

**Remedial Action Contract
for Remedial Response, Enforcement Oversight, and Non-Time
Critical Removal Activities at Sites of Release or Threatened Release
of Hazardous Substances in EPA Region VIII**

U.S. EPA Contract No. EP-W-05-049

**Sampling and Analysis Plan/Quality Assurance Project Plan:
2013 Indoor Activity-Based Sampling
Libby Asbestos Superfund Site, Operable Unit 4
*Revision 0 - February 2013***

**Work Assignment No.: 329-RICO-08BC
Libby Asbestos Superfund Project,
OU4 Remedial Investigation/
Feasibility Study**

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A PROJECT MANAGEMENT

A1. Title and Approval Sheet

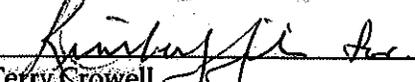
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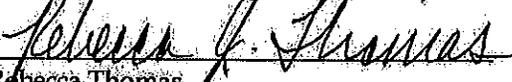
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List of Acronyms and Abbreviations

%	percent
ABS	activity-based sampling
Ago	grid opening area
C_{air}	air concentration
cc^{-1}	per cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHISQ	chi-squared
COC	chain-of-custody
DE Tool	data entry tool
DQO	data quality objective
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
f/cc	fibers per cubic centimeter
FSDS	field sample data sheet
FTL	field team leader
GIS	geographic information system
GO_x	number of grid openings
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and Safety
HV	high volume filter
ID	identification
IDW	investigation-derived waste
L	liters
L/cc	liters per cubic centimeter
L/min	liters per minute
LA	Libby amphibole
LC	laboratory coordinator
LV	low volume filter
MDEQ	Montana Department of Environmental Quality
mm	millimeter
mm^2	square millimeters
N	number
NFG	National Functional Guidelines
NIST	National Institute of Standards and Technology
NVLAP	National Voluntary Laboratory Accreditation Program

OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PLM	polarized light microscopy
OU4	Operable Unit 4
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RPM	Regional Project Manager
ROM	Record of Modification
s/cc	structures per cubic centimeter
SAP	sampling and analysis plan
SAED	selective area electron diffraction
Shaw	Shaw Environmental, Inc.
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	Soil Preparation Facility
SRM	standard reference materials
STEL	short-term exposure limit
TEM	transmission electron microscopy
TWA	time-weighted average
USGS	United States Geological Survey
V	sample air volume
µm	micrometers

A3. Distribution List

Copies of this completed and signed sampling and analysis plan/quality assurance project plan (SAP/QAPP) should be distributed to:

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1595 Wynkoop Street

Denver, Colorado 80202-1129

- Rebecca Thomas, Thomas.Rebecca@epa.gov (1 hard copy, electronic copy)
- Elizabeth Fagen, Fagen.Elizabeth@epa.gov (electronic copy)
- Don Goodrich, Goodrich.Donald@epa.gov (electronic copy)
- Jeff Mosal, Mosal.Jeffrey@epa.gov (electronic copy)
- Dania Zinner, Zinner.Dania@epa.gov (electronic copy)
- David Berry, Berry.David@epa.gov (electronic copy)

EPA Information Center - Libby

108 East 9th Street

Libby, Montana 59923

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Montana Department of Environmental Quality

1100 North Last Chance Gulch

Helena, Montana 59601

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ESAT, Region VIII

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Libby, Montana 59923

- Catherine Cox, coxCA@cdmsmith.com (2 hard copies, electronic copy)
- Terry Crowell, crowellTL@cdmsmith.com (electronic copy)
- Damon Repine, repineDL@cdmsmith.com (electronic copy)

CDM Smith - Denver Office

555 17th Street, Suite 1100

Denver, Colorado 80202

- Nathan Smith, smithNT@cdmsmith.com (electronic copy)

Copies of the SAP/QAPP will be distributed to the individuals above by CDM Federal Programs Corporation (CDM Smith), either in hard copy or in electronic format (as indicated above). The CDM Smith Project Manager (or their designee) will distribute updated copies each

time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

A4. Project Task Organization

Figure A-1 presents an organizational chart that shows lines of authority and reporting responsibilities for this project. The following sections summarize the entities and individuals that will be responsible for providing project management, technical support, and quality assurance (QA) for this project.

A4.1 Project Management

The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency for Superfund activities within the Libby Asbestos Superfund Site (Site). The EPA Region VIII Libby Asbestos Project Team Leader is Rebecca Thomas. The EPA Regional Project Manager (RPM) for this sampling effort is Elizabeth Fagen. The EPA Region VIII Onsite RPM for this sampling effort is Michael Cirian.

The Montana Department of Environmental Quality (MDEQ) is the support regulatory agency for Superfund activities at the Site. The MDEQ Project Manager for this sampling effort is Carolyn Rutland. The EPA will consult with MDEQ as provided for by the Comprehensive Environmental Response, Compensation, and Liability Act, the National Contingency Plan, and applicable guidance in conducting Superfund activities.

A4.2 Technical Support

A4.2.1 SAP/QAPP Development

This SAP/QAPP was developed by CDM Smith at the direction of, and with oversight by, the EPA. This SAP/QAPP contains all the elements required for both a SAP and a QAPP and has been developed in general accordance with the *EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5* (EPA 2001) and the *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G4* (EPA 2006).

Copies of the SAP/QAPP will be distributed by the CDM Smith Project Manager (or their designee), either in hard copy or in electronic format, as indicated in Section A3. The CDM Smith Project Manager (or their designee) will distribute updated copies each time a SAP/QAPP revision occurs. An electronic copy of the final, signed SAP/QAPP (and any subsequent revisions) will also be posted to the Libby Field eRoom.

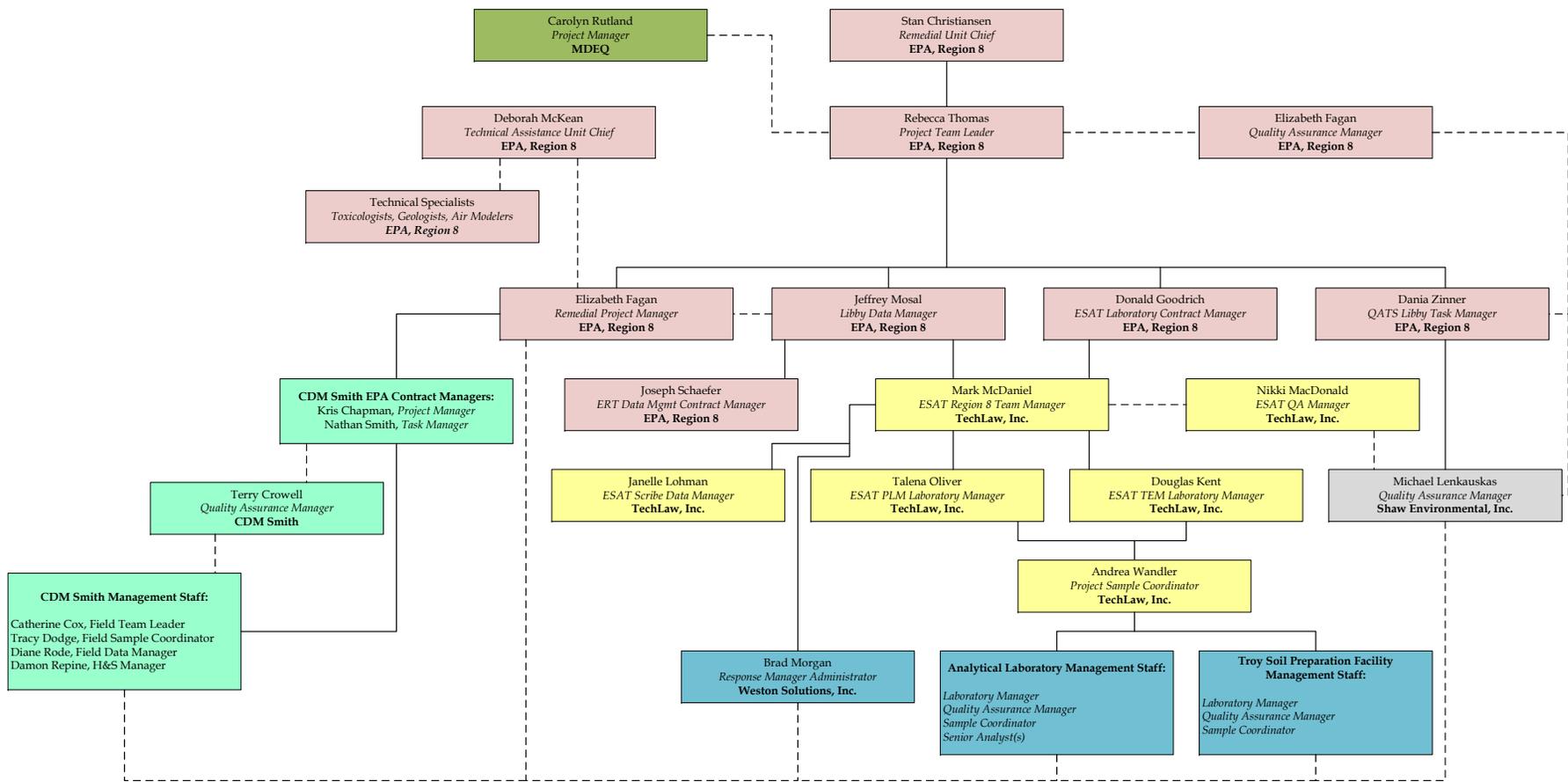


Figure A-1. Organizational Chart for the 2013 Indoor Activity-Based Sampling Program



A4.2.2 Field Sampling Activities

CDM Smith will be responsible for conducting all field sampling activities in support of the investigation described in this SAP/QAPP. Key CDM Smith personnel that will be involved in this investigation include:

- Nathan Smith, Project Manager
- Catherine Cox, Field Team Leader
- Tracy Dodge, Sample Coordinator
- Diane Rode, Field Data Manager
- Terry Crowell, Quality Assurance Coordinator
- Damon Repine, Health and Safety Manager

A4.2.3 Asbestos Analysis

All samples collected as part of this project will be sent for preparation and analysis for asbestos at laboratories selected and approved by the EPA to support the Site. The EPA Environmental Services Assistance Team (ESAT) is responsible for procuring all analytical and preparation laboratory services and providing direction to the analytical laboratories. Don Goodrich (EPA Region 8) is responsible for managing the ESAT laboratory support contract for asbestos. The ESAT Region 8 Team Manager at TechLaw, Inc. is Mark McDaniel. He is also the designated laboratory coordinator (LC) for the Libby project that is responsible for directing the analytical laboratories, prioritizing analysis needs, and managing laboratory capacity.

A4.2.4 Data Management

All data generated as part of this sampling effort will be managed and maintained in Scribe. The EPA Environmental Response Team (ERT) is responsible for the administration of all Scribe data management aspects of this project. Joseph Schafer is responsible for overseeing the ERT data management support contract. ERT is responsible for the development and management of Scribe and the project-specific data reporting requirements for the Libby project.

The CDM Smith field data manager (Diane Rode) is responsible for uploading sample information to the field Scribe project database. ESAT is responsible for uploading new analytical results to the analytical Scribe project database. The ESAT project data manager for the Libby project is Janelle Lohman (TechLaw, Inc.).

Because of the quantity and complexity of the data collected at the Site, the EPA has designated a Libby Data Manager to manage and oversee the various data support contractors. The EPA Region 8 Data Manager for the Libby project is Jeff Mosal.

A4.3 Quality Assurance

There is no individual designated as the EPA Quality Assurance Manager for the Libby project. Rather, the Region 8 Quality Assurance (QA) program has delegated authority to the EPA RPMs. This means that the EPA RPMs have the ability to review and approve governing investigation documents developed by Site contractors. Thus, it is the responsibility of the EPA RPM for this sampling effort (Elizabeth Fagen), who is independent of the entities planning and obtaining the data, to ensure that this SAP/QAPP has been prepared in accordance with the EPA QA guidelines and requirements. The EPA RPM is also responsible for managing and overseeing all aspects of the quality assurance/quality control (QA/QC) program for this sampling effort. In this regard, the RPM is supported by the EPA Quality Assurance Technical Support (QATS) contractor, Shaw Environmental, Inc. (Shaw). The QATS contractor will evaluate and monitor laboratory QA/QC and is responsible for performing annual audits of each analytical laboratory.

Terry Crowell (CDM Smith) is the field Quality Assurance Coordinator for this project. Ms. Crowell is responsible for evaluating and monitoring field QA/QC, for providing oversight of field sampling and data collection activities, and for designating a qualified individual to conduct the field surveillance (see Section B5.1).

A5. Problem Definition/Background

A5.1 Site Background

Libby is a community in northwestern Montana located 7 miles southwest of a vermiculite mine that operated from the 1920s until 1990. The mine began limited operations in the 1920s and was operated on a larger scale by the W.R. Grace Company from approximately 1963 to 1990. Studies revealed that the vermiculite from the mine contains amphibole-type asbestos, referred to as Libby amphibole (LA).

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald *et al.* 1986, 2004; Amandus and Wheeler 1987; Amandus *et al.* 1987; Whitehouse 2004; Sullivan 2007). Additionally, radiographic abnormalities were observed in 17.8 percent (%) of the general population of Libby including former workers, family members of workers, and individuals with no specific pathway of exposure (Peipins *et al.* 2003; Whitehouse *et al.* 2008; Antao *et al.* 2012; Larsen *et al.* 2010, 2012a, 2012b). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of ongoing exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List in October 2002.

A5.2 Reasons for this Project

Previous investigations conducted at the Site have demonstrated that LA is present in various environmental source media (e.g., dust, vermiculite insulation, soil) at locations in and around the Site. EPA has also performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities, referred to as “activity-based sampling” (ABS). These inhalation exposures may pose a risk of cancer and/or non-cancer effects. The purpose of this project is to conduct ABS to investigate potential exposures to airborne LA during typical activities inside residences and workplaces in Operable Unit 4 (OU4). OU4 is defined as residential, commercial, industrial (not associated with mining operations), and public properties, including schools and parks in and around the City of Libby.

In 2007/2008, EPA conducted an ABS study to evaluate indoor air concentrations in OU4 (EPA 2010). Based on a review of this indoor ABS data, EPA has identified two data gaps that require additional investigation at residential properties, as described below.

Data Gap 1. In the 2007/2008 indoor ABS study, four different “categories” of properties were evaluated based on the status of the outdoor soil. These categories included properties where yard removals had been conducted in only a portion of the yard or for which no soil removal was deemed necessary. Properties in which a full yard cleanup (i.e., a “curb-to-curb” cleanup) had been conducted were not evaluated. Therefore, additional indoor ABS data are needed to determine if residual risks from indoor air at post-cleanup “curb-to-curb” properties are within acceptable limits.

Data Gap 2. Although the 2007/2008 indoor ABS study evaluated properties following soil cleanup or where no cleanup was deemed warranted, LA was frequently detected in samples of indoor ABS air. Because no additional indoor ABS data have been collected since this study, there is no data to provide information on potential changes in indoor ABS air concentrations over time. Therefore, additional indoor ABS data are needed to provide information on whether measured ABS air concentrations have changed over time at properties that were originally evaluated in 2007/2008.

A5.3 Applicable Criteria and Action Limits

At the Site, EPA has developed action levels and cleanup criteria for LA that are applicable to emergency response actions performed at residential/commercial properties (EPA 2003). However, there are no action levels or cleanup criteria that have been developed which are specific to ABS air. Final action levels for the Site will not be developed until completion of the remedial investigation/feasibility study and the publication of the record of decision.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with

these requirements, health and safety air monitoring samples will be analyzed for asbestos by phase contrast microscopy (PCM) (see Section B4.1.2) and compared to the OSHA limits for workplace exposures. The short-term (15-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter of air (f/cc), and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc. (Note that the health and safety air monitoring samples are separate from the indoor ABS air samples collected as part of this investigation.)

A6. Project/Task Description

A6.1 Task Summary

Basic tasks that are required to implement this SAP/QAPP include collecting ABS air under sampling conditions that emulate a person performing typical indoor activities. Two general types of indoor activities will be evaluated – passive behaviors (e.g., watching television, reading) and active behaviors (e.g., sweeping, cleaning). These basic tasks are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

Two ABS events will be conducted – one in the winter (February-March 2013) and one in the summer (July-August 2013). In order to accommodate resident schedules, there are no specific sampling dates established provided that sampling events occur within these timeframes. Following sample collection, analysis, data evaluation and interpretation tasks will be performed in the summer of 2013.

A6.3 Locations to be Evaluated

All indoor ABS activities will be performed at residential and commercial properties located within OU4. Property selection criteria are described in Section B1.1.

A6.4 Resources and Time Constraints

There are both resource and time constraints associated with the scope of this investigation. Because ABS activities need to be representative of exposure under winter and summer environmental conditions, samples must be collected from February-March 2013 (under winter conditions) and from July-August 2013 (under dry, summer conditions). Because these data will be used to support the human health risk assessment for OU4, analytical results and data interpretation will need to be completed before the fall of 2013.

Due to the amount of funding allocated for this project, this investigation will be limited to an evaluation of 20 properties (10 curb-to-curb locations and 10 properties that were originally evaluated in 2007/2008). A total of two ABS events will be performed at curb-to-curb

properties – one in the winter and one in the summer. One summer ABS event will be performed at properties that were originally evaluated in 2007/2008.

A7. Quality Objectives and Criteria

A7.1 Data Quality Objectives

Data quality objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and types of analyses to be performed. The EPA has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific decision-making (EPA 2001, 2006).

Appendix A provides the detailed implementation of the seven-step DQO process associated with this SAP/QAPP.

A7.2 Performance Criteria

During the 2007/2008 study, average indoor ABS air concentrations¹ ranged from non-detect to 0.003 LA structures per cubic centimeter of air (s/cc) (EPA 2010). Results tended to be highly variable, often spanning several orders of magnitude depending upon the type of disturbance activity, season, and outdoor soil conditions.

The transmission electron microscopy (TEM) analytical requirements for LA measurements in ABS air, as established in Section B4.1.1, ensure concentrations will be reliably detected and quantified if present at levels of concern. Detailed calculations in support of these analytical requirements are provided as part of the DQOs (see **Appendix A**).

The PCM analytical requirements for health and safety air monitoring samples are based on the requirements specified in NIOSH Method 7400 (see Section B4.1.2).

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos structures counted in each sample. The coefficient of variation resulting from random Poisson counting error is equal to $1/N^{0.5}$. In general, when good precision is needed, it is desirable to

¹ Air concentrations are reported based on phase contrast microscopy-equivalent (PCME) structures. PCME structures have a length greater than 5 micrometers (um), width greater than or equal to 0.25 um, and an aspect ratio (length:width) of 3:1 or greater.

count a minimum of 3-10 structures per sample, with counts of 20-25 structures per sample being optimal.

Recount and re-preparation analyses will be performed as part of the TEM analysis (see Section B5.2.3). These analyses will provide information on analysis reproducibility and precision (both inter- and intra-laboratory).

A7.4 Bias and Representativeness

There is no established set of reference materials or spiked standards that can be used to assess accuracy of TEM analyses of LA in air. Results for field blanks and laboratory blanks will be utilized to ensure that air sample results are not biased as a consequence of cross-contamination due to field sampling procedures or preparation and analysis methods.

It is expected that LA levels in ABS air may vary widely as a function of the level of LA in the source materials disturbed, the types of activities performed, and meteorological and environmental conditions. This ABS study is intended to represent the range of potential exposure conditions. The ABS air sample collection will be performed under simulated activities that are representative of the types of activities that may actually be performed by residents and workers inside homes and commercial properties.

A7.5 Completeness

Target completeness for this project is 100%. If any samples are not collected, or if LA analysis is not completed successfully, this could result in that portion of the study providing no useful information. In this event, additional sampling may be needed to support EPA decision-making.

A7.6 Comparability

The data generated during this study will be obtained using standard analytical methods for LA that have been utilized previously in other studies, and will yield data that are comparable to previous analyses of LA in ABS air.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for analysis of LA in air is discussed in Section B4.

A8. Special Training/Certifications

A8.1 Field

Asbestos is a hazardous substance that can increase the risk of cancer and serious non-cancer effects in people who are exposed by inhalation. Therefore, all individuals involved in the collection of samples must have appropriate training. Prior to starting any field work, any new field team member must complete the following, at a minimum:

Training Requirement	Location of Documentation Specifying Training Requirement Completion
Read and understand the governing Health and Safety Plan (HASP)	HASP signature sheet
Attend an orientation session with the field health and safety (H&S) manager	Orientation session attendance sheet
OSHA 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) and relevant 8-hour refreshers	OSHA training certificates
Current 40-hour HAZWOPER medical clearance	Physician letter in the field personnel files
Respiratory protection training, as required by 29 CFR 1910.134	Training certificate
Asbestos awareness training, as required by 29 CFR 1910.1001	Training certificate
Sample collection techniques	Orientation session attendance sheet

All training documentation will be stored in the CDM Smith field office. It is the responsibility of the field H&S manager to ensure that all training documentation is up-to-date and on-file for each field team member.

Prior to beginning field sampling activities, a field planning meeting will be conducted to discuss and clarify the following:

- Objectives and scope of the fieldwork
- Equipment and training needs
- Field operating procedures, schedules of events, and individual assignments
- Required quality control (QC) measures
- Health and safety requirements

It is the responsibility of each field team member to review and understand all applicable governing documents associated with this investigation, including this SAP/QAPP, all associated standard operating procedures (SOPs) (see **Appendix B**), and the applicable HASP.

A8.2 Laboratory

A8.2.1 Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Each laboratory is accredited by the National Institute of Standards and Technology (NIST)/National Voluntary Laboratory Accreditation Program (NVLAP) for the analysis of airborne asbestos by transmission electron microscope (TEM) and/or analysis of bulk asbestos by polarized light microscopy (PLM). This includes the analysis of NIST/NVLAP standard reference materials, or other verified quantitative standards, and successful participation in two proficiency rounds per year each of bulk asbestos by PLM and airborne asbestos by TEM supplied by NIST/NVLAP.

Copies of recent proficiency examinations from NVLAP or an equivalent program are maintained by each participating analytical laboratory. Many of the laboratories also maintain certifications from other state and local agencies. Copies of all proficiency examinations and certifications are also maintained by the LC.

Each laboratory working on the Libby project is also required to pass an on-site EPA laboratory audit. The details of this EPA audit are discussed in Section B5.3.3. The LC also reserves the right to conduct any additional investigations deemed necessary to determine the ability of each laboratory to perform the work. Each laboratory also maintains appropriate certifications from the state and possibly other certifying bodies for methods and parameters that may also be of interest to the Libby project. These certifications require that each laboratory has all applicable state licenses and employs only qualified personnel. Laboratory personnel working on the Libby project are reviewed for requisite experience and technical competence to perform asbestos analyses. Copies of personnel resumes are maintained for each participating laboratory by the LC in the Libby project file.

A8.2.2 Laboratory Team Training/Mentoring Program

Initial Mentoring

The orientation program to help new laboratories gain the skills needed to perform reliable analyses at the Site involves successful completion of a training/mentoring program that was developed for new laboratories prior to their analysis of Libby field samples. All new laboratories are required to participate in this program. The training program includes a rigorous 2-3 day period of on-site training provided by senior personnel from those laboratories already under contract on the Libby project, with oversight by the QATS contractor (Shaw). The tutorial process includes a review of morphological, optical, chemical, and electron diffraction characteristics of LA, as well as training on project-specific analytical methodology, documentation, and administrative procedures used on the Libby site. The mentor will also

review the analysis of at least one sample by each type of analytical method with the trainee laboratory.

Site-specific Reference Materials

Because LA is not a common form of asbestos, U.S. Geological Survey (USGS) prepared Site-specific reference materials using LA collected at the Libby mine site (EPA 2008a). Upon entry into the Libby program, each laboratory is provided samples of these LA reference materials. Each laboratory is required to analyze multiple LA structures present in these samples by TEM in order to become familiar with the physical and chemical appearance of LA and to establish a reference library of LA Energy Dispersive Spectroscopy (EDS) spectra. These laboratory-specific and instrument-specific LA reference spectra (EPA 2008b) serve to guide the classification of asbestos structures observed in Libby field samples during TEM analysis.

Regular Technical Discussions

Ongoing training and communication is an essential component of QA for the Libby project. To ensure that all laboratories are aware of any technical or procedural issues that may arise, a regular teleconference is held between the EPA, their contractors, and each of the participating laboratories. Other experts (e.g., USGS) are invited to participate when needed. These calls cover all aspects of the analytical process, including sample flow, information processing, technical issues, analytical method procedures and development, documentation issues, project-specific laboratory modifications, and pertinent asbestos publications.

Professional/Technical Meetings

Another important aspect of laboratory team training has been the participation in technical conferences. The first of these technical conferences was hosted by USGS in Denver, Colorado, in February 2001, and was followed by another held in December 2002. The Libby laboratory team has also convened on multiple occasions at the ASTM Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conferences in January 2010 and January 2013. In addition, members of the Libby laboratory team attended an EPA workshop to develop a method to determine whether LA is present in a sample of vermiculite attic insulation held in February 2004 in Alexandria, Virginia. These conferences enable the Libby laboratory and technical team members to have an ongoing exchange of information regarding all analytical and technical aspects of the project, including the benefits of learning about developments by others.

A8.2.3 Analyst Training

All TEM analysts for the Libby project undergo extensive training to understand TEM theory and the application of standard laboratory procedures and methodologies. The training is

typically performed by a combination of personnel, including the laboratory manager, the laboratory quality assurance manager (QAM), and senior TEM analysts.

In addition to the standard TEM training requirements, trainees involved with the Libby project must familiarize themselves with Site-specific method deviations, project-specific documents, and visual references. Standard samples that are often used during TEM training include known pure (traceable) samples of chrysotile, amosite, crocidolite, tremolite, actinolite and anthophyllite, as well as fibrous non-asbestos minerals such as vermiculite, gypsum, antigorite, kaolinite, and sepiolite. New TEM analysts on the Libby project are also required to perform an EDS spectra characterization evaluation (EPA 2008b) on the LA-specific reference materials provided during the initial training program to aide in LA mineralogy recognition and definition. Satisfactory completion of each of these tasks must be approved by a senior TEM analyst.

All TEM analysts are also trained in the Site-specific laboratory QA/QC program requirements for TEM (see Section B5.3.4). The entire program is discussed to ensure understanding of requirements and responsibilities. In addition, analysts are trained in the project-specific reporting requirements and data reporting tools utilized in transmitting results. Upon completion of training, the TEM analyst is enrolled as an active participant in the Libby laboratory program.

A training checklist or logbook is used to assure that the analyst has satisfactorily completed each specific training requirement. It is the responsibility of the laboratory QAM to ensure that all TEM analysts have completed the required training requirements.

A9. Documentation and Records

A9.1 Field

Field teams will record sample information on the most current version of the Site-specific field sample data sheets (FSDSs) developed for each medium². Section B3.1.2 provides detailed information on the documentation requirements for FSDS forms. In brief, the FSDS forms document the unique sample identifier assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate).

A9.2 Laboratory

All preparation and analytical data for asbestos generated in the laboratory will be documented on Site-specific laboratory bench sheets and entered into a database or spreadsheet electronic

² The most recent version of the FSDS forms are provided in the Libby Field eRoom.

data deliverable (EDD) for submittal to the data managers. Section B4.2 provides detailed information on the requirements for laboratory documentation and records.

A9.3 Logbooks and Records of Modification/Deviations

It is the also responsibility of the field team and analytical laboratory staff to maintain logbooks and other internal records throughout the sample lifespan as a record of sample handling procedures. Significant deviations (i.e., those that impact or have the potential to impact investigation objectives) from this SAP/QAPP, or any procedures referenced herein governing sample handling, will be discussed with the EPA Project Manager (or their designee) and the CDM Smith Project Manager prior to implementation. Such deviations will be recorded on a Record of Modification (ROM) form. Sections B5.1.2 and B5.2.2 provide detailed information on the procedures for preparing and submitting ROMs by field and analytical laboratory personnel, respectively.

B DATA GENERATION AND ACQUISITION

B1. Study Design

The goal of this study is to collect data that will address the two data gaps for indoor ABS identified by EPA (see Section A5.2). This SAP will guide two sampling scenarios designed to address each data gap, including:

- Scenario 1: Evaluation of indoor ABS air concentrations at curb-to-curb properties
- Scenario 2: Re-evaluation of indoor ABS air concentrations at 2007/2008 ABS properties

The following subsections describe the study designs for each indoor ABS scenario.

B1.1 Property Selection Criteria

As noted above, all indoor ABS activities will be performed at residential and commercial properties located within OU4. There are specific criteria for each sampling scenario that will be applied when identifying and selecting properties for evaluation in this investigation.

Scenario 1: Curb-to-Curb Properties

The objective of Scenario 1 is to collect indoor ABS data to evaluate the efficacy and protectiveness of a “curb-to-curb” yard removal. Thus, only those OU4 properties that have undergone a “curb-to-curb” yard cleanup will be eligible for selection. Because it is likely that there is some lag time between when the curb-to-curb removal is performed and when the effects of this removal influence indoor air conditions inside the property, only those properties where removals were performed prior to 2011 will be selected.

Table B-1 presents the list of properties that had a “curb-to-curb” yard removal performed in 2008 to 2010. Due to budgetary limitations, a total of 10 curb-to-curb properties will be selected for evaluation. To the extent possible, selected properties should provide a reasonable spatial representation of OU4. If possible, properties evaluated as part of the curb-to-curb outdoor ABS program in 2011 (CDM Smith 2011a) would be preferred (highlighted in grey in **Table B-1**), since this would provide paired indoor and outdoor ABS information for the same property.

Table B-1. List of Candidate Curb-to-Curb Properties

Curb-to-curb Removal Completion Year	Property Address
2010	70 N Kearney Ave
	610 Utah Ave
	814 Wisconsin Ave
	1117 Louisiana Ave
	317 Mineral Ave
	418 Flower Creek
	134 White Ave
	1024 Washington Ave
	811 California Ave
	337 Airfield Road
	36318 Highway 2
	222 Mineral Ave
	214 & 216 Mineral Ave
	2009
341 White Ave	
96 Collins Ave	
115 White Ave	
145 Pearl St	
60 Burr Ave	
2008	808 Mineral Ave
	1508 Kaniksu Ave
	1116 California Ave
	111 Mineral Ave
	920 Main Ave
	1013 Minnesota Ave
	86 Glendora Ave
	1020 Idaho Ave
	158 Forest Ave
	431 Granite Ave
	62 Evergreen St
	228 White Ave
	77 Rose St
	939 E Lincoln Blvd
	34154 US Highway 2
	82 Collins Ave
515 Wisconsin Ave	
468 City Service Rd	
407 Dakota Ave	
755 Farm To Market Rd #5	

 property evaluated in the 2011 outdoor ABS study

Scenario 2: 2007/08 Re-evaluation

Because the objective of Scenario 2 is to compare results of this indoor ABS effort to results from the 2007/2008 indoor ABS effort, properties evaluated in this study must have been evaluated in 2007/2008 as part of the indoor ABS evaluation (EPA 2010). As noted above, properties selected for indoor ABS evaluation in 2007/2008 were drawn from four categories, depending upon their outdoor soil cleanup status and the post-cleanup soil conditions. (Selected properties included properties where interior cleanups had been performed and properties where no cleanup was deemed necessary.)

Table B-2 presents the list of properties evaluated in 2007/2008 stratified by category. Due to budgetary limitations, a total of 10 properties will be randomly selected for evaluation; five properties where a partial outdoor soil cleanup was performed and five properties where an outdoor soil cleanup was not deemed necessary. To the extent possible, selected properties should provide a reasonable spatial representation of OU4.

Should any of the selected properties become inaccessible at any point during or prior to the sampling event, new properties that meet the same criteria will be identified and presented to the EPA for approval. These changes would be documented on a ROM form as described in Section B5.1.

B1.2 ABS Scripts

Indoor ABS activities will be performed by CDM Smith field staff. Participating residents will be required to leave the property during the time period of indoor sample collection. Each property sampled will have two 4-hour samples collected to represent indoor air levels during two types of activity – passive behaviors and active behaviors.

Passive Behaviors. In this 4-hour interval, the actor will engage in minimal physical activity. Movement will be restricted to walking between rooms, sitting on chairs, couches, or the floor, etc. While seated, the actor may read, watch television, or complete required paperwork. The key attribute is that the actor is engaging in minimally energetic actions that will have low tendency to disturb source materials.

Active Behaviors. In this 4-hour interval, the actor will engage in a standardized sequence (“script”) of active behaviors, as detailed in **Appendix C**. This script is intended to capture a wide range of different activities that residents may engage in during normal living conditions. This includes things such as walking between rooms, sitting down on chairs and couches, simulated play with children or pets, sweeping, vacuuming, and dusting.

Table B-2. 2007/2008 Indoor ABS Candidate Properties

Soil Cleanup Performed?	Post-Cleanup Soil	Indoor ABS Category	Indoor ABS Index	Address	Mean PCME LA Air Conc (s/cc)	
					Passive	Active
					No (no soil cleanup deemed necessary)	PLM = ND & VV-
9	1047 Sheldon Flats Rd	0.00E+00	0.00E+00			
10	105 W. Oak St	4.92E-05	0.00E+00			
26	1464 E. 5th St Ext	0.00E+00	4.97E-05			
33	188 Terrace View Rd	0.00E+00	1.50E-04			
41	25 Evans Rd	0.00E+00	6.63E-05			
42	255 Lodgepole Way	4.76E-05	1.31E-04			
48	32 Shalom Kerry	5.01E-05	9.94E-05			
49	323 E. Cedar St	0.00E+00	9.28E-05			
50	337 Commerce Way	0.00E+00	4.98E-05			
52	3576 Highway 2 S	2.00E-04	4.58E-04			
58	460 Woodland Heights Rd	4.63E-05	0.00E+00			
63	5862 Highway 2 S	4.81E-05	1.85E-04			
64	5865 Highway 2 S	0.00E+00	1.88E-04			
65	600 Granite Ave	4.95E-05	0.00E+00			
66	610 Granite Ave	0.00E+00	4.94E-05			
69	6797 Farm to Market Rd	2.37E-04	4.50E-04			
79	985 Farm to Market Rd	0.00E+00	0.00E+00			
81	998 Terrace View Rd	0.00E+00	1.50E-04			
PLM ≠ ND or VV+	INT2	2	101 Woodland Rd	4.98E-05		1.13E-03
		3	1016 Nevada Ave	0.00E+00		0.00E+00
		5	1021 Nevada Ave	0.00E+00		7.36E-05
		8	104 Granite Ave	0.00E+00		6.19E-05
		14	112 W. Cedar St	4.99E-05		4.86E-05
		15	118 White Ave	2.58E-03		2.80E-03
		16	120 Forest Ave	0.00E+00		1.63E-04
		17	120 Manor Dr	0.00E+00		6.30E-05
		21	1313 Renwood Dr	0.00E+00		0.00E+00
		32	1711 Airstrip Rd	1.49E-04		1.34E-03
		35	1915 Kootenai River Rd	0.00E+00		0.00E+00
		40	2375 Kootenai River Rd	4.60E-05		0.00E+00
		43	269 N. Central Rd	4.56E-05		3.15E-04
		47	310 W. Flower St	4.98E-05	2.52E-04	
		51	3518 Highway 2 S	4.93E-05	1.49E-04	
		56	397 Sheldon Ln	1.42E-04	1.57E-04	
59	487 Kootenai Dr	0.00E+00	4.68E-05			
67	628 Avenue B	0.00E+00	1.95E-04			
68	660 Reserve Rd	0.00E+00	2.12E-04			
70	700 Farm to Market Rd	0.00E+00	9.93E-05			
78	912 California Ave	0.00E+00	2.58E-04			
80	99 Vanderwood Rd	0.00E+00	3.49E-04			

Table B-2. 2007/2008 Indoor ABS Candidate Properties

Soil Cleanup Performed?	Post-Cleanup Soil	Indoor ABS Category	Indoor ABS Index	Address	Mean PCME LA Air Conc (s/cc)	
					Passive	Active
					Yes (soil cleanup was performed in a portion of the yard)	PLM = ND & VV-
7	1037 California Ave	0.00E+00	1.10E-04			
11	106 Voves Ave	0.00E+00	4.96E-05			
13	1118 Montana Ave	0.00E+00	2.75E-04			
20	1302 Airth Ave	0.00E+00	7.73E-04			
25	1414 Main Ave	0.00E+00	4.94E-05			
28	1525 Lolo Ave	4.95E-05	4.75E-05			
29	156 S. Central Rd	4.96E-05	5.01E-05			
31	1621 Main Ave	0.00E+00	3.64E-04			
34	191 Farm to Market Rd	0.00E+00	6.23E-05			
38	2293 Kootenai River Rd	0.00E+00	0.00E+00			
44	281 S. Central Rd	0.00E+00	2.49E-04			
46	304 Spencer Rd	4.98E-05	4.88E-04			
54	3798 Highway 2 S	0.00E+00	5.00E-05			
57	4304 Highway 37 N	4.87E-05	1.14E-03			
60	515 Minnesota Ave	0.00E+00	1.00E-04			
62	56 Enders Dr	4.93E-05	1.50E-04			
72	76 Pine St	1.00E-04	4.56E-04			
75	817 W. Balsam St	4.53E-05	6.19E-04			
77	893 Greers Ferry Rd	3.17E-05	3.30E-04			
PLM ≠ ND or VV+	INT4	1	10 Park St	9.91E-05		4.98E-05
		12	1106 Nevada Ave	9.90E-05		3.26E-03
		18	1203 Louisiana Ave	0.00E+00		6.33E-05
		19	125 Spencer Hill Way	0.00E+00		1.99E-04
		22	1314 Dakota Ave	0.00E+00		6.08E-05
		23	133 Spencer Rd	0.00E+00		3.97E-04
		24	1405 Dakota Ave	9.47E-05		6.64E-04
		27	15 Avenue B	4.97E-05		7.75E-04
		30	1573 Kootenai River Rd	0.00E+00	4.54E-04	
		36	21 Voves Ave	0.00E+00	0.00E+00	
		37	226 Spencer Rd	0.00E+00	1.15E-03	
39	2297 Kootenai River Rd	0.00E+00	4.95E-05			
45	292 Spencer Rd	6.35E-05	1.00E-04			
53	3796 Highway 2 S	5.00E-05	1.49E-04			
55	38 Spencer Hill Way	0.00E+00	9.66E-05			
61	546 Granite Ave	4.96E-05	6.08E-05			
71	71 Claire Ave	0.00E+00	0.00E+00			
73	781 Terrace View Rd	0.00E+00	2.35E-04			
74	813 Wisconsin Ave	0.00E+00	2.39E-04			
76	87 Yellowtail Rd	0.00E+00	1.50E-04			

Selection Goals:

- INT1 2 properties
- INT2 3 properties
- INT3 2 properties
- INT4 3 properties

In order to ensure that each 4-hour sample is spatially representative of the home, each sample shall be collected from multiple rooms on all floors of the home (see **Appendix C**).

Depending on what is most convenient for the resident, sampling will either occur over one 8-hour time interval, divided into two sub-periods of 4-hours each, or else will occur by collecting two 4-hour samples on two sequential days. If both samples are collected on one day, the passive activity sample will be collected in the morning, and the active sample will be collected in the afternoon to minimize the likelihood of cross-contamination between activity periods. If samples are collected on two sequential days, the order of collection may be random. That is, if the active phase is conducted in the morning of the first day at House #1 then the passive phase of sampling will be conducted at House #1 in the afternoon on the second day.

B1.3 Property Background Information

Residual sources that may contribute to LA in indoor air in OU4 properties include things like carpets, upholstery, air ducts, and vermiculite insulation in enclosed spaces. While there are too many independent variables to allow measurement and stratification of sampling locations based on all of these potential sources of contamination, it is important that the data collected at each property include a documentation of all potential sources known to exist as well as information on vectors for indoor track-in (e.g., pets), heating sources, whether a HEPA vacuum is used, etc. Thus, prior to conducting ABS, property background information will be collected on a Property Background Form for Indoor ABS (see **Appendix D**).

If a subset of properties is recognized as having higher indoor air levels of LA than most others, the property background data may help form hypotheses about which property characteristics may be responsible, which in turn may form the basis for a focused follow-up investigation, as may be judged necessary to support decision-making.

B1.3 Sampling Design Overview

For Scenario 1 (curb-to-curb) properties, two indoor ABS events will be performed – one in the winter and one in the summer. For Scenario 2 (2007/08 re-evaluation) properties, one indoor ABS event will be performed in the summer.

One individual will participate in each indoor ABS event. This individual will engage in activities intended to simulate typical active and passive behaviors. Because personal air samples are more representative of breathing zone exposures than stationary monitors, this individual will wear two different sampling pumps – a high volume pump and a low volume pump. Thus, each ABS event will include the collection of two indoor ABS air samples for each behavior type – one with a high volume pump and one with a low volume pump. Only one of the two air filters, either the high volume or the low volume, will be analyzed by TEM (see Section B4).

Table B-3 summarizes the anticipated number of samples collected and analyses performed as part of this investigation.

The requirements for field QC sample collection are discussed in Section B5.1.

Table B-3: Number of Samples per Scenario

Scenario, Season	Number of properties evaluated	Number of ABS air samples collected per property	Total number of ABS air samples collected (across properties)	Number of ABS air samples analyzed (across properties)
Scenario 1, Winter	10	4 (2 HV, 2 LV) ⁺	40 (20 HV, 20 LV)	20*
Scenario 1, Summer	10	4 (2 HV, 2 LV) ⁺	40 (20 HV, 20 LV)	20*
Scenario 2, Summer	10	4 (2 HV, 2 LV) ⁺	40 (20 HV, 20 LV)	20*

⁺ 1 HV and 1 LV during passive behaviors and 1 HV and 1 LV during active behaviors.

* Either the HV or LV will be selected for analysis, depending upon filter loading.

ABS = activity-based sampling

HV = high volume filter

LV= low volume filter

B1.4 Study Variables

Review of the 2007/08 indoor ABS results, which collected samples in the spring, summer, fall, and winter, shows that the level of asbestos in indoor ABS air is seasonally dependant (EPA 2010), with highest concentrations measured in summer and lowest concentrations in the winter. These differences are likely due, at least in part, to meteorological and environmental factors (e.g., air temperature, humidity, snow cover).

Because the goal of Scenario 1 is to collect indoor ABS air data that can be used to estimate long-term average concentrations, to ensure that resulting data span the full range of expected concentrations, indoor ABS air concentrations will be collected in the summer and winter.

Because the goal of Scenario 2 is to collect indoor ABS air data for the purposes of comparison to the previous indoor ABS investigation, to maximize the likelihood of seeing a potential difference in indoor ABS air concentrations as a function of time, indoor ABS activities will be collected in the summer (the season when indoor ABS air concentrations are likely to be highest).

The previous indoor ABS investigation shows that there is high variability in indoor ABS air concentrations between properties within OU4 (EPA 2010), even for properties that are of similar outdoor soil conditions. Thus, this investigation will include the collection of indoor ABS air samples of multiple properties within each scenario (i.e., 10 curb-to-curb properties). Even within a property, it is expected that indoor ABS air concentrations may differ from room to room. Because of this, the ABS scripts specify that the actor will perform ABS activities in each room of the property in which routine living activities occur.

The previous indoor ABS investigation shows that there are differences in measured indoor ABS air concentrations as a function of the nature and intensity of the disturbance activity (EPA 2010). For this reason, the ABS scripts include a range of activities, including passive and active behaviors to ensure that resulting data will be representative of the range of possible exposures under varying conditions.

B1.5 Critical Measurements

The critical measurement associated with this project is the measurement of the concentration of LA in indoor ABS air. The analysis of LA may be achieved using several different types of microscope, but the EPA generally recommends using TEM because this technique has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent³ (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks from the ABS air samples.

B1.6 Data Reduction and Interpretation

ABS air filters collected as part of this study will be used to prepare grids for TEM examination (see Section B4). From this examination, the total number of PCME LA structures observed is recorded and the ABS air concentration is calculated as follows:

$$C_{air} = (N \cdot EFA) / (GOx \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

- C_{air} = Air concentration (structures per cubic centimeter [s/cc])
- N = Number of PCME LA structures observed (structures)
- EFA = Effective filter area (square millimeters [mm²])
- GOx = Number of grid openings examined
- Ago = Area of a grid opening (mm²)
- V = Sample air volume (liters [L])
- 1000 = L/cc (conversion factor in liters per cubic centimeter)
- f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Data for PCME LA concentrations in ABS air will be used to evaluate potential human health risks from exposures to indoor air.

³ PCME structures have a length greater than 5 micrometers (µm), width greater than or equal to 0.25 µm, and an aspect ratio (length:width) greater than or equal to 3:1.

B2. Sampling Methods

B2.1 Sample Collection

The following subsections provide investigation-specific requirements for sample collection. A list of general field equipment that will be used to perform this sampling is provided in each of the field sampling SOPs. A medium- and investigation-specific equipment list is provided in Section B8.1 of this SAP/QAPP.

B2.1.1 Health & Safety Air Samples

As part of this investigation, personal air samples will also be collected for ongoing health and safety monitoring. The health and safety samples will be collected using an additional low volume sampling pump and are not intended for use as ABS air samples. To differentiate these samples from the other personal air samples collected as part of this sampling effort, 'PA-EXC' or 'PA-TWA' will be selected in the *Sample Air Type* field of the FSDS to distinguish these personal air-excursion and personal air-time-weighted average samples, respectively. These samples will be collected and analyzed in accordance with the *Response Action SAP* (CDM Smith 2011b) and will represent both the TWA and STEL sampling periods.

B2.1.2 ABS Air Samples

ABS air samples will be collected, handled, and documented in general accordance with Site-specific standard operating procedure (SOP) EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air* (see **Appendix B**). In addition, the following investigation-specific requirements apply for ABS air samples collected under this SAP/QAPP.

As noted above, during every event, each actor will wear two different sampling pumps – a high volume pump and a low volume pump – to allow for the collection of two “replicate” filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes. The high volume pump will be an F&J L-15P, or equivalent, and the low volume pump will be an SKC 224-PCXR4, or equivalent. The appropriate flow rate for each sampling pump will be optimized to achieve the highest sample air volume possible without causing the filter to become overloaded. Initially, the high volume pump flow rate will be 5.5 liters per minute (L/min) and the low volume pump flow rate will be 2.0 L/min. Only one of the two resulting air samples from each actor will be selected for analysis (see Section B4).

During the ABS event, pump flow rates will be verified at 30-minute intervals. Pump flow rates will also be verified if the actor needs to be relieved from an activity by a backup individual. See Section B6/B7.1 for details regarding pump calibration.

B2.2 Global Positioning System Coordinate Collection

For this investigation, it is anticipated that global positioning system (GPS) coordinates will not be necessary, since location coordinates for each property should already be available. If necessary, GPS location coordinates will be recorded in basic accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix B**). GPS coordinates will be collected as Sample Points, requiring the input of sample identification (ID) (also referred to as index ID) and location ID.

Field-collected GPS data are converted to a usable geographic information system (GIS) format using the general processes described in SOP CDM-LIBBY-09. After the conversion from GPS points to GIS files, 100% of the data is checked visually to identify any potential data entry errors.

B2.3 Equipment Decontamination

Equipment used to collect, handle, or measure environmental samples will be decontaminated in basic accordance with Site-specific SOP EPA-LIBBY-2012-04, *Field Equipment Decontamination at Nonradioactive Sites* (see **Appendix B**). Materials used in the decontamination process will be disposed of as investigation-derived waste (IDW) as described below. This SOP specifies the minimum procedural requirements for equipment decontamination. Additional equipment decontamination procedures are also specified in the medium-specific collection SOPs.

B2.4 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in general conformance with Site-specific SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (see **Appendix B**). In brief, IDW will be double-bagged, with the outer bag being a clear heavy-weight trash bag that has been pre-printed with 'IDW' on the outside. If pre-printed IDW bags are not available, the outer bag needs to be clearly labeled (once) using an indelible marker or a taped label. All IDW generated during this investigation will enter the waste stream at the local class IV asbestos landfill.

B3. Sample Handling and Custody

B3.1 Sample Identification and Documentation

B3.1.1 Sample Labels

Samples will be labeled with sample ID numbers supplied by field administrative staff and will be signed out by the sampling teams. For air samples, the labels will be affixed to the sample cassette and the inside of the sample bag. Sample ID numbers will identify the samples

collected during this sampling effort using the following format:

IN-1####

where:

IN-1 = Prefix that designates samples collected under this Indoor ABS SAP/QAPP

= A sequential four-digit number

B3.1.2 Field Sample Data Sheets

As noted previously in Section A9, field teams will record sample information on the most current version of the Site-specific FSDS. Use of standardized forms ensures consistent documentation across samplers. Hard copy FSDSs are location-specific and allow for the entry of up to three individual samples from the same location on the same FSDS form. If columns are left incomplete due to fewer than three samples being recorded on a sheet, the blank columns will be crossed out, dated, and signed by the field team member completing the FSDS. Erroneous information recorded on a hard copy FSDS will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

FSDS information will be completed in the field before field personnel leave the sampling location. To ensure that all applicable data is accurately entered and all fields are complete, a different field team member will check each FSDS. The team member completing the hard copy form and the team member checking the form will initial the FSDS in the proper fields. In addition, the field team leader (FTL) will also complete periodic checks of FSDSs prior to relinquishment of the samples to the field sample coordinator. Once FSDSs and samples are relinquished to the field sample coordination staff, the FSDSs are again checked for accuracy and completeness when data are input into the local Scribe field database.

If a revision is required to the hard copy FSDS during any of these checks, it will be returned to the field team member initially responsible for its completion. The error will be explained to the team member and the FSDS corrected. If the team member is no longer on site, revisions will be made by sample coordination staff or the FTL. It is the responsibility of the field data manager to make the appropriate change in the local Scribe field database.

Each hard copy FSDS is assigned a unique sequential number. This number will be referenced in the field logbook entries related to samples recorded on individual sheets. Field administrative staff will manage the hard copy FSDSs in their respective field office. Original FSDSs will be filed by medium and FSDS number. Hard copies of all FSDS forms will also be sent to the CDM Smith office in Denver, Colorado, for archive.

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing documents. Field logbooks will be maintained in general conformance with Site-specific SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control* (see **Appendix B**). In addition to general logbook content requirements outlined in the SOP, the pump calibration and flow rate verification should also be recorded.

Separate field logbooks will be kept for each investigation and the cover of each field logbook will clearly indicate the name of the investigation and its sequence number. Field logbooks will be completed for each investigation activity prior to leaving a sampling location. Field logbooks will be checked for completeness and adherence to SOP requirements on a daily basis by the FTL (or their designee) for the first week of each investigation. When incorrect field logbook completion procedures are discovered during these checks, the errors will be discussed with the author of the entry and corrected. Erroneous information recorded in a field logbook will be corrected with a single line strikeout, initial, and date. The correct information will be entered in close proximity to the erroneous entry.

The field administrative staff will manage the field logbooks by assigning unique identification numbers to each field logbook, tracking to whom and the date each field logbook was assigned, the general investigation activities recorded in each field logbook, and the date when the field logbook was returned. As field logbooks are completed, originals will be catalogued and maintained by the field administrative staff in their respective field office. Scanned copies of field logbooks will be maintained on the local server of the CDM Smith office in Libby.

B3.1.4 Photographs and Video

Photographic documentation will be collected with a digital camera in general conformance to SOP EPA-LIBBY-2012-02, *Photographic Documentation of Field Activities* (see **Appendix B**). Photographs should be taken to document representative examples of ABS activities performed, sampling locations, site conditions during ABS activities, pre-sampling conditions, and at any other special conditions or circumstances that arise during the activity. Electronic captions will be used to describe the photographs instead of maintaining photographic logs in daily logbook entries.

Photograph file names will be in the format:

Address_IN_date_### (e.g., 123 Elm Street_IN_021213_001)

where:

Address is the property address for the sampled location
IN indicates the Indoor ABS Study

The date is formatted as MMDDYY

The ### is a three-digit number to indicate the photo identifier

As appropriate, a digital video may be prepared to document a representative example of indoor ABS activities and will include any special conditions or circumstances that arise during the activity. File names will be in the same format as photographic documentation listed above.

B3.2 Field Sample Custody

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be relinquished to the sample coordinator or designated secure sample storage area. The field team will be responsible for documenting this transfer of sample custody in the logbook.

B3.3 Chain-of-Custody Requirements

The chain-of-custody (COC) is used as physical evidence of sample custody and control. This record system provides the means to identify, track, and monitor each individual sample from the point of collection through final data reporting. A complete COC record is required to accompany each shipment of samples. COC procedures will follow the requirements as stated in Site-specific SOP EPA-LIBBY-2012-06, *Sample Custody* (see **Appendix B**).

At the end of each day, all samples will be relinquished to the field sample coordinator or a designated secure storage location by the sampling team following COC procedures, and an entry will be made into the field logbook indicating the time samples were relinquished and the sample coordinator who received the samples. The field sample coordinator will follow COC procedures to ensure proper sample custody between acceptance of the sample from the field teams to delivery or shipment to the laboratory.

A member of the sample coordination staff will manually enter sample information from the hard copy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hard copy FSDSs (by a different sample coordination staff member than completed the original data entry), the DE Tool is used to prepare an electronic COC. A three-page carbon copy COC will be generated from the electronic COC. The field sample coordinator will retain one hard copy of the COC for the project file; the other two hard copies of the COC will accompany the sample shipment. A copy of the investigation-specific Analytical Requirements Summary Sheet (see **Appendix E**) will also accompany each COC.

If any errors are found on a COC after shipment, the hard copy of the COC retained by the field sample coordinator will be corrected with a single strikeout, initial, and date. A copy of the

corrected COC will be provided to the LC for distribution to the appropriate laboratory. It is the responsibility of the field data manager to make any corrections to the local Scribe field project database. Sample and COC information will be published to Scribe.NET regularly from the local Scribe field project database by the field data manager (see Section B10.1 for additional details).

B3.4 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples* (see **Appendix B**). In brief, a custody seal will be placed over at least two sides of the shipping cooler and then secured by tape. Prior to sealing the shipping container, the sample coordinator will perform a final check of the contents of the shipment with the COC, sign and date the designated spaces at the bottom of the COC. The field sample coordinator will then place the custody seals on the shipping container.

The field sample coordinator will be responsible for sending samples to the appropriate location, as specified by the LC. For this investigation, all samples will be hand-delivered to the Troy Sample Preparation Facility (SPF) for subsequent shipment to the appropriate analytical laboratory, or archive.

For hand-deliveries, samples will be packaged for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose. For samples requiring shipment, an established overnight delivery service provider (e.g., Federal Express) will be used. There are no preservation requirements for ABS air samples.

B3.5 Holding Times

There are no holding time requirements for ABS air samples collected as part of this investigation.

B3.6 Archival and Final Disposition

All filters will be maintained in storage at the analytical laboratory for a period of 6 months. After this time, filters will be sent to the SPF in Troy, Montana for final archival. All prepared grids will be maintained in storage at the analytical laboratory until authorized by EPA. When authorized by the EPA, the laboratory will be responsible for proper disposal of any remaining grids, sample containers, shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

B4. Analytical Methods

B4.1 Analytical Methods and Requirements

This section discusses the analytical methods and requirements for samples collected in support of this investigation. This section includes detailed information on the analysis of ABS air, as well as the data reporting requirements, analysis turn-around times, and custody procedures.

An analytical requirements summary sheet (**INOU4-1012**), which details the specific preparation and analytical requirements associated with this investigation, is provided in **Appendix E**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this investigation prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

B4.1.1 ABS Air Samples

The DQOs (see **Appendix A**) provide detailed information on the sample preparation, analysis method, counting rules, and stopping rules for ABS air. Each of these analysis requirements is summarized below.

Sample Preparation

Two filters are collected during each ABS event – a high volume filter and a low volume filter. The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded (i.e., > 25% particulate loading on the filter), the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter. If the low volume filter is also deemed to be overloaded, an indirect preparation (with ashing) may be performed of the high volume filter in accordance with the procedures in Libby-specific SOP EPA-LIBBY-08, *Indirect Preparation of Air and Dust Samples for Analysis by TEM* (see **Appendix B**). The filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E).

Analysis Method

Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications⁴ LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

⁴ Copies of all Libby Laboratory Modifications are available in the Libby Lab eRoom.

Counting Rules

Because of the high number of grid openings that are needed to achieve the target analytical sensitivity (see **Appendix A**), all ABS air samples will be examined using counting protocols for recording PCME structures only (per ISO 10312 Annex E). That is, filters will be examined at a magnification of about 5,000x, and all amphibole structures (including not only LA but all other amphibole asbestos types as well) that have appropriate selective area electron diffraction patterns and energy dispersive x-ray analysis spectra, and having length > 5 micrometers (μm), width $\geq 0.25 \mu\text{m}$, and aspect ratio (length:width) $\geq 3:1$, will be recorded on the Libby-specific TEM laboratory bench sheets and EDDs for the recording of air samples. If observed, chrysotile structures should be recorded using the same basic procedures, but chrysotile recording may stop after 25 structures have been observed.

Stopping Rules

Appendix A provides detailed information on the derivation of the stopping rules for ABS air field samples analyzed by TEM. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
 - a. The target analytical sensitivity is achieved. For passive ABS air samples, the target analytical sensitivity is 0.00001 per cubic centimeter (cc^{-1}). For active ABS air samples, the target analytical sensitivity is 0.00004 cc^{-1} .
 - b. 25 PCME LA structures have been observed.
 - c. A total filter area of 10 mm^2 has been examined (this is approximately 1,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

For lot blanks and field blanks, the TEM analyst should examine an area of 1.0 mm^2 (approximately 100 grid openings).

B4.1.2 Health & Safety Air Samples

The personal air samples collected for the ongoing health and safety monitoring will be analyzed in accordance with the *Response Action SAP* (CDM Smith 2011b). In brief, air samples will be prepared and analyzed by PCM in accordance with NIOSH Method 7400, Issue 2 and the most recent version of Libby Laboratory Modification LB-000015.

B4.2 Analytical Data Reports

An analytical data report will be prepared by the laboratory and submitted to the appropriate LC after the completion of all required analyses within a specific laboratory job (or sample delivery group). This analytical data report may vary by laboratory and analytical method but generally includes a case narrative that briefly describes the number of samples, the analyses, and any analytical difficulties or QA/QC issues associated with the submitted samples. The data report will also include copies of the signed COC forms, analytical data summaries, a QC package, and raw data. Raw data is to consist of instrument preparation logs, instrument printouts, and QC sample results including, instrument maintenance records, COC check in and tracking, raw data instrument print outs of sample results, analysis run logs, and sample preparation logs. The laboratory will provide an electronic scanned copy of the analytical data report to the LC and others, as directed by the LC.

B4.3 Laboratory Data Reporting Tools

Standardized data reporting tools (i.e., EDDs) have been developed specifically for the Libby project to ensure consistency between different laboratories in the presentation and submittal of analytical data. In general, unique Libby-specific EDDs have been developed for each analytical method and each medium. Since the beginning of the Libby project, each EDD has undergone continued development and refinement to better accommodate current and anticipated future data needs and requirements. EDD refinement continues based on laboratory and data user input. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

For TEM analyses, detailed raw structure data will be recorded and results will be transmitted using the Libby-specific EDDs for TEM. Standard project data reporting requirements will be met for all TEM analyses. EDDs will be transmitted electronically (*via* email) to the following:

- Doug Kent, Kent.Doug@epa.gov
- Janelle Lohman, Lohman.Janelle@epa.gov
- Holly Sprunger, Sprunger.Holly@epa.gov
- Tracy Dodge, DodgeTA@cdmsmith.com
- Phyllis Haugen, HaugenPJ@cdmsmith.com
- Libby project email address for CDM Smith, libby@cdmsmith.com

B4.4 Analytical Turn-around Time

Analytical turn-around time will be negotiated between the EPA LC and the laboratory. It is anticipated that, turn-around times of 2-4 weeks are acceptable, but this may be revised as determined necessary by the EPA.

B4.5 Custody Procedures

Specific laboratory custody procedures are provided in each laboratory's *Quality Assurance Management Plan*, which have been independently reviewed at the time of laboratory procurement. While specific laboratory sample custody procedures may differ between laboratories, the basic laboratory sample custody process is described briefly below.

Upon receipt at the facility, each sample shipment will be inspected to assess the condition of the shipment and the individual samples. This inspection will include verifying sample integrity. The accompanying COC will be cross-referenced with all of the samples in the shipment. The laboratory sample coordinator will sign the COC and maintain a copy for their project files.

Depending upon the laboratory-specific tracking procedures, the laboratory sample coordinator may assign a unique laboratory identification number to each sample on the COC. This number, if assigned, will identify the sample through all further handling at the laboratory. It is the responsibility of the laboratory manager to ensure that internal logbooks and records are maintained throughout sample preparation, analysis, and data reporting.

B5. Quality Assurance/Quality Control

B5.1 Field

Field QA/QC activities include all processes and procedures that have been designed to ensure that field samples are collected and documented properly, and that any issues/deficiencies associated with field data collection or sample processing are quickly identified and rectified. The following sections describe each of the components of the field QA/QC program implemented at the Site.

B5.1.1 Training

Before performing field work in Libby, field personnel are required to read all governing field guidance documents relevant to the work being performed and attend a field planning meeting specific to the Comparative Exposure sampling effort. Additional information on field training requirements is provided in Section A8.1.

B5.1.2 Modification Documentation

All field deviations from, and modifications to, this SAP/QAPP will be recorded on the Libby field ROM form⁵. The field ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that

⁵ The most recent version of the field ROM form is available in the Libby Field eRoom.

have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) will be documented in the field logbooks. ROMs are completed by the FTL overseeing the investigation/activity, or by assigned field or technical staff. As modifications to governing documents are implemented, the FTL will communicate the changes to the field teams conducting activities associated with the modification.

Each completed field ROM is assigned a unique sequential number (e.g., LFO-000226) by the CDM Smith field quality assurance coordinator. A ROM tracking log for all field modifications is maintained by the field quality assurance coordinator. This tracking log briefly describes the ROM being documented, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the appropriate EPA RPM for review and approval. Copies of approved ROMs are maintained on the CDM Smith server in Libby.

B5.1.3 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. Because sample collection efforts will utilize field methods and procedures that are well-established by seasoned field teams, it is not anticipated that a field surveillance will be performed for this investigation. However, field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

B5.1.4 Field Audits

Field audits are broader in scope than field surveillances. Audits are evaluations conducted by qualified technical or QA staff that are independent of the activities audited. Field audits can be conducted by field contractors, internal EPA staff, or EPA contracted auditors. It is the responsibility of the EPA RPM to ensure that field auditing requirements are met for each investigation. One field audit will be conducted during the early stages of this investigation to identify any early deficiencies so that any impact on project data quality is limited.

B5.1.5 Field QC Samples

Field QC samples are collected to help ensure that field samples are not contaminated from exogenous sources during sample collection, and to help evaluate the precision of field sample analytical results. Field QC samples are assigned unique field identifiers and are submitted to the analytical laboratory along with the associated field samples.

Two types of field QC samples will be collected as part of the air sampling portion of this study – lot blanks and field blanks.

Lot Blank

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. A lot blank is a randomly selected filter cassette from a manufactured lot. One lot blank is required for every 500 cassettes. It is the responsibility of the FTL to submit the appropriate number of lot blanks prior to cassette use in the field. The lot blanks are analyzed for asbestos by TEM as described above (see Section 5.1.3). Lot blank results will be reviewed by the FTL before any cassette in the lot is used for sample collection. The entire batch of cassettes will be rejected if any asbestos is detected on either lot blank. Only filter lots with acceptable lot blank results are placed into use for this study.

Field Blank

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this sampling effort, field blanks will be collected at a rate of one per field team per air sampling day. It is the responsibility of each field team to collect the appropriate number of field blanks. Field blanks are collected by removing the end cap of the sample cassette to expose the filter in the same area where sample collection occurs for about 30 seconds before re-capping the sample cassette. A total of six field blanks, chosen at random by the sample coordinator, will be analyzed (i.e., two field blanks during the winter sampling event and four field blanks during the summer sampling events). The field blanks are analyzed for asbestos by TEM as described above (see Section 5.1.3).

If any asbestos is observed on a field blank, all other field blanks collected by that field team will be submitted for analysis to determine the potential impact on the related sample results. The FTL and/or laboratory manager will be notified and will take appropriate measures (e.g., re-training on sample collection and analysis procedures) to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "FB" may be added to the related field sample results in the project database to denote that the associated field blank had asbestos structures detected.

B5.2 Analytical Laboratory

Laboratory QA/QC activities include all processes and procedures that have been designed to ensure that data generated by an analytical laboratory are of high quality and that any problems in sample preparation or analysis that may occur are quickly identified and rectified. The following sections describe each of the components of the analytical laboratory QA/QC program implemented at the Site.

B5.2.1 Training/Certifications

All analytical laboratories participating in the analysis of samples for the Libby project are subject to national, local, and project-specific certifications and requirements. Additional information on laboratory training and certification requirements is provided in Section A8.2.

Laboratories handling samples collected as part of this investigation will be provided a copy of and will adhere to the requirements of this SAP/QAPP. Samples collected under this SAP/QAPP will be analyzed in accordance with standard EPA and/or nationally-recognized analytical procedures (i.e., Good Laboratory Practices) in order to provide analytical data of known quality and consistency.

B5.2.2 Modification Documentation

All deviations from project-specific and method guidance documents will be recorded on the laboratory ROM form⁶. The ROM will be used to document all permanent and temporary changes to analytical procedures. ROMs will be completed by the appropriate laboratory or technical staff. As ROMs are completed, it is the responsibility of the LC to communicate any changes to the project laboratories. When the project management team determines the need, this SAP/QAPP will be revised to incorporate necessary modifications.

Copies of approved ROMs for this SAP/QAPP will be made available in the Libby Lab eRoom.

B5.2.3 Laboratory Audits

Each laboratory working on the Libby project is required to participate in an annual on-site laboratory audit carried out by EPA through the QATS contract. These audits are performed by EPA personnel (and their contractors), that are external to and independent of, the Libby laboratory team members. These audits ensure that each analytical laboratory meets the basic capability and quality standards associated with analytical methods for asbestos used at the Libby site. They also provide information on the availability of sufficient laboratory capacity to meet potential testing needs associated with the Site.

External Audits

Audits consist of several days of technical and evidentiary review of each laboratory. The technical portion of the audit involves an evaluation of laboratory practices and procedures associated with the preparation and analysis of samples for the identification of asbestos. The evidentiary portion of the audit involves an evaluation of data packages, record keeping, SOPs, and the laboratory *QA Management Plan*. A checklist of method-specific requirements for the commonly used methods for asbestos analysis is prepared by the auditor prior to the audit, and

⁶ The most recent version of the laboratory ROM form is available in the Libby Lab eRoom.

used during the on-site laboratory evaluation.

Evaluation of the capability for a laboratory to analyze a sample by a specific method is made by observing analysts performing actual sample analyses and interviewing each analyst responsible for the analyses. Observations and responses to questions concerning items on each method-specific checklist are noted. The determination as to whether the laboratory has the capability to analyze a sample by a specific method depends on how well the analysts follow the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

Evaluation of the laboratory to be sufficient in the evidentiary aspect of the audit is made by reviewing laboratory documentation and interviewing laboratory personnel responsible for maintaining laboratory documentation. This includes personnel responsible for sample check-in, data review, QA procedures, document control, and record archiving. Certain analysts responsible for method QC, instrument calibration, and document control are also interviewed in this aspect of the audit. Determination as to the capability to be sufficient in this aspect is made based on staff responses to questions and a review of archived data packages and QC documents.

It is the responsibility of the QATS contractor (Shaw) to prepare an On-site Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The On-site Audit Report includes both a summary of the audit results and completed checklist(s), as well as recommendations for corrective actions, as appropriate. Responses from each laboratory to any deficiencies noted in the On-site Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an On-Site Audit Trend Analysis Report on an annual basis. This report shall include a compilation and trend analysis of the on-site audit findings and recommendations. The purpose of this report is to identify common asbestos laboratory performance problems and isolate the potential causes.

Internal Audits

Each laboratory will also conduct periodic internal audits of their specific operations. Details on these internal audits are provided in the laboratory *QA Management Plan*. The laboratory QAM should immediately contact the LC and the QATS contractor if any issues are identified during internal audits that may impact data quality.

B5.2.4 Laboratory QC Analyses

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by NVLAP. In brief, there are three types of laboratory-based QC analyses for TEM – laboratory blanks, recounts, and reparations. Detailed information on the

Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029.

With the exception of inter-laboratory analyses, it is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed. Inter-laboratory analyses for TEM will be selected *post hoc* by the QATS contractor (or their designee) in accordance with the selection procedures presented in LB-000029. The LC will provide the list of selected inter-laboratory analyses to the laboratory manager and will facilitate the exchange of samples between the analytical laboratories.

B6/B7. Instrument Maintenance and Calibration

B6/B7.1 Field Equipment

B6/B7.1.1 General Maintenance

All field equipment (e.g., sampling pumps) should be maintained in basic accordance with manufacturer specifications. When a piece of equipment is found to be operating incorrectly, the piece of equipment will be labeled “out of order” and placed in a separate area from the rest of the sampling equipment. The person who identified the equipment as “out of order” will notify the FTL overseeing the investigation activities. It is the responsibility of the FTL to facilitate repair of the out-of-order equipment. This may include having appropriately trained field team members complete the repair or shipping the malfunctioning equipment to the manufacturer. Field team members will have access to basic tools required to make field acceptable repairs. This will ensure timely repair of any “out of order” equipment.

B6/B7.1.2 Air Pump Calibration

Air sampling pumps will be calibrated at the start of each day's sampling period using a rotameter that has been calibrated to a primary calibration source. The primary calibration standard used at the Site is a Bios DryCal® DC-Lite. For pre-sampling purposes, calibration will be considered complete when $\pm 5\%$ of the desired flow rate is attained, as determined by three measurements with the calibrator using a cassette reserved for calibration (from the same lot as the sample cassettes to be used in the field). Additional calibration may be performed during sample collection as described below.

If at any time the observed flow rates are $\pm 10\%$ of the target rate, the sampling pump should be re-calibrated, if possible. If at any time an air sampling pump is found to have faulted or the observed flow rates are 25% below (due to heavy particulate loading or a pump malfunction) or 50% above the target rate, the pump will be replaced or the activity will be terminated. Collection of air samples will continue, regardless of the amount of particulate loading on the

filters, unless the flow rate is affected. At the beginning of the sampling program, flow rates and particulate loading may be checked more frequently as conditions require, establishing expected conditions.

To calculate the percentage of an observed flow to the target flow, the following formula is used:

$$X\% = \frac{\text{Observed Flow Rate (L/min)}}{\text{Target Flow Rate (L/min)}} \cdot 100$$

For post-sampling calibration, three separate constant flow calibration readings will be obtained with the sampling cassette inline and those flow readings will be averaged. If the flow rate changes by more than 5% during the sampling period, the average of the pre- and post-sampling rates will be used to calculate the total sample volume.

Samples for which there is more than a 30% difference from initial calibration to end calibration will be invalidated. The sample collector will record the pump serial number, sample number, initial flow rate, sample start/end times, sample locations, and final flow rate, as well as mark the sample "void," in the field logbook and FSDS. These samples will not be submitted for analysis.

To prevent potential cross-contamination, each rotameter used for field calibration will be transported to and from each sampling location in a sealed zip-top plastic bag. The cap and calibration cassette used at the end of the rotameter tubing will be replaced each day after it is used.

B6/B7.2 Laboratory Instruments

All laboratory instruments used for this project will be maintained and calibrated in accordance with the manufacturer's instructions. If any deficiencies in instrument function are identified, all analyses shall be halted until the deficiency is corrected. The laboratory shall maintain a log that documents all routine maintenance and calibration activities, as well as any significant repair events, including documentation that the deficiency has been corrected.

B8. Inspection/Acceptance of Supplies and Consumables

B8.1 Field

In advance of field activities, the FTL will check the field equipment/supply inventory and procure any additional equipment and supplies that are needed. The FTL will also ensure any in-house measurement and test equipment used to collect data/samples as part of this SAP/QAPP is in good, working order, and any procured equipment is acceptance tested prior

to use. Any items that the FTL determines unacceptable will be removed from inventory and repaired or replaced as necessary.

The following list summarizes the general equipment and supplies required for most investigations:

- Field logbook – Used to document field sampling activities and any problems in sample collection or deviations from the investigation-specific QAPPs. See Section B3.1.3 for standard procedures for field logbooks.
- Field sample data sheets (FSDSs) – FSDSs forms that are used to document sample details (i.e., sampling location, sample number, medium, field QC type, etc.). See Section B3.1.2 for standard procedures for the completion of FSDSs.
- Sample number labels – Sample numbers are sequential numbers with investigation-specific prefixes. Sample number labels are pre-printed and checked out to the field teams by the FTL (or their designee). To avoid potential transcription errors in the field, multiple labels of the same sample number are prepared – one label is affixed to the collected sample, one label is affixed to the hard copy FSDS form. Labels may also be affixed to the field logbook.
- COC forms and custody seals – COCs are project-specific forms that are used to document sample custody from field collection through analysis reporting. See Section B3.3 for standard procedures for the completion of COC forms.
- Indelible ink pen, permanent marker – Indelible ink pens are used to complete required manual data entry of information on the FSDS and in the field logbook (pencil may not be used). Permanent markers may also be used to write sample numbers on the sample containers.
- Personal protective equipment - As required by the HASP.
- Land survey map or aerial photo – Used to identify appropriate sampling locations. In some cases, sketches may be added to the map/photo to designate sampling and visual inspection locations and other Site features.
- Digital camera – Used to document sampling locations and conditions. See Section B3.1.4 for standard procedures in photographic documentation.
- GPS unit – Used to identify and mark sampling locations. See Section B2.2 for standard procedures in GPS documentation.

- Plastic zip-top bags – Zip-top bags are used as sample containers for most types of environmental samples. Sample number labels will be affixed to the bags or the sample number will be hand-written in permanent marker on the bags.
- Decontamination equipment – Used to remove any residual asbestos contamination on reusable sampling equipment between the collection of samples. See Section B2.3 for standard decontamination procedures.

In addition to the generic equipment list, the following equipment will be required for sampling activities as part of this indoor ABS investigation:

- ABS air sampling equipment: 25-millimeter (mm) diameter mixed cellulose ester filter cassette (0.8 μm pore), high and low flow rate battery-powered air sampling pumps, rotameter, rotameter, tygon tubing, belt or backpack to attach pumps to sampler

B8.2 Laboratory

The laboratory manager is responsible for ensuring that all reagents and disposable equipment used in this project is free of asbestos contamination. This is demonstrated by the collection of blank samples, as described in Section B5.

B9. Non-direct Measurements

There are no non-direct measurements that are anticipated for use in this project.

B10. Data Management

The following subsections describe the field and analytical laboratory data management procedures and requirements for this investigation. These subsections also describe the project databases utilized to manage and report data from this investigation. Detailed information regarding data management procedures and requirements can be found in the *EPA Data Management Plan* for the Libby Asbestos Superfund Site (EPA 2012a).

B10.1 Field Data Management

Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Data for the Site are captured in various Scribe projects. Additional information regarding Scribe and the Libby Scribe project databases is discussed in Section B10.3.

The field data manager utilizes a “local” field Scribe project database (i.e., LibbyCDM_Field.mdb) to maintain field sample information. The term “local” denotes that the

database resides on the server or personal computer of the entity that is responsible for the creating/managing the database. It is the responsibility of the field data manager to ensure that all local field Scribe project databases are backed-up nightly to a local server.

Field sample information from the FSDS is manually entered by a member of the field sample coordination staff using a series of standardized data entry forms (i.e., DE Tool). This tool is a Microsoft Access database that was originally developed by ESAT. The DE Tool is currently maintained by CDM Smith and resides on the local server in the Libby field office. This tool is used to prepare an electronic COC. Data in the DE Tool are imported into the local field Scribe project database by the field data manager.

It is the responsibility of the field data manager to “publish” sample and COC information from the local field Scribe database to Scribe.NET on a daily basis. It is not until a database has been published via Scribe.NET that it becomes available to external users.

B10.2 Analytical Laboratory Data Management

The analytical laboratories utilize several standardized data reporting tools developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique Libby-specific EDD has been developed for each analytical method and each sampling medium. Electronic copies of all current EDD templates are provided in the Libby Lab eRoom.

Once the analytical laboratory has populated the EDD with results, the spreadsheet(s) are transmitted via email to the ESAT TEM Laboratory Manager, the ESAT project data manager, and the FTL (or their designee). (Other email recipients may also be specified by the ESAT LC).

The ESAT project database manager utilizes a local analytical Scribe project database (i.e., LibbyLab2013.mdb) to maintain analytical results information. The EDDs are uploaded directly into the analytical Scribe project database. It is the responsibility of the ESAT project data manager to publish analytical results information from the local analytical Scribe database to Scribe.NET.

B10.3 Libby Project Database

As noted above, Scribe is a software tool developed by ERT to assist in the process of managing environmental data. A Scribe project is a Microsoft Access database. Multiple Scribe projects can be stored and shared through Scribe.NET, which is a web-based portal that allows multiple data users controlled access to Scribe projects. Local Scribe projects are “published” to Scribe.NET by the entity responsible for managing the local Scribe project. External data users may “subscribe” to the published Scribe projects via Scribe.NET to access data. Subscription requests are managed by ERT.

All data collected for this investigation will be maintained in Scribe. As discussed above, data will be captured in various Scribe project databases, including a field Scribe project (i.e., LibbyCDM_Field.mdb) and an analytical results Scribe project (i.e., LibbyLab2013.mdb).

B10.4 Data Reporting

Data users can access data for the Libby project through Scribe.NET. To access data, a data user must first download the Scribe application from the EPA ERT website⁷. The data user must then subscribe to each of the published Scribe projects for the Site using login and password information that are specific to each individual Scribe project. Scribe subscriptions for the Libby project are managed by ERT. Using the Scribe application, a data user may download a copy of any published Scribe project database to their local hard drive. It is the responsibility of the data user to regularly update their local copies of the Libby Scribe projects via Scribe.NET.

The Scribe application provides several standard queries that can be used to summarize and view results within an individual Scribe project. However, these standard Scribe queries cannot be used to summarize results across multiple Scribe projects (e.g., it is not possible to query both the “LibbyCDM_Field” project and the “LibbyLab2013” project using these standard Scribe queries).

If data users wish to summarize results across multiple published Scribe projects, there are two potential options. Data users may request the development of a “combined” project from ERT. This combined project compiles tables from multiple published Scribe projects into a single Scribe project. This allows data users to utilize the standard Scribe queries to summarize and view results.

Alternatively, data users may download copies of multiple published Scribe project databases for the Site and utilize Microsoft Access® to create user-defined queries to extract the desired data across Scribe projects. This requires that the data user is proficient in Microsoft Access and has an intimate knowledge of proper querying methods for asbestos data for the Site.

It is the responsibility of the data users to perform a review of results generated by any data queries and standard reports to ensure that they are accurate, complete, and representative. If issues are identified by the data user, they should be reported to the EPA Region 8 data manager for resolution via email (Mosal.Jeffrey@epa.gov). It is the responsibility of the EPA Region 8 data manager (or their designee) to notify the appropriate entity (e.g., field, analytical laboratory) in order to rectify the issue. A follow-up email will be sent to the party reporting the issue to serve as confirmation that a resolution has been reached and any necessary changes have been made.

⁷ http://www.ertsupport.org/scribe_home.htm

C ASSESSMENT AND OVERSIGHT

Assessments and oversight reports to management are necessary to ensure that procedures are followed as required and that deviations from procedures are documented. These reports also serve to keep management current on field activities.

C1. Assessment and Response Actions

C1.1 Assessments

System assessments are qualitative reviews of different aspects of project work to check the use of appropriate QC measures and the general function of the QA system. Field and office system assessments will be performed under the direction of CDM Smith's QA Director, with support from the CDM Smith QA Manager. As noted previously, it is anticipated that a field audit will be performed during this sampling program. The field audit findings will be documented in an audit report. A copy of the report will be provided to the EPA RPM and the QATS contractor. Field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

System assessments/audits of the analytical laboratories will be conducted by the QATS contractor, as coordinated by the EPA.

C1.2 Response Actions

Corrective response actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken to immediately correct a quality problem will be documented via logbook and reported to the appropriate manager (e.g., the FTL or EPA LC). Major corrective actions (i.e., those that impact or have the potential to impact investigation objectives) will be approved by the EPA RPM and the appropriate manager prior to implementation. Major corrective actions will be documented via a ROM form. EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

C2. Reports to Management

No regularly-scheduled written reports to management are planned as part of this investigation. However, QA reports may be provided to management for routine audits and whenever significant quality problems are encountered.

D DATA VALIDATION AND USABILITY

D1. Data Review, Verification and Validation

D1.1 Data Review

Data review of Scribe project data typically occurs at the time of data reporting by the data users and includes cross-checking that sample IDs and sample dates have been reported correctly and that calculated analytical sensitivities or reported values are as expected. If discrepancies are found, the data user will contact the EPA data manager, who will then notify the appropriate entity (field, preparation facility, or laboratory) in order to correct the issue.

D1.2 Criteria for LA Measurement Acceptability

Several factors are considered in determining the acceptability of LA measurements in samples analyzed by TEM. This includes the following:

1. *Evenness of filter loading.* This is evaluated using a chi-squared (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the result may not be representative of the true concentration in the sample, and the result should be given low confidence.
2. *Results of QC samples.* This includes both field and laboratory QC samples, such as field and laboratory blank samples, as well as various types of recount and re-preparation analyses. If significant LA contamination is detected in field or laboratory blanks, all samples prepared on that day should be considered to be potentially biased high. If agreement between original analyses and field or laboratory duplicates (i.e., re-preparation or recount analyses) is poor, results for those samples should be given low confidence.

D2. Verification and Validation Methods

D2.1 Data Verification

Data verification includes checking that results have been transferred correctly from the original hand-written, hard copy field and analytical laboratory documentation to the project databases. The goal of data verification is to identify and correct data reporting errors.

For analytical laboratories that utilize the Libby-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, since the results of this study will be provided to the property owners, a detailed manual data verification effort will be performed

for 100% of all ABS air samples and TEM analytical results collected as part of this sampling effort. This data verification process utilizes Site-specific SOPs (see **Appendix B**) developed to ensure TEM results and field sample information in the project databases is accurate and reliable:

- EPA-LIBBY-09 – SOP for TEM Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory benchesheets, and verification of the transfer of results from the benchesheets into the project database.
- EPA-LIBBY-11 - SOP for FSDS Data Review and Data Entry Verification – This Site-specific SOP describes the steps for the verification of field sample information, based on a review of the FSDS form, and verification of the transfer of results from the FSDS forms into the project database. An FSDS review is performed on all samples selected for TEM or PLM data verification.

The data verification review ensure that any data reporting issues are identified and rectified to limit any impact on overall data quality. If issues are identified during the data verification, the frequency of these checks may be increased as appropriate.

Data verification will be performed by appropriate technical staff that is familiar with project-specific data reporting, analytical methods, and investigation requirements. The data verifier will prepare a data verification report (template reports are included in the SOPs) to summarize any issues identified and necessary corrections. A copy of this report will be provided to the appropriate project data manager, LC, and the EPA RPM. The data verifier will also transmit the results of the data verification, including any electronic files summarizing identified discrepancies, via email to the EPA Region 8 data manager (Mosal.Jeffrey@epa.gov) for resolution. A follow-up email will be sent to the data verifier to serve as confirmation that a resolution has been reached on any issues identified.

It is the responsibility of the EPA Region 8 data manager to coordinate with the FTL and/or LC to resolve any project database corrections and address any recommended field or laboratory procedural changes from the data verifier. The EPA Region 8 data manager is also responsible for electronically tracking in the project database which data have been verified, who performed the verification, and when.

D2.2 Data Validation

Unlike data verification, where the goal is to identify and correct data reporting errors, the goal of data validation is to evaluate overall data quality and to assign data qualifiers, as appropriate, to alert data users to any potential data quality issues. Data validation will be performed by the QATS contractor (Shaw, or their designee), with support from technical

support staff that are familiar with project-specific data reporting, analytical methods, and investigation requirements.

Data validation for asbestos will be performed in basic accordance with the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011), and should include an assessment of the following:

- Internal and external field audit/surveillance reports
- Field ROMs
- Field QC sample results
- Internal and external laboratory audit reports
- Laboratory contamination monitoring results
- Laboratory ROMs
- Internal laboratory QC analysis results
- Inter-laboratory analysis results
- Performance evaluation results
- Instrument checks and calibration results
- Data verification results (i.e., in the event that the verification effort identifies a larger data quality issue)

A comprehensive data validation effort should be completed quarterly and results should be reported as a technical memorandum. This technical memorandum shall detail the validation procedures performed and provide a narrative on the quality assessment for each type of asbestos analysis, including the data qualifiers assigned, and the reason(s) for these qualifiers. The technical memorandum shall detail any deficiencies and required corrective actions.

The QATS contractor will also prepare an annual addendum to the *Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site (1999-2009)* (EPA 2012b) to summarize results of the quarterly data validation efforts. This addendum should include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet NFG guidelines and/or project-specific acceptance criteria. This addendum should also include recommendations for Site QA/QC program changes to address any data quality issues.

The data validator will transmit the results for each data validation effort via email to the EPA Region 8 data manager (Mosal.Jeffrey@epa.gov). This email should include an electronic summary of the records that have been validated, the date they were validated, any recommended data qualifiers, and their associated reason codes. It is the responsibility of the EPA Region 8 data manager to ensure that the appropriate data qualifiers and reason codes recommended by the data validator are added to the project database, and to electronically track in the project database which data have been validated, who performed the validation, and when.

In addition to performing quarterly data validation efforts, it is the responsibility of the QATS contractor (or their designee) to perform regular evaluations of all field blanks and laboratory blanks, to ensure that any potential contamination issues are quickly identified and resolved. If any blank contamination is noted, the QATS contractor should immediately contact the appropriate field or laboratory QA coordinator to ensure that corrective actions are made.

D3. Reconciliation with User Requirements

It is the responsibility of data users to perform a data usability assessment to ensure that DQOs have been met, and reported investigation results are adequate and appropriate for their intended use. This data usability assessment should utilize results of the data verification and data validation efforts to provide information on overall data quality specific to each investigation.

The data usability assessment should evaluate results with regard to several data usability indicators. **Table D-1** summarizes several indicators of data usability and presents general evaluation methods for each indicator. Depending upon the nature of the intended data use, other evaluation methods may also be appropriate. The data usability assessment results and conclusions should be included in any investigation-specific data summary reports.

Non-attainment of project requirements may result in additional sample collection or field observations in order to achieve project needs.

Table D-1: General Evaluation Methods for Assessing Asbestos Data Usability

Data Usability Indicator	General Evaluation Method
Precision	<p><u>Sampling</u> – Review results for co-located samples and field duplicates to provide information on variability arising from medium spatial heterogeneity and sampling and analysis methods.</p> <p><u>Analysis</u> – Review results for TEM laboratory duplicates, filter replicates, recounts, and reparations to provide information on variability arising from analysis methods. Review results for inter-laboratory analyses to provide information on variability and potential bias between laboratories.</p>
Accuracy/Bias	Calculate the background filter loading rate and use results to assign detect/non-detect in basic accordance with ASTM 6620-00. For air samples, determine the frequency of indirect preparation.
Representativeness	Review relevant field audit report findings and any field/laboratory ROMs for potential data quality issues.
Comparability	Compare the sample collection SOPs, preparation techniques, and analysis methods to previous investigations.
Completeness	Determine the percent of samples that were able to be successfully collected and analyzed (e.g., 99 of 100 samples, 99%).
Sensitivity	Determine the fraction of all analyses that stopped based on the area examined stopping rule (i.e., did not achieve the target sensitivity).

% = percent

ASTM = American Society of Testing and Materials

ROM = record of modification

SOP = standard operating procedure

TEM = transmission electron microscopy

References

Amandus, H.E., and Wheeler, R. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part II Mortality. *American Journal of Industrial Medicine* 11:15-26.

Amandus, H.E., Wheeler, P.E., Jankovic, J., and Tucker, J. 1987. The Morbidity and Mortality of Vermiculite Miners and Millers Exposed to Tremolite-Actinolite: Part I Exposure Estimates. *American Journal of Industrial Medicine* 11:1-14.

Antao, V.C., Larson, T.C., Horton, D.K. 2012. Libby vermiculite exposure and risk of developing asbestos-related lung and pleural diseases. *Current Opinion in Pulmonary Medicine* 18(2):161-167.

CDM Smith. 2011a. Sampling and Analysis Plan: 2011 Residential Activity-based Sampling, Libby Asbestos Site, Operable Unit 4, Libby, Montana. Revision 0 – July.

_____. 2011b. Response Action Sampling and Analysis Plan, Revision 2. June.

EPA. 2001. *EPA Requirements for Quality Assurance Project Plans – EPA QA/R-5*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-01/003. March. <http://www.epa.gov/quality/qs-docs/r5-final.pdf>

_____. 2003. Technical Memorandum: Libby Asbestos Site Residential/Commercial Cleanup Action Level and Clearance Criteria. U.S. Environmental Protection Agency, Region 8. Draft Final – December 15, 2003.

_____. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-06/001. February. <http://www.epa.gov/quality/qs-docs/g4-final.pdf>

_____. 2008a. Performance Evaluation of Laboratory Methods for the Analysis of Asbestos in Soil at the Libby, Montana Superfund Site. Produced by Syracuse Research Corporation for EPA, Region 8. Draft – October 7, 2008.

_____. 2008b. Characteristic EDS Spectra for Libby-Type Amphiboles. Produced by Syracuse Research Corporation for EPA, Region 8. Final – March 18, 2008.

_____. 2010. Activity-Based Sampling Summary Report, Operable Unit 4, Libby Asbestos Superfund Site. Produced by SRC, Inc. for EPA, Region 8. Final – June 2, 2010.

_____. 2011. *National Functional Guidelines for Asbestos Data Review*. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. Draft – August 2011.

_____. 2012a. EPA Data Management Plan for the Libby Asbestos Superfund Site. September (version 2012.2).

_____. 2012b. Quality Assurance and Quality Control Summary Report (1999 - 2009) for the Libby Asbestos Superfund Site. December 2012.

Larson TC, Meyer CA, Kapil V, Gurney JW, Tarver RD, Black CB, and Lockey JE. 2010. Workers with Libby Amphibole Exposure: Retrospective Identification and Progression of Radiographic Changes. *Radiology* 255(3):924-933.

Larson TC, Lewin M, Gottschall EB, Antao VC, Kapil V, Rose CS. 2012a. Associations between radiographic findings and spirometry in a community exposed to Libby amphibole. *Occup Environ Med.* 69(5):361-6.

Larson TC, Antao AC, Bove FJ, Cusack C. 2012b. Association Between Cumulative Fiber Exposure and Respiratory Outcomes Among Libby Vermiculite Workers. *J. Occup. Environ. Med.* 54(1): 56-63.

McDonald, J.C., McDonald, A.D., Armstrong, B., and Sebastien, P. 1986. Cohort Study of Mortality of Vermiculite Miners Exposed to Tremolite. *British Journal of Industrial Medicine* 43:436-444.

McDonald JC, Harris J, Armstrong B. 2004. Mortality in a cohort of vermiculite miners exposed to fibrous Amphibole in Libby, Montana. *Occup. Environ. Med.* 61:363-366.

Peipins, L.A., Lewin, M., Campolucci, S., Lybarger, J.A., Kapil, V., Middleton, D., Miller, A., Weis, C., Spence, M., and Black, B., 2003. Radiographic Abnormalities and Exposure to Asbestos-Contaminated Vermiculite in the Community of Libby, Montana, USA. *Environmental Health Perspectives* 111:1753-1759.

Sullivan, P.A. 2007. Vermiculite, Respiratory Disease and Asbestos Exposure in Libby, Montana: Update of a Cohort Mortality Study. *Environmental Health Perspectives* 115(4):579-585.

Whitehouse AC. 2004. Asbestos-related pleural disease due to tremolite associated with progressive loss of lung function: serial observations in 123 miners family members, and residents of Libby, Montana. *Am. J. Ind. Med.* 46:219-225.

Whitehouse AC, Black CB, Heppes MS, Ruckdeschel J, Levin SM. 2008. Environmental exposure to Libby asbestos and mesotheliomas. *Am. J. Ind. Med.* 51:877-880.

**Sampling and Analysis Plan/Quality Assurance Project Plan:
2013 Indoor Activity-Based Sampling
Libby Asbestos Site, Operable Unit 4
*Revision 0 - February 2013***

**Appendix A
Data Quality Objectives (DQOs)**

Appendix A

Data Quality Objectives for the 2013 OU4 Indoor ABS Study

Data quality objectives (DQOs) are statements that define the type, quality, quantity, purpose, and use of data to be collected. The design of a study is closely tied to the DQOs, which serve as the basis for important decisions regarding key design features such as the number and location of samples to be collected and types of analyses to be performed. The U.S. Environmental Protection Agency (EPA) has developed a seven-step process for establishing DQOs to help ensure that data collected during a field sampling program will be adequate to support reliable site-specific risk management decisions (EPA 2001, 2006).

The following sections implement the seven-step DQO process associated with this study.

A.1 Step 1: State the Problem

Libby is a community in northwestern Montana that is located near a large vermiculite mine. Vermiculite from this mine contains varying levels of a form of asbestos referred to as Libby Amphibole asbestos (LA). Historic mining, milling, and processing operations at the site are known to have caused releases of vermiculite and LA to the environment that have caused a range of adverse health effects in exposed people, including not only workers at the mine and processing facilities (Amandus and Wheeler 1987, McDonald *et al.* 1986, McDonald *et al.* 2004), but also in residents of Libby (Peipins *et al.* 2003). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of ongoing exposure and risk to current and future residents and workers in the area. Since 1999, EPA has conducted sampling and cleanup activities at the Site related to asbestos-related health problems in the Libby population. The Libby Asbestos Superfund Site (Site) was listed on the National Priorities List in October 2002.

Starting in 2000, EPA began taking a range of cleanup actions at the site to reduce or eliminate sources of LA exposure to residents and workers. Cleanup actions taken at homes and workplaces in Operable Unit 4 (OU4) typically included the removal of unenclosed vermiculite insulation from living spaces and other readily accessible spaces (e.g., unfinished attics), removal of some or all contaminated outdoor soils, and cleanup of indoor dusts.

The EPA has performed several investigations at the Site to evaluate potential exposures to LA released from source materials by measuring the concentration of LA in breathing zone air during various disturbance activities, referred to as “activity-based sampling” (ABS). In 2007/2008, EPA conducted an ABS study to evaluate indoor air concentrations. Based on a review of this indoor ABS data, EPA has identified two data gaps that require additional investigation at residential properties, as described below.

Data Gap 1. In the 2007/2008 indoor ABS study, four different “categories” of properties were evaluated based on the status of the outdoor soil as follows:

Category	Outdoor Soil Cleanup?	Post-Cleanup Soil Condition
INT 1	No (no soil cleanup deemed necessary)	PLM = ND & VV-
INT 2		PLM ≠ ND or VV+
INT 3	Yes (soil cleanup was performed in a portion of the yard)	PLM = ND & VV-
INT 4		PLM ≠ ND or VV+

As shown, categories included properties where yard removals had been conducted in only a portion of the yard or for which no soil removal was deemed necessary. Properties in which a full yard cleanup (i.e., a “curb-to-curb” cleanup) had been conducted were not evaluated. Therefore, additional indoor ABS data are needed to determine if residual risks from indoor air at post-cleanup “curb-to-curb” properties are within acceptable limits.

Data Gap 2. Although the 2007/2008 indoor ABS study evaluated properties following soil cleanup or where no cleanup was deemed warranted, LA was frequently detected in samples of indoor ABS air. Because no additional indoor ABS data have been collected since this study, there is no data to provide information on potential changes in indoor ABS air concentrations over time. Therefore, additional indoor ABS data are needed to provide information on whether measured ABS air concentrations have changed over time at properties that were originally evaluated in 2007/2008.

A.2 Step 2: Identify the Goal of the Study

The goal of this study is to collect indoor ABS data that address each of the data gaps identified above. These data will be used to estimate exposure and risk from LA to residents and individuals that work at residential properties in OU4. Results will be used by risk managers to decide whether or not additional response actions are needed to protect individuals from unacceptable risks from LA in OU4.

This SAP will guide multiple sampling scenarios designed to address each data gap, including:

- Scenario 1: Evaluation of indoor ABS air concentrations at curb-to-curb properties
- Scenario 2: Re-evaluation of indoor ABS air concentrations at 2007/2008 ABS properties

A.3 Step 3: Identify Information Inputs

The following sections describe the types of information needed to meet the study goals.

A.3.1 Indoor ABS Air Concentrations of LA

The information needed consists of reliable measurements of LA concentrations in air under realistic and representative scenarios that are characteristic of indoor activities in OU4.

Disturbance Activities

Indoor air samples may also be collected under a variety of differing activity scenarios, with varying levels of activity and source disturbance. While there are a wide variety of such activities, it is not necessary to collect data under every possible combination of activity and source disturbance. Rather, for the purposes of this effort, samples should be representative of two generic conditions:

- Active behaviors - This category includes a wide range of indoor activities in which a person is moving about the building and potentially disturbing indoor sources. For example, walking from room to room, sitting down on upholstered chairs, dusting, sweeping, vacuuming, and moving furniture would all be included.
- Passive behaviors - This category includes activities such as sitting and reading a book, watching television, and working at a desk. The key attribute is that the person is engaging in minimally energetic actions that will have low tendency to disturb source materials.

Type of Air Sample

Experience at Libby and at other asbestos sites has demonstrated that personal air samples (i.e., samples that collect air in the breathing zone of a person) tend to have higher concentrations of LA than air samples collected by a stationary monitor (EPA 2007a). Because personal air samples are more representative of breathing zone exposures, this study should focus on the collection of personal air samples during ABS. ABS measurements should be obtained by drawing a known volume of air through a filter that is located in the breathing zone of the individual performing the disturbance activity and measuring the number of LA structures that become deposited on the filter surface.

Analysis Method

ABS air samples should be analyzed for asbestos using transmission electron microscopy (TEM). Because the toxicity of asbestos when inhaled may depend on the structure dimensions and asbestos mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). The structure-specific dimensions allow for the estimation of phase contrast microscopy-equivalent (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks from the ABS air samples (see Section A5.1).

Meeker *et al.* (2003) observed that most LA structures from the Libby ore body contain detectable levels of both sodium and potassium, whereas LA originating from other potential sources may not. Thus, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded.

A.3.2 Property Information

Residual sources that may contribute to LA in indoor air in post-cleanup properties include things like carpets, upholstery, air ducts, and vermiculite insulation in enclosed spaces. While there are too many independent variables to allow measurement and stratification of sampling locations based on all of these potential residual sources, it is important that the data collected at each property include a thorough documentation of all potential sources known to exist in the building. Information collected regarding residual sources will be captured on an Indoor ABS Property Background and Sampling Form. If a subset of properties is recognized as having higher indoor air levels of LA than most others, these data on residual sources may help form hypotheses about which residual sources are most likely to be responsible, which in turn may form the basis for a focused follow-up investigation, as may be judged necessary to support decision-making.

A.4 Step 4: Define the Bounds of the Study

The following sections specify the geographic (spatial) and temporal boundaries of this study.

A.4.1 Spatial Bounds

The spatial bounds of this study should be restricted to properties located within OU4 of the Libby Asbestos site. This OU includes most current residential and commercial properties in the Libby community.

A.4.2 Temporal Bounds

Indoor ABS air data from the 2007/2008 study showed that concentrations were seasonally dependant, with the highest concentrations observed in the summer and the lowest concentrations observed in the winter. For Scenario 1, because no indoor ABS data are available for curb-to-curb properties, ideally, data would be collected from each property for each season (i.e., winter, spring, summer, and fall) similar to what was performed in the 2007/2008 study. This will help ensure that reliable estimates of long-term average concentrations may be computed from individual short-term measurements. If it is not possible to conduct ABS in all seasons, preference should be given to sampling in the summer (July-September) and winter (December-March) to ensure that results span the full range of expected concentrations.

For Scenario 2, since the goal is to compare indoor ABS conditions in 2007/2008 to conditions in 2013, focus should be placed on sampling in the summer (July-September), since this is the season when indoor ABS concentrations were shown to be highest. By focusing on the season when concentrations are highest, it increases the likelihood of seeing a potential difference in concentrations as a function of time.

For both scenarios, the exact dates of ABS sampling are not important and may be selected at random within the season of interest.

A.5 Step 5: Define the Analytic Approach

ABS data collected at curb-to-curb properties (Scenario 1) as part of this study can be used to estimate exposure and risk from LA during indoor activities that will support risk management decision-making. Indoor ABS data collected as part of Scenario 2 can also be used to support temporal evaluations that will provide a better understanding of indoor ABS results. The analytic approach for each intended data use is described below.

A.5.1 Risk Characterization

For Scenario 1, EPA will use indoor ABS results to estimate exposure and calculate potential risks to individuals from various indoor exposure scenarios in OU4 and determine whether additional remedial action is needed to protect human health.

The EPA has recently proposed LA-specific toxicity values for use in estimating cancer risks and non-cancer hazard quotients (HQs) from exposures to LA in air. The LA-specific lifetime inhalation unit risk (IUR) value is 0.17 LA PCM^a (structures per cubic centimeter [s/cc])⁻¹ and the LA-specific reference concentration (RfC) value is 0.00002 LA PCM s/cc. EPA is currently reviewing these values. The following sections describe how cancer risks and non-cancer HQs will be calculated.

Estimation of Cancer Risk

The basic equation for estimating cancer risk from LA using the LA-specific IUR value is as follows:

$$\text{Risk} = \text{EPC} * \text{TWF}_c * \text{IUR}_{\text{LA}}$$

where:

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of site-related LA exposure.

EPC = Exposure point concentration of LA in air (PCME s/cc). The EPC is an estimate of the long-term average concentration of LA in inhaled air for the specific activity being assessed.

TWF_c = Time-weighting factor for cancer. The value of the TWF term ranges from zero to one, and describes the average fraction of a lifetime during which exposure occurs from the specific activity being assessed.

^a Calculations of human exposure and risk from asbestos in air are expressed in terms of PCM s/cc. When analysis is performed by TEM, structures that satisfy PCM counting rules are referred to as PCME structures. The PCM counting rules include structures with a length > 5 microns (µm), a width greater than or equal to (≥) 0.25 µm, and an aspect ratio ≥ 3:1.

$$TWF_c = ET/24 * EF/365 * ED/70$$

where:

ET = Average exposure time (hours/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

$$IUR_{LA} = \text{LA-specific lifetime inhalation unit risk (LA PCM s/cc)}^{-1}$$

Estimation of Non-Cancer Hazard Quotient

The basic equation for characterizing non-cancer risk from LA using the LA-specific RfC value is as follows:

$$HQ = EPC * TWF / RfC_{LA}$$

where:

HQ = Hazard quotient for non-cancer effects from site-related LA exposure

EPC = Exposure point concentration of LA in air (PCME s/cc)

TWF_{nc} = Time-weighting factor for non-cancer. Note that the interval over which exposure duration is calculated is from age 0 to age 60. This is because the non-cancer toxicity factor is based on cumulative lifetime exposure lagged by 10 years.

$$TWF_{nc} = ET/24 * EF/365 * ED/60$$

where:

ET = Average exposure time (hours/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

$$RfC_{LA} = \text{LA-specific lifetime reference concentration (LA PCM s/cc)}$$

Decision Rule

These risk estimates will provide a basis for EPA to determine whether action is needed at the Site to protect human health from exposures to LA in indoor air. The EPA guidance provided in Office of Solid Waste and Emergency Response (OSWER) Directive #9355.0-30, "Role of the

Baseline Risk Assessment in Superfund Remedy Selection Decisions” (EPA 1991) indicates that if the cumulative cancer risk to an individual based on reasonable maximum exposure (RME) is less than 1E-04 and the non-cancer HQ is less than 1, then remedial action is generally not warranted unless there are adverse environmental impacts. The guidance also states that a risk manager may decide that remedial action is warranted for risk levels lower than 1E-04 where there are uncertainties in the risk assessment results.

A.5.2 Dataset Comparisons

For Scenario 2, EPA will also use the indoor ABS results from this study to make comparisons to the indoor ABS results from the 2007/2008 study to help risk managers gain a better understanding of temporal differences in indoor ABS air. Concentrations of LA in indoor ABS samples collected in the summer of 2007 can be compared to concentrations of LA in indoor ABS samples from the same property collected in the summer of 2013. If there are differences in concentration as a function of time, then risk managers will need to decide which ABS results are likely to be most representative of current residential exposures.

Other types of comparisons may also be made to evaluate other factors (e.g., property conditions, meteorological conditions) that may influence ABS air concentrations. These comparisons may be made using a variety of methods, ranging from simple visual comparisons using graphical plots to statistical comparisons using the Poisson ratio test (Nelson 1982). The Poisson ratio test can only be used in making statistical comparisons between individual samples or pooled concentrations. No statistically valid approach is available for making comparisons of asbestos datasets that cannot be pooled; therefore, these types of comparisons will rely upon graphical presentations.

A.6 Step 6: Specify Acceptance Criteria

A.6.1 Risk Assessment

ABS data collected as part of this study will be used to evaluate risks to support risk management decision-making. In making decisions about human health risks, two types of decision errors are possible – false negative and false positive.

- A *false negative decision error* occurs when a risk manager decides an exposure is acceptable when it actually results in unacceptable health risks.
- A *false positive decision error* occurs when a risk manager decides an exposure is unacceptable when it really is acceptable.

EPA is most concerned about guarding against the occurrence of false negative decision errors, since an error of this type may leave humans exposed to unacceptable levels of LA. To minimize chances of underestimating the true amount of exposure and risk, EPA generally recommends that risk calculations be based on the 95 percent upper confidence limit (95UCL) of the sample mean (EPA 1992). Use of the 95UCL in risk calculations limits the probability of a false negative

decision error to no more than 5 percent. To support this approach, EPA has developed a software application (ProUCL) to assist with the calculation of 95UCL values (EPA 2010). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). EPA is presently working to develop a new software application that will be appropriate for use with asbestos datasets, but the application is not yet available for use. Because the 95UCL cannot presently be calculated with confidence, risk calculations will be based on the sample mean only, as recommended by EPA (2008). This means that risk estimates may be either higher or lower than true values, and this will be identified as a source of uncertainty in the risk assessment.

EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. The risk of false positive decision errors can be minimized by increasing the number of samples. The number of samples needed depends on the magnitude of between-sample variability and the proximity of EPC to the decision rule. If between-sample variability is low, or if the EPC is not near a decision rule, then the number of samples needed is usually relatively low. However, if between-sample variability is high and the EPC is relatively near a decision rule, then the number of samples needed is usually higher.

A.6.2 Dataset Comparisons

When making statistical comparisons between two ABS datasets, the goal is to be able to have adequate power to reject the null hypothesis if the difference between the datasets is greater than some specified level. However, because there is no statistically valid approach for making comparisons of asbestos datasets, it is not possible to calculate the number of samples required to achieve a desired statistical power. Measured LA concentrations from previous sampling efforts show that data can be highly variable as a consequence of inherent sampling variability and analytical measurement error. Because of this, it may be nearly impossible to distinguish small differences (e.g., factor of 2-3) between datasets.

A.7 Step 7: Develop the Plan for Obtaining Data

The following sections present a sampling design that will yield data that will address the DQOs specified in Steps 1-6 above.

A.7.1 General Study Design Considerations

Indoor ABS Script

Indoor ABS activities will be performed by EPA contractor staff. Participating residents will be required to leave the house during the time period of indoor sample collection. Each home sampled will have two 4-hour samples collected to represent indoor air levels during two categories of activity – passive behaviors and active behaviors.

Period 1 (Passive Behaviors)

In this 4-hour interval, the EPA contractor will engage in minimal physical activity. Movement will be restricted to walking between rooms, sitting on chairs, couches, or the floor, etc. While seated, the EPA contractor may read, watch television, or complete required paperwork.

Period 2 (Active Behaviors)

In this 4-hour interval, the contractor will engage in a standardized sequence (“script”) of “active” behaviors, as detailed in **Appendix C**. This script is intended to capture a wide range of different activities that residents may engage in during normal living conditions. This includes things such as walking between rooms, sitting down on chairs and couches, simulated play with children or pets, sweeping, vacuuming, and dusting.

In order to ensure that each 4-hour sample is spatially representative of the home, each sample shall be collected from multiple rooms on all floors of the home.

Depending on what is most convenient for the resident, sampling will either occur over one 8-hour time interval, divided into two sub-periods of 4-hours each, or else will occur by collecting two 4-hour samples on two sequential days. If both samples are collected on one day, the passive activity sample will be collected in the morning, and the active sample will be collected in the afternoon to minimize the likelihood of cross-contamination between activity periods. If samples are collected on two sequential days, the order of collection may be random. That is, if the active phase is conducted in the morning of the first day at House #1 then the passive phase of sampling will be conducted at House #1 in the afternoon on the second day.

ABS Air Sampling Approach

Two key variables that may be adjusted during collection of air samples are sampling duration and pump flow rate. The product of these two variables determines the amount of air drawn through the filter, which in turn is an important factor in the analytical cost and feasibility of achieving the target analytical sensitivity (TAS) (see below). In general, longer sampling times are preferred over shorter sampling times because: a) longer time intervals are more likely to yield representative measures of the average concentration (as opposed to short-term fluctuations); and b) longer collection times are associated with higher volumes, which reduces the number of grid openings that need to be examined to achieve the TAS. Likewise, higher flow rates are generally preferred over lower flow rates because high flow results in high volumes drawn through the filter over shorter sampling times.

In accordance with the indoor ABS script, the target sampling duration is four hours for each indoor ABS sample. When feasible, ABS personnel should wear two different sampling pumps – a high volume pump and a low volume pump. This will allow for the collection of two “replicate” filters (i.e., each filter represents the same sample collection duration, but different total sample air volumes). The appropriate flow rate for each sampling pump should be optimized to achieve the highest sample air volume possible without causing the filter to

become overloaded.

The high volume filter will be analyzed in preference to the low volume filter. If the high volume filter is deemed to be overloaded, the low volume filter should be analyzed in preference to performing an indirect preparation on the high volume filter to avoid potential bias associated with indirect preparation^b. If the low volume filter is deemed to be overloaded, an indirect preparation (with ashing) may be performed (following consultation with and approval from the laboratory coordinator).

TEM Stopping Rules

In general, three alternative stopping rules are specified for TEM analyses to ensure resulting data are adequate:

1. The TAS to be achieved
2. A maximum number of structures to be counted
3. A maximum area of filter to be examined

The basis for each of these values for this study is presented below.

Target Analytical Sensitivity (TAS)

The level of analytical sensitivity needed to ensure that analysis of ABS air samples will be adequate is derived by finding the concentration of LA in ABS air that might be of potential concern, and then ensuring that if an ABS sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy. This process is implemented below:

Step 1. Calculation of Risk-Based Concentrations

Cancer. The basic equation for calculating the risk-based concentration (RBC) for cancer is:

$$\text{RBC (cancer)} = \text{Maximum Acceptable Cancer Risk} / (\text{TWF}_c * \text{IUR}_{\text{LA}})$$

For cancer, the maximum acceptable risk is a risk management decision. For the purposes of calculating an adequate target sensitivity, a value of 1E-05 is assumed.

The RME exposure parameters needed to calculate TWF_c were selected based on information in EPA's *Exposure Factors Handbook* (EPA 1997) and on professional judgment. Relevant data items available from EPA (1997) for estimating

^b Indirect preparation has the potential to increase the number of LA structures recorded during TEM analysis, which may bias resulting air concentrations high (Berry *et al.* 2012). However, it is expected that this potential bias is lower for amphibole asbestos relative to chrysotile asbestos (Hwang and Wang 1983; HEI-AR 1991; Breyse 1991).

exposure times (ET) are summarized below:

- Hours/day at residence = 23.3 (RME) (*page 5-17*)
- Hours/day spent house-cleaning = 5.6 (RME) (*Table 15-71*)

Indoor activities are conservatively assumed to occur with an exposure frequency (EF) of 365 days/year.

No site-specific data exist that provide information on the exposure duration (ED) of area residents. For the purposes of deriving a target analytical sensitivity the ED parameter was estimated to be 50 years.

Based on this exposure information, the TWF values are as follows:

Activity	ET (hrs/day)	EF (days/yr)	ED (yrs)	TWFC	TWFnc
Passive	17.5	365	50	0.52	0.62
Active	5	365	50	0.15	0.17

The proposed IUR_{LA} is $0.17 \text{ (PCM s/cc)}^{-1}$. Based on these values, the passive RBC for cancer is $0.00011 \text{ LA PCME s/cc}$ and the active RBC for cancer is $0.00040 \text{ LA PCME s/cc}$.

Non-Cancer. The basic equation for calculating the RBC for non-cancer effects is:

$$RBC(\text{non-cancer}) = (\text{Maximum Acceptable HQ} * RfC_{LA}) / TWF_{nc}$$

For non-cancer, the maximum acceptable HQ is 1. The proposed RfC_{LA} is $0.00002 \text{ LA PCME s/cc}$. Based on these values, the passive RBC for non-cancer is $0.00003 \text{ LA PCME s/cc}$ and the active RBC is $0.00012 \text{ LA PCME s/cc}$.

Because the non-cancer RBCs are lower than the cancer RBCs, the non-cancer RBCs are used to derive the target analytical sensitivity, as follows.

Step 2: Determining the Target Analytical Sensitivity

The target analytical sensitivity (TAS) is determined by dividing the RBC by the target number of structures to be observed during the analysis of a sample with a true concentration equal to the RBC:

$$TAS = RBC / \text{Target Count}$$

The target count is determined by specifying a minimum detection frequency required during the analysis of samples at the RBC. This probability of detection

is given by:

$$\text{Probability of detection} = 1 - \text{Poisson}(0, \text{Target Count})$$

Assuming a minimum detection frequency of 95 percent, the target count is 3 structures. Based on this, the target analytical sensitivity is:

$$\text{Passive TAS} = (0.00003 \text{ s/cc}) / (3 \text{ s}) = 0.00001 \text{ cc}^{-1}$$

$$\text{Active TAS} = (0.00012 \text{ s/cc}) / (3 \text{ s}) = 0.00004 \text{ cc}^{-1}$$

Maximum Number of LA Structures

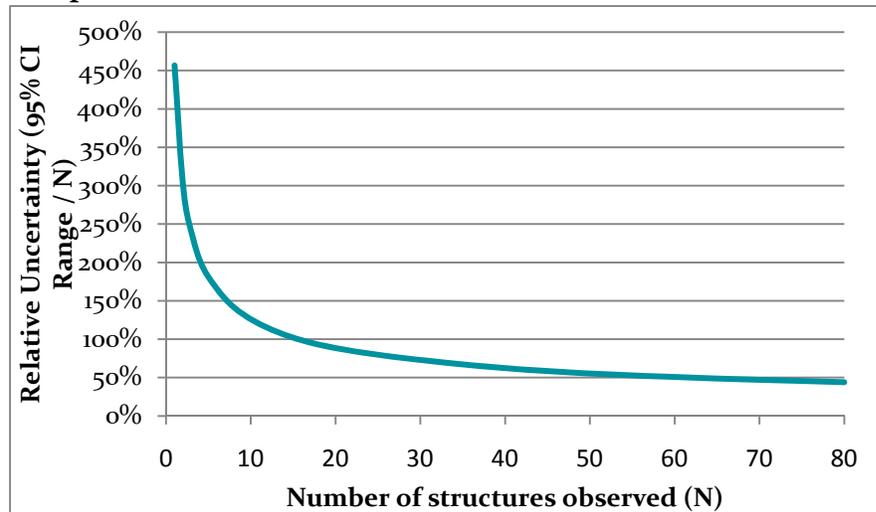
Ideally, all samples would be examined by TEM until the target analytical sensitivity is achieved. However, for filters that have high asbestos loading, reliable estimates of concentration may be achieved before achieving the target analytical sensitivity. This is because the uncertainty around a TEM estimate of asbestos concentration in a sample is a function of the number of structures observed during the analysis. The 95% confidence interval (CI) around a count of N structures is computed as follows:

$$\text{Lower bound (2.5\%)} = \frac{1}{2} \cdot \text{CHIINV}(0.975, 2 \cdot N_{\text{observed}} + 1)$$

$$\text{Upper bound (97.5\%)} = \frac{1}{2} \cdot \text{CHIINV}(0.025, 2 \cdot N_{\text{observed}} + 1)$$

As N_{observed} increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by Nobs) decreases. This concept is illustrated in the figure below.

Relationship Between Number of Structures Observed and Relative Uncertainty



The goal is to specify a target N such that the resulting Poisson variability is not a substantial factor in the evaluation of method precision. As shown in the figure, above about 25 structures, there is little change in the relative uncertainty. Therefore, the count-

based stopping rule for TEM should utilize a maximum structure count of 25 LA structures. Note: This stopping rule is based on the number of PCME LA structures observed (i.e., not total LA structures).

Maximum Area to be Examined

The number of grid openings that must be examined (GOx) to achieve the target analytical sensitivity is calculated as:

$$\text{GOx} = \text{EFA} / (\text{TAS} \cdot \text{Ago} \cdot \text{V} \cdot 1000 \cdot \text{f})$$

where:

EFA = Effective filter area (assumed to be 385 square millimeters [mm²])

TAS = Target analytical sensitivity (cc)⁻¹

Ago = Grid opening area (assumed to be 0.01 mm²)

V = Sample air volume (liters [L])

1000 = L/cc (conversion factor in liters per cubic centimeter)

f = Indirect preparation dilution factor (assumed to be 1 for direct preparation)

Assuming that the sampling duration is 4 hours (240 minutes) and the flow rate is 4 liters/minute (L/min), each ABS air sample should have a sample air volume of 960 liters (L). Assuming that the filter is able to be prepared directly (i.e., f = 1), about 1,000 grid openings would need to be examined for each active ABS air sample and more than 3,600 grid openings would need to be examined for each passive ABS air sample to achieve the TAS. If an indirect preparation is necessary, the number of grid openings that will need to be examined is inversely proportional to the dilution needed (i.e., an f of 0.1 will increase the number of grid openings by a factor of 10).

In consideration of the draft nature of the LA-specific toxicity values, and in order to limit analytical costs, a maximum area examined of 10 mm² is identified for this project. Assuming that each grid opening has an area of about 0.01 mm², this would correspond to about 1,000 grid openings. The adequacy of the achieved analytical requirements for all indoor ABS air samples collected as part of this program will be assessed once the LA-specific toxicity values have been finalized. If needed, additional grid openings may be examined for these samples to improve achieved analytical sensitivity in the future.

Summary of TEM Stopping Rules

The TEM stopping rules for this study should be as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
 - a. The scenario-specific TAS is achieved.
 - b. 25 LA structures have been observed.

- c. A total filter area of 10 mm² has been examined (this is approximately 1,000 grid openings).

When one of these criteria has been satisfied, complete the examination of the final grid opening and stop.

A.7.2 Specific Study Design Considerations – Scenario 1

Selected Properties

The objective of Scenario 1 is to collect indoor ABS data to evaluate the efficacy and protectiveness of a “curb-to-curb” yard removal. Thus, only those OU4 properties that have undergone a “curb-to-curb” yard cleanup should be eligible for selection. Because it is likely that there is some lag time between when the curb-to-curb removal is performed and when the effects of this removal influence indoor air conditions inside the property, only those properties where removals were performed prior to 2011 will be selected. To the extent possible, selected properties should provide a reasonable spatial representation of OU4. If possible, properties evaluated as part of the curb-to-curb outdoor ABS program in 2011 would be preferred (highlighted in grey in the table), since this would provide paired indoor and outdoor ABS information for the same property.

Sampling Events

Due to limits on both time and budget, it will only be possible to conduct ABS during two seasons. Thus, to ensure that resulting data span the full range of expected concentrations, indoor ABS air concentrations should be evaluated in the summer and winter.

A.7.3 Specific Study Design Considerations – Scenario 2

Selected Properties

Because the objective of Scenario 2 is to compare results of this indoor ABS effort to results from the 2007/2008 indoor ABS effort, properties evaluated in this study must have been evaluated in 2007/2008 as part of the indoor ABS evaluation (EPA 2010). As noted above, properties selected for indoor ABS evaluation in 2007/2008 were drawn from four categories, depending upon their outdoor soil cleanup status and the post-cleanup soil conditions. To the extent possible, selected properties should provide a reasonable spatial representation of OU4.

Sampling Events

To maximize the likelihood of seeing a potential difference in indoor ABS air concentrations as a function of time, indoor ABS activities should be evaluated in the summer (the season when indoor ABS air concentrations are likely to be highest).

A.7.3 Refining the Study Design

In accordance with the EPA’s DQO process, it is expected that the sampling program described in this document may be modified as data are obtained. For example, the TAS may be either increased or decreased depending on the detection frequency, mean values, and sample

variability observed in the sample results. Sampling durations and pump flow rates may also be modified if a high frequency of filter overloading is reported.

REFERENCES

- Berry, D. et al. 2012. Comparison of Amphibole Air Concentrations Resulting from Direct and Indirect Filter Preparation and Transmission Electron Microscopy Analysis. [*Manuscript in preparation*]
- Breyse PN. 1991. Electron Microscopic Analysis of Airborne Asbestos Fibers. *Crit. Rev. Anal. Chem.* 22:201-227.
- EPA. 2001. *EPA Requirements for Quality Assurance Project Plans – EPA QA/R-5*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-01/003. March. <http://www.epa.gov/quality/qs-docs/r5-final.pdf>
- _____. 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA/240/B-06/001. February. <http://www.epa.gov/quality/qs-docs/g4-final.pdf>
- _____. 2007a. Summary Report for Data Collected under the Supplemental Remedial Investigation Quality Assurance Project Plan Libby, Montana Superfund Site. U.S. Environmental Protection Agency, Region 8. October.
- _____. 2007b. Phase I Sampling and Analysis Plan for Operable Unit 3 Libby Asbestos Superfund Site. U.S. Environmental Protection Agency, Region 8. September 26, 2007.
- _____. 2010. Phase IV Sampling and Analysis Plan, Remedial Investigation for Operable Unit 3, Libby Asbestos Superfund Site, Part A: Data to Support Human Health Risk Assessment. U.S. Environmental Protection Agency, Region 8. June 2010.
- _____. 2011. 2011 Miscellaneous Activity-Based Sampling for Operable Unit 4, Libby Asbestos Superfund Site. U.S. Environmental Protection Agency, Region 8. Revision 1 – September 22, 2011.
- HEI-AR (Health Effects Institute – Asbestos Research). 1991. *Asbestos in Public and Commercial Buildings: A Literature Review and Synthesis of Current Knowledge*. Health Effects Institute – Asbestos Research. Cambridge, Massachusetts.
- Hwang and Wang. 1983. Comparison of Methods of Assessing Fiber Concentrations. *Arch. Environ. Health* 38:5-10.

Meeker GP, Bern AM, Brownfield IK, Lowers HA, Sutley SJ, Hoeffen TM, Vance JS. 2003. The Composition and Morphology of Amphiboles from the Rainy Creek Complex, Near Libby, Montana. *American Mineralogist* 88:1955-1969.

Nelson,W. 1982. *Applied Life Data Analysis*. John Wiley & Sons, New York. pp 438-446.

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**Appendix B
Standard Operating Procedures (SOPs)**

SOP ID	SOP Description
Field Procedures	
EPA-LIBBY-2012-01	Field Logbook Content and Control
EPA-LIBBY-2012-02	Photographic Documentation of Field Activities
EPA-LIBBY-2012-04	Field Equipment Decontamination
EPA-LIBBY-2012-05	Handling Investigation-Derived Waste
EPA-LIBBY-2012-06	Sample Custody
EPA-LIBBY-2012-07	Packaging and Shipping of Environmental Samples
EPA-LIBBY-2012-10	Sampling of Asbestos Fibers in Air
CDM-LIBBY-09	GPS Coordinate Collection and Handling
Laboratory Procedures	
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for Analysis by TEM
Data Verification Procedures	
EPA-LIBBY-09	TEM Data Review and Data Entry Verification
EPA-LIBBY-11	FSDS Data Review and Data Entry Verification

The most recent versions of all field SOPs are provided electronically in the Libby Field eRoom (<https://team.cdm.com/eRoom/R8-RAC/Libby>) or in the CDM Smith Libby Field Office.

The most recent version of all laboratory and data verification SOPs are provided electronically in the Libby Lab eRoom (<https://team.cdm.com/eRoom/mt/LibbyLab>).

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**Appendix C
Indoor ABS Scripts**

Indoor Activity-Based Sampling Script

The following provides guidance for performing indoor activity-based sampling (ABS) as described in the current version of the *2013 Indoor ABS Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)* for Operable Unit (OU4) of the Libby Asbestos Superfund Site.

Pre-Activity Documentation

Prior to beginning sample collection, each structure will be assessed to determine the number of rooms on each living floor of the main structure where sampling will be conducted. The interior layout of rooms, carpeting, and upholstery will be documented on the 2013 Interior ABS Property Background Form. The total sampling time for each period (passive and active) will be divided evenly among the total number of rooms in which routine living activities occur. Areas such as bathrooms and closets will not be included.

For example, if the property is comprised of one floor that contains 6 rooms (living room, 1 study, 1 kitchen, and 3 bedrooms) the total time of the passive sampling period (4 hours) would be divided evenly among the 6 rooms (240 minutes / 6 rooms = 40 minutes per room).

In the above example, if the property described above included an unfinished basement that was not part of the functional living space, the time per room would remain the same (unfinished basement would not be included).

Passive Period Sampling

Activities conducted in the passive sampling period will be mostly sedentary with little movement. Movement will be restricted to walking between rooms and sitting on upholstered chairs and/or cushions. While seated the actor may read, watch television, play video games, or complete required paperwork.

The actor should transition to each room when required, walk around the perimeter of the room once upon initial entry, and then remain seated for the duration of the time required in the room.

Given the example property described above, the following is an example of how the passive period sampling would be executed:

Location	Minutes Elapsed Since Start	Activity	Total Time of Activity in Location (minutes)
Room 1	0 to 0.5	Walk around perimeter of Room 1	0.5
	0.5 to 40.5	Seated in Room 1	40
Room 2	40.5 to 41.0	Transition to Room 2 and walk around perimeter	0.5
	41.0 to 81.0	Seated in Room 2	40
Room 3	81.0 to 81.5	Transition to Room 3 and walk around perimeter	0.5

Location	Minutes Elapsed Since Start	Activity	Total Time of Activity in Location (minutes)
	81.5 to 101.5	Seated in Room 3	40
Room 4	101.5 to 102.0	Transition to Room 4 and walk around perimeter	0.5
	102.0 to 142.0	Seated in Room 4	40
Room 5	142.0 to 142.5	Transition to Room 5 and walk around perimeter	0.5
	142.5 to 182.5	Seated in Room 5	40
Room 6	182.5 to 222.5	Transition to Room 6 and walk around perimeter	0.5
	222.5 to 242.5	Seated in Room 6	40

Active Period Sampling

Activities conducted in the active sampling period will involve various levels of dust generating activities. These activities will include walking, sitting on upholstered chairs and/or cushions, and sweeping non-carpeted floors or vacuuming carpeted floors. Brooms used for the activity will be supplied by the contractor and (to the extent possible) reused at the same property during subsequent sampling events. Vacuums to be used will be the vacuum used by the owner of the property. If the resident uses a high-efficiency particulate air (HEPA) filter equipped vacuum, the filter will be removed during the sampling activities.

When carpeted and non-carpeted flooring is present in the same room, sweeping or vacuuming will be conducted only on the flooring type that covers the majority of the surface area.

These activities should be conducted for equal periods of time in each room. For example, if the time required per room is 40 minutes, each of the three activities (i.e., walking, sitting, sweeping/vacuuming) should be conducted for approximately 13 minutes.

Given the example property described above, the following is an example of how the active period sampling would be executed (assuming no upholstered furniture is present in Room 2 or Room 5):

Location	Minutes Elapsed Since Start	Activity	Total Time of Activity in Location (minutes)
Room 1	0 to 13.0	Walk on flooring in Room 1	13
	13.0 to 26.0	Sit on upholstered furniture in Room 1	13
	26.0 to 39.0	Sweep non-carpeted flooring in Room 1	13
Room 2	39.0 to 39.5	Transition to Room 2	0.5
	39.5 to 59.5	Walk on flooring in Room 2	20
	59.5 to 79.5	Vacuum carpeted flooring in Room 2	20
Room 3	79.5 to 80.0	Transition to Room 3	0.5

Location	Minutes Elapsed Since Start	Activity	Total Time of Activity in Location (minutes)
	80.0 to 93.0	Walk on flooring in Room 3	13
	93.0 to 106.0	Sit on upholstered furniture in Room 3	13
	106.0 to 119.0	Sweep non-carpeted flooring in Room 3	13
Room 4	119.0 to 119.5	Transition to Room 4	0.5
	119.5 to 132.5	Walk on flooring in Room 4	13
	132.5 to 145.5	Sit on upholstered furniture in Room 4	13
	145.5 to 158.5	Vacuum carpeted flooring in Room 4	13
Room 5	158.5 to 159.0	Transition to Room 5	0.5
	159.0 to 179.0	Walk on flooring in Room 5	20
	179.0 to 199.0	Vacuum carpeted flooring in Room 5	20
Room 6	199.0 to 199.5	Transition to Room 6	0.5
	199.5 to 212.5	Walk on flooring in Room 6	13
	212.5 to 225.5	Sit on upholstered furniture in Room 6	13
	225.5 to 238.5	Sweep carpeted flooring in Room 6	13

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**Appendix D
Property Background Information Form for Indoor ABS**

BD# _____

LIBBY ASBESTOS PROJECT
2013 Indoor Activity-Based Sampling (ABS)
Property Background and Sampling Form

Address: _____

Resident: _____ Phone Number: _____

Owner (if different than occupant): _____ Phone Number: _____

Data Item	Notes	
ABS Category (circle one): C2C: curb-to-curb property 07/08: re-evaluation of 2007-08 property		
<p>Primary Structure Description and Resident Information</p> <p>Primary structure descriptions and resident information were gathered from a verbal interview conducted on _____ by _____ . All data below were provided by the resident during the interview.</p> <p style="text-align: right;">Section Check Completed By: _____</p>		
Number of Floors Above Ground	1 2 3 Other: _____	
Understructure (Circle all that apply)	Basement: Living Space Non-Living Space Crawlspace N/A	If basement is both a living/non-living space- specify percentage of each:
Wood Stove	Is there a wood stove? Yes No	If so, is it used? Yes No
Heating Source	Wood/Coal Electric Propane/Gas Oil Other: _____	
Heat Distribution	Forced air Radiant Other: _____	

ABS Property Background and Sampling Form (continued)

Address: _____

Was the residence/building remodeled? (prior to EPA removal activities)	Yes No	Explanation:
	If yes, When (years): <2 2-5 >5 Where: Attic Living Areas Garage Basement Other: _____	
Was the residence/building remodeled after EPA removal activities were completed?	Yes No	Explanation:
	If yes, When (years): <2 2-5 >5 Where: Attic Living Areas Garage Basement Other: _____	
Is the resident, past or present, diagnosed with an asbestos-related disease?	Yes No Unknown	If unknown, why?
Total number of occupants	_____	Explanation of part-time occupants:
Age and number of occupants	Age: 0-5 5-12 12-18 18-35 35-60 60+ ___ ___ ___ ___ ___ ___	
Number and type of pets	Dogs: _____ Cats: _____ Other: _____ _____	Are pets indoor only, outdoor only, or both?
Are the windows kept open during the day when weather conditions permit?	Yes No	During what approximate temperature range?
Do you regularly use a vacuum equipped with a HEPA filter? (if applicable)	Yes No N/A	

Property Background and Sampling Form (continued)

Address: _____

During the passive phase of the sampling, may we use your radio or television?	Yes No	Additional comments/restrictions on use:
Are there any additional restrictions on activities performed at the property? (e.g., rooms prohibited from accessing, items not to be disturbed, firearms, scheduling requests {day of the week, start time, split days}, etc.)		
_____ _____ _____ _____ _____ _____ _____ _____ _____		
Indoor Characterization		
<input type="checkbox"/> Indoor Characterization Date Completed: _____ Section Check Completed By: _____		
Square Footage of House		
Number of Rooms Per Floor	1: _____ 2: _____ 3: _____ BSMT: _____	
Percentage of each floor covered by carpet	1: _____% 2: _____% 3: _____% BSMT: _____%	
Carpeting	Approximate age of carpet per floor: 1: _____ 2: _____ 3: _____ BSMT: _____ <i>Choose age from the following categories</i> <5 5-10 10-20 20+	Additional Comments:

Property Background and Sampling Form (continued)

Address: _____

<p>Interior Contamination- <i>Data summarized from IFF. Additional indoor inspections for vermiculite were not conducted as a part of the ABS investigation.</i></p> <p>Section Check Completed By: _____ <input type="checkbox"/> Attached completed IFF to this form</p>		
<p>Current location of indoor vermiculite</p> <p>(Circle all that apply)</p>	<p>Attic Walls Crawlspace None</p> <p>Visual in Living Space: Basement, Ground Floor, Second Floor, Attached Garage</p> <p>Other: _____</p>	<p>If in living space, provide specific location:</p>
<p>Are there vermiculite additives in any of the building materials?</p>	<p>Yes No</p>	<p>Type and location of building material:</p>
<p>Outdoor Contamination- <i>Data summarized from PCC, Redline and/or Completion Letter. Additional outdoor inspections for vermiculite were not conducted as a part of the ABS investigation.</i></p> <p>Section Check Completed By: _____ <input type="checkbox"/> Attached completed PCC/Redline/Completion Letter to this form</p>		
<p>Location of outdoor vermiculite</p> <p>(Circle all that apply)</p>	<p>Driveway Flowerbed Garden Yard</p> <p>Stockpile None</p> <p>Other _____</p>	<p>Notes:</p>
<p>Are there known areas of the property with LA? (previously sampled)</p>	<p>Yes No</p>	<p>Location:</p>
<p>Removal History- <i>Data summarized from PCC.</i></p> <p>Section Check Completed By: _____ <input type="checkbox"/> Attached completed PCC to this form</p>		
<p>Has EPA performed an interior remediation at the property?</p>	<p>Yes No</p>	<p>In what year(s)?</p>
<p>Has EPA performed an exterior remediation at the property?</p>	<p>Yes No</p>	<p>In what year(s)?</p>
<p>Location of clean fill</p> <p>(Circle all that apply)</p>	<p>Driveway Flowerbed Garden Yard</p> <p>Stockpile None N/A</p> <p>Other: _____</p>	<p>Approximate location:</p>

Property Background and Sampling Form (continued)

Address: _____

Indoor ABS Event 1		<input type="checkbox"/> Indoor ABS- Event 1 Date Completed: _____		
		Section Check Completed By: _____		
Field Logbook: _____ Page Number(s): _____ Team Members: _____				
Activity Summary	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;"> Passive Date: _____ AM </td> <td style="width: 50%; padding: 2px;"> Active Date: _____ AM PM </td> </tr> </table>	Passive Date: _____ AM	Active Date: _____ AM PM	Comments (schedule delays)
Passive Date: _____ AM	Active Date: _____ AM PM			
Total number of samples collected:	Air: _____ FB: _____			
Indoor ABS Event 2		<input type="checkbox"/> Indoor ABS- Event 2 Date Completed: _____		
		Section Check Completed By: _____		
Field Logbook: _____ Page Number(s): _____ Team Members: _____				
Activity Summary	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;"> Passive Date: _____ AM </td> <td style="width: 50%; padding: 2px;"> Active Date: _____ AM PM </td> </tr> </table>	Passive Date: _____ AM	Active Date: _____ AM PM	Comments (schedule delays)
Passive Date: _____ AM	Active Date: _____ AM PM			
Total number of samples collected:	Air: _____ FB: _____			
ADDITIONAL INFORMATION				

Property Background and Sampling Form (continued)

Address: _____

FIELD DIAGRAM OF INTERIOR

Identify important features (i.e. plan view for each floor, entrances, room types, etc.). **Include north arrow.** Note: sampling activities will not be conducted in areas such as bathrooms, closets, and unfinished basements; only areas of the interior in which routine living activities occur will be sampled.

- Identify rooms with carpeting and the approximate coverage of the floor (No C, <50% C, >50% C)
- Identify rooms with upholstered drapery, chairs and/or cushions (Up, No Up)

**Sampling and Analysis Plan/Quality Assurance Project Plan:
2013 Indoor Activity-Based Sampling
Libby Asbestos Site, Operable Unit 4
*Revision 0 – February 2013***

**Appendix E
Analytical Requirements Summary Sheet
[INOUE-0213]**

*The most recent version of the Analytical Requirements Summary Sheet is provided electronically in the Libby Lab eRoom
(<https://team.cdm.com/eRoom/mt/LibbyLab>).*

SAP/QAPP REQUIREMENTS SUMMARY #INO4-0213
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Sampling and Analysis Plan/Quality Assurance Project Plan, 2013 Indoor Activity-Based Sampling, Libby Asbestos Site, Operable Unit 4

SAP Date (Revision): February 2013 (Revision 0)

EPA Technical Advisor: Elizabeth Fagen (303-312-6095, Fagen.Elizabeth@epa.gov)
 (contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This program will conduct activity-based sampling (ABS) inside residential and commercial properties within Operable Unit 4 (OU4) of the Libby Asbestos Superfund Site. As part of this program, ABS air samples will be collected and analyzed for asbestos by transmission electron microscopy (TEM) for two different indoor ABS activities (passive, active). Personal air samples will also be collected for health and safety monitoring and analyzed by phase contrast microscopy (PCM).

Sample ID Prefix: IN-1 _ _ _ _

Estimated number and timing of field samples:

- >> ABS Air, winter [March 2013] = (10 locations * 2 ABS scenarios) = 20 samples + field QC samples
- >> ABS Air, summer [July/August 2013] = (20 locations * 2 ABS scenarios) = 40 samples + field QC samples

TEM/PCM Preparation and Analytical Requirements for Air Field Samples:

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investigative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
A	Air, Passive ABS	Yes	Yes, if material is overloaded (>25%) or unevenly loaded on filter	No	Yes	TEM – Modified ISO 10312, Annex E (Low Mag, 5,000X)	All PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) the target sensitivity is achieved ii) 25 PCME LA structures are recorded iii) 10 mm ² of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
B	Air, Active ABS								

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investigative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
C	Air, Health & Safety	No	No	Yes, if material is overloaded (>25%) or unevenly loaded on filter	Yes	PCM – NIOSH 7400, Issue 2 TEM–AHERA (upon request)	For PCM: NIOSH 7400, “A” rules If AHERA is requested: All asbestos; L ≥ 0.5 μm AR ≥ 5:1	For PCM: Count a minimum of 20 FOVs, then continue counting until one is achieved: i) 100 fibers are recorded ii) 100 FOVs are examined (regardless of count) For AHERA: Examine 0.1 mm ² of filter	For PCM: LB-000015 For AHERA: LB-000029, LB-000031, LB-000067, LB-000085

(a) The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.

(b) See most current version of SOP EPA-LIBBY-08 for preparation details.

(c) If observed, chrysotile and other amphibole asbestos should be recorded.

(d) Target analytical sensitivity for passive ABS scenario is 0.00001 cc⁻¹ and for active ABS scenario is 0.00004 cc⁻¹.

TEM/PCM Preparation and Analytical Requirements for Air Field Quality Control Samples:

Medium Code	Medium, Sample Type	Preparation Details			Analysis Details			Applicable Laboratory Modifications (current version of)
		Indirect Prep?		Archive?	Method	Recording Rules	Stopping Rules	
		With Ashing	Without Ashing					
D	Air, lot blank and field blank	No	No	Yes	TEM – Modified ISO 10312, Annex E (Low Mag, 5,000X)	All PCME asbestos; L: > 5 μm W: ≥ 0.25 μm AR: ≥ 3:1	Examine 1.0 mm ² of filter.	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
E	Air, Health & Safety field blank	No	No	Yes	PCM – NIOSH 7400, Issue 2 TEM–AHERA (upon request)	For PCM: NIOSH 7400, “A” rules If AHERA is requested: All asbestos; L ≥ 0.5 μm AR ≥ 5:1	For PCM: Count a minimum of 20 FOVs, then continue counting until one is achieved: i) 100 fibers are recorded ii) 100 FOVs are examined (regardless of count) For AHERA: Examine 0.1 mm ² of filter	For PCM: LB-000015 For AHERA: LB-000029, LB-000031, LB-000067, LB-000085

Analytical Laboratory Quality Control Sample Frequencies:

TEM (e): Lab Blank – 4%
 Recount Same – 1%
 Recount Different – 2.5%
 Verified Analysis – 1%
 Interlab – 0.5%
 Repreparation – 1%

PCM (f): Blind Recounts – 10%

(e) See LB-000029 for selection procedure and QC acceptance criteria
 (f) See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	2/14/13	N/A

Analytical Laboratory Review Sign-off:

- | | |
|--|--|
| <input type="checkbox"/> EMSL – Libby [sign & date: _____] | <input type="checkbox"/> ESAT [sign & date: _____] |
| <input type="checkbox"/> EMSL – Cinnaminson [sign & date: _____] | <input type="checkbox"/> Hygeia [sign & date: _____] |
| <input type="checkbox"/> EMSL – Beltsville [sign & date: _____] | <input type="checkbox"/> RESI [sign & date: _____] |
| <input type="checkbox"/> EMSL – Denver [sign & date: _____] | |

[Checking the box and initialing above indicates that the laboratory has reviewed and acknowledged the preparation and analytical requirements associated with the specified SAP.]