviation (%RSD) will be calculated for determining precision. Field duplicate samples will not be collected when incremental sampling is performed.

Accuracy/Bias
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. Additional laboratory QC samples may be used to assess accuracy as appropriate to the analytical method.

Bias is the systematic or persistent distortion of a measurement process that causes error in one direction (e.g., consistently higher or lower than the true concentration). As with accuracy, analytical bias can also be assessed based on %R of laboratory QC samples. Sampling bias is addressed through the use of proper sampling design and methods.

Representativeness
Representativeness is the degree to which sample data represent a characteristic of a population, parameter, or environmental condition. Representativeness is a qualitative parameter that is most concerned with proper design of the sampling and analytical schemes. Representativeness is achieved by determining the number and locations of samples and the appropriate sampling techniques needed to depict, as accurately and precisely as necessary, the conditions being measured. Representativeness deals with protocols for sample storage, preservation, and transportation; analyzing samples with appropriate methods, techniques, and instrumentation; and using the methods to document these protocols. Representativeness will be achieved through judicious selection of sampling locations and methods. This QAPP requires that samples are representative of the medium being sampled and that there are a sufficient number of samples to meet the project DQOs and satisfy the project remedial action design elements.

Representativeness for incremental sampling will be enhanced by collecting multiple increments in three replicate samples from a DU.

Comparability
Data comparability is defined as the measure of the confidence with which one data set can be compared to another. Comparability is a qualitative parameter but must be considered in the design of the sampling plan and selection of analytical methods, QC protocols, and data reporting requirements. Comparability will be ensured by analyzing samples obtained in accordance with this QAPP and applicable laboratory Standard Operating Procedures (SOPs), as well as the Program SOPs, which are comparable to the sampling methods used during previous investigations at the site (Attachment C contains various field and laboratory SOPs). All data will be reported in units consistent with standard reporting procedures so that the results of the analyses can be compared with results from previous investigations. Soil data will be reported in units of mg/kg.

Completeness
Completeness is a measure of the amount of valid data obtained from the measurement system. Proposed sample collection points may fail to produce usable data for many reasons (e.g., non-traceable sample identification, sample container breakage, elevated storage temperature,

exceeded sample holding time, or data loss). When samples are analyzed, but the data are rejected, the numerator of this calculation becomes the number of valid results minus the number of possible results rejected. Valid data are data not rejected or deemed unusable during the data validation process. Completeness describes the amount of valid data that meets the DQOs for representativeness, accuracy, and precision versus the amount of data obtained or considered necessary to achieve a specific level of confidence in decision-making. For relatively clean, homogeneous matrices, data would be expected to be 100% complete. As matrix complexity and sample heterogeneity increases, however, completeness may decrease. Based on the complexity of sample matrices anticipated to be collected from the project sites, the analytical data completeness goal following validation is stated to be greater than or equal to 90% and will be generated on a Sample Delivery Group (SDG) basis.

Project completeness with regard to the collection of samples and identified data gaps will be addressed by the data generators and users. A goal of 90% is anticipated for each project location (e.g., each school location).

In order to more accurately depict the percent analytical completeness, individual analyte completeness will be calculated and reported. In addition to the analyte percent completeness, a summary of completeness for each fraction will be provided in the validation reports. In the event reanalyses are performed by the laboratory, only a single analytical set (may be a mixture of original and reanalyses data based on usability) will be included in the analytical completeness calculation so as not to count duplicate data. Valid results used to meet completeness objectives are those results that provide a defensible estimate of the true concentration of an analyte in a sample. These valid results include data that are not qualified and data that are qualified but that can still be used to meet project objectives. Invalid data are those results for which there is an indication that the prescribed sampling or analytical protocol was not followed or results did not meet QC specifications.

Sensitivity

Sensitivity is related to the ability to compare analytical results with project-specific action levels. Analytical quantitation limits for the sample analytes should be below the level of interest to allow an effective comparison.

Method Sensitivity

Achieving proper sensitivity (i.e., reporting limits) will depend on instrument sensitivity and potential matrix effects. Data sensitivity is the ability of the analytical method to differentiate the target analyte from instrument "noise." With regard to instrument sensitivity, it is important to monitor the instrument performance to ensure consistent instrument performance at the low end of the calibration range. Instrument sensitivity will be monitored through analysis of method blanks and calibration check samples. Project data will be reported to the method detection limit (MDL) with variations due to sample amount digested, potential dilutions and percent moisture correction for mercury analysis. The MDLs are below the soil action limits defined in the DQO steps above.

Additional details regarding bias, sensitivity, and QC acceptance criteria are included in Section 3.6.2.

Laboratory Analyses
The method sensitivity for laboratory analyses is determined as part of the laboratory's SOPs. A review of these detection limits will be conducted as part of the data validation process.

2.8 Special Training

All RMAP field personnel will review the requirements of this QAPP and receive training on Program-related tasks during a project meeting held prior to the beginning of fieldwork. A review of sampling procedures and requirements will be completed prior to field activities to ensure sample collection and handling methods are according to QAPP requirements. Field personnel will be trained in proper use of field equipment, sample collection tools, etc., and procedures according to field data collection SOPs (Attachment C-1) and methods described in the Program. Field personnel performing sampling activities or members who can potentially contact contaminated materials should receiver hazardous waste operations and emergency response (Hazardous Waste Operations and Emergency Response [HAZWOPER]) training.

The BSB Department of Reclamation and Environmental Services Director is responsible for ensuring field personnel receive appropriate training and will maintain up-to-date training records and/or certifications. The BSB Department of Reclamation and Environmental Services Human Health/RMAP Division Manager will ensure that each member of the sampling team obtains and is familiar with the recent version of the QAPP, will maintain signatures of each team member who has read the QAPP (including reviews and addenda, as necessary), and make sure each team member has been trained in the appropriate sample collection methods per the Program. The Human Health/RMAP Division Manager will review the SSHASP with all field personnel prior to fieldwork to assess the site's specific hazards and the control measurements that have been put in place to mitigate these hazards. The SSHASP review will also cover all other safety aspects of the site including site personnel responsibilities and contact information, additional site-specific safety requirements and procedures, and the emergency response plan. One hard copy of the approved version of this QAPP will be maintained for reference in the field vehicle and/or field office. All field team personnel will have access to Portable Document Format (.pdf) files of the complete QAPP.

2.9 Documents and Records

This section describes procedures for documentation management and record keeping for this QAPP from initial record generation through final data formatting and storage. All sampling data conducted for all media under the Program and records of property access requests are housed within the Program database. The Program database is housed in an Access Structured Query Language (SQL) server database and maintained by BSB. Document backups are contained in the BPSOU Document SharePoint and EPA document repository. The BPSOU *Final Data Management Plan* will provide additional details regarding data management, backup, and storage[1]. Atlantic Richfield and BSB will coordinate Agency testing of the database with the program architects and primary users in a manner to minimize provision of written comment and the potential misinterpretation of those comments.

2.9.1 Property Access Agreements

An executed sampling access agreement (see Attachment B) must be obtained from the property owner (which for non-residential properties may include BSB or other non-private entities/agencies) before sampling takes place. Similarly, an executed Construction Access Agreement must be obtained before remediation begins. Program access agreements are also described in detail within the *Institutional Controls Implementation and Assurance Plan (ICIAP)* (Atlantic Richfield Company, 2019). The agreements represent a temporary agreement between BSB and the property owner stating that the owner is willing to permit BSB to conduct certain sampling and abatement activities on the specified property. Completed agreements will be photocopied, scanned, and the electronic version stored on a hard drive. The status of property access will be tracked in the Program's database tracking system. A copy of the access agreements (Attachment B) will also be included in the project record files.

2.9.2 Field Documentation

Field documentation provides a description of site conditions during sampling activities and provides a permanent record of all field activities. Field documentation will primarily be achieved through electronic means (i.e., field tablets). Field documentation includes a sample location map of the site that shows property boundaries, structures, driveways, contaminant source material, gardens, and lawns. Field personnel creating the sample location map will delineate property features with an accuracy of approximately plus or minus 2.0 feet. Each property will be divided into components (e.g., play area, high access area, etc.) for sampling, and these areas will be identified on the map.

Documentation for each site will include the information listed below, at a minimum:

- 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 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.).
- Details of the fieldwork performed with special attention noted to any deviation from the QAPP or applicable field SOPs. Such deviations will be brought to the attention of and discussed with Agency field oversight personnel. If the deviations are deemed to be minor by the Agency representative, a resolution and path forward will be determined in the field. If the Agency representative determines that the deviation is major in scope, it will be his/her responsibility to elevate the question internally and to receive Agency direction.
- All field measurements made (e.g., minor field modifications to sampling polygons, delineation of additional sampling polygons, etc.).
- Personnel and equipment decontamination procedures.

For any field sampling work, the field documentation will include all applicable items from the Level A/B Assessment Checklist (see Section 6.1.2.1 and Attachment D). At a minimum this includes documentation of the following:

- Sample team and/or leader.
- Sample location, depth, and traceable sample designation number.
- Sample type collected.
- Date and time of sample collection.
- Samples taken by other parties (note the type of sample, sample location, time/date, sampler's name, sampler's company, and any other pertinent information).
- Sampling method, particularly any deviations from the field SOPs (Attachment C).
- 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), specifically if sample bottles/preservatives are not provided by the laboratory and certified as cleaned.
- Collection of field duplicates.
- Decontamination of sampling equipment.
- Sample custody documentation.
- Sample preservation (if used).

Sufficient information should be recorded to allow the sampling event to be reconstructed without having to rely on the sampler's memory.

A report containing all the above-listed information will be provided to the property owner and the information recorded in the Program database and tracking system and uploaded to cloud-based databases managed by BSB (BPSOU *Final Data Management Plan* currently being developed by Atlantic Richfield). Sample results will be validated and Agency approved prior to submission to property owners unless otherwise approved by the Agencies.

2.9.3 Field Photographs

Field personnel will use a digital camera to take photographs at the site. Photographs may be taken of sampling locations, field activities, and to document site conditions, as necessary. Photographs should include a scale in the picture when practical. Documentation of all photographs taken during sampling activities will be recorded in a bound field logbook or appropriate field collection device and will specifically include the following for each photograph taken:

- The date, time, and site identification.
- A brief description of the subject and the fieldwork portrayed in the picture.
- Sequential number of the photograph.

Electronic files will be placed in project files with copies of supporting documentation from the bound field logbooks/data collection device.

2.9.4 Chain of Custody Records

Each sample collected will be assigned a unique sample number, and the sample container will be labeled with sample designation number, date and time of collection, and requested analyses. Then the information will be recorded in the field documentation. Chain of custody records ensure that samples are traceable from the time of collection until final disposition. After samples have been collected, they will be maintained under strict chain of custody protocols in accordance with the SOPs (Attachment C). A chain of custody record will be initiated by the individual physically in charge of the sample collection. The chain of custody form may be completed concurrently with the field sampling or before shipping or hand delivery of samples to the laboratory. The sampler is personally responsible for the care and custody of the samples until they are shipped or hand delivered to the laboratory. When transferring the sample possession, the individual relinquishing and receiving the sample will sign and record the date and time of day on the chain of custody record.

A copy of each as-transmitted chain of custody form will be scanned and stored on a hard drive. Chain of custody records will also be copied to the project record files (refer to Section 3.11).

2.9.5 Analytical Laboratory Records

Results received from the laboratories will be documented both in report form and in an electronic format. Laboratory documentation includes laboratory confirmation reports such as information on how samples have been batched, the analyses requested, data packages containing the laboratory report and the electronic data deliverable (EDD), and any change requests or corrective action requests. Section 6.1.3 lists the laboratory reporting requirements in detail. The deliverable (data package or report) issued by the laboratory must include data necessary to complete validation of laboratory results. Original reports and electronic files received from laboratories will be maintained with the project quality records. The BPSOU *Final Data Management Plan*[1] currently being developed by Atlantic Richfield will include additional requirements.

2.9.6 Project Data Reports

Upon receipt of laboratory results and completion of the data review/validation process, all analytical data will be uploaded into a project database and submitted to the Agencies for review and approval. For the school sampling portion of this project, these data would be anticipated to be submitted on a per school basis to decrease the turnaround time required for landowner reporting as much as possible. Upon receipt of Agency approval, the sample results (for all analytes) will be reported to individual landowners along with a letter explaining what the results indicate (see result letter templates in Attachment E). The action levels for arsenic, lead, and mercury will be reported along with sample results.

Following landowner notification, sample results will be used to develop an individual site work plan (ISWP) for each parcel where sample results exceeded BPSOU action levels (Table 1). The ISWPs will summarize the number of individual sampling components associated with each property, depth of each sample, and corresponding surface area of each component.

In addition to the "real time" submittals described above, all sampling data will be forwarded to the Agencies for review and approval in the form of an annual DSR. This DSR will include figures displaying location of parcels sampled, analytical results, and copies of all field data. As described above, all sampling data will reside in the project records.

Sampling for remedial design/remedial action under the RMAP will be documented through annual DSRs submitted for review and approval by the Agencies. Sample data, with their laboratory and data usability qualifiers, will be maintained electronically by BSB/Atlantic Richfield and reported in the annual report. The annual report will be a DSR prepared based on the guidelines in *Clark Fork River Superfund Site Investigations (CFRSSI) Pilot Data Report Addendum* (AERL, 2000) following each year of data collection. The annual report will describe the sampling activities for the year, provide a summary of the data obtained, discuss the results of data validation, and provide a detailed listing of any deviations from the QAPP. The DSR will also include a data usability assessment for laboratory data. The data usability assessment has a data summary table with all the samples and analyte concentrations listed, along with the laboratory- and data validation-assigned qualifiers. The Level A/B checklists, laboratory data validation checklists, and data validation summary will provide an overall assessment of the quality and usability of the data. Furthermore, the DSR will also contain copies of all analytical reports, EDDs, and data validation reports. Annual DSRs will be submitted to the Agencies for review approximately three months after all data validation activities are completed for the season.

2.9.7 Quality Records

Quality records are defined as completed, legible documents that furnish objective evidence of the quality of items or services, activities affecting quality, or the completeness of data. These records will be organized and managed by the BSB Department of Reclamation and Environmental Services Data Management Division Manager/QA Manager (or designee) in cooperation with the BSB Department of Reclamation and Environmental Services Director, and will include the following at a minimum:

- This QAPP and any approved revisions or addenda.
- Approved versions of the SSHASP and any addenda.
- Copies of field SOPs for field data collection, with any updates, revisions, or addenda to those SOPs.
- Incoming and outgoing project correspondence (letters, telephone conversation records, and faxes).
- Copies of completed access agreements (Attachment B) for the individual properties sampled.

- Individual property maps, including any field drawings and field photographs.
- Field documentation forms.
- Copies of all field documentation/records.
- Copies of all sample chain-of-custody forms.
- Copies of all laboratory agreements and amendments.
- Laboratory data packages (printed report and electronic version).
- Documentation of field and/or laboratory audit findings and any corrective actions.
- Draft and final delivered versions of all reports and supporting procedures such as statistical analyses, numerical models, etc.

All project data will be maintained indefinitely in the BPSOU Residential Soils and Attic Dust Global Information System (GIS) database, or similar format. The database has not yet been completely developed, and Atlantic Richfield/BSB will be working with the Agencies to finalize the database. This is a long-term project with access to the database provided to many interested parties. Any addendums or revisions to this QAPP will be electronically distributed to all parties identified on the distribution list.

3.0 MEASUREMENT AND DATA ACQUISITION

This section addresses all aspects of project design and implementation for generating and acquiring data. Adhering to the procedures provided in Attachment C in this QAPP and described in this section ensures that the appropriate methods for sampling, sample handling, laboratory analyses, field and laboratory QC, instrument/equipment testing, inspection, maintenance, instrument/equipment calibration, data management, and data security are followed.

3.1 Property Access

Non-residential RMAP sampling occurs at a combination of third-party and BSB-owned properties (see Figures 5 and 6). Prior to conducting any sampling or cleanup activities at a third-party property, access must be obtained from the property owner in the form of an executed sampling access agreement (see Attachment B). To gain access to these properties, Program representatives will actively pursue access in the form of phone calls, text messaging, and in person visits. As required, up to three documented attempts to gain access will be made. After the third unsuccessful contact attempt, Program representatives will cease actively pursuing sampling access. The owner will still be allowed to request sampling on a test-by-request basis. Transfer of property ownership will reset the Program's attempts to gain access to zero. At that point, Program representatives will start over on documented attempts to gain sampling access with the new property owner. The Program will monitor ownership changes on an annual basis.

The Human Health/RMAP Division Manager (or designee) will manage requests for access, track the status of access requests, and maintain copies of completed agreements received from property owners. Completed agreements will be photocopied and scanned and the electronic

version stored on a hard drive. A copy of the access agreements will also be included in the project record files.

Any dispute concerning access should be brought to the attention of the Agencies. It is essential to begin access procurement as early as possible in the remedial process to avoid potentially lengthy delays. If access for response work cannot be reasonably obtained from a third-party owner, EPA may choose to use its authorities under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to secure access as provided in the current Unilateral Administrative Order (UAO) (EPA, 2011b) and any updated UAOs.

When access is denied (or the owner is deemed to be unresponsive through three unsuccessful contact attempts), Program representatives will track the attempt to gain access of the property for environmental assessment within the Program database. After three attempts are recorded, the property will be flagged in the database (as either having declined access or becoming non-responsive) and the Agencies will be notified of the property status. At this time, the Agencies may elect to issue the property owner an enforcement letter. A copy of the Agency notice form letter is provided in Attachment B-2. Future changes in ownership will be monitored annually. If ownership changes, the access procurement process will be reinitiated.

3.2 RMAP Composite Soil Sampling

All non-residential RMAP soil sampling work associated with schools, play areas, gardens, and non-residential daycares will be conducted as described below and as in Table 4 to determine the presence of the COCs listed in Table 1. Field personnel will follow the procedures in the SOPs (Attachment C-1) and will record all information in the field logbook/data collection device. These RMAP non-residential parcels will be broken down into sampling components and characterized by five land use categories:

- Land Use Category #1 – This category consists of playground areas. This will typically be defined as the area around playground equipment such as swings, slides, jungle gyms, and other types of equipment.
- Land Use Category #2 – This category consists of high accessible areas near school buildings such as school courtyards. Also contained within the category will be barren sports areas such as a baseball/softball infield.
- Land Use Category #3 – This category consists of maintained grassy areas such as sodded school grounds and turf covered sports fields.
- Land Use Category #4 – This category consists of low use/low maintenance areas that are rarely accessed by children. Examples include school grounds that are fenced off to restrict access by students.
- Land Use Category #5 – This category consists of vegetable and/or flower gardens.

Sample request paperwork will be pursued by program representatives for all non-residential RMAP parcels. Current school/non-residential daycare parcels are listed in Table 5. Table 5 is believed to be comprehensive. If additional relevant parcels are identified through future Stakeholder meetings, these additional parcels will be considered for inclusion on the RMAP

sampling list. Butte-Silver Bow County will catalogue action items and document milestones in the Program database. The EPA will be notified prior to initiating any RMAP sampling events.

Consistent with how residential sampling logic does not change for parcels within or outside the BPSOU, all non-residential RMAP parcels within the 2020 RMAP Area (see Figure 1) will be characterized and sampled per the requirements of this section regardless of geographic location within the 2020 RMAP Area. This will ensure proper characterization of all non-residential parcels regardless of their location in relation to the BPSOU boundary.

Generally speaking, the property boundary will be used to establish the extent of the sample area. Exceptions to this rule will include, but are not limited to, school areas that are inaccessible to children due to existing fencing, heavy existing cover (e.g., trees), and steep terrain. Field sampling plans will be developed for each parcel and submitted to the Agencies for review and approval prior to beginning sampling work. The procedures for RMAP soil sampling are summarized below.

3.2.1 Sample Density, Location, and Compositing

Sample locations within sampling components will be determined by sampling personnel based upon site-specific conditions. Non-residential RMAP sampling density and compositing decisions will be made dependent upon current land use determinations.

Soil subsamples will not be collected from an area between adjacent structures where the distance between the structures is less than 3 feet.

The decision to collect additional "opportunistic" samples will be made in the field by the sampling crew personnel and/or Agency personnel during the time of sampling. Opportunistic samples will be collected of suspect piles, discolored materials, or notable barren areas greater than approximately 25 feet by 25 feet in area. All opportunistic samples collected will be comprised of a minimum of 3 subsamples.

Soil samples for mercury analysis for this project will be collected by removing a subsample aliquot from the homogenized sample contained in the resealable plastic bag (e.g., Ziploc®) during the sample collection process and placed in glass containers. This process helps to ensure sample representativeness between the sample aliquots. According to Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. EPA Publication SW 846, the sample jars for mercury analysis will be shipped from the field on ice to the primary laboratory.

The project soil samples collected in resealable plastic bags for arsenic and lead will be shipped from the field and stored by a second laboratory at ambient temperature conditions.

If the Agency representative or property owner chooses to collect split samples, an adequate quantity of soil will be made available by the sampler at the time of sample collection. However, the Agency representative or property owner will be responsible for providing sample containers and coolers, etc.

3.2.1.1 Land Use Category #1 (Playground Areas)

For Land Use Category #1 sampling components, subsamples will be collected from a minimum of 3 subsample locations or at a rate of 1 subsample per 625 square feet (ft^2) (25 feet by 25 feet) in surface area per sampling component, whichever is greater. Subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury. Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single composite sample will be 6,250 ft^2 (meaning a maximum of 10 subsamples will be collected from any single Land Use Category #1 sampling component) (see Table 1).

Samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analyses. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Sample volumes will consist of approximately 500 to 800 grams of material. Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

3.2.1.2 Land Use Category #2 (Highly Accessible Areas/Barren Sports Fields)

For Land Use Category #2 sampling components, subsamples will be collected from a minimum of 3 subsample locations or at a rate of 1 subsample per 625 ft^2 (25 feet by 25 feet) in surface area per sampling component, whichever is greater. Subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury. Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single composite sample will be 9,375 ft^2 (meaning a maximum of 15 subsamples will be collected from any single Land Use Category #2 sampling component) (see Table 1).

Samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analyses. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Sample volumes will consist of approximately 500 to 800 grams of material. Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

3.2.1.3 Land Use Category #3 (Maintained Grass Areas/Grass Sports Fields)

For Land Use Category #3 sampling components, subsamples will be collected from a minimum of 3 subsample locations or at a rate of 1 subsample per 2,200 ft^2 in surface area per sampling component, whichever is greater. Subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury. Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single composite sample will be 10,890 ft^2 (meaning a maximum of 5 subsamples will be collected from any single Land Use Category #3 sampling component) (see Table 1).

Samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analyses. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Sample volumes will consist of approximately 500 to 800 grams of material. Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

3.2.1.4 Land Use Category #4 (Low Access Areas/Low Maintenance Areas/Open Space)

For Land Use Category #4 sampling components, subsamples will be collected from a minimum of 3 subsample locations or at a rate of 1 subsample per 2,200 ft^2 in surface area per sampling component, whichever is greater. Subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury. Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single composite sample will be 21,780 ft^2 (meaning a maximum of 10 subsamples will be collected from any single Land Use Category #4 sampling component) (see Table 1).

Samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analyses. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Sample volumes will consist of approximately 500 to 800 grams of material. Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

3.2.1.5 Land Use Category #5 (Flower/Vegetable Gardens)

In order to limit disturbance in small components (such as vegetable and flower gardens), only one sample location will be used when the component area is approximately 50 ft^2 or less in area. For Land Use Category #5 sampling components greater than 50 square feet in area, subsamples will be collected from a minimum of 2 subsample locations or at a rate of 1 subsample per 625 ft^2 in surface area per sampling component, whichever is greater. When applicable, subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury. Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single composite sample will be 3,125 ft^2 (meaning a maximum of 5 subsamples will be collected from any single Land Use Category #5 sampling component) (see Table 1).

Samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analyses. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Sample volumes will consist of approximately 500 to 800 grams of material. Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

3.2.2 Sample Depths

Three depth samples will be collected from each identified component. There will be 1 surface sample (0 to 2 inches below ground surface [bgs]) along with 2 subsurface samples (2 to 6 inches bgs and 6 to 12 inches bgs).

Because most of these sampling components are expected to be covered with a turf mat, the surface sample will be collected immediately beneath the vegetative mat (sod), or in the absence of vegetation, 0 to 2 inches bgs. If a vegetative mat is present, it will be separated from the soil surface with a stainless steel knife or equivalent. The removed vegetative mat will be shaken and scraped over the sample collection container to dislodge any mineral soil particles. All dislodged soil particles will be included in the composite sample.

Exceptions to this procedure will occur when the sample location falls on a graveled driveway or similar surface. If the surface material is coarse-grained and free of intermixed materials, the sample will be collected from the 0- to 2-inch soil layer immediately beneath the coarse materials. However, if the graveled driveway or similar surface contains fine soil material on the surface, the sample will be collected from the surface (0- to 2-inch) layer.

Gardens will be subject to additional subsurface sampling. In addition to the 3 depth samples described above, 2 additional subsurface samples will be collected from the 12- to 18-inch and 18- to 24-inch depth intervals, for a total of 5 depth samples within a vegetable or flower garden.

3.2.3 Previously Sampled Properties

Butte-Silver Bow County will review the Program database to identify properties that were previously sampled but have incomplete data sets (e.g., lack of all required analyte and/or depth interval data). This information will be provided to the Agencies in the form of FSP submittals. Property owners of these previously partially sampled properties will be contacted to request access to conduct additional sampling to fill the data gaps. The goal will be to produce a complete data set that includes data for all required depth intervals and analytes.

Areas of the property that were sampled at the 0- to 2-inch depth interval and remediated will not be resampled because these components have already been remediated to a 12-inch depth.

3.2.4 Soil Sample Equipment Decontamination

Reusable equipment will be decontaminated between sampling sites in accordance with manufacturer's recommendations and established SOPs (Attachment C-1) prior to being reused. Equipment used for sample homogenization or scoops used for sample bagging or subsampling for mercury analysis will be single-use, disposable equipment. Decontamination solutions may be disposed of to the ground surface, in the same general area in which soil sampling occurred. Disposable supplies will be collected by the field team leader and disposed of at the BPSOU Mine Waste Repository or local landfill as appropriate.

3.2.5 Soil Sample Preparation Methods

The temperature upon mercury sample receipt is measured and recorded by the laboratory on sample condition upon receipt documentation. The samples will be stored chilled (less than or equal to 6 degrees Celsius [°C], but not frozen) in temperature-monitored refrigerators prior to laboratory digestion and analysis within 28 days of sample collection. The mercury digestion and analysis will be performed on "wet" sample aliquots and reported on a dry weight basis.

The project soil samples collected in resealable plastic bags for lead and arsenic will be shipped from the field and stored by a second laboratory at ambient temperature conditions. The soil samples will undergo sample drying and sieving (within approximately 5 days of collection) prior to ambient shipment of the dried sample to the primary laboratory for sample digestion and analysis for lead and arsenic.

Sample preparations and analyses will be in accordance with the EPA analytical method specifications provided below as well as standard laboratory practices. Specifically, the soil samples must be measured for percent moisture and prepared for metals analyses. Samples must be sieved using a No. 60 sieve to obtain the fine fraction, less than 250 micrometers or microns (µm) for metals analyses. The remaining coarse fraction will be placed in a new plastic bag labeled with the original sample number, date of sieving, and "Coarse Fraction" and then archived along with the remaining fine fraction until the criteria for sample disposal is met (see Section 3.8). The weight of the coarse fraction and the fine fraction will be measured and recorded by the laboratory for each soil sample prepared in this manner. The SOPs addressing soil sieving are included in Attachment C-2. The laboratory SOPs provided are developed for multiple projects and clients. In the event of a discrepancy between QAPP text and laboratory SOPs, the QAPP text shall take precedence.

Consistent with prior sampling programs, samples will be sieved to the less than 250 µm fraction, reflecting the fine fraction of soil most likely to adhere to children's hands. More recent EPA guidance (EPA OLEM Directive 9200.1-128) requires sieving to less than 150 µm based on studies that show lead enrichment in very fine soil fractions (e.g., less than 63 µm). There are no data adequate to predict if the less than 150 µm fractions might be detectably enriched as compared with the less than 250 µm fraction. In light of this uncertainty, EPA has agreed with use of the less than 250 µm fraction for the 2021 sampling program while a particle size enrichment demonstration study is planned and conducted.

3.2.6 Soil Sample Collection Equipment

Soil samples are collected using primarily hand tools and are limited to readily available products. If supplies should be exhausted, replacement supplies can be purchased at nearby retailers. Hand tools may include sampling probe, Sharpshooter® type shovels, and heavy duty 5- to 6-foot steel pry bars. Single-use scoops and protective (latex/nitrile) gloves will be used to collect and mix the samples. Resealable plastic bags will be used as sample containers for those samples requiring arsenic and lead analyses. Those samples requiring mercury analysis will use glass sample jars as sample containers.

3.3 RMAP ISM Soil Sampling

Non-residential RMAP soil sampling work associated with portions of park parcels that will be sampled using ISM are described below and in Table 4 to determine the presence of the COCs listed in Table 1. Field personnel will follow the procedures in the SOPs (Attachment C-1) and will record all information in the field logbook/data collection device. These RMAP non-residential park parcels will be broken down into sampling components and characterized by five land use categories. Land use categories 1, 2, and 5 will be sampled according to the composite sampling guidelines established in Section 3.2 (RMAP Composite Soil Sampling). The remaining land use categories may be sampled according to ISM as described below:

- Land Use Category #3 – This category consists of maintained grassy areas such as sodded lawn areas and turf-covered sports fields.
- Land Use Category #4 – This category consists of low use/low maintenance areas that are rarely accessed by children. Examples include areas that are fenced off to restrict access by the public or typical open space areas comprised of unmaintained natural vegetation.

Sample request paperwork will be pursued by program representatives for all non-residential RMAP parcels. Current park/playground/open area parcels that are presumed eligible for RMAP soil sampling are listed in Table 6. Current park/playground/open area parcels that are presumed to be ineligible for RMAP soil sampling are listed in Table 7. Tables 6 and 7 are believed to be comprehensive but vetting with BSB and the Agencies is on-going. If additional relevant parcels/information are identified through future Stakeholder meetings, these tables will be updated as needed through future QAPP revisions. Butte-Silver Bow County will catalogue action items and document milestones in the Program database. The EPA will be notified before initiating any RMAP sampling activities.

Consistent with how residential sampling logic does not change for parcels inside or outside the BPSOU, all non-residential RMAP parcels within the 2020 RMAP Area (see Figure 1) will be characterized and sampled per the requirements of this section regardless of geographic location within the 2020 RMAP Area. This will ensure proper characterization of all non-residential parcels regardless of their location in relation to the BPSOU boundary.

Generally speaking, the property boundary will be used to establish the extent of the park sampling area. Exceptions to this rule will include, but are not limited to, areas that are inaccessible to the public. These cases will be addressed on an individual basis through conversations with Agency personnel. Field sampling plans will be developed for each parcel and submitted to the Agencies for review and approval prior to beginning sampling work. The procedures for RMAP ISM soil sampling are summarized below.

3.3.1 Sample Density, Location, and Compositing

Incremental sampling locations will be based on a pre-determined sampling grid detailed in the FSP. Specific sampling locations within each gridded area will be pseudo random and will be determined by sampling personnel based upon site-specific conditions with the goal of achieving as much geographic distribution as possible. Incremental density and compositing decisions will

be made dependent upon current land use determinations and as documented in the Agency-approved FSP.

Soil subsamples will not be collected from an area between adjacent structures where the distance between the structures is less than 3 feet.

The decision to collect additional "opportunistic" samples will be made in the field by the sampling crew personnel and/or Agency personnel during the time of sampling. Opportunistic samples will be collected according to the composite sampling guidelines established in Section 3.2 (RMAP Composite Soil Sampling). Any areas associated with opportunistic composite sampling will be deducted from the appropriate ISM areas and calculations (as appropriate).

Soil samples for mercury analysis for this project will be collected by removing and placing in glass containers a subsample aliquot from the homogenized sample contained in the resealable plastic bag during the sample collection process (see Table 4). To further ensure homogenization and representativeness, the aliquots for the mercury subsample will be obtained from several areas of the homogenized sample bag using a clean scoop. This process helps to ensure sample representativeness between the sample aliquots. According to *Test Methods for Evaluating Solid Waste Physical/Chemical Methods, U.S. EPA Publication SW 846*, the sample jars for mercury analysis will be shipped from the field on ice to the primary laboratory.

The project soil samples collected in resealable plastic bags for arsenic and lead analyses will be shipped from the field and stored by a second laboratory at ambient temperature conditions.

If the Agency representative or property owner chooses to collect split samples, an adequate quantity of soil will be made available by the sampler at the time of sample collection. However, the Agency representative or property owner will be responsible for providing sample containers and coolers, etc.

3.3.1.1 Land Use Category #3 (Maintained Grass Areas/Grass Sports Fields)

For Land Use Category #3 incremental DUs, subsamples will be collected from a minimum of 30 incremental subsample locations or at a rate of 1 incremental subsample location per 4,400 ft^2 in surface area, whichever is greater. Subsamples from these locations will be composited in the field, and a single composite sample per depth interval will be analyzed for arsenic, lead, and mercury (see Table 4 and Field SOPs in Attachment C-1). Each subsample should have similar mass so that each location is equally represented in the total sample mass. The maximum area represented by a single incremental sample will be 440,000 ft^2 (meaning a maximum of 100 incremental subsample locations will be collected from any single Land Use Category #3 incremental sampling DU) (see Table 1).

Samples will be thoroughly homogenized in the field to ensure representativeness of the aliquot ultimately submitted for analyses (see Table 4 and Field SOPs in Attachment C-1). For the 0- to 2-inch depth interval, the entire composite sample will be submitted to the laboratory. For the 2- to 12-inch depth interval, a 1- to 1.5-kilogram sample will be submitted to the laboratory (see

Table 4 and Field SOPs in Attachment C-1). Samples will be submitted to the laboratory by the samplers under chain of custody procedures.

Land Use Category #3 areas equal to or less than ¼ acre in area will be sampled according to the composite sampling guidelines established in Section 3.2 (RMAP Composite Soil Sampling).

3.3.1.2 Land Use Category #4 (Low Access Areas/Low Maintenance Areas/Open Space)

ISM samples for Land Use Category #4 will be collected using the sampling methodology as described above for Land Use Category #3 (Section 3.3.1.1).

Land Use Category #4 areas equal to or less than ½ acre in area will be sampled according to the composite sampling guidelines established in Section 3.2 (RMAP Composite Soil Sampling).

3.3.2 Sample Depths

Two depth samples will be collected from each identified component. There will be 1 surface sample (0 to 2 inches bgs) and 1 subsurface sample (2 to 12 inches bgs).

Because most of these sampling DUs are expected to be covered with a turf mat, the surface sample will be collected immediately beneath the vegetative mat (sod). If a vegetative mat is present, it will be separated from the soil surface with a stainless steel knife or equivalent. The removed vegetative mat will be shaken and scraped over the sample collection container to dislodge any mineral soil particles. All dislodged soil particles will be included in the incremental sample.

3.3.3 Previously Sampled Properties

Butte-Silver Bow County will review the Program database to identify properties that were previously sampled but have incomplete data sets (e.g., lack of all required analyte and/or depth interval data). This information will be provided to the Agencies in the form of FSP submittals. Property owners of these previously partially sampled properties will be contacted to request access to conduct additional sampling to fill the data gaps. The goal will be to produce a complete data set that includes data for all required depth intervals and analytes.

Areas of the property that were sampled at the 0- to 2-inch depth interval and remediated will not be resampled because these components have already been remediated to a 12-inch depth.

3.3.4 Soil Sample Equipment Decontamination

Reusable equipment will be decontaminated between ISM replicate samples according to the manufacturer's recommendations and established SOPs (Attachment C-1) before being reused. This includes equipment used for field sample homogenization. Procedures for appropriately decontaminating reusable equipment are as follows:

1. Remove excess soil particles from the equipment prior to "gross wash." This may be achieved by using a dedicated stiff brush or other hand tool such as a flat head screwdriver.
2. Remove gross contamination by manually scrubbing the equipment in the 5-gallon bucket of tap water marked *Gross Wash* and a stiff brush (dedicated to the gross was step).
3. Move the equipment to the 5-gallon bucket marked *Soap Wash*. Wash equipment in solution of tap water and soap (no phosphate, such as Liquinox©) with a stiff brush (dedicated to the soap wash step).
4. Triple rinse the equipment in the 5-gallon bucket with deionized (DI) water marked *DI Rinse* to remove any soap residue.
5. Perform a second triple rinse of the equipment in a bucket with DI water marked *Final Rinse.* Alternatively, a designated pressurized hand spray bottle (i.e., 2-gallon lawn and garden sprayer) with DI water may be used for final rinse stage.
6. Place equipment on plastic sheeting or foil to air dry.
7. Wrap equipment in foil or plastic wrap to transport or store.
8. Clean decontamination equipment:
    a. Triple rinse equipment from the *Gross Wash* and *Soap Wash* (brushes and buckets) with clean tap water, preferably with pressurized water. Soap can be used on particularly dirty equipment.
    b. Triple rinse all decontamination equipment with DI water, including *DI Rinse* and *Final Rinse* buckets.
    c. Store decontamination equipment, labeled and in a clean location so they are used only for decontamination purposes.

Scoops used for sample bagging or subsampling for mercury analysis will be single-use disposable equipment. Decontamination solutions may be disposed of to the ground surface, in the same general area in which soil sampling occurred. Disposable supplies will be collected by the field team leader and disposed of at the BPSOU Mine Waste Repository or local landfill, as appropriate. Field equipment "rinsate blanks" will be collected on reusable equipment to ensure proper decontamination is being achieved, as describe in Section 3.7 below.

3.3.5 Soil Sample Preparation Methods

Soil samples collected using the ISM methodology are subject to both field soil sample preparation methods and laboratory preparation methods (see Table 4). Soil collected from each depth interval from each increment within the Decision Unit will be composited into a 5-gallon bucket for field homogenization. Field homogenization and representative aliquot subsampling will be performed according to RMAP-SOP-2 located in Attachment C-1. Each ISM sample will be packaged and shipped, consistent with procedures detailed in the SOPs, to the appropriate laboratory facility for sample preparation and analysis.

The temperature upon mercury sample receipt is measured and recorded by the laboratory on Sample Condition Upon Receipt documentation. The samples will be stored chilled (less than or

equal to 6 °C, but not frozen) in temperature-monitored refrigerators before laboratory digestion and analysis within 28 days of sample collection. The mercury digestion and analysis will be performed on "wet" sample aliquots and reported on a dry weight basis.

The project soil samples collected in resealable plastic bags for lead and arsenic analyses will be shipped from the field and stored by a second laboratory at ambient temperature conditions. The soil samples will undergo sample drying and sieving (within approximately 5 days of collection) prior to ambient shipment of the dried sample to the primary laboratory for sample digestion and analysis for lead and arsenic.

Sample preparations and analyses will be conducted according to EPA analytical method specifications provided below as well as standard laboratory practices (SOPs provided in Attachment C-2). Specifically, the soil samples must be measured for percent moisture and prepared for metals analyses. Samples must be sieved using a No. 60 sieve to obtain the fine fraction, less than 250 µm, for metals analyses. The remaining coarse fraction will be placed in a new plastic bag labeled with the original sample number, date of sieving, and "Coarse Fraction" and then archived along with the remaining fine fraction until the criteria for sample disposal is met (see Section 3.8). The weight of the coarse fraction and the fine fraction will be measured and recorded by the laboratory for each soil sample prepared in this manner. The SOPs addressing soil sieving are included in Attachment C-2. The laboratory SOPs provided are developed for multiple projects and clients. In the event of a discrepancy between QAPP text and laboratory SOPs, the QAPP text shall take precedence.

Consistent with prior sampling programs, samples will be sieved to the less than 250 µm fraction, reflecting the fine fraction of soil most likely to adhere to children's hands. More recent EPA guidance (EPA OLEM Directive 9200.1-128) requires sieving to less than 150 µm based on studies that show lead enrichment in very fine soil fractions (e.g., less than 63 µm). There are no data adequate to predict if the less than 150 µm fractions might be detectably enriched as compared with the less than 250 µm fraction. In light of this uncertainty, EPA has agreed with using the less than 250 µm fraction for the 2021/2022 sampling program while a particle size enrichment demonstration study is planned and conducted.

3.3.6 Soil Sample Collection Equipment

Soil samples are collected using soil sampling probes typically only available through specialized online retailers. Sampling crews will attempt to use 1½-inch diameter soil probes to minimize disturbance within park lawn areas. Site conditions may prompt use of larger diameter soil probes. If sampling probes become damaged or exhausted, replacements can be ordered. Field soil homogenization equipment will consist of a battery powered portable mortar mixer equipped with stainless steel paddle, typical 5-gallon poly bucket or equivalent suitable plastic container/tray, portable table, stainless steel trowels or an equivalent tool for splitting samples, and Visqueen® or equivalent poly sheeting for sample containment. All reusable equipment is subject to the decontamination procedures as outline above in Section 3.3.4. Single-use scoops and protective (latex/nitrile) gloves will be used to collect and mix the subsamples. Resealable plastic bags will be used as sample containers for those samples requiring arsenic and lead analyses. Those samples requiring mercury analysis will use glass sample jars as sample

containers. The remaining equipment can be procured locally and some may be provided by the laboratory.

3.4 Sample Handling and Chain of Custody

After collection and labeling, the samples will be maintained under strict chain of custody protocols, in accordance with the sample packaging SOP (Attachment C-1). The field sampling personnel will complete a chain of custody form for each shipment/delivery (i.e., batch of coolers) of samples to be delivered to the laboratory for analysis. The coolers containing sample jars for mercury analysis will be shipped from the field on ice to the Pace Analytical Services, LLC in Minneapolis, Minnesota (1700 Elm Street SE, Minneapolis, MN 55414) for analysis. The coolers containing project soil samples collected in resealable plastic bags for lead and arsenic will be shipped from the field at ambient temperature conditions to the Pace Analytical Services, LLC in Green Bay, Wisconsin (1241 Bellevue Street, Suite 9, Green Bay, WI 54302) for drying and sieving. The chain of custody will clearly differentiate between incremental sampling methodology (Section 3.3) and standard composite soil sampling (Section 3.2). Additionally, composite and incremental soil samples will be segregated onto separate chain of custody documents based on site and sampling methodology. This is necessary as each sampling methodology is subject to unique field quality control procedures/samples. For example, composite samples are subject to field duplicate sample collection for QA/QC while ISM sample QA/QC is achieved by collecting the three replicates. Conversely, composite samples use single use disposable equipment that does not require a field decontamination quality control sample while ISM uses reusable sampling equipment that requires decontamination between ISM replicate samples and is therefore subject to field decontamination quality control. Upon completion of drying/sieving activities, these samples will be shipped to the Pace Analytical Services, LLC in Minneapolis for analysis. Jennifer Anderson is the Pace Analytical Services, LLC, point of contact.

The sampler is responsible for initiating and filling out the chain of custody form. The chain of custody for a shipment/delivery will list only those samples in that shipment/delivery. Any documentation, including chain of custody, should be placed inside a resealable plastic bag, within the shipment/delivery container. Coolers which are to be shipped will be custody sealed, securely taped shut, and have a shipping label securely adhered to the cooler.

The sampling personnel whose signature appears on the chain of custody form is responsible for the custody of the samples from the time of sample collection until custody of the samples is transferred to a designated laboratory, a courier, or to another project employee for the purpose of transporting the samples to the designated laboratory. Custody is transferred when both parties to the transfer complete the portion of the chain of custody under "Relinquished by" and "Received by." Signatures, printed names, company names, dates and times are required. Upon transfer of custody, the sampling personnel who relinquished the samples will retain the third sheet (pink copy), photocopy, or electronic copy of the chain of custody. When the samples are shipped by a common carrier, a Bill of Lading supplied by the carrier will be used to document the sample custody, and its identification number will be entered on the chain of custody. Copies, receipts, and carbons of Bills of Lading will be retained as part of the permanent documentation in the project file. It is not necessary for courier personnel to sign the chain of custody.

Upon receipt by the laboratory, the samples will be inspected for sample integrity. The chain of custody will be immediately signed, dated, and reviewed by laboratory personnel to verify completeness. Any discrepancies between the chain of custody and sample labels and any problems or questions noted upon sample receipt will be communicated immediately to the Field Team Leader. The laboratory will provide the Field Team Leader and/or the QA Manager with a copy of the chain of custody and associated sample receipt information within two working days of receipt of samples. The sample-receipt information routinely provided will include sample receipt date, sample IDs transcribed from the chain of custody sample matrix type, and list of analyses to be performed for each sample. Broken custody seals, damaged sample containers, sample labeling discrepancies between container labels and the chain of custody form, and analytical request discrepancies will be noted on the chain of custody form. The Field Team Leader and QA Manager will be notified of any such problems and the discrepancies or non-conformances will be resolved and addressed before the samples are analyzed.

The laboratory will be responsible for following their internal custody procedures from the time of sample receipt until sample disposal. Samples and extracts will be stored in a secure area controlled by the laboratory's designated sample custodian. Samples will be removed from the shipping container and stored in their original containers unless damaged. Damaged samples will be disposed of in an appropriate manner after notifying the Field Team Leader and QA Manager, and authorization to dispose is received and documented. In addition, samples will be stored after completion of analyses in accordance with contractual requirements.

3.5 Sample Identification

The RMAP sample identification procedures are detailed in this section. An alphanumeric coding system will be used to uniquely identify each sample collected during RMAP sampling events. Sample identifiers will begin with the matrix, followed by the RMAP Database Resident ID. The Resident ID is a unique identifier that is associated with a specific property (address and/or geocode specific). Following the Resident ID will be the parcel component, QA/QC Code (when applicable), and sample depth.

Matrix:

S – Soil

RMAP Database Resident ID: (example of R-00001)

Site Property Codes:

C – Commercial

P – Park

S – School

Resident ID:

00001 – associated with a specific address or geocode

Parcel Component:
Component ID's will be derived on a site-specific basis during development of the Sample Location Map and refined by the sampling team (as necessary). Examples of Component IDs are listed below.

PA – Playground Area (Land Use Category #1)
HA – High Access Area (Land Use Category #2)
GA – Maintained Grass Area (Land Use Category #3)
LA – Low Access Area (Land Use Category #4)
G – Flower/Vegetable Garden (Land Use Category #5)
OP – Opportunistic Sample
BA - Bare Area
SA - Source Area
IS – ISM Area

Quality Control/Quality Assurance Codes:

D – Field Duplicate
R – Sample Processing Replicate
B – Field Equipment Rinsate Blank

Depth Intervals: Depth intervals are only applicable to soil sampling events.

1. 0 to 2 inches bgs
2. 2 to 6 inches bgs
3. 6 to 12 inches bgs
4. 12 to 18 inches bgs (flower/vegetable gardens only)
5. 18 to 24 inches bgs (flower/vegetable gardens only)
6. 0 to 2 inches bgs (ISM Samples)
7. 2 to 12 inches bgs (ISM Samples)

Replicate Sample ID (for ISM Samples only):

A: Replicate Sample #1 for an ISM DU
B: Replicate Sample #2 for an ISM DU
C: Replicate Sample #3 for an ISM DU

An example sample identification would be S-S-0001-PA-2. This indicates that the soil sample was collected at the School with the Resident ID S-0001 (corresponding to a physical address and/or geocode) in a playground area at the 2 to 6-inch depth interval. The sample identification for a field duplicate collected at this location would be S-S-0001-PA-D-2.

A second example sample identification would be: P-0024-IS2-7B. This indicates that the soil sample was collected at the park with the Resident ID P-0024 (corresponding to a physical address and/or geocode) in incremental sampling polygon IS2 at the 2 to 12-inch depth interval. This also indicates that this sample was the second of three ISM replicate samples for this DU. The sample identification for a field equipment rinsate blank collected at this location would be P-0024-IS2-7B-B.

Sample identifiers will be documented in field logbooks/data collection device and on the chain of custody forms, as required by the RMAP Field SOPs located in Attachment C-1.

3.6 Analyses Methods

The subsections below describe analytical methods the respective laboratories must use to analyze RMAP samples.

3.6.1 Soil Sample Analysis Method

All RMAP soil samples will be analyzed to determine metals concentrations via standard laboratory analytical methodologies for arsenic, lead, and mercury. Sample preparations and analyses will be in accordance with the referenced EPA analytical method specifications as well as standard laboratory practices. Samples collected by standard composite sampling techniques (Section 3.2) will use a portion of the field and laboratory homogenized field sample (approximately 2 cups of material) from the zipper-style bag for air-dry and sieve sample preparation prior to digestion. The amount of field homogenized incremental sample (Section 3.3) that will be air-dried and sieved prior to digestion will vary depending on the depth interval. For the 0- to 2-inch depth interval, the entire composited incremental sample will be submitted to the laboratory. For the 2- to 12-inch depth interval, a 1- to 1.5-kilogram sample will be submitted to the laboratory (see Table 4 and Field SOPs in Attachment C-1).

Laboratory personnel will place the sample onto a tray lined with brown freezer paper. The paper will be folded to create a "boat" to contain the sample and prevent loss or potential cross contamination during the drying process. The soil sample will be spread across the entire tray surface, and pieces greater than ½ inch will be broken by hand. New gloves will be used between each sample to prevent cross contamination. ISM samples may require multiple trays for sample drying due to increased sample mass. The trays will be placed on racks and into a room temperature closet containing fans and dried overnight. If samples are not completely dried the next day, the samples will be dried for an additional time.

Once dried, the sample trays will be removed from the closet and additional disaggregation will be performed by hand. Rocks, twigs, and other foreign material will be removed and set aside. Disaggregation is defined as a process for loosening the clump soil and around rocks. This process is not a grinding process. The soil is further disaggregated by placing a piece of butcher paper (wax side up) on top of the tray and using a 2.2-kilogram marble rolling pin. The rolling pin is rolled over the dried soil for 1 to 2 minutes in several directions. No downward pressure is applied to the rolling pin. Alternative methods are also suggested such as a rubber mallet as long as no crushing of rocks was performed in accordance with the SOP.

Both the standard composite sample and incremental samples will be sieved at room temperature. The sample will be sieved to 250 µm. The entire portion of 250 µm material will be placed in a resealable plastic bag, sealed, labeled, and transferred to Pace Analytical Services, LLC in Minneapolis. The fine fraction of the sieved soil will be further homogenized in a sealed bag by gently rolling the sample bag on a laboratory bench, such that fine materials less than 250 µm are not segregated. The sample will then be flattened into all sections of the bag thereby

creating a slab cake for sample aliquoting for digestion. The bag will be opened, and a portion from each of six areas of the bag will be removed and placed in a sample tube to digest approximately 1 gram of material. The sample aliquots will be digested according to modified EPA Method 3050B, and arsenic and lead concentrations will be determined per EPA Method 6010 (ICP-AES) or EPA Method 6020 (ICP-MS).

Mercury concentrations will be determined per EPA Method 7471B (Manual Cold-Vapor Technique) on the wet sample collected in the field as a subsample from the homogenized sample bag. The laboratory SOPs for EPA Methods soil sieving for standard composite and incremental sampling, 3050B, 6010, 6020A, and 7471B are included in Attachment C-2. The laboratory SOPs provided are developed for multiple projects and clients. In the event of a discrepancy between QAPP text and laboratory SOPs, the QAPP text shall take precedence.

3.6.2 Laboratory Quality Control Samples

As outlined above in Sections 3.6.1, RMAP soil samples will be analyzed to determine metals concentrations (arsenic, lead, and mercury) via standard laboratory analytical methodologies. Laboratory QC procedures are outlined below.

All analyses will be governed by the appropriate calibration procedures and frequencies that are specified in the laboratory's SOPs (see Attachment C).

Laboratory QC samples will be analyzed in addition to the calibration samples with each QC batch. Laboratory QC samples are introduced into the measurement process to evaluate laboratory performance and sample measurement bias. Control samples may be prepared from environmental samples or generated from standard materials in the laboratory.

Laboratory blanks, laboratory control samples, analytical duplicates, serial dilutions, and pairs of matrix spike/matrix spike duplicate (MS/MSD) samples will be analyzed in each laboratory QC batch with a minimum frequency of 1 each per 20 field samples. If less than 20 field samples are submitted, then 1 set of these QA/QC samples will still be run with the set of less than 20 samples. A second MS sample is not necessary for all laboratory QC batches that already have one MS/MSD.

Laboratory Blanks

Method blanks will be used to monitor laboratory processes and performance. A method blank is a volume of deionized water or a specified weight of inert material for solid samples that is carried through the entire sample preparation and analyses procedures. The method blank volume or weight will be approximately equal to the sample volumes or sample weights being processed. Method blanks are used to monitor interference caused by constituents in solvents and reagents and on glassware and other sampling equipment. Method blank results outside of specified control limits will be rerun/redigested and reanalyzed with all associated samples and/or flagged by the laboratory per the QC requirements of the analytical method. Initial and continuing calibration blanks are also analyzed every 10 samples and samples are reanalyzed within compliant blank analyses. All elements of interest must be evaluated to plus or minus the reporting limit (RL) for Method 6020.

Laboratory Control Samples
A LCS, or a blank spike, is an aqueous or solid control sample of known composition that is analyzed using the same sample preparation, reagents, and analytical methods employed for the Program samples. The LCS is obtained from an outside source or is prepared in the laboratory by spiking reagent water or a clean solid matrix from a stock solution that is different from that used for the calibration standards. The LCS is the primary indicator of process control used to demonstrate whether the sample preparation and analytical steps are in control, apart from sample matrix effects. If the LCS recovery falls outside the specified control limits, the LCS is reanalyzed once. If reanalysis of the LCS fails, all samples affected by the failing LCS elements need to be redigested and reanalyzed.

Analytical Duplicates
Analytical duplicates are samples that are split in the laboratory at some step in the measurement process and then carried through the remaining steps of the process. Duplicate analyses provide information on the precision of the operations involved. Analytical duplicates are a pair of subsamples from a field sample that are taken through the entire preparation and analyses procedure; any difference between the results indicates the precision of the entire method in the given matrix. Analyses of analytical duplicates and matrix spike duplicates monitor the precision of the analytical process. The frequency of analyses, precision goals, and corrective action information pertaining to analytical duplicates are provided in the laboratory SOPs (Attachment C). If the analytical duplicate precision falls outside the specified control limits, the samples will be rerun and/or flagged by the laboratory per the QC requirements of the analytical method.

Serial Dilutions
Serial dilutions are performed in conjunction with EPA Method 6010 or 6020 to determine whether significant physical or chemical interferences exist due to sample matrix. A serial dilution is performed by analyzing a 5-fold dilution of a field sample (field blanks may not be used) and calculating the percent difference between the original determination and the serial dilution result. Serial dilutions are only applicable for analyte concentrations that are greater than 50 times the MDL. The frequency of analyses, precision goals, and corrective action information pertaining to serial dilutions are provided in the laboratory SOPs in Attachment C.

Matrix Spikes
Laboratory MS samples are used to evaluate potential sample matrix effects on the accurate quantitation of an analyte using the prescribed analytical method. The MS/MSDs are prepared by adding an analyte to a subsample of a field sample before sample preparation and analyses. A percent recovery is calculated from the concentrations of the analyte in the spiked and un-spiked samples. Perform a post digestion spike on any elements that fail to meet criteria. If the %R for the MS and MSD falls outside the control limits, the results are flagged by the laboratory that they are outside acceptance criteria along with the parent sample.

Additional Quality Control Samples
The laboratory will also analyze ICP/MS interference check, internal standards, and ICP/MS instrument tunes as part of the analytical sequence for Method 6020. These instrument QC samples will be evaluated against the method requirements during data validation.

Table 3 contains acceptance criteria for the QC samples detailed above.

3.7 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. All field QC samples will be delivered with field samples to the laboratory. This section includes brief descriptions of the QC samples to be collected during sampling activities along with frequency, collection, and analytical instructions.

Sampling protocols will be consistent with the Field SOPs included in Attachment C-1 and will include 1 field duplicate collected for every 20 composite primary samples or once per sampling event (e.g., once per sampling day), whichever is more frequent (in accordance with Level A/B field screening/data review criteria, Attachment D). All sampling equipment used for composite sampling is anticipated to be "one time use"; therefore, no external contamination blank/cross-contamination blank samples will be submitted unless the equipment is decontaminated and used between samples. Sampling equipment used for ISM sampling consists of reusable equipment and therefore 1 field equipment rinsate blank will be collected for every 20 ISM samples collected or once per sampling event (e.g., once per park sampled), whichever is more frequent (in accordance with Level A/B field screening/data review criteria, Attachment D). Any deviation from the SOPs or this QAPP will be identified in the logbook/data collection device and discussed in the annual DSR.

3.7.1 Field Duplicate (Composite Soil Samples)

A field duplicate consists of one well-mixed and homogenized sample that is split in the field into two samples and placed in different sample containers for separate analyses.

As with all other samples, samples to be split for duplicate samples will be thoroughly mixed in a clean 1-gallon resealable plastic bag or stainless steel bowl to ensure representativeness of the aliquot ultimately submitted for analysis. During this homogenization process, particles greater than 0.5 inches in diameter will be discarded. Once the homogenization process is complete, the natural sample is split into two samples. Each split will have its own sample number. Both split samples will be analyzed for identical chemical parameters. The results of the field duplicate will be compared to determine laboratory and sampling precision. Field duplicate samples will be collected at a frequency of 1 per 20 samples or once per sampling event (e.g., once per sampling day), whichever is more frequent. The RPD field precision goal for soil field duplicates will be 35% for sample pairs with both sample results being greater than 5 times the RL. For soil field duplicate/primary sample pairs with 1 or both sample results being less than 5 times the RL, an absolute difference of less than or equal to 2 times the RL (difference less than or equal to 2 times the RL) will be used as the precision goal. Laboratory precision goals are laboratory specific.

Field duplicates will not be collected for incremental sampling because three replicate samples are collected in each DU.

3.7.2 Sample Processing Replicate Samples (ISM Soil Samples)

A sample processing replicate sample consists of one homogenized sample that is collected from the field homogenized ISM replicate sample slab cake. The slab cake will be gridded into 30 equally sized sections and used to develop the sample processing replicate sample. Using the same procedure used for collecting the ISM replicate sample, the sample processing replicate will be collected using a new disposable square bottom plastic scoop to collect even subsample aliquots from each of the 30 grids in the slab cake. Each scoop is placed into an appropriate labeled quart resealable plastic bag. Enough material should be obtained to send approximately 1 to 1.5 kg to the laboratory (a near full quart sized resealable plastic bag). One sample processing replicate will be collected per ISM decision unit.

Each sample processing replicate will have its own sample number and will be analyzed for identical chemical parameters as the parent ISM sample. The results of the sample processing replicate will be compared to determine laboratory and sampling precision. The RPD field precision goal for sample processing replicates will be 35% for sample pairs with both sample results being greater than 5 times the RL. For processing replicate/primary sample pairs with 1 or both sample results being less than 5 times the RL, an absolute difference of less than or equal to 2 times the RL (difference less than or equal to 2 times the RL) will be used as the precision goal. Laboratory precision goals are laboratory specific.

3.7.3 Field Equipment Rinsate Blanks (ISM Soil Samples)

A field equipment rinsate blank consists of a sample collected after the decontamination of sampling equipment is completed and before sampling. Equipment rinsate blanks are collected by pouring distilled, deionized, or analyte free water through or over the cleaned sampling equipment and collecting the rinse in a nitric acid preserved 250-milliliter high-density polyethylene (HDPE) bottle. The goal of each field equipment rinsate blank is to confirm no measurable contamination is present. However, if contamination is measured, no additional corrective action can be taken at that time for that blank. The data validation process will evaluate the effects on sample data. Additional field corrective action can be taken on subsequently collected field equipment rinsate blanks through evaluation of the current practice and adding additional cleaning steps and rinsates to reduce the potential of equipment based cross contamination between DUs.

The aqueous results will be used to determine blank qualification during data validation. A minimum of 1 field equipment rinsate blank will be collected per 20 ISM samples or once per sampling event (e.g., once per park sampled), whichever is more frequent. Field equipment rinsate blanks are not necessary for one-use or disposable sampling equipment that is not being used for collection of more than 1 natural sample.

Aqueous field equipment rinsate blank samples will be analyzed to determine metals concentrations via standard laboratory analytical methodologies for arsenic, lead, and mercury. Sample preparations and analyses will be in accordance with the referenced EPA analytical method specifications as well as standard laboratory practices. Aqueous samples will be prepared

by EPA Method 3010A, and arsenic and lead concentrations will be determined per EPA Method 6010 (ICP-AES) or EPA Method 6020 (ICP-MS). Mercury concentrations will be determined by EPA Method 7470A: Mercury in Liquid Wastes (manual cold-vapor technique).

3.8 Sample Disposal

Soil samples shipped to the laboratory for analyses will be held until the laboratory analyses has been completed, the Agencies have reviewed and approved all subsequent project laboratory data and work plans, and the sample hold times have expired. At this point, the laboratory may dispose of samples or return them to BSB for disposal. Any excess soil mass that was not included in the aliquot submitted to the laboratory will be subject to the same disposal criteria.

3.9 Instrument/Equipment Testing, Inspection and Maintenance

To ensure continual quality performance of any instruments or equipment, the testing, inspection, and maintenance activities listed in the sections below will be performed and recorded.

3.9.1 Field Equipment

Field equipment will be examined daily to certify that it is in proper operating order prior to its use. Equipment, instruments, tools, and other items requiring preventative maintenance will be serviced in accordance with the manufacturer's specified recommendations. Field equipment will be cleaned and safely stored between each use. Any routine maintenance recommended by the equipment manufacturer will also be performed and documented in field logbooks. Equipment will be inspected, and the calibration checked, if applicable, before it is transported to a field setting for use.

3.9.2 Laboratory Equipment

Instruments used by the laboratories will be maintained in accordance with each laboratory's QA plan 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 laboratories will keep maintenance records and make them available for review, if requested, during laboratory audits. Laboratory preventive maintenance will include routine equipment inspections and calibrations at the beginning of each day or each analytical batch, per the laboratory's internal SOPs and method requirements.

3.10 Inspection/Acceptance of Supplies and Consumables

All supplies and consumables received for the project (e.g., sampling equipment, supplies, etc.) will be checked for damage and other deficiencies that would affect their performance. The types of equipment that will be needed to complete sampling activities are described in the relevant SOPs. Inspections of field supplies will be performed by field team members.

The personnel at each laboratory will be responsible for performing inspections of laboratory supplies in accordance with their QA plan.

3.11 Data Management Procedures

This section describes the management of data for the project including field and laboratory data. The Program quality records will be maintained by the Data Management Division Manager, as described in the BPSOU *Final Data Management Plan*[1] (currently being developed by Atlantic Richfield). These records, either electronic or hard copy in form, may include the following:

- Project work plans with any approved modifications, updates, and addenda.
- Individual property maps (hard copy or scanned field drawings and electronic files).
- Individual property owner result letters (both no action and remedial action required).
- Project QAPP, including this QAPP, with any approved modifications, updates, addenda, and corrective or preventative actions.
- Access agreements from property owners.
- Field documentation.
- Chain of custody records.
- Laboratory documentation (results received from the laboratory will be documented both in report form and in an electronic format).
- Data validation documentation.
- Annual completion 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 are also scanned to produce electronic copies. The electronic versions of these records are maintained on a central server system with backup scheduled on a daily basis.

Before field and laboratory data are incorporated into the project database, the data and supporting documentation will be subject to appropriate review to ensure the accuracy and completeness of original data records. Field data that have been reviewed in a hard-copy format will be entered into electronic data files for upload to the project database. All manual data entry into an electronic format will be reviewed by a separate party before the information is incorporated into the database. Laboratory EDDs and related data packages will be reviewed as part of the internal data review process. The Data Management Division Manager, or designated alternate, will be responsible for ensuring data integrity prior to database uploads. 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. An existing EDD format will be used to upload into the project

database. Standardized parameter names, numerical formats, and units of measure may be applied to the original information to facilitate comparability across all datasets and within the database. Data management activities for the RMAP program will be further defined in the *BPSOU Data Management Plan*[1].

3.11.1 Requests for Data

Requests for data can be made to the Data Management Division Manager or to the Agencies who can access data directly through the secure project database. Refer to the *Institutional Controls Management System Plan* (BSB and Atlantic Richfield Company, 2019a) for additional details and specific examples of the Program's database and tracking system. The *Institutional Controls Management System Plan* (BSB and Atlantic Richfield Company, 2019a) is located in Appendix G of the *Institutional Controls Implementation and Assurance Plan* (BSB and Atlantic Richfield Company, 2019b).

4.0 RECLAMATION MATERIAL

Should sample results indicate that removal of soils at a school, park, or non-residential daycare is warranted, a removal work plan will be submitted by BSB and Atlantic Richfield for approval by the Agencies. All materials used for reclamation activities in areas above action levels must meet requirements set forth in the Butte Hill Revegetation Specifications (BHRS) (BPSOU ROD [EPA, 2006b]). The source of all materials used in site reclamations will be provided in writing for approval.

4.1 Backfill

Backfill material (i.e., replacement soil) will be from a pre-approved source and will not contain any trash, debris, or large roots from shrubs or trees. Backfill material for garden areas must be suitable for germination and cultivation of flowers and vegetables with ordinary amendments.

4.1.1 Backfill Testing

A minimum of three soil samples from the source area will be submitted to an approved laboratory for analyses. Samples will be analyzed for the parameters listed below using U.S. Department of Agriculture (USDA) classification and test methods as described in the American Society of Agronomy (ASA)/Soil Science Society of America (SSSA) Monograph No. 9, Methods of Soil Analysis, Parts 1-2, most recent edition.

- Texture class and particle size.
- pH.
- Saturation percent.
- Electrical conductivity in millimhos per centimeter (mmhos/cm).
- Organic matter percent.

- Nitrate Ion - nitrogen.
- Available phosphorus.
- Available potassium.

Samples will also be analyzed for the presence of the following metals in soil: arsenic, cadmium, copper, lead, and zinc. All soil imported to remediation areas must include a Butte Hill Cover Soil Approval Submittal form (Attachment F) and meet the BHRS requirements (EPA, 2006b) prior to placement.

4.2 Engineered Cover Materials

Materials used for engineered covers must also be analyzed for metals described in Section 4.1.1. For driveways and parking areas, a pit-run gravel base will be used, and it will be capped with a 6-inch depth of ¾-inch minus base course "road-mix" gravel material.

Sod must be certified weed free and source areas approved prior to placement. Seed mixtures and sources must be approved prior to placement as described in the BHRS (EPA, 2006b). Copies of seed bag tags and certification must be collected and recorded to be included in the annual construction completion documentation for the specific remediated property (refer to Section 5.3).

5.0 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 QAPP. The audits of field and laboratory activities include two independent parts: internal and external audits. All internal audits will be conducted by Atlantic Richfield's contractor Environmental Standards, Inc. The internal field audit will be conducted during the initial week of sampling activities to ensure compliance with the QAPP and consistency between individual crews. The internal laboratory audit of the Pace Analytical Services, LLC, Green Bay, Wisconsin, facility will also be conducted during the initial week of sampling activities. The internal laboratory audit of the Pace Analytical Services LLC, Minneapolis, Minnesota, facility will follow shortly thereafter. External audits may be performed by the Agencies as necessary.

Performance and system audits of field and laboratory data collection and reporting procedures are described in this section.

5.1 Corrective Actions

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. A corrective action template is provided in Attachment G.

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 the purpose of this 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 action in the laboratory may occur prior to, during, and after initial analyses. Several 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 Human Health/RMAP Division Manager or the Data Management Division Manager/QA Manager. 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 or new samples may be obtained.

If during analyses of the samples the associated laboratory QC results fall outside of the project's performance criteria, the laboratory should initiate corrective actions immediately. Following consultation with laboratory analysts and section leaders, it may be necessary for the contract laboratory's QA officer to approve implementing a corrective action. These conditions may include dilution of samples, additional sample extract cleanup, or automatic reinjection/reanalysis when certain QC criteria are not met, etc. 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 Human Health/RMAP Division Manager and/or the BSB QA Manager 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 BSB QA Manager to assess whether reanalysis or resampling is required.

All corrective actions taken by the laboratory will be documented in writing by the laboratory project manager and reported to the BSB QA Manager. 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 in the QAPP quality records.

5.2 Corrective Action During Data Assessment

The need for corrective action may be identified by any member of the project team during data assessment. Potential types of corrective action may include resampling by the field team, reanalysis of samples by the laboratory, or resubmitting data packages with corrected clerical errors. The appropriate and feasible corrective actions are dependent upon the ability to mobilize the field team and whether the data to be collected is necessary to meet the required QA objectives (e.g., the holding time for samples is not exceeded). 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. Corrective actions

of this type will be documented by the BSB QA Manager on a Corrective Action Report (CAR) and will be included in any subsequent reports.

5.3 Reports to Management

Upon receipt of laboratory results and completion of the data review/validation process, all analytical data will be uploaded into a project database and submitted to the Agencies for review and approval. For the school sampling portion of this project, these submittals would be anticipated to be submitted on a per school basis to decrease the turnaround time required for landowner reporting as much as possible. Upon receiving Agency approval, the sample results (for all analytes) will be reported to individual landowners along with a letter explaining what the results indicate (see result letter templates in Attachment E). The action levels for arsenic, lead, and mercury will be reported along with sample results.

After site investigations and remedial actions are complete, the Data Management Division Manager/QA Manager will prepare an annual DSR (Section 2.9.6) summarizing the sampling activities. The laboratory and data validation turnaround times for providing sample results will be expedited in order to achieve project assessment and remediation goals while also allowing timely completion of the annual DSR. This is estimated to be a 5 to 7 business day turnaround time on laboratory data and level 2 data packages and 10 to 12 business day turn around on laboratory data and level 4 data packages. Data validation is estimated to be a 7 business day turnaround time after data packages are received from the laboratory. The report will describe specific field sampling activities performed during implementation of the QAPP. Each annual report will include field documentation, documentation of field QC procedures, results of all field and laboratory data, data validation results, and data usability assessments.

A separate report will be prepared by the BSB QA Manager, as needed, to communicate the results of performance evaluations or program audits to identify specific significant QA issues and provided to the EPA for review. Any corrective action reporting described in Section 5.2 above will be summarized and included as appropriate.

6.0 DATA REVIEW AND USABILITY

The following sections address the final project checks conducted after the data collection phase of the project is completed to confirm that the data obtained meet the project objectives and to estimate the effect of any deviations on data usability for the express purposes of achieving the stated DQOs (Section 2.7.1). Data review/validation process under this QAPP is streamlined to support the post-BPSOU ROD (EPA, 2006b) decision-making process. The analytical data collected under this QAPP and produced by analytical laboratories will undergo a combination of Stage 4 and 2B data validation. The field documentation will be subject to Level A/B criteria review, and analytical data will be validated per the *Clark Fork River Superfund Site Investigations Data Management/Data Validation Plan* (ARCO, 1992a), the *EPA National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2020b), and the project DQOs. Data review and validation will be conducted by a qualified technical consultant who is independent from the sampling consultant (i.e., an individual other than the individual who performed sampling).

6.1 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.

6.1.1 Data Review Requirements

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

6.1.1.1 Field Data Review

Raw field data will be entered in field logbooks/data collection device and reviewed for accuracy and completeness by the Human Health/RMAP Division Manager, QA Manager, or Field Team Leader before those 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. The field data will be reviewed quarterly by the Program QA Manager or designated alternate.

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/data collection device and that any necessary and appropriate corrective actions were implemented and recorded. Such data will be recorded in the field logbook/data collection device 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/data collection device 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.

As appropriate, field measurement data will be entered into electronic files for import to the project database. Data entries will be made from the reviewed logbooks/data collection device, and all data entries will be reviewed for accuracy and completeness by a separate party 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.

6.1.1.2 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 the Laboratory

Supervisor (or designee) will take place prior to final data reporting. The laboratory is responsible for assigning appropriate flags/qualifiers in accordance with the analytical method and internal laboratory SOPs.

6.1.2 Data Verification Requirements

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

6.1.2.1 Field Data Verification

The Level A/B review (see checklist in Attachment D), as described in the *CFRSSI Data Management/Data Validation (DV/DM) Plan* (ARCO, 1992a) 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 analyses.

The Level A criteria include:

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

The Level B criteria include:

- Field instrumentation methods and standardization complete.
- Sample containers 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.

6.1.3 Laboratory Data Verification

The laboratory will prepare Level 3 and Level 4 data packages for transmittal of results and associated QC information to the Human Health/RMAP Division Manager or its designee within a standard turnaround time unless otherwise required.

These data packages will be prepared in general accordance with the *EPA Contract Laboratory Program Statement of Work for Superfund Analytical Methods (Multi-Media, Multi-Concentration) SFAM01.1* (EPA, 2020c). Deviations from these specifications may be acceptable based on the SW-846 Methods provided the report presents all the requested types of information in an organized, consistent, and readily reviewable format.

Each data package, as described above, will be accompanied by an EDD prepared by the laboratory. If data qualifiers are required, they will be added to the laboratory EDD and provided for uploading to the database. 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. All data will be submitted in both Level 3 and Level 4 format.

6.1.3.1 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.

6.1.4 Data Validation Requirements

The purpose of analytical data validation is to provide an assessment of data quality. Data validation will be performed by qualified, independent data validation personnel, who are not associated with data collection or sampling responsibilities have applicable training.
Data validation categorizes data as acceptable for use, unacceptable for use, or qualified for select use. The validation effort routinely identifies data use limitations and corrects a reporting and quantitation errors. The data packages provided for validation will be evaluated for compliance with respect to the requested analytical methods and/or the QAPP and completeness of requested deliverables. Concurrent with the data validation efforts, analytical data usability will also be assessed. Analytical data usability is the determination of whether or not a data set is sufficiently complete and of sufficient quality for further evaluation by the data user as detailed in Section 6.3 of the QAPP to support a decision or action.

The data will be validated during the data validation process with guidance from the *CFRSSI QAPP* (ARCO, 1992b), the *CFRSSI DM/DV Plan* (ARCO, 1992a), the *CFRSSI DM/DV Plan Addendum* (AERL, 2000), the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2020b), laboratory-specific QC criteria, and/or method-specific criteria where applicable. The use of the Functional Guidelines versions listed above is important to maintain consistency between data validation and qualification of data currently being performed and future work to be performed under the RMAP program. It should be noted that the U.S. EPA National Functional Guidelines, which were developed for the validation of data generated in

accordance with the Contract Laboratory Program (CLP), are not directly applicable to the type of analyses/protocols associated with the analyses for this project. U.S. EPA National Functional Guidelines qualifies data based on strict contractual CLP method requirements and acceptance criteria which may not be consistent with the requirements and acceptance criteria presented in SW-846 methods. Data validators will apply the U.S. EPA guidelines as appropriate, assess the data relative to method QC protocols and DQOs in this QAPP, and use professional judgment according to the documents listed above. Laboratory quality assurance sample data associated with composite sample batches will not be cross applied to quality control data associated with ISM sample preparation and analysis batches. Field Equipment Blank results will only be applied to ISM samples.

6.2 Verification and Validation Methods

The Level A/B Assessment checklists included in Attachment D are based on the *CFRSSI DM/DV Plan Addendum* (AERL, 2000) guidance and will be used for Field Data Verification as detailed in Section 6.1.2.1.

Data qualifiers will follow those used in the EPA *National Functional Guidelines for Inorganic Superfund Methods Data Review* (EPA, 2020b). Data validation for each laboratory data package will be documented on the data validation checklists based on the *CFRSSI DM/DV Plan Addendum* (AERL, 2000) guidance (Attachment H).

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 Human Health/RMAP Division Manager and QA Manager.

Qualifiers that may be applied to the data during the data validation process include the following:

U	The result is qualified as non-detect due to the detection of the analyte in an associated QC blank.
J	The analyte was positively identified; the associated numerical value is an estimate of the concentration of the analyte in the sample. This will also include results reported between the MDL and RL.
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
UJ	The analyte was not detected above the sample reporting limit. However, the reporting limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
No Flag	Result accepted without qualification.

6.2.1 Differences Between Stage 2B and Stage 4 Validation

The content and scope of the Stage 2B and Stage 4 data validation will be performed with guidance from *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, OSWER No. 9200.1-85, EPA 540-R-08-005, 13* (EPA, 2009). The major difference between Stage 2B and Stage 4 data validation is the detail level of the data evaluation. Stage 4 data validation is an in-depth process that consists of a comparison between raw data and summary forms to check for inconsistencies between reported data and raw data. Stage 2B data validation does not involve evaluating raw data or checking reported data and raw data and assumes that all results and recoveries are correctly reported.

Stage 2B and Stage 4 data validations and reports are generated by an initial reviewer on a per-SDG or sampling location basis from the complete Level 4 data package to ensure completeness and data usability of data packages. Level 3 data packages are a condensed version of final data prior to completion and receipt of Level 4 data packages. Level 3 data packages contain the same information as the Level 4 data packages with the exception that instrumental QC (i.e., instrument tunes and raw data) to support the sample and the QA/QC results are not provided. Each validation report is reviewed by a senior chemist for accuracy to ensure that the initial reviewer has rigorously evaluated the recoveries/results and applied the applicable qualifiers to the data.

6.2.2 Stage 2B and Stage 4 Validation Procedure

A comprehensive QA review will be performed to independently verify compliance with the required analytical protocols and to determine the qualitative and quantitative reliability of the data. Stage 4 data validation includes a detailed review and interpretation of the data generated by the laboratory. Stage 4 data validation includes the review of the summary forms for all QC procedures and all sample and quality control raw data (including instrument calibration) to support the results reported. The purpose of a Stage 2B validation is to qualify data based on identified data quality limitations.

For each of the inorganic constituent the Stage 4 Verification and Validation checks include an evaluation of the following, as applicable for each analytical method. A Stage 2B validation focuses solely on data usability and does not include a review of raw data.

- Completeness of laboratory data package.
- Requested analytical methods performed.
- Compliance with the QAPP, analytical method, and analyte list.
- Proper sample collection, custody, preservation, and handling procedures.
- Holding times.
- Reported detection limits.

- Dilution factors.
- Tuning.
- Instrument Calibration.
- Initial and Continuing Calibration Verification Standards.
- Initial and Continuing Calibration Blank Standards.
- ICP and ICP/MS interference check samples.
- Method blanks.
- Field Equipment Blanks (ISM samples only)
- LCSs.
- Reporting Limit Check Standard recoveries.
- Field duplicate results.
- MS/MSDs (pre-digestion and post-digestion for inorganics only).
- ICP/MS internal standard recoveries.
- ICP and ICP/MS serial dilutions.
- Results verification and reported detection limits.
- Sample Preparation and Analytical Run Logs

6.2.3 Data Validation Ratios

Initially, 10% of both composite and ISM soil project data will undergo Stage 4 validation. The data validator will perform Stage 4 data validation on the first SDG of each designated school and park or playground sampling event to verify that the laboratory is analyzing the project samples in accordance with the applicable analytical methods and QAPP procedures and is providing all required data deliverables. This process will ensure Stage 4 validation is performed for each school and park or playground and periodically throughout the entire sampling event. However, in some instances, where multiple small project SDGs containing the same analytical list are being prepared, validation of the first data package of each project school may represent the entire data set for the project, thereby raising the percentage of Stage 4 validation performed. This approach should allow the data validator to identify and have the laboratory correct any non-compliances early on in the data collection process. In the event significant problems or issues are identified during the 10% Stage 4 data validation effort, it may be necessary to increase the percent of data subjected to Stage 4 validation to ensure that all errors and non-compliances have been appropriately corrected. The remaining 90% of the data will be validated at a Stage 2B level. In addition, the Consultant PM can also offer guidance or request greater percentage of Stage 4 data validation as the required level of validation based on project DQOs.

6.3 Reconciliation and User Requirements

A 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 the project-specific DQOs have been satisfied. The DQA 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: There are no statistical tests that are planned in the interpretation of the non-residential soils results; laboratory results will be compared directly to action limits defined in the DQOs (Section 2.7.1).

Step 4: Verify assumptions.

Step 5: Draw conclusions about the quality of the data (data report will not include interpretation 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 and documented in the data reporting. Corrective actions include, but are not limited to, revision of the DQOs, based on the results of the investigation 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 data limitations.

The PARCCS data quality indicators (Section 2.7.2) 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 DV/DM* (ARCO, 1992b):

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, confirmational purpose, risk assessment, and engineering design.

2. Screening Quality (Restricted Use). Data potential uses of screening quality data, depending upon 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 useable 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, U qualifier or J qualifier (see note below) 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.

Enforcement/Screening Designation

	Meets Level A and B	Meets Level A	Does not meet Level A or B
No qualifier, A, U, or laboratory results reported between the MDL and RL with a J qualifier	E	S	R
J, J+, J-, or UJ	S	S	R
R	R	R	R

Note: It is appropriate to note that sample results qualified as estimated "J" by the laboratory because the reported result is between the MDL and RL values are considered enforcement data if no other qualifiers were required during validation.

Results of the QA review and/or validation will be included in any subsequent report, which will provide a basis for meaningful interpretation of the data quality and evaluate the need for corrective actions. Furthermore, all data validation information, including usability designations and qualifiers, will be captured in the project database.

Evaluation of Results

Composite Sampling

The composite analytical results that have been validated according to Sections 6.1 and 6.2 of this QAPP will be compared to the BPSOU residential action levels (Arsenic – 250 mg/kg, Lead – 1,200 mg/kg, Mercury – 147 mg/kg) for all work completed under this QAPP (see Table 1). Analytical results will be compared to the action levels, and the three statements below will be used for identifying data groupings for decision-making purposes. These statements assume the primary and duplicate results are valid and not qualified for other QA/QC deficiencies. If either the primary and/or duplicate sample are qualified for other reasons, professional judgement will be used with Agency engagement and approval in the decision-making process.

1. Undetected results (MDL less than the action level) or positive sample results are less than the action level(s).

2. Primary and field duplicate sample results are greater than the action level(s).

3. Primary and field duplicate sample results where one result is above the action level(s) and the other result is below the action level(s). The sample results will be evaluated using the following criteria.
    a. If the RPD between the primary and field duplicate results is less than 35% and the results are unqualified for field duplicate precision, then the highest of the primary and duplicate results will be used for decision making.
    b. If the RPD between the primary and field duplicate results is greater than 35% and the results are qualified for field duplicate precision, the data are considered screening quality "S" in accordance with the QAPP. For exterior soils, repreparation and

reanalysis of sample pairs will occur when the RPD is greater than 35%, and the deeper depth interval sample concentration in the same yard component is less than the action level(s).

If these conditions are met for soil samples, then both the parent and the field duplicate sample will be reprepared from the air-dried, sieved soil and reanalyzed by the laboratory.

Upon reanalysis no further action will be taken if:

c. The parent sample and field duplicate sample results are below the action level(s), and the RPD is less than 35%, Statement 1 above will be applied to the results. If the above conditions were not met, the highest of the primary and duplicate results will be used for decision making.

ISM Sampling

Three alternate actions were identified in DQO Step 2 (Section 2.7.1): take no action, complete remedial action, and complete additional sampling. The decision framework through which incremental sampling results will inform selection of each alternate action is described below.

- Take no action: This action will be selected if the 95% UCL is below the action level.
- Complete remedial action: This action will be selected if the 95% UCL is above the action level, and the following condition is met:
    - The total incremental sampling area is less than 1 acre.
- Complete additional sampling: This action will be selected if the conditions specified above for the first two alternative actions (take no action or complete remedial action) are not met, and an evaluation of site conditions and data indicate that additional sampling will be informative for decision-making.

  Additional sampling may include separating the initial DU into multiple sampling/DUs for additional incremental sampling, identifying separate DUs for composite sampling, and/or collecting an additional replicate sample from the incremental sampling DU. The design of additional sampling will be dependent on specific conditions in the DU, as generally described below.

    - If review of available information about potential contaminant sources, visual cues, or other relevant information indicates that a portion of the incremental sampling area has unique characteristics that warrant separate evaluation, additional sampling may be completed. The DU may be separated into multiple sampling/DUs for additional incremental sampling, or composite sampling may be used to characterize the unique sub-area(s).
    - If variability is low (i.e. the CV of increments (with adjustment as calculated in the ITRC ISM UCL calculator) is less than 1.5) and all replicate concentrations are less than AL, or if variability is moderate to high (i.e. the adjusted CV of increments is greater than or equal to 1.5), collecting an additional replicate may reduce the width of the confidence interval and better inform cleanup decisions. If

these conditions are met, an additional replicate may be collected from the incremental sampling DU.

- While high variability is not expected for most parks, if sampling results indicate strong disagreement among replicates, then additional increments may be needed to properly characterize the DU. Separating the area into multiple sampling/DUs for additional incremental sampling, or composite sampling, may be suitable alternatives depending on the park's layout or other characteristics.

If the relative standard deviation between the triplicate results is greater than 35% (if greater than 5 times the reporting limit), the results are qualified for field triplicate precision, and the data are considered screening quality "S" in accordance with the QAPP.

Relative Standard Deviation values less than 35% will generally be considered acceptable, while those greater than 100% will generally be considered unacceptable. However, consideration as to whether a particular RSD value is acceptable will not be a "bright line" evaluation. RSD values may be elevated when concentrations are estimated by the laboratory below reporting limits ("J"-qualified), or reporting limits are substituted in calculations for non-detect results. If the estimated concentrations are well below screening limits, then they should not be discounted solely based upon RSD calculations in which statistical assumptions of equal variance may not be valid due to the estimated concentrations. The validity of ISM results for any DU with an RSD value over 35% will be specifically discussed in ISM reporting. If the RSD of any analyte detected in a DU exceeds 35%, then consideration will be given to the concentrations relative to RSLs and the proportion of analytes in the DU with RSDs above 35% before determining whether additional evaluation is appropriate.

7.0 REFERENCES

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