Sampling and Analysis Plan: Evaluation of Natural Beryllium and Its Ratio to Other Metals in Background Hanford Surface Soils

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

P.O. Box 550
Richland, Washington 99352

Approved for Public Release; Further Dissemination Unlimited
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Richland Operations Office

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Title: Sampling and Analysis Plan: Evaluation of Natural Beryllium and Its Ratio to Other Metals in Background Hanford Surface Soils

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Contents

1 Introduction .............................................................................................................. 1-1
  1.1 Background ......................................................................................................... 1-4
  1.2 Sampling and Sample Management ....................................................................... 1-4
  1.3 Data Needs .......................................................................................................... 1-6
  1.4 Sampling Design .................................................................................................. 1-6
  1.5 Project Schedule .................................................................................................. 1-6

2 Quality Assurance Project Plan .................................................................................. 2-1
  2.1 Project Management ............................................................................................. 2-1
    2.1.1 Project/Task Organization .............................................................................. 2-1
    2.1.2 Problem Definition/Background .................................................................... 2-3
    2.1.3 Project/Task Description ............................................................................... 2-3
    2.1.4 Quality Objectives and Criteria ..................................................................... 2-4
    2.1.5 Special Training/Certification ....................................................................... 2-4
    2.1.6 Documents and Records ................................................................................ 2-8
  2.2 Data Generation and Acquisition .......................................................................... 2-10
    2.2.1 Sampling Process Design ............................................................................... 2-10
    2.2.2 Sampling Methods ......................................................................................... 2-10
    2.2.3 Sample Handling, Preparation, and Custody .................................................. 2-10
    2.2.4 Analytical Methods ....................................................................................... 2-11
    2.2.5 Quality Control ............................................................................................. 2-11
    2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance ....................... 2-13
    2.2.7 Instrument/Equipment Calibration and Frequency ......................................... 2-14
    2.2.8 Inspection/Acceptance of Supplies and Consumables ................................... 2-14
    2.2.9 Nondirect Measurements .............................................................................. 2-14
    2.2.10 Data Management ....................................................................................... 2-14
  2.3 Assessment and Oversight .................................................................................... 2-15
    2.3.1 Assessments and Response Actions ............................................................... 2-15
    2.3.2 Reports to Management ................................................................................. 2-15
  2.4 Data Validation and Usability .............................................................................. 2-15
    2.4.1 Data Review, Verification, and Validation ....................................................... 2-16
    2.4.2 Verification and Validation Methods ............................................................... 2-16
    2.4.3 Reconciliation with User Requirements .......................................................... 2-16
    2.4.4 Corrective Actions ....................................................................................... 2-17

3 Field Sampling Plan .................................................................................................. 3-1
  3.1 Site Background and Objectives .......................................................................... 3-1
3.2 Documentation of Field Activities ................................................................. 3-1
3.3 Sampling Design .................................................................................................. 3-1
3.4 Calibration of Field Equipment ............................................................................ 3-1
3.5 Sample Locations ................................................................................................ 3-2
3.6 Sampling Methods .............................................................................................. 3-2
   3.6.1 Corrective Actions and Deviations for Sampling Activities ......................... 3-2
   3.6.2 Decontamination of Sampling Equipment ....................................................... 3-4
   3.6.3 Radiological Field Data .................................................................................. 3-4
3.7 Sample Handling ................................................................................................ 3-4
   3.7.1 Packaging ...................................................................................................... 3-4
   3.7.2 Container Labeling ....................................................................................... 3-5
   3.7.3 Sample Custody ............................................................................................ 3-5
   3.7.4 Sample Transportation .................................................................................. 3-6
3.8 Management of Waste ........................................................................................ 3-6

4 Health and Safety ................................................................................................... 4-1

5 References ............................................................................................................... 5-1

Tables

Table 1-1. Summary of Sampling Locations ............................................................. 1-1
Table 1-2. Initial Target Analytes .............................................................................. 1-5
Table 2-1. Data Quality Indicators ............................................................................ 2-5
Table 2-2. Change Control for Sampling Projects ...................................................... 2-8
Table 2-3. Project Quality Control Checks ................................................................. 2-12
Table 3-1. Sample Locations, Numbers, and Methods .............................................. 3-3
Table 3-2. Sample Preservation, Container, and Holding Time for Soil Samples .......... 3-4

Figures

Figure 1-1. Sampling Locations ................................................................................. 1-3
Figure 2-1. Functional Organizational Structure—Development of Metal Ratio Process for Beryllium .......................................................... 2-2
# Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-Be</td>
<td>anthropogenic beryllium</td>
</tr>
<tr>
<td>AES</td>
<td>atomic emission spectroscopy</td>
</tr>
<tr>
<td>AIHA</td>
<td>American Industrial Hygiene Association</td>
</tr>
<tr>
<td>BTR</td>
<td>Buyer’s Technical Representative</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>DQA</td>
<td>data quality assessment</td>
</tr>
<tr>
<td>DQI</td>
<td>data quality indicator</td>
</tr>
<tr>
<td>DQO</td>
<td>data quality objective</td>
</tr>
<tr>
<td>DUP</td>
<td>duplicate</td>
</tr>
<tr>
<td>EB</td>
<td>equipment (rinsate) blank</td>
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<tr>
<td>ECO</td>
<td>Environmental Compliance Officer</td>
</tr>
<tr>
<td>FWS</td>
<td>Field Work Supervisor</td>
</tr>
<tr>
<td>GPS</td>
<td>global positioning system</td>
</tr>
<tr>
<td>HSS</td>
<td>DOE Office of Health, Safety, and Security</td>
</tr>
<tr>
<td>ICP</td>
<td>inductively coupled plasma</td>
</tr>
<tr>
<td>LCS</td>
<td>laboratory control sample</td>
</tr>
<tr>
<td>MS</td>
<td>mass spectrometry</td>
</tr>
<tr>
<td>N-Be</td>
<td>natural beryllium</td>
</tr>
<tr>
<td>N/A</td>
<td>not applicable</td>
</tr>
<tr>
<td>POC</td>
<td>point of contact</td>
</tr>
<tr>
<td>QA</td>
<td>quality assurance</td>
</tr>
<tr>
<td>QAPjP</td>
<td>quality assurance project plan</td>
</tr>
<tr>
<td>QC</td>
<td>quality control</td>
</tr>
<tr>
<td>SAP</td>
<td>sampling and analysis plan</td>
</tr>
<tr>
<td>SMT</td>
<td>Sample Management Team</td>
</tr>
<tr>
<td>SRM</td>
<td>standard reference material</td>
</tr>
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1 Introduction

This sampling and analysis plan (SAP) was written in support of an effort to evaluate background levels of natural beryllium (N-Be) in surface soils around the Hanford Site in southeastern Washington State. More specifically, this SAP assists in implementing an effort to evaluate the ratio of N-Be to other metals in windblown soils. This comparison should facilitate identification of a per weight ratio or set of ratios by which N-Be concentrations can then be predicted in trackable (e.g., on shoes) and windblown soils found in materials in Hanford Site buildings, thereby distinguishing N-Be from anthropogenic beryllium (A-Be) in these materials. This SAP describes the sampling and analysis to be performed at 77 locations (72 background locations and 5 other onsite locations) identified in DOE/RL-2011-68, Data Quality Objectives Summary Report: Evaluation of Natural Beryllium and Its Ratio to Other Metals in Background Hanford Surface Soils. Table 1-1 provides latitude and longitude coordinates for each of these locations, and Figure 1-1 shows their relative positions.

Table 1-1. Summary of Sampling Locations

<table>
<thead>
<tr>
<th>Location Number</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Location Number</th>
<th>Latitude</th>
<th>Longitude</th>
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<td>Be–5</td>
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<td>119.76517</td>
<td>Be–44</td>
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<td>119.55563</td>
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<tr>
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<td>Be–45</td>
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### Table 1-1. Summary of Sampling Locations

<table>
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<th>Location Number</th>
<th>Latitude</th>
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<td>119.44403</td>
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</table>

* These locations are being sampled for general information and are not assumed to be representative of background.
Figure 1-1. Sampling Locations
1.1 Background

As Hanford Site cleanup continues, a variety of dust generating activities will increase. These activities will increase the potential of worker exposure to A-Be. Beryllium is a naturally occurring element in the mineralogy of the Columbia Basin, and deposition of windblown material is common in many Hanford Site facilities. The presence of naturally occurring beryllium becomes an issue in characterizing facilities as either contaminated or beryllium cleared. The current consensus in the professional and medical community is that natural (mineral) forms of N-Be present little or no hazard, while the A-Be (process) forms present substantial risk to the worker. Therefore, this effort is being undertaken to evaluate N-Be levels in hopes of helping focus efforts at anthropogenic forms.

The current facility characterization and assessment processes involve collection of bulk material from those surfaces with a heavy dust loading for comparison to background beryllium soil levels. As part of the U.S. Department of Energy (DOE) Office of Health, Safety, and Security (HSS) oversight inspection (HSS, 2010, Independent Oversight Inspection of the Hanford Site Chronic Beryllium Disease Prevention Program), issues were raised as to the applicability of current Hanford Site beryllium soil background levels used for building characterization. Other approaches used in the DOE complex rely heavily on the analysis of wipe samples obtained from surfaces within facilities. Current discussions involve using a combination of wipe and bulk samples for these processes at the Hanford Site and other potential locations.

To accomplish the task of adequately characterizing facilities, the DOE Richland Operations Office has requested that the site contractors consider using metal ratios in the determination of N-Be levels used as part of the facility characterization process. CH2M HILL Plateau Remediation Company has taken the lead in addressing this concern raised by the HSS inspection and completed a data quality objective (DQO) process to ensure that appropriate data are collected to support the establishment of background N-Be soil ratios for the Hanford Site facility characterization process. The product of that DQO process (DOE/RL-2011-68) provides the directions needed to initiate this SAP. The DQO process is iterative, and changes in that document may be made during implementation when data are obtained indicating that fewer, additional, or modified requirements will better fulfill the goals of the project.

1.2 Sampling and Sample Management

Soil samples will be collected from the locations specified in Table 1-1 and shown in Figure 1-1. These will be identified, stored, and archived in the Hanford Geotechnical Sample Library or other suitable storage location identified by the Project Lead using the unique sample identification number in addition to the location numbers given in Table 1-1. Sufficient soil material will be collected from each location to prepare multiple aliquots (subsamples) as well as wipe samples for submission to the laboratory for chemical analysis. The collection of soil samples from the identified field locations will be a one-time activity. The typical process, per this SAP, is to composite soil obtained from four sample points in close proximity to the sampling location specified in Table 1-1 (or alternate location as appropriate).

Laboratory chemical analyses will be conducted in three rounds. Round 0 will use aliquots prepared using soils from 10 percent of the locations sampled; these will be used by the lab for refining the sample preparation and analytical methods (e.g., determining the best number of dilutions and eliminating poor candidate analytes). Round 1 analyses will target a broad suite of other metals. The results from the Round 1 analyses will be used to select a few metals that appear to be most promising for predicting N-Be using metal ratios; the Round 1 results will also allow further refinement of the sample preparation and analytical techniques. Round 2 analyses will be limited to that short list of predictor metals and will serve to finalize and validate the predictive results from Round 1.
In all three rounds, the Sample Management Team (SMT) will be responsible for preparing soil subsamples, obtaining sample identification numbers and appropriate chain-of-custody records, transferring these subsamples to the lab, and receiving data reports from the lab. The SMT will maintain records associating all sample identification numbers for each particular location with the original location number specified in Table 1-1.

Soil aliquot (and wipe samples) will be analyzed for select suites of metals, using two analytical methods, inductively coupled plasma (ICP) mass spectrometry (MS) and ICP atomic emission spectroscopy (AES), to identify the ratios of N-Be to other background metals. While it is theoretically possible that one background metal could be sufficiently correlated to allow distinguishing N-Be from A-Be in samples to be obtained inside facilities in the future, preliminary evaluation of analytical data from archived Hanford Site surface soils suggests that, due to the complex nature of Hanford Site soils, a “fingerprint” set of multiple analytes is more likely to be necessary. An initial broad set of target analytes has been identified for investigating this potential correlation to background concentrations of N-Be, as shown in Table 1-2.

<table>
<thead>
<tr>
<th>Target Analyte</th>
<th>Chemical Abstracts Service Number</th>
<th>Target Analyte</th>
<th>Chemical Abstracts Service Number</th>
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</thead>
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<td>Nickel</td>
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<td>Iron</td>
<td>7439-89-6</td>
<td>Tin</td>
<td>7440-31-5</td>
</tr>
<tr>
<td>Lanthanum</td>
<td>7439-91-0</td>
<td>Tungsten</td>
<td>7440-33-7</td>
</tr>
<tr>
<td>Lead</td>
<td>7439-92-1</td>
<td>Uranium</td>
<td>7440-61-1</td>
</tr>
<tr>
<td>Lithium</td>
<td>7439-93-2</td>
<td>Vanadium</td>
<td>7440-62-2</td>
</tr>
</tbody>
</table>
Table 1-2. Initial Target Analytes

<table>
<thead>
<tr>
<th>Target Analyte</th>
<th>Chemical Abstracts Service Number</th>
<th>Target Analyte</th>
<th>Chemical Abstracts Service Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium</td>
<td>7439-95-4</td>
<td>Yttrium</td>
<td>7440-65-5</td>
</tr>
<tr>
<td>Manganese</td>
<td>7439-96-5</td>
<td>Zinc</td>
<td>7440-66-6</td>
</tr>
<tr>
<td>Molybdenum</td>
<td>7439-98-7</td>
<td>Zirconium</td>
<td>7440-67-7</td>
</tr>
</tbody>
</table>

1.3 Data Needs

A DQO planning process, including problem statement definition, was used to identify data and information gaps. Due to the need for a dynamic interaction between data collection and analysis activities, wide flexibility was allowed for in the DQO report. This flexibility includes unspecified reporting limits and an expectation that data will be reported “uncensored” to allow consideration of data values below those used in typical industrial hygiene or environmental sampling scenarios for N-Be and other metals. It is expected that the methods employed in completing this study will be refined as the project progresses and any limitations of the sampling, sample preparation, and analytical techniques are identified, in particular between the initial investigation in Round 1 and the confirmatory analyses of a short list of metals in Round 2.

1.4 Sampling Design

The sampling design is based on a systematic grid, with (in general) one location selected per grid cell. Most of the sampling locations were picked from a set of locations previously vetted as representative of background soils; however, additional locations were included in the interest of comparing onsite soils with offsite and, in some cases, simply to fill geographic gaps in the sampling grid. The map provided in Figure 1-1 shows these locations, and a detailed discussion of how the list was compiled is provided in Chapter 4 of DOE/RL-2011-68.

1.5 Project Schedule

The beryllium background study field sampling effort is scheduled to begin early in December 2011, with all laboratory and statistical analyses to be completed by the end of March 2012. The potential for complications, which extend these dates, are acknowledged, and minor schedule extensions will not require a revision to this SAP as long as the scope of the study remains the same.
2 Quality Assurance Project Plan

This Quality Assurance Project Plan (QAPP) establishes the quality requirements for data collection, including planning, implementation, and assessment of sampling and laboratory analysis. This QAPP was written in accordance with EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, adapted to the unique needs of this project, blending environmental sampling techniques with industrial hygiene analytical techniques. Additional quality requirements specific to environmental data collection (e.g., ANSI/ASQC E4-1994, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*) will be applied to the sampling process to the extent practical, given the unique needs of the project. In addition, American Industrial Hygiene Association (AIHA) quality assurance requirements will apply to laboratory analysis.

2.1 Project Management

This section addresses elements of project management, including the objectives, roles, and responsibilities of the participants. These elements ensure that the project has a defined goal, that the participants understand the goal and the approach to be used, and that the planning outputs are documented.

2.1.1 Project/Task Organization

The primary contractor, or its approved subcontractor, is responsible for planning, coordinating, sampling, preparation, packaging, and shipping samples to the laboratory. The project organization (concerning sampling and sample handling) is described in the following subsections and is shown graphically in Figure 2-1. The Project Manager maintains a list of individuals or organizations as points of contact (POCs) for each functional element in the figure. For each functional primary contractor role, there is a corresponding oversight role within DOE. These positions include the following:

- **DOE Project Manager.** The DOE Project Manager is responsible for authorizing the contractor to perform activities related to the Chronic Beryllium Disease Prevention Program Corrective Action Plan.

- **DOE Technical Lead.** The DOE Technical Lead is responsible for overseeing activities of the contractor performing the work, working with the contractor to identify and resolve technical issues, and providing technical input to the DOE Project Manager.

- **Project Manager.** The Project Manager is responsible for managing sampling documents and requirements, field activities, and subcontracted tasks and ensuring that the project file is properly maintained. The Project Manager works closely with Quality Assurance (QA), Health and Safety, and the Field Work Supervisor (FWS) to integrate these and other lead disciplines in planning and implementing the work scope. The Project Manager maintains a list of individuals or organizations filling each of the functional elements of the project organization (Figure 2-1). In addition, the Project Manager is responsible for version control of the SAP to ensure that personnel are working to the most current job requirements. The Project Manager also coordinates with DOE and the primary contractor management on all sampling activities.

- **Quality Assurance.** The QA POC is in the Environmental QA organization and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements, reviewing project documents (including DQO summary report and SAP), and participating in QA assessments on sample collection and analysis activities, as appropriate. The QA POC must be independent of the unit generating the data.
Environmental Compliance Officer. The Environmental Compliance Officer (ECO) is not expected to play a significant role in this data collection activity; however, the ECO will be consulted on appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The ECO also oversees project implementation for compliance with applicable internal and external environmental requirements.

Health and Safety. The Health and Safety organization is responsible for coordinating industrial safety and health support within the project, as carried out through health and safety plans, job hazard analyses, and other pertinent safety documents required by federal regulation or by internal primary contractor work requirements. In addition, the Health and Safety organization provides assistance to project personnel in complying with applicable health and safety standards and requirements. The Health and Safety organization coordinates with Radiological Engineering to determine personal protective clothing requirements.
Radiological Engineering. The Radiological Engineering lead is responsible for radiological/health physics support across the Hanford Site. Given the nature of this study (collecting samples representative of background), the radiological lead is not expected to be particularly involved in this project but will be consulted for input on access to onsite sampling locations and will direct Radiological Control Technician support in the unlikely event that it is deemed appropriate for any portion of this work.

Sample Management and Reporting Organization. The Sample Management and Reporting organization coordinates laboratory analytical work, ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent). Sample Management and Reporting receives the analytical data from the laboratories and arranges for data validation. Sample Management and Reporting is responsible for informing the Project Manager of any issues reported by the analytical laboratory. Sample Management and Reporting develops and oversees data validation and implementation of the letter of instruction to the analytical laboratories, and provides sampling and analysis results to the Project Manager.

Contract Laboratories. The contract laboratories analyze samples, in accordance with established protocols, and provide necessary sample reports and explanation of results in support of data validation. The laboratories must meet site-specified QA requirements and must have an approved QA plan in place. Since this project is in effect developing new methods, part of the project will involve collaboration between lab and project personnel to identify appropriate QA requirements for future use of metal ratio methods.

Waste Management. Waste Management involvement in this project is expected to be minimal. If necessary, Waste Management will communicate policies and protocols and ensure project compliance for storage, transportation, disposal, and waste tracking in a safe and cost effective manner.

Field Work Supervisor. The FWS is responsible for planning and coordinating field sampling resources. The FWS ensures that samplers are appropriately trained and available. Additional related responsibilities include ensuring that the sampling design is understood and can be performed as specified and directing field activities to support overall project goals. The samplers collect soil samples, including replicates and duplicates (DUPs), and prepare sample blanks in accordance with the SAP. They also prepare soil aliquot samples for submission to the laboratory. The samplers complete field logbook entries, chain-of-custody forms, and shipping paperwork, and they ensure delivery of the samples to the analytical laboratory.

2.1.2 Problem Definition/Background
This SAP describes the sampling and analysis, associated with the surface soils at 77 locations specified in DOE/RL-2011-68, in order to evaluate the ratio of beryllium to other metals in natural background soils. General background information is provided in Section 1.1 of this SAP. Soil is the media that will be sampled. Figure 1-1 shows the locations of the planned sampling locations within the scope of this SAP.

2.1.3 Project/Task Description
The field sampling plan is presented in Chapter 3. The target analytes and contaminants of potential concern are presented in Table 1-2. Section 1.5 provides guidance on the implementation schedule.
2.1.4 Quality Objectives and Criteria

The QA objective of this plan is to develop implementation guidance providing data of known quality. Data quality indicators (DQIs) describe data quality by evaluation against identified DQOs and the work activities identified in this SAP. The applicable quality control (QC) guidelines, quantitative target limits, and levels of effort for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. The principal DQIs are precision, bias or accuracy, representativeness, comparability, completeness, and sensitivity. These DQIs are defined for the purposes of this document in Table 2-1. The DQIs will be evaluated during the data quality assessment (DQA) process (Section 2.4.3).

2.1.5 Special Training/Certification

A graded approach is used to ensure that workers receive a level of training commensurate with responsibilities and that complies with applicable DOE orders and government regulations. The FWS, in coordination with line management, will ensure that special training requirements for field personnel are met.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the contract, regulations, DOE orders, DOE contractor requirement documents, and the American National Standards Institute/American Society of Mechanical Engineers. For example, the environmental, safety, and health training program provides workers with the knowledge and skills necessary to execute assigned duties safely. Field personnel typically complete the following training before starting work:

- Occupational Safety and Health Administration 40-Hour Hazardous Waste Worker Training and supervised 24-hour hazardous waste site experience
- 8-Hour Hazardous Waste Worker Refresher Training (as required)
- Hanford General Employee Radiation Training
- Hanford General Employee Training
- Radiological Worker Training

Project-specific safety training, geared specifically to the project and the day’s activity, will be provided. Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements. Samplers are required to have training and/or experience in the type of sieving and sampling that is being performed in the field.
<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Definition</th>
<th>Example Determination Methodologies</th>
<th>Project-Specific Information</th>
<th>Corrective Action Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Precision</strong></td>
<td>The measure of agreement among repeated measurements of the same property under identical or substantially similar conditions; calculated as either the range or as the standard deviation. May also be expressed as a percentage of the mean of the measurements, such as relative range, relative percent difference, or relative standard deviation (coefficient of variation).</td>
<td>Use the same analytical instrument to make repeated analyses on the same sample. Use the same method to make repeated measurements of the same sample within a single laboratory or have two or more laboratories analyze identical samples with the same method. Split a sample in the field and submit both for sample handling, preservation and storage, and analytical measurements. Collect, process, and analyze collocated samples for information on sample acquisition, handling, shipping, storage, preparation, and analytical processes and measurements.</td>
<td>Field precision: duplicate soil aliquots will be prepared using soils from one randomly selected location per 10 locations per media. Laboratory precision: analysis of laboratory duplicate or matrix spike duplicate.</td>
<td>Once achievable QA/QC parameters are established, this QAPjP will be revised to list specific DQOs. If duplicate data do not meet these objectives: - Evaluate apparent cause (e.g., sample heterogeneity). - Request reanalysis or remeasurement. - Qualify the data before use.</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>A measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations.</td>
<td>Analyze a reference material or reanalyze a sample to which a material of known concentration or amount of pollutant has been added (a spiked sample); usually expressed either as percent recovery or as a percent bias.</td>
<td>Laboratory accuracy determination based on matrix spikes and matrix spike duplicates.</td>
<td>Once achievable QA/QC parameters are established, this QAPjP will be revised to list specific DQOs. If recovery does not meet objective: - Request reanalysis or remeasurement. - Qualify the data before use.</td>
</tr>
<tr>
<td>Data Quality Indicator</td>
<td>Definition</td>
<td>Example Determination Methodologies</td>
<td>Project-Specific Information</td>
<td>Corrective Action Examples</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------</td>
<td>------------------------------------</td>
<td>-----------------------------</td>
<td>---------------------------</td>
</tr>
</tbody>
</table>
| Representativeness     | A qualitative term to express “the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.” (ANSI/ASQC S2-1995) | Evaluate whether measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the environment or condition being measured or studied. | Samples will be collected as described in the sampling design. The sampling design assumes that locations are representative of background trackable and windblown soils. Large deviations/outliers will be considered and, if necessary, rejected, on a case-by-case basis. | If results are not representative of the system sampled:  
- Identify the source of the nonrepresentation.  
- Reject the data or, if data are otherwise usable, qualify the data for limited use and define the portion of the system the data represent.  
- Redefine sampling and measurement requirements and protocols.  
- Resample and reanalyze. |
| Comparability          | A qualitative term expressing the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made. | Compare sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. | Sampling personnel will use the same sampling protocols. Samples will be submitted to the same laboratories when possible (based on laboratory contracts) for analysis by the same methods, thus data results will be comparable. | If data are not comparable to other data sets:  
- Identify appropriate changes to data collection and/or analysis methods.  
- Identify quantifiable bias, if applicable.  
- Qualify the data as appropriate.  
- Resample and/or reanalyze if needed.  
- Revise sampling/analysis protocols to ensure future comparability. |
<table>
<thead>
<tr>
<th>Data Quality Indicator</th>
<th>Definition</th>
<th>Example Determination Methodologies</th>
<th>Project-Specific Information*</th>
<th>Corrective Action Examples</th>
</tr>
</thead>
</table>
| Completeness           | A measure of the amount of valid data needed to be obtained from a measurement system. | Compare the number of valid measurements completed (samples collected or samples analyzed) with those established by the project’s quality criteria (DQOs or performance/acceptance criteria). | The percent complete will be determined during data validation. | If data set does not meet completeness objective:  
  - Identify appropriate changes to data collection and/or analysis methods.  
  - Identify quantifiable bias, if applicable.  
  - Qualify the data as appropriate.  
  - Resample and/or reanalyze if needed.  
  - Revise sampling/analysis protocols to ensure future comparability. |
| Sensitivity            | The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest. | Determine the minimum concentration or attribute to be measured by a method (method detection limit), by an instrument (instrument detection limit), or by a laboratory (quantitation limit). The practical quantitation limit is the lowest level that can be routinely quantified and reported by a laboratory. | Ensure that sensitivity is useful for the intended purpose. It is expected that reporting levels for this project may be anomalous as compared to more typical environmental sampling. | Once achievable QA/QC parameters are established, this QAPjP will be revised to list specific DQOs. If sensitivity does not meet objective:  
  - Request reanalysis or remeasurement.  
  - Qualify/reject the data before use. |


* Field sampling requirements are noted. Laboratories will follow requirements for use and interpretation of laboratory control samples.

QA = quality assurance  
QC = quality control  
QAPjP = quality assurance project plan
In addition, pre-job briefings will be performed to evaluate an activity and associated hazards by considering many factors, including the following:

- Objective of the activities; in particular, the need for collecting blowable/trackable soil fractions
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- Environment in which the job will be performed
- Facility where the job will be performed
- Equipment and material required
- Safety protocols applicable to the job
- Training requirements for individuals assigned to perform the work
- Level of management control
- Proximity of emergency contacts

Training records are maintained for each individual employee in an electronic training record database. The contractor’s training organization maintains the training records system. Line management will be used to confirm that an individual employee’s training is appropriate and up-to-date prior to performing any fieldwork.

2.1.6 Documents and Records

The Project Manager is responsible for ensuring that the current version of the SAP is being used and providing updates to field personnel. Version control is maintained by the administrative document control process. Changes to the SAP affecting the DQOs will be reviewed and approved by DOE prior to implementation. Table 2-2 defines the types of changes that may be made to the sampling design and the documentation requirements.

<table>
<thead>
<tr>
<th>Type of Change</th>
<th>Action</th>
<th>Documentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Field Work Supervisor: Move sample location by &lt;500 m</td>
<td>No SAP revision necessary</td>
<td>Field logbooks and project record file</td>
</tr>
<tr>
<td>By Project Lead: Move sample location by &gt;500 m</td>
<td>No SAP revision necessary</td>
<td>Field logbooks and project record file</td>
</tr>
<tr>
<td>By laboratory staff: Adjust prep method, dilutions, or target analytes</td>
<td>SAP revision between Rounds 1 and 2 of analyses</td>
<td>Laboratory logbooks, project record files, and SAP revision</td>
</tr>
<tr>
<td>By beryllium corrective action plan oversight: Significantly adjust number of sampling locations or analyses</td>
<td>SAP revision and reapproval</td>
<td>SAP revision and letter to project file explaining change</td>
</tr>
</tbody>
</table>

SAP = sampling and analysis plan
The FWS is responsible for ensuring that the field instructions are maintained and aligned with any revisions or approved changes to the SAP. The FWS or Buyer’s Technical Representative (BTR) will ensure that deviations from the SAP or problems encountered in the field are documented appropriately (e.g., in the field logbook or on nonconformance report forms) in accordance with internal corrective action protocols.

The Project Manager, or designee, is responsible for communicating field corrective action requirements and ensuring that immediate corrective actions are applied to field activities.

Logbooks are required for field activities. A logbook must be identified with a unique project name and number. The individual(s) responsible for logbooks will be identified in the front of the logbook, and only authorized persons may make entries in logbooks. Logbooks will be signed by the field manager, supervisor, cognizant scientist/engineer, or other responsible individual. Logbooks will be permanently bound, waterproof, and ruled with sequentially numbered pages. Pages will not be removed from logbooks for any reason. Entries will be made in indelible ink. Corrections will be made by marking through the erroneous data with a single line, entering the correct data, and initialing and dating the changes.

The Project Manager is responsible for ensuring that a project file is properly maintained. The project file will include the following documentation, as appropriate:

- Field logbooks or operational records
- Data forms
- Records associating location numbers of soil samples with sample identifications of soil aliquots prepared for submission to the lab
- Global positioning system (GPS) data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports
- Laboratory data packages
- Verification and validation reports

The project file will either contain these records or provide references to the storage locations of these records.

The laboratory is responsible for maintaining, and having available upon request, the following items:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material (SRM) and/or proficiency test sample data
- Instrument calibration information
Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes to ensure the accuracy and retrievability of stored records.

2.2 Data Generation and Acquisition

This section addresses aspects of project design and implementation. Implementation of these elements ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling, and QC activities are employed and properly documented.

2.2.1 Sampling Process Design

In this study, a form of systematic (grid) sampling is used to identify sampling locations reasonably and regularly spaced over the target background area. An initial grid location is randomly chosen, and the remaining grid cells are selected for equal spacing (3,500 by 3,500 m [11,483 by 11,483 ft]). In general, one sampling location is selected from each grid cell. Systematic (grid) sampling is often used to search for hot spots; in this application, however, its purpose is to infer means, percentiles, correlations between metals, or other parameters, and is useful for estimating spatial patterns. This design provides a practical method for designating sample locations and ensures uniform coverage of a site, unit, or process. For further detail on the location selection used in this study, see DOE/RL-2011-68.

The background locations are assigned location numbers Be-1 through Be-72 in Table 1-1. The additional locations, Be-73 through Be-77, are located in onsite areas that are possibly contaminated; data from these locations will be compared with those from locations Be-1 through Be-72 to see if there are substantial differences relevant to the selection of the short list of predictor metals.

2.2.2 Sampling Methods

Sampling methods are described in the Section 3.6. Specific information includes the following:

- Field sampling methods
- Preparation of soil aliquots for submission to the lab
- Corrective actions for sampling activities (ultimately, the task lead will be responsible for corrective action)
- Decontamination of sampling equipment

2.2.3 Sample Handling, Preparation, and Custody

A sampling and data tracking database is used to track the samples from the point of collection through the laboratory analysis process. Samplers should note any anomaly with a sample (e.g., sample appears unusual or sample is sludge) to prevent laboratory batching across similar matrices. Specific sample handling information is provided in Section 3.7 and includes the following:

- Container requirements
- Container labeling and tracking process
- Sample custody requirements
- Shipping and transportation

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are
maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by the Sample Management and Reporting organization.

2.2.4 Analytical Methods

The laboratory will be using a modification of a standard sample prep method, and the preparation, dilution, and calibration methods and parameters may evolve as data are generated. The laboratory will provide method validation data to confirm that the method is adequate for the intended use of the data. This information includes typical recoveries and analytical precision and bias and an estimation or determination of reporting detection and quantitation limits.

The following preparation method for bulk samples is initially expected:

- Weigh out approximately 0.5 g of material.
- Add 5 mL of a one percent ammonium bifluoride solution, then 5 mL of concentrated nitric acid.
- Digest in a hot block for 1 hour at a setting sufficient to produce 95°C in the digestion vessel.
- Cool, add a second 5 mL aliquot of nitric acid, and heat a second time for one hour at 95°C.
- Cool, add water for a final volume of 50 mL, and filter at 0.45 µm.

Due to the exploratory nature of this study, particularly in Round 1, it will be useful for the laboratory to provide listings of the mass numbers associated with every metal in the ICP-MS analyses, and the wavelengths associated with every metal in the ICP-AES analyses, as a separate document. For example, beryllium has mass number 9 for ICP-MS, and is typically analyzed in ICP-AES by looking for optical emissions around wavelengths 313.042, 234.861, or 313.107 nm (313.42, 2348.61, or 3131.07 Å). This information will assist in considering possible analytical interferences while developing the shorter list of metals to be considered in Round 2. Additionally, any changes to the prep and/or analytical methods following Round 1 of the analysis must be clearly documented prior to incorporation in Round 2 to ensure that subsequent statistical evaluations remain relevant.

Laboratories providing analytical services in support of this SAP will have a corrective action program in place that addresses analytical system failures and documents the effectiveness of any corrective actions. Issues that may affect analytical results are to be resolved by the Sample Management and Reporting organization in coordination with the Project Manager.

2.2.5 Quality Control

The QC protocols must be followed in the field, sample preparation, and laboratory to ensure that reliable data are obtained. QC samples will be collected and/or prepared by the SMT to evaluate the potential for cross contamination and provide information pertinent to sampling variability. QC samples will include equipment (rinsate) blanks (EBs), field DUPs, and certified SRMs of known concentrations. Laboratory QC samples estimate the precision and bias of the analytical process. Field and laboratory QC samples are summarized in Table 2-3.

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1 Certified geologic SRMs of interest include basalt, sediment, soil, and fly ash available from the U.S. Geological Survey, National Institute of Standards and Technology, Canadian Certified Reference Materials Project, and (European) Institute for Reference Materials.
Table 2-3. Project Quality Control Checks

<table>
<thead>
<tr>
<th>Quality Control Sample Type</th>
<th>Purpose</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample Management Quality Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment (rinsate) blanks (EBs); sieved and unsieved silica samples</td>
<td>Evaluate possibility of soil contamination during the sieving process.</td>
<td>At least one EB should be submitted per sample team for each day in which field sample material is being collected and sieved.</td>
</tr>
<tr>
<td>Duplicate soil aliquots</td>
<td>Estimate precision, including both sampling and analytical variability.</td>
<td>10% of locations submitted for each round of analysis.</td>
</tr>
<tr>
<td>Prepared standards of known concentrations</td>
<td>Estimate accuracy, at least to an extent that allows differentiation of high concentrations from low concentrations.</td>
<td>A minimum of two samples for each round of analysis, to include substantially different beryllium concentrations.</td>
</tr>
<tr>
<td>Blank wipes</td>
<td>Evaluate metal content of wipe media as well as potential analytical interferences from wipe media; evaluate statistical noise in wipe measurement data.</td>
<td>Minimum of 4 during each of Rounds 0, 1, and 2.</td>
</tr>
<tr>
<td><strong>Laboratory Quality Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method blank</td>
<td>Assess response of an entire laboratory analytical system</td>
<td>One per batch,* 20 samples maximum or as identified by the method guidance per media sampled.</td>
</tr>
<tr>
<td>Matrix spike</td>
<td>Identify analytical (preparation + analysis) bias; possible matrix affect on the analytical method used</td>
<td>When required by the method guidance, one per batch,* 20 samples maximum or as identified by the method guidance per media sampled.</td>
</tr>
<tr>
<td>Matrix spike duplicate</td>
<td>Estimate analytical bias and precision</td>
<td>When required by the method guidance, one per batch,* 20 samples maximum or as identified by the method guidance per media sampled.</td>
</tr>
<tr>
<td>Laboratory control samples</td>
<td>Assess method accuracy</td>
<td>One per batch,* 20 samples maximum or as identified by the method guidance per media sampled.</td>
</tr>
</tbody>
</table>

* Batching across projects is allowed for similar matrices (e.g., background soils).

2.2.5.1 Field Quality Control Samples
Field QC samples will be collected and/or prepared to evaluate the potential for cross contamination and to provide information pertinent to sampling variability and laboratory performance. Soil blanks are typically prepared using reagent silica sand. The QC samples and the required frequency for collection are described in this section. All samples, including QC samples, will be given sample identifications by the SMT that do not indicate their origin or source.
**Equipment (Rinsate) Blanks.** EBs consist of reagent silica sand passed through the sieves and placed in sample containers, as identified on the project sampling authorization form. The EB sample bottles will be placed in the same storage containers with the samples from the associated sampling event. The EB samples will be analyzed for the same constituents as the samples from the associated sampling event. The EBs will be used to identify contamination of the background soil samples by the sieving and sampling process; this information will be used in selecting the short list of metals for consideration in the Round 2 analyses.

**Field Duplicates.** Field DUPs are additional subsets of the samples collected from the identified locations, to be prepared by the sample management team. Analytical results from DUPs will be used to determine precision for both sampling and laboratory measurements. Evaluation of the results can provide an indication of intra-laboratory variability. One DUP will be prepared for each day on which laboratory analyses are run, or for each 10 locations sampled for each round of analyses, whichever is greater.

### 2.2.5.2 Laboratory Quality Control Samples

The laboratory QC samples (e.g., method blanks or laboratory control sample [LCS]/blank spikes) are defined in laboratory operating procedures and quality assurance manual and will be run at the frequency specified in the respective reference unless superseded by agreement. LCS and MS recoveries should be within a range of 75 to 125 percent, and LCS and MS DUPs should produce results with less than 25 percent relative percent difference; however, the use of a new digestion and the reporting of uncensored data may influence the achievability of this goal.

The QC checks outside of control limits will be reflected in the data validation report and during the DQA process, described in Section 2.4.

### 2.2.5.3 Quality Control Requirements

Table 2-3 lists the field QC requirements for sampling. The control limits for laboratory DUP samples, matrix spike samples, matrix spike DUP samples, and LCSs are typically derived from historical data at the laboratories in accordance with AIHA policy documents.

Additional QC measures include laboratory audits and participation in nationally based performance evaluation studies. The contract laboratories participate in national studies such as AIHA Performance Evaluation studies. Audit results are used to improve performance.

Failure of QC will be determined and evaluated during data validation and DQA processes. Data will be qualified, and flagged, as appropriate. However, no data will be omitted from data reports, since data quality issues will be one of the considerations in selecting usable short-list metals for metal ratio approaches to determining N-Be and A-Be in samples to be obtained inside facilities in the future.

### 2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance

Equipment used for collection, measurement, and testing meets applicable standards (e.g., American Society for Testing and Materials) or has been evaluated as acceptable and valid in accordance with the methods, requirements, and specifications. Measurement and testing equipment used in the field or in the laboratory directly affecting the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (e.g., documentation of routine maintenance) will be included in the individual laboratory and onsite organization’s QA plan or operating protocols, as appropriate. Maintenance of laboratory instruments will be performed in a manner consistent with standard laboratory practices or with auditable DOE, Hanford...
Site, and contractual requirements. Consumables, supplies, and reagents will be reviewed per AIHA requirements and will be appropriate for their use.

2.2.7 Instrument/Equipment Calibration and Frequency

Section 3.4 provides specific field equipment calibration information. Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratory’s QA plan.

2.2.8 Inspection/Acceptance of Supplies and Consumables

Supplies and consumables used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes described in the contractor acquisition system. Responsibilities and interfaces necessary to ensure that items procured or acquired for the contractor meet the specific technical and quality requirements must be in place. The procurement system ensures that purchased items comply with applicable procurement specifications. Supplies and consumables are checked and accepted by users prior to use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with the laboratory’s QA plan.

2.2.9 Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements will not be evaluated as part of this activity.

2.2.10 Data Management

The Sample Management and Reporting organization, in coordination with the Project Manager, is responsible for ensuring that analytical data are appropriately reviewed and relayed to the SMT in accordance with the applicable project requirements. Electronic data access, when appropriate, will include flags or other notations to indicate the uncensored nature of the data.

Laboratory issues are reported to the Sample Management and Reporting organization as data qualifiers on final data reports. Simple issues may be resolved by the Project Coordinator, who will inform the Project Manager. Any issues affecting the utility of data for its intended purpose will be elevated to the Project Manager for resolution.

In the event that specific protocols do not exist for a particular work evolution, or if it is determined that additional guidance is needed to complete certain tasks is needed, a work package will be developed to provide adequate control of the activities, as appropriate. Examples of sampling method requirements include activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks
- Checklists
- Sample packaging and shipping
2.3 Assessment and Oversight

The elements in assessment and oversight address the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAP is implemented as prescribed.

2.3.1 Assessments and Response Actions

Contractor Management, Regulatory Compliance, QA, and/or Health and Safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, and regulatory requirements. A DQA will be performed for the activities identified in this SAP. Section 2.4 discusses the DQA process. The results of the DQA will be incorporated into project reports. No other planned assessments have been identified.

If circumstances arise in the field dictating the need for additional assessment activities, then additional assessments will be performed. Deficiencies identified by any such assessments will be reported in accordance with existing programmatic requirements. The project’s line management chain coordinates the corrective actions/deficiencies in accordance with the contractor QA program, the corrective action management program, and associated protocols implementing these programs.

Oversight activities in the analytical laboratory, including corrective action management, are conducted in accordance with the laboratory’s QA plans. It is anticipated that all analyses for this study will be performed by the contractor laboratory itself. It may happen in the future that other laboratories will need to apply the methods being developed during this study; for this reason, it is imperative that the methods developed be documented with formal standard operating procedures by the beginning of Round 2 of the analyses.

2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified. Issues reported by the laboratories are communicated to the Sample Management and Reporting organization, which then initiates a sample issue resolution form in accordance with contractor protocols. This process is used to document analytical or sample issues and to establish resolution with the Project Manager.

DQA evaluations will be prepared to determine whether the type, quality, and quantity of collected data met the quality objectives described in this SAP. These first two steps of the formal DQA process (EPA/240/B-06/002, Data Quality Assessment: A Reviewer’s Guide) will be incorporated into other project reports. The remaining three steps of the formal DQA process will involve the actual statistical analysis of the analytical data to be obtained during the study. The formal DQA process is rather generic with regard to statistical analysis, but clearly anticipates meeting much less complex objectives than the current study. Therefore, major reports will be prepared on the substantive aspects of the project, such as selecting and verifying appropriate statistical treatments of the data and answering the basic question of whether metal ratios can predictably be used in distinguishing A-Be from N-Be in samples to be taken inside facilities during assessment and characterization in the future. These reports will meet the objectives of the remaining three steps of the formal DQA process.

2.4 Data Validation and Usability

The elements in this group address the QA activities that occur after the data collection phase of the project is completed. Implementation of these elements determines whether or not the data conform to the specified criteria, thus supporting the project objectives.
2.4.1 Data Review, Verification, and Validation

The criteria for verification include, but are not limited to, review for completeness (samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application and accurate reporting of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

Data validation will be performed to ensure that the data quality goals established during the planning phase have been achieved. Data validation will be based on AIHA functional guidelines. The criteria for data validation are based on a graded approach. The primary contractor has defined five levels of validation: A through E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data and calculations of representative samples from the data set).

Data validation will be performed to contractor Level C. Level C validation consists of a review of the QC data and specifically requires verification of deliverables, requested versus reported analytes, and qualification of the results based on evaluation of method blank results, matrix spike/matrix spike DUP results, and DUP sample results. Level C data validation will be performed on 100 percent of the data generated in each round of analysis described by this plan.

2.4.2 Verification and Validation Methods

Validation activities will be based on AIHA functional guidelines. When outliers or questionable results are identified, the data associated with these outliers and questionable data will be evaluated, and additional data validation will be performed. This additional data validation will consist of selecting up to an additional five percent of the data for the analytical method for which statistical outliers and/or questionable data were found during the initial round of data validation (e.g., a second validation of the 20 sample delivery groups for soil metals will be performed). The additional validation will begin with Level C and may increase to Levels D and E, as needed, to ensure that data are usable. Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. Data validation will be documented in data validation reports that will be included in the project file. The determination of data usability will be conducted and documented in the report discussing the first two steps of the formal DQA process.

2.4.3 Reconciliation with User Requirements

The first two steps of the DQA process compare completed field sampling activities to those proposed in corresponding sampling documents and provide an evaluation of the resulting data. The purpose of this data evaluation is to determine whether quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The results of the DQA will be used in interpreting the data and determining if the objectives of this activity have been met.

These steps of the DQA will be in accordance with EPA/240/B-06/002 and EPA/240/B-06/003, Data Quality Assessment: Statistical Methods for Practitioners. The remaining three steps of the formal DQA process comprise the statistical analysis of the data. This study is in the nature of research and method development, during which appropriate methods of statistical analysis for background and future data will be developed, validated, and documented. It is premature to prescribe the details of this effort at this time, beyond stating that they will involve multivariate distributional and correlation analysis, prediction analysis, algorithm development, and (in Round 2) validation of the methods to be used in future analyses of samples to be obtained inside facilities.
2.4.4 Corrective Actions

The responses to data quality defects identified through the DQA process will vary and may be data-specific or measurement-specific. Moreover, data quality issues will be among the evaluation criteria for determining whether other individual metals will be accepted as potentially useful in metal ratio applications. Some pre-identified corrective actions examples are identified in Table 2-1; however, the decision to use these, others, or none at all will rest with the Project Lead (in consultation with the SMT).
3 Field Sampling Plan

Additional details regarding field-specific collection requirements are provided in the following subsections.

3.1 Site Background and Objectives

Site background information is contained in Chapter 1 and the references cited therein. The initial target analytes are presented in Table 1-2, and Section 1.5 of this SAP provides a schedule for implementation. The objective of the field sampling plan is to provide clear identification of project sampling and analysis activities. The field sampling plan uses the sampling design identified during the DQOs planning process and presents the design to identify sampling locations, the total number of samples to be collected, and analyses to be performed.

3.2 Documentation of Field Activities

Logbooks or data forms are required for field activities. Section 2.1.6 provides the requirements for the logbook. Data forms may be used to collect field information; however, the information recorded on data forms must follow the same requirements as those for logbooks. The data forms must be referenced in the logbooks.

A summary of information to be recorded in logbooks is as follows:

- Purpose of activity
- Day, date, time, and weather conditions
- Names, titles, and organizations of personnel present
- Deviations from the QAPjP
- All site activities
- Materials quality documentation (e.g., certifications)
- Details of samples collected
- Locations and types of samples
- Chain-of-custody details and variances relating to chain-of-custody
- Field calibrations and surveys, and equipment identification numbers, as applicable
- Equipment failures or breakdowns, and descriptions of any corrective actions
- Telephone calls relating to field activities

3.3 Sampling Design

In this study, a form of systematic (grid) sampling is used to identify sampling locations reasonably and regularly spaced over the target background area. An initial grid location is chosen at random, and then the remaining grid cells are selected for equal spacing (3,500 by 3,500 m [11,483 by 11,483 ft]). In general, one sampling location is selected from each grid cell. Further information on this approach and the sampling locations selected is provided in Section 2.2.1 of this document and in DOE/RL-2011-68.

3.4 Calibration of Field Equipment

In this project, no field instruments requiring calibration are anticipated. If radiological surveys are deemed necessary, calibration of radiological field instruments will be performed by Pacific Northwest National Laboratory, as specified in their program documentation.
3.5 Sample Locations

The purpose of this section is to identify the sampling locations and define the sampling and analysis requirements for samples and measurements to be collected. The map provided in Figure 1-1 shows the approximate locations of the sites to be sampled in accordance with this SAP. The actual locations will be determined based on a field walkdown of current site conditions to avoid Hanford Site National Historic restrictions, roads, prohibitively dense vegetation, and other obstructions. The designated amount of soil (at least 250 g) will be collected at each sample location, through compositing soil obtained at four proximal sublocations. These samples will be identified by the location numbers given in Figure 1-1 and Table 1-1.

Observed physical properties of the samples will be recorded in field logs, as will the GPS coordinates of the locations actually sampled.

For the purposes of this study, it is expected that a single sampling will be needed at each location. These soil samples will be subsampled to provide the aliquots of soil needed for the analyses of Round 0 (one aliquot from each of 7 locations) and Rounds 1 and 2 (one from all locations and an additional [DUP] aliquot for 10 percent of locations), as well as soils to be used in preparing wipe samples for laboratory analysis. All samples to be transported to the lab will be assigned sample identifications that are noninformative regarding the original location and/or nature of the sample. Table 3-1 provides sample/ measurement locations and depths.

3.6 Sampling Methods

Sampling methods include the following:

- Identify suitable sampling location at or near specified coordinates.
- Collect soil sample from top 15 cm of soil at 4 points within 1 m (3 ft) of sampling location.
- Composite and homogenize soils in stainless steel mixing bowl, sieve to <1,000 μm, then collect a minimum of 250 grams of soil in a 120 mL poly bottle. If samples require drying to facilitate sieving, heating methods (e.g., a microwave oven) may be employed, so long as these steps are documented in the field logs.
- Label bottle with location number per Table 1-1.

3.6.1 Corrective Actions and Deviations for Sampling Activities

The Project Manager, FWS, BTR, or designee must document deviations from protocols and problems pertaining to sample collection, chain-of-custody, target analytes, sample transport, or noncompliant monitoring. Examples of deviations include samples not collected, or collected differently, because of field conditions, changes in sample locations because of physical obstructions, or additions of sample depth(s).

As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective action protocols. The Project Manager, FWS, BTR, or designee will be responsible for communicating field corrective action requirements and for ensuring that immediate corrective actions are applied to field activities.

Changes in sample locations not affecting the DQOs will require notification and approval of the Project Manager. Changes to sample locations affecting the DQOs will require concurrence from DOE. Changes to the SAP will be documented as noted in Section 2.1.6.
<table>
<thead>
<tr>
<th>Sampling Objectives</th>
<th>Sample Matrix</th>
<th>Sample Locations</th>
<th>Allowable Variation on Locations</th>
<th>Number of Samples</th>
<th>Sampling Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling locations Be-1 through Be-77, as identified in Table 1-1</td>
<td>Soil</td>
<td>Representative surface soils at specified latitude and longitude</td>
<td>Find clear area near coordinates per GPS. Actual coordinates sampled should be noted in logbook. Variation greater than 500 m (1,640 ft) should be approved by the Project Manager and noted in field logbook</td>
<td>77 field samples, which will then be repeatedly subsampled for Rounds 0, 1, and 2 bulk and wipe analyses</td>
<td>Identify suitable sampling location at or near specified coordinates. Collect soil sample from top 15 cm (5.9 in.) of soil at 4 points within 1 m (3 ft) of sampling location. Composite and homogenize soils in stainless steel mixing bowl, sieve to &lt;1,000 μm, then collect a minimum of 250 g of soil in a 120 mL poly bottle.</td>
</tr>
<tr>
<td>Field duplicates</td>
<td>Soil</td>
<td>Repository of sample material collected during field operations</td>
<td>N/A</td>
<td>17 (1 in Round 0, 8 each in Rounds 1 and 2)</td>
<td>For each location identified for a duplicate sample, prepare a second sample at the same approximate time and location and in the same manner as the first.</td>
</tr>
<tr>
<td>Equipment blanks</td>
<td>Reagent silica sand</td>
<td>Field sampling locations</td>
<td>N/A</td>
<td>TBD based on number and speed of sampling teams (1 per team per day of sampling)</td>
<td>Prepare two identical sample containers of reagent silica sand, one of which is has been run through the sieve used for soil sieving, the other unsieved.</td>
</tr>
</tbody>
</table>

*GPS = global positioning system*

*N/A = not applicable*

*TBD = to be determined*
3.6.2 Decontamination of Sampling Equipment

Sampling equipment will be decontaminated with detergent and water and/or compressed air in accordance with the sampling equipment decontamination protocols. To prevent potential contamination of the samples, care should be taken to use decontaminated equipment for each sampling activity.

Special care should be taken to avoid the following common ways in which cross contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events

3.6.3 Radiological Field Data

As the locations to be sampled in accordance with this SAP were selected to be representative of background, no radiological contamination is expected, and no radiological field data are needed to meet the data needs of this project.

3.7 Sample Handling

Sample handling methods are described in the following subsections.

3.7.1 Packaging

Level I U.S. Environmental Protection Agency precleaned sample containers will be used for soil samples collected for chemical analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. Preliminary container types and volumes are identified in Table 3-2.

<table>
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<tr>
<th>Method</th>
<th>Preservation Requirement</th>
<th>Holding Time</th>
<th>Bottle Type</th>
<th>Minimum Sample Size*</th>
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<tr>
<td>ICP-MS, ICP-AES</td>
<td>None</td>
<td>None</td>
<td>120 mL poly</td>
<td>250 g of raw material collected in the field</td>
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<tr>
<td></td>
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<td></td>
<td>Subsequent soil aliquots/duplicates for bulk analysis should contain at least 10 g</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>Subsequent soil aliquots for addition to wipes should contain at least 1 g</td>
</tr>
</tbody>
</table>

AES = atomic emission spectroscopy
ICP = inductively coupled plasma
MS = mass spectrometry
3.7.2 Container Labeling

The sample location (GPS coordinates) and corresponding location number from Table 1-1 are documented in the sampler’s field logbook. A custody seal (e.g., evidence tape) is affixed to each sample container and/or the sample collection package in such a way as to allow the detection of potential tampering.

Each container of soil sampled in the field will be labeled with the following information on firmly affixed, water resistant labels:

- Project identification
- Sample number
- Location number
- Sample collection date and time
- Sample authorization form number

Subsequent aliquots/subsamples for delivery to the laboratory will be labeled with the following information:

- Sample number
- Sample authorization form number
- Subsample collection date and time
- Sample matrix
- Analysis required

A custody seal will be affixed to the lid of each sample container. The custody seal will be inscribed with the sampler’s initials and the date.

3.7.3 Sample Custody

Sample custody will be maintained in accordance with existing Hanford Site protocols to ensure the maintenance of sample integrity throughout the analytical process. Chain-of-custody protocols will be followed throughout sample collection, storage/archival, transfer, analysis, and disposal to ensure sample integrity is maintained. A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples to the storage location identified by the Project Manager. An additional chain-of-custody record will be initiated for each subsampling evolution that will accompany subsamples to the laboratory.

Shipping requirements will determine how sample shipping containers are prepared for shipment. The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Each time the responsibility changes for the custody of the sample, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit the copy to the Sample Management and Reporting organization within 48 hours of shipping.

The following information is required on a completed chain-of-custody form for field samples:

- Project name
- Signature of sampler
- Unique sample number
The following information is required on a completed chain-of-custody form for subsamples sent to the laboratory:

- Project name
- Signature of sampler
- Unique sample number
- Date and time of subsample collection
- Matrix (soil)
- Preservatives (none anticipated) requested analyses (or reference thereto)
- For soil intended to be added to wipes, amount of soil to be added (this may vary from sample to sample)
- Signatures of individual involved in sample transfer

### 3.7.4 Sample Transportation

Samples are expected to be nonregulated and transported as such. If unexpected contamination is encountered, the pertinent sampling locations will likely be moved to an uncontaminated area within 500 m (1,640.4 ft). In the unlikely event that the Project Manager approves the collection of a sample that is suspected or known to be contaminated, transportation will be in compliance with the applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste mandated by Chapter 1 (“Research and Special Programs Administration, Department of Transportation”) of 49 CFR 171, “General Information, Regulations, and Definitions,” through 49 CFR 177, “Carriage By Public Highway,” in association with the International Air Transportation Authority, DOE requirements, and applicable program-specific implementing protocols.

### 3.8 Management of Waste

All waste generated by sampling activities associated with this SAP is expected to be nonregulated and will be managed as environmental media or miscellaneous rubbish. In the event of an unexpected event that generates potentially regulated waste, the Project Manager, in consultation with waste services and the ECO, will determine a safe and compliant disposal pathway.
4 Health and Safety

Field operations will be performed in accordance with 10 CFR 851, “Worker Safety and Health Program,” health and safety requirements, and appropriate Soil and Groundwater Remediation Project requirements. Additionally, work control documents will be prepared to provide further control of site operations. Safety documentation will include an activity hazard analysis and, as applicable, radiological work permits. The sampling and associated activities will implement “as low as reasonably achievable” practices to minimize the radiation exposure to the sampling team and possible release of radiological contamination, consistent with the requirements defined in 10 CFR 835, “Occupational Radiation Protection.”
5 References


## Distribution

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