Sampling and Analysis Plan/Quality Assurance Project Plan: 2013 Post-Construction Activity-Based Sampling Libby Asbestos Superfund Site, Operable Unit 1

Revision 0 – June 20, 2013

Project Period June to August 2013
Contract No. EP-S8-11-02
Task Order No. 00005

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by:

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A1. Title and Approval Page

Sampling and Analysis Plan/Quality Assurance Project Plan: 2013 Post- Construction Activity-Based Sampling Libby Asbestos Site, Operable Unit 1

Revision 0 – June 20, 2013

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Sampling and Analysis Plan/Quality Assurance Project Plan: 2013 Post-Construction Activity-Based Sampling Libby Asbestos Site, Operable Unit 1

REVISION LOG:

Revision No.	Date	Description
0	6/20/2013	---

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List of Acronyms and Abbreviations

%	percent
ABS	activity-based sampling
Ago	grid opening area
APP	Accident Prevention Plan
ASTM	American Society for Testing and Materials
BNSF	Burlington Northern Santa Fe
Cair	air concentration
CB&I	CB&I Federal Services, LLC
cc	cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHISQ	chi-squared
cm^{-2}	per square centimeter
COC	chain-of-custody record
DE tool	data entry tool
DQO	data quality objective
ED	exposure duration
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy dispersive x-ray analysis
EF	exposure frequency
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESAT	EPA Environmental Services Assistance Team
ET	exposure time
f	indirect preparation dilution factor
FSDS	field sample data sheet
FTL	field team leader
GO_x	number of grid openings
GPS	global positioning system
Grace	W.R. Grace Company
HAZWOPER	hazardous waste operations and emergency response
H&S	health and safety
HV	high volume
ICs	institutional controls
ID	identification
IUR	inhalation unit risk
IDW	investigation-derived waste
ISO	International Organization for Standardization
L	liters

L/cc	liters per cubic centimeter
L/min	liters per minute
LA	Libby amphibole
LC	laboratory coordinator
LV	low volume
MDEQ	Montana Department of Environmental Quality
MDT	Montana Department of Transportation
mm	millimeter
mm^2	square millimeters
N	number
NFG	National Functional Guidelines
NIST	National Institute of Standards and Technology
NIOSH	National Institute for Occupational Safety and Health
NOAA	National Oceanic Atmospheric Administration
NVLAP	National Voluntary Laboratory Accreditation Program
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OUs	operable units
OU1	Operable Unit 1
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
POC	point of contact
PPE	personal protective equipment
QA	quality assurance
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RBC	risk-based concentration
RI/FS	remedial investigation/feasibility study
RPM	Remedial Project Manager
ROD	Record of Decision
ROM	Record of Modification
s/cm^3	structures per cubic centimeter
SAP	sampling and analysis plan
SAED	selective area electron diffraction
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	Troy sample preparation facility
SRMs	standard reference materials
STEL	short-term exposure limit

TAS	target analytical sensitivity
TEM	transmission electron microscopy
TWA	time-weighted average
TWF	time-weighting factor
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
V	air sample volume
VWC	volumetric water content
µm	micrometers

A Project Management

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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- Rebecca Thomas,Thomas.Rebecca@epa.gov (electronic copy)
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- David Berry, Berry.David@epa.gov (electronic copy)

EPA Information Center – Libby
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Libby, Montana 59923

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Rapid Response Program Office
Offutt AFB, Nebraska 68113

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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[1]. CDM Smith maintains the eRooms for the Libby project. The point of contact for log-in credentials is Terry Crowell; she can be contacted at crowellTL@cdmsmith.com.

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 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 8 Libby Asbestos Project Team Leader is Rebecca Thomas. The EPA Remedial Project Manager (RPM) for this sampling effort is Dania Zinner. The EPA Region 8 Onsite RPM for this sampling effort is Mike Cirian.

The U.S. Army Corps of Engineers (USACE), Omaha District, provides project management, environmental engineering, and remediation support to EPA at the Site. The USACE Program Managers are Mark Herse and Mary Darling. The USACE Construction Control Representatives are Jeremy Ayala, Jeff Hubbard, and Mark Buss.

[1] https://team.cdm.com/eRoom/R8-RAC/Libby

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 (CERCLA), 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). This SAP/QAPP was developed under a contract agreement with EPA (Contract No. EP-S8-11-02, Task Order No. 00005).

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.

A4.2.2 Field Sampling Activities

CDM Smith will be responsible for conducting all field sampling activities in support of the sampling program described in this SAP/QAPP. Field support will be provided under a contract agreement with USACE (Contract No. W9128F-11-D-0023). Key CDM Smith personnel that will be involved in this field sampling program include:

- Thomas Cook, Project Manager
- Dominic Pisciotta, Field Team Leader
- Tracy Dodge, Sample Coordinator
- Diane Rode, Field Data Manager
- Terry Crowell, Quality Assurance Manager
- 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 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 also 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.

The project data management processes and reporting requirements, and related contractor responsibilities, are described in the *EPA Data Management Plan for the Libby Asbestos Superfund Site* (EPA 2012). This document is located on the Libby Field eRoom[2].

A4.3 Quality Assurance

There is no individual designated as the EPA Quality Assurance Manager for the Libby project. Rather, the Region 8 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 (or their designee) for this sampling effort, this individual 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 EPA RPM is supported by the EPA Quality Assurance Technical Support (QATS) contractor, CB&I Federal Services, LLC (CB&I), in managing and overseeing all aspects of the laboratory QA/QC program for this sampling effort. The QATS contractor will evaluate

[2] https://team.cdm.com/eRoom/R8-RAC/Libby/0_aea4.

and monitor laboratory QA/QC activities and is responsible for performing annual audits of each analytical laboratory (see Section B5.2).

Terry Crowell (CDM Smith) is the field QA Coordinator (QAC) for this project. Ms. Crowell is responsible for evaluating and monitoring field quality assurance/quality control (QA/QC), for providing oversight of field sampling and data collection activities.

The USACE Point of Contact (POC) for the Libby project is David Ray. It is the responsibility of the USACE POC to oversee all aspects of USACE's QA program for field work conducted under the Libby project Interagency Agreement with the EPA.

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 (Grace) 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; Larson *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 Libby Asbestos Superfund Site (Site) was listed on the U.S. Environmental Protection Agency (EPA) National Priorities List in October 2002.

For long-term management purposes, the Site has been divided into eight operable units (OUs). This document describes a sampling effort to be conducted in Operable Unit 1 (OU1) (see **Figure A-2**). OU1 includes areas affected by contamination released from the former Grace Export Plant. The former Export Plant is situated on the south side of the Kootenai River, just north of the downtown area of the City of Libby, Montana. OU1 includes the embankments of Montana Highway 37, the former Export Plant, and the former Riverside Park. The property is bounded by the Kootenai River on the north, Highway 37 on the east, the Burlington Northern Santa Fe (BNSF) railroad thoroughfare on the south, and State of Montana property on the west (see **Figure A-3**).

A5.2 OU1 Description

From the early 1960s to approximately 1990, OU1 was owned and used by Grace for stockpiling, staging, and distributing vermiculite and vermiculite concentrate to vermiculite processing areas and insulation distributors outside of Libby. It is also believed that during this time vermiculite materials were used to fill in low lying areas of OU1. Ownership was transferred to the City of Libby in the mid-1990s. Throughout its history, portions of OU1 were leased to various parties for both commercial (e.g., lumberyard, metal scrap dealer, and a larch gum manufacturer) and non-commercial enterprises (e.g., baseball fields).

OU1 covers roughly 17 acres and is divided into three areas (Area 1, Area 2, and Area 3) (see **Figure A-3**) based on former land use. These areas are described below.

Area 1 is approximately 12 acres in size. It is currently owned by the City of Libby and is a landscaped park with paved access and parking, with the exception of a small area used by David Thompson Search and Rescue. In 2004, the search and rescue organization constructed a building containing an office and a five-bay garage on the northwest portion of OU1 on the south side of City Service Road. The garage is used for storing search and rescue equipment and vehicles. Several other agencies, including local and state law enforcement, also hold meetings in the main office.

Area 2, the former Riverside Park, is approximately 4.7 acres in size. It is also owned by the City of Libby and was combined with Area 1 to create the Riverfront Park serving a variety of recreational visitors. The main features of the park include two boat ramps, a pavilion with surrounding lawn areas, picnic tables, and a pumphouse. The newer of the two boat ramps is used by recreational boaters and commercial fishing outfitters; the older ramp is not commonly used due to swift current at its approach. The pumphouse contains a pump that draws non-potable water from the Kootenai River. The pump was installed jointly by the City of Libby and Lincoln County in 1999 to provide a backup water source to local fire departments. The pumphouse is accessed by City personnel in order to perform maintenance on the pump. The pump is connected to an external water spigot, which is used by the City to draw water for street sweeping and other maintenance operations, and other workers (such as employees of local fill pits) to draw water primarily for use in dust suppression equipment.

Area 3, the embankments, is less than 1 acre in size and is owned and maintained by the Montana Department of Transportation (MDT). MDT currently performs only periodic maintenance of these embankments as needed. The types of maintenance activities conducted by MDT include application of herbicides, replacement of guardrails and guardrail posts, and replacement and maintenance of roadside light posts. Access to this area is unrestricted.

Future use of Area 1 and Area 2 is expected to continue as a public park. The City expects that David Thompson Search and Rescue will continue to utilize the northwest portion of OU1. It is also anticipated that Area 3 will not change use and will remain undeveloped and owned and maintained by MDT.

A5.3 Removal Actions Conducted at OU1

Numerous investigations and removal events have occurred at OU1. Removal actions at OU1 conducted between October 2002 and October 2003 removed all historical Export Plant buildings and all surface soil with LA concentrations greater than or equal to 1%. There are only two buildings currently within the boundary of OU1 (see **Figure A-3**): the pumphouse in Area 2, and the search and rescue support building in Area 1. Only the search and rescue support building is consistently occupied. Subsequent post-removal investigations conducted in 2007 indicated LA continued to be present at the OU in indoor air, indoor dust, outdoor air, and surface soil (EPA 2010). In addition, buried vermiculite was encountered at OU1 during removal activities (EPA 2010).

EPA's detailed investigation and evaluation of conditions at OU1 included a remedial investigation/feasibility study (RI/FS) in 2009 and the completion of numerous removal actions to address significant human health risks during completion of the RI and FS. Exposure to the residual contamination has largely been mitigated by removal of surface soils and the extensive cap placed across OU1 during the 2011 and 2012 removal activities (CDM Smith 2013a). Details of investigation and remediation activities conducted at the OU1 are provided in the *Final OU1 Remedial Investigation Report* (EPA 2009), the *OU1 Record of Decision* (EPA 2010), and the *Final Remedial Action Report* (CDM Smith 2013a).

The Record of Decision (ROD) for OU1 was issued in March 2010. The selected remedy was a removal (excavation and disposal) and containment (with soil covers) remedy. Because there are no established quantitative, risk-based cleanup levels for asbestos, EPA removed and/or capped all visible vermiculite and any detectable LA to reduce future potential LA exposures. Exceptions included those circumstances where vermiculite was otherwise well-contained. For example soil and sediment is contained by riprap with clean fill placed in interstitial spaces in some areas of OU1.

One of the main concerns at OU1 is the presence of residual vermiculite in subsurface soil. Buried vermiculite was encountered during several excavations at the OU (e.g., during the installation of phone lines and a water pipeline and during cleanup activities). The *Final OU1 RI* (EPA 2009) indicated that buried vermiculite at OU1 could serve as a potential source of release and re-contamination of surface soils with LA under circumstances in which subsurface soils might become exposed. This could result from natural weathering and erosion at the OU, children or workers digging in the dirt, as well as a range of potential future construction activities that involve soil excavation or earthwork. However, institutional controls (ICs) for OU1 restrict these types of activities. Long-term operation and maintenance (O&M) of OU1 will be performed by MDEQ to maintain the integrity of the remedy components.

A5.4 Reasons for this Project

Because the construction of the remedial action at OU1 is complete, the purpose of this sampling program is to collect data to support a post-construction risk assessment to confirm the effectiveness of the remedy. In particular, data are needed to evaluate potential exposures to City workers that mow and maintain the Riverfront Park and individuals that may recreate at the park. Individuals may be exposed to LA that is released to air during activities in these areas. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

A5.5 Applicable Criteria and Action Levels

As noted above, remedial actions are already complete at OU1. There are no LA-specific criteria or action levels that apply to this sampling program.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with these requirements, samples will be analyzed for asbestos by phase contrast microscopy (PCM) 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 8-hour time-weighted average (TWA) exposure limit is 0.1 f/cc.

A6. Project/Task Description

A6.1 Task Summary

Basic tasks that are required to implement this SAP/QAPP include collecting personal air samples under conditions simulated to mimic the types of outdoor activities and exposures that may occur in OU1. This type of sampling is referred to as "activity-based sampling", or ABS. These ABS air samples will be analyzed for asbestos and the resulting air concentrations will be used to estimate potential exposures in a post-construction human health risk assessment for OU1. These basic tasks are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

Prior to conducting ABS for this investigation a site reconnaissance should be conducted to ensure that the ABS scripts are valid for current conditions. The site reconnaissance is necessary because, at this time, the landscaping of Riverfront Park has not been completed.

It is anticipated that this ABS program will be performed to cover a range of potential exposure conditions and include three sampling events starting in late June of 2013 with subsequent sampling events to occur every other week in July of 2013. The tentative sampling schedule is to perform the first sampling event on June 25, 2013, the second sampling event on July 9, 2013, and the third sampling event on July 23, 2013. However, this schedule is dependent on site conditions being appropriate for ABS (see Section B1.3) and field team availability.

A total of three ABS events will be performed, resulting in the generation of 18 air ABS samples, 9 of which will be analyzed by transmission electron microscopy (TEM) (see Section B1.2). It is anticipated that analytical results for these samples will be received from the analytical laboratories within the requested turn-around time (approximately 2 to 4 weeks) (see Section B4.4). Upon receipt, results will be compiled, verified (see Section D2), and utilized in the post-construction human health risk assessment (HHRA) for OU1. Data evaluation and interpretation of the results will be performed in the fall of 2013.

A6.3 Locations to be Evaluated

The location selected for the collection of ABS air is described in Section B1.1.

A6.4 Resources and Time Constraints

As noted above, sampling is scheduled to occur in June and July of 2013. The intent is to collect ABS air samples during the most arid times of the year. This will help ensure that the air samples are representative of the worst-case exposure conditions for asbestos release from potential source materials in OU1. In addition, this will ensure that results will be available in time to prepare the post-construction HHRA for OU1 in early fall.

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

The range of LA concentrations that will occur in ABS air during disturbance activities in OU1 is not known. However, it is possible to estimate the air concentrations that correspond to a level of human health concern. These calculations are provided in the DQOs (see **Appendix A**). The analytical requirements for LA measurements in ABS air as established in Section B4 ensure concentrations will be reliably detected and quantified if present at levels of concern.

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 count a minimum of 3-10 structures per sample, with counts of 20-25 structures per sample being optimal to limit uncertainty due to analytic counting error.

Recount and repreparation analyses will be performed as part of TEM analysis (see Section B5.2.4). These analyses will provide information on analysis reproducibility and precision (both inter- and intra-laboratory).

A7.4 Bias/Accuracy 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 lot blanks, 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 location, activities performed, and meteorological conditions. The ABS locations selected for evaluation in this study are located in OU1 in areas where actual activities may occur. The ABS air sample collection will be performed under simulated scenarios intended to be representative of the types of activities that may occur in OU1 that have the most potential for soil disturbance. The equipment used to perform the ABS activity (i.e., walk-behind mower and weed whacker) could be different from the commercial equipment used by City workers (i.e., riding mower) which could result in differences in asbestos releases to air. Based on visual observations of mowing activities with different types of mowers, it appears that the walk-behind mowers have a higher potential for dust generation than the riding mowers. In addition, the mower operator of a walk-behind mower has a higher potential for exposure due to a nearer proximity to the ground surface, thus it is expected that resulting ABS air concentrations would be representative of the high-end of potential exposures, but this is not known with certainty. ABS activities will be performed during the summer months when the potential for LA release is likely to be higher, thus measured LA concentrations in ABS air should be representative of the high-end of temporal exposure conditions.

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

Although the ABS scripts for this sampling program are unique to this effort, the data generated during this study will be obtained using sample collection, preparation, and analysis methods for measuring LA in air used previously at OU1 and other OUs at the Site. The use of consistent methods will yield data that are comparable to previous ABS studies at the Site.

A7.7 Method Sensitivity

The method sensitivity (analytical sensitivity) needed for LA analysis of ABS 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 Accident Prevention Plan (APP)	APP signature sheet
Attend an orientation session with the field health and safety (H&S) manager	Orientation session attendance sheet
Occupational Safety and Health Administration (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 sampling program, including this SAP/QAPP, all associated standard operating procedures (SOPs) (see **Appendix B**), and the *APP* (CDM Smith 2013b).

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 TEM. This includes the analysis of NIST/NVLAP standard reference materials (SRMs), or other verified quantitative standards, and successful participation in two proficiency rounds per year of airborne asbestos by TEM performed 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 onsite 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. 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

On-going 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 American Society for Testing and Materials (ASTM) Johnston Conference in Burlington, Vermont, including in July 2002, July 2005, July 2008, and July 2011, and at the Michael E. Beard Asbestos Conference 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 on-going 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 (similar to 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 personal air samples[3]. 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). Section B10.1 provides detailed information on the data management of field records.

A9.2 Laboratory

All filter preparation and analytical data for asbestos generated in the laboratory will be documented on Site-specific laboratory bench sheets and entered into an electronic data deliverable (EDD) for submittal to the data managers. Section B4.2 provides detailed information on the requirements for laboratory documentation and records and Section B10.2 provides detailed information on the data management of laboratory data.

A9.3 Logbooks and Records of Modification/Deviations

It is the 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 RPM (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.

[3] The most recent versions of the FSDS forms are provided in the Libby Field eRoom.

B Data Generation and Acquisition

B1. Study Design

B1.1 ABS Locations

Two types of ABS scenarios will be evaluated as part of this sampling program – mowing and weed trimming. ABS will be conducted to determine possible exposures to City workers that maintain areas of Riverfront Park (see **Figure A-3**). Three ABS events will take place at Riverfront Park during 2013. Prior to the start of field activities, appropriate access agreements will be obtained by EPA, as necessary. Additionally the public (i.e., park users) should be informed before the sampling events to assuage concerns associated with actors performing ABS.

Should any portion of the selected ABS area become inaccessible during or prior to the ABS event, this should be documented on a field ROM form, as described in Section B5.1. In addition, global positioning system (GPS) coordinates should be collected to reflect the boundaries of the actual ABS area (see Section B2.2).

B1.2 Sampling Design

The following provides an overview of the sampling effort that will be conducted. Detailed information on sampling procedures and methods are presented in Section B2.

Different areas of the park require different types of lawn maintenance equipment. For the mowing ABS scenario, actors wearing personal air monitors will mow the grass in Riverfront Park using walk-behind mowers. [Note: It is recognized that this type of equipment may differ from the commercial riding mowers used by City workers, but due to a lack of available equipment, this alternate mowing scenario will be used. As noted previously, using a walk-behind mower is considered to be a more conservative ABS activity than a riding mower.] For the lawn edging/weed trimming ABS scenario an actor wearing a personal monitor will operate a weed edger/trimmer (i.e., weed whacker). **Appendix C** provides a detailed description of the ABS script for the mowing and weed trimming scenarios.

During the ABS event, two replicate ABS air samples will be collected – one with a high volume pump and one with a low volume pump – for each actor during each ABS task. However, only one of the two air filters for each ABS sample, either the high volume or the low volume, will be analyzed by TEM (see Section B4). A total of three mowing ABS events will be performed, separated in time by approximately two weeks (i.e., every other week). Thus, a total of 18 air filters (total = 4 filters for actors operating walk-behind mowers, 2 filters for the actor operating the weed whacker, for each of 3 events) will be generated, 9 of which will be analyzed by TEM (see **Table B-1**).

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

Table B-1: Number of Samples

Scenario	Number of samples collected per ABS event	Number of ABS events	Total number of samples collected	Number of samples analyzed*
Mowing – infield	2 (1 HV, 1 LV)	3	6 (3 HV, 3 LV)	3
Mowing – areas other than infield	2 (1 HV, 1 LV)	3	6 (3 HV, 3 LV)	3
Weed Trimming	2 (1 HV, 1 LV)	3	6 (3 HV, 3 LV)	3
Total	**6**	**3**	**18**	**9**

* Either the HV or LV for each ABS sample will be selected for analysis, depending upon filter loading.
HV = high volume filter
LV= low volume filter

B1.3 Study Variables

The level of asbestos in outdoor ABS air under source disturbance activities can depend on factors that vary seasonally (e.g., soil moisture, wind speed, humidity, etc.). ABS should be performed under conditions that have a high probability of resulting in measureable ABS air concentrations of LA, if it is present.

It is preferable to conduct ABS sampling when the conditions for release of LA fibers are generally favorable, so mowing ABS will be conducted in summer months (June and July) when rainfall and soil moisture levels are low. ABS sampling will not occur if rainfall or lawn irrigation in the past 36 hours has exceeded ¼ inch, if there is standing water present, or if the soil moisture is greater than the maximum threshold (see Section B2.1.2) to ensure conditions are optimal for asbestos release from any source materials. Additionally, ABS sampling will not occur if there are excessive windy conditions. Although there are no real-time quantitative measurements of wind for this event, the ABS field team leader (FTL) will use field judgment in determining if too much wind is present.

ABS events will be conducted on June 25th, July 9th, and July 23rd, providing conditions for ABS sampling are acceptable. If one or more events cannot be completed on these sampling dates, additional sampling will be conducted every other week from the last sampling period to allow for the grass to regrow. The exact dates of sampling are not important provided that each sampling event is spaced appropriately.

B1.4 Critical Measurements

The critical measurement associated with this project is the measurement of the concentration of LA in ABS air under scenarios that are representative of potential outdoor exposure conditions for humans that may work in OU1. Measurement of the concentration of LA in ABS air for workers at OU1 is expected to be protective of people recreating at OU1 (i.e., workers are expected to have greater exposure potential than recreational visitors).

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 phase contrast microscopy-equivalent[4] (or PCME) air concentrations, which is required for the purposes of assessing exposure and risk for human health.

B1.5 Data Reduction and Interpretation

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

$$Cair = (N \cdot EFA) / (GOx \cdot Ago \cdot V \cdot 1000 \cdot f)$$

where:

Cair	= Air concentration (structures per cubic centimeter [s/cc])
N	= Number of PCME LA structures observed (structures)
EFA	= Effective filter area (mm^2)
GOx	= Number of grid openings examined
Ago	= Area of a grid opening (mm^2)
V	= Sample air volume (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 compute an exposure point concentration (EPC) as part of a post-construction human health risk assessment for OU1. The EPC will be calculated as the average measured ABS air concentration, treating non-detects at a value of zero (EPA 2008c). The EPC will be combined with assumptions about exposure frequency and duration and toxicity factors for LA in the risk assessment that is expected to provide a basis for the EPA to determine, in consultation with MDEQ, whether response actions have been effective in protecting human health in OU1. **Appendix A** (DQO Step 5) provides detailed information on how risks will be calculated and results interpreted.

[4] PCME structures are defined as structures longer than 5 micrometers (µm), with a width greater than or equal to 0.25 um, and an aspect ratio (length:width) of 3:1 or greater.

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.

As part of this investigation, personal air samples will also be collected for ongoing H&S monitoring. The H&S 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 designate the H&S personal air excursion and TWA samples, respectively. These samples will be collected and analyzed in accordance with the *Response Action SAP* (CDM Smith 2013c) and will represent both the TWA and STEL sampling periods.

B2.1.1 ABS Air

ABS air samples will be collected, handled, and documented in general accordance with Site-specific 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. ABS should not be conducted if soil moisture conditions do not meet the requirements specified in Section B2.1.2, if rainfall in the past 36 hours has exceeded ¼ inch, or if site conditions are windy.

During each sampling 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).

Pump flow rates will be verified at the beginning and end of the ABS scenario. See Section B6/B7.1 for details regarding pump calibration.

B2.1.2 Soil Moisture

As part of the planning and coordination for the ABS event the FTL will coordinate with the city of Libby to suspend automated irrigation of the park immediately before and during the sampling event. Prior to conducting ABS, soil moisture will be measured from a minimum of 10 locations (0-3 inches below ground surface) within the ABS area using a soil moisture meter. ABS activities will not be performed if the average volumetric water content (VWC) is greater than 50%, or if the VWC for any of the measurement points is greater than 75%. The 10 soil moisture readings for the ABS area will be recorded in the field logbook and the average VWC will be recorded on the ABS Property Background and Sampling Form.

B2.1.3 Vegetative Cover

Prior to the start of ABS activities, vegetative condition of the ABS area will be qualitatively ranked as either poor, good, or lush on the FSDS. To the extent that the vegetative condition differs across the ABS area, this should be documented on the FSDS. Any changes in vegetation condition, as a consequence of ABS, should also be recorded on the FSDS after the ABS activities have been completed.

Photographic documentation will be collected to document the conditions at the ABS area. Procedures for collecting photographic documentation are discussed in Section B3.1.4.

B2.1.4 Visible Vermiculite

During ABS efforts, sampling team members should continually inspect the ground surface for visible vermiculite within the ABS area. All visible vermiculite observations should be documented in the comments section of the FSDS, as well as within the field logbook. If vermiculite is observed within an ABS area, the team member should immediately notify the FTL.

B2.1.5 Meteorological Data

During days when ABS activities are occurring, the FTL or appropriate data manager will download meteorological data from the local National Oceanic Atmospheric Administration (NOAA) station, LBBM8. For comparison and additional data, meteorological data will also be downloaded from two other nearby stations located at the mine (ZONM8) and Troy (TROM8). The following parameters are recorded hourly at these stations:

- Temperature (degrees Fahrenheit [°F])
- Dew point (°F)
- Relative humidity (percent)
- Wind speed (miles per hour [mph])
- Wind gusts (mph)

- Wind direction
- Solar radiation (watts per square meter per hour)
- Precipitation (inches)

B2.2 Global Positioning System Coordinate Collection

GPS location coordinates of the actual mowing and weed trimming areas will be recorded to document where ABS activities were performed (see **Figure B-1**). GPS coordinates will be recorded in basic accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix B**).

GPS coordinates are collected as sample points, requiring the input of sample ID (also referred to as index ID) and location ID. Since multiple samples may be attributed to one area, for this sampling program the Index ID will be input as 'N/A'.

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 will be 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 sampling program will remain in the custody of the sampling team until the team returns to Libby where the IDW 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 identification (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:

RP-#####

where:

RP = Prefix that designates samples collected under this SAP/QAPP (**R**iverfront **P**ark ABS Investigation)

= A sequential five-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 for personal air. 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 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.

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the OU 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 following items will be recorded for each logbook entry:

- Soil VWC
- Pump calibration and flow rate verification

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 (e.g., ambient air monitoring), 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 until relinquished to the EPA at project closeout. Scanned copies of field logbooks will be maintained on the local servers for the CDM Smith offices in Libby and Denver.

B3.1.4 Photographs

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 scenarios 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:

OU1_RP_date_##

where:

OU1_RP indicates the OU1 Riverfront Park ABS Investigation

The date is formatted as MM-DD-YY

indicates the photograph number

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. At the conclusion of each sampling event, the team will relinquish all samples and FSDSs 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 field 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 sampling event, all samples will be relinquished to the field sample coordinator 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 D**) 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 container 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. With the exception of samples that are hand-delivered to the EMSL Mobile Laboratory in Libby, all samples will be sent to the Troy Sample Preparation Facility (SPF) for subsequent shipment to the appropriate analytical laboratory, or archive.

Samples will be hand-delivered, picked up by a courier service, or shipped by a delivery service to the designated location, as applicable. For hand-deliveries and courier pickups, 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.

B3.5 Holding Times

There are no holding time requirements for air samples collected for asbestos analysis.

B3.6 Archival and Final Disposition

All filters will be maintained in storage at the analytical laboratory for a period of six 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 samples, 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 the OU1 post-construction sampling program. This section includes detailed information on the analysis of ABS air, as well as the data reporting requirements, sample holding times, and custody procedures.

An analytical requirements summary sheet (**POSTOU1-0613**), which details the specific preparation and analytical requirements associated with this sampling program, is provided in **Appendix D**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this sampling program prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC record.

B4.1.1 Health and Safety Monitoring Samples

The personal air samples collected for the ongoing H&S 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 National Institute for Occupational Safety and Health (NIOSH) Method 7400, Issue 2.

B4.1.2 ABS Air Samples

The DQOs for the OU1 post-construction sampling program (see **Appendix A**) provide detailed information on the sample preparation, analysis method, counting rules, and stopping rules for ABS air samples. Each of these analysis requirements is summarized below.

Sample Preparation

Two filters are collected for each ABS actor for each task during each sampling 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 International Organization for Standardization (ISO) 10312:1995(E) (ISO 1995).

Analysis Method

Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312, as modified by the most recent versions of Libby Laboratory Modifications[5] LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

Counting Rules

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 (SAED) patterns and energy dispersive x-ray analysis (EDXA) spectra, and having length > 5 micrometers (µm), width ≥ 0.25 µm, and aspect ratio ≥ 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 in accordance with ISO 10312 recording procedures, but chrysotile recording can stop after 25 chrysotile structures have been recorded.

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. Examine a minimum of two grid openings from each of two grids.
2. Continue examining grid openings until one of the following is achieved:
    a. The target analytical sensitivity (see below) is achieved.
    b. 25 PCME LA structures have been observed.

[5] Copies of all Libby Laboratory Modifications are available in the Libby Lab eRoom.

c. A total filter area of 10 square millimeters (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.

The target analytical sensitivity differs between the two types of ABS scenarios. For the mowing ABS scenario (Scenario 1), the target analytical sensitivity is 0.003 per cubic centimeter $(cc)^{-1}$. For the weed trimming ABS scenario (Scenario 2), the target analytical sensitivity is 0.018 cc^{-1}. The COC will identify the applicable ABS scenario for all ABS air samples (see **Appendix D**).

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

B4.2 Analytical Data Reports

An analytical data report will be prepared by the laboratory and submitted to the 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 reporting TEM analyses of air samples. Standard project data reporting requirements will be met for TEM analyses. EDDs will be transmitted electronically (*via* email) to the following:

- Doug Kent, Kent.Doug@epa.gov
- Holly Sprunger, Sprunger.Holly@epa.gov
- Janelle Lohman, Lohman.Janelle@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 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 OU.

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 OU1 post-construction ABS 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 form[6]. The field ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that 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-000026) by the CDM Smith field QAC. A ROM tracking log for all field modifications is maintained by the field QAC. 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, and to identify any potential deficiencies so that any impact on project data quality is mitigated or limited. Due to the limited scope of the OU1 post-construction ABS field activities and because similar post-construction ABS field activities were surveyed during 2012 at OU2 (the former screening plant and associated areas) with no significant findings, a field surveillance for OU1 is not planned.

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 field QAC (in consultation with the EPA RPM) to ensure that field auditing requirements are met for each investigation. Again, due to the limited scope of the OU1 post-

[6] The most recent version of the field ROM form is available on the Libby Field eRoom.

construction ABS field activities, and because similar post-construction ABS field activities were surveyed during 2012 at OU2 with no significant findings, a field audit for OU1 is not planned.

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 this ABS program – 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 analysis 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 the ABS effort.

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 for ABS air will be collected at a rate of one per sampling event (i.e., a total of three field blanks will be collected). 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. One of the three collected field blanks, chosen at random by the sample coordinator, will be analyzed. The field blank will be analyzed for asbestos by TEM analysis as described above (see Section 5.1.3).

If any asbestos is observed on the field blank, all other field blanks collected for this sampling program 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" will 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 sampling program 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 form[7]. 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 laboratory 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 the 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.

[7] The most recent version of the laboratory ROM form is available on the Libby Lab eRoom.

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 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 quality control, 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 to prepare an Onsite Audit Report for each analytical laboratory participating in the Libby program. These reports are handled as business confidential items. The Onsite 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 Onsite Audit Report are also maintained with the respective reports.

It is the responsibility of the QATS contractor to prepare an Onsite 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 reported 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 repreparations. 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., soil moisture meters, GPS units) 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. Additional equipment and spare parts are available at the CDM Smith Libby Office.

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 ± 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 ± 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:

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

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. Specifics regarding maintenance and calibration of equipment are detailed in NIOSH Method 7400, ISO 10312, and Libby Laboratory Modification #LB-000085. 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 SAP/QAPP. See Section B3.1.3 for standard procedures for field logbooks.

- Field sample data sheets (FSDSs) – FSDSs are medium-specific 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.

- 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 (PPE) - As required by the *APP*.

- 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, measuring wheel, stakes – Used to identify and mark sampling locations. See B2.2 for standard procedures in GPS documentation.

- Soil moisture meter – Used to measure soil moisture content in the ABS area.

- 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 program:

- ABS air sampling equipment: 25-mm diameter mixed cellulose ester filter cassette (0.8 µm pore), high and low flow rate battery-powered air sampling pumps, tygon tubing, 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 (i.e., the post-construction human health risk assessment for OU1 is expected to only rely upon samples collected as part of this sampling 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 2012).

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. Data are stored indefinitely until further direction is provided by EPA.

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 (see Section B4.3 for the email distribution list). Other email recipients may also be specified by the 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. Analytical electronic data are stored and maintained in the Libby Scribe project databases that are housed on a local computer located at the TechLaw office in Golden, Colorado, which is backed up daily to an external hard drive.
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 are captured in various Scribe project databases, including a field Scribe project (i.e., LibbyCDM_Field.mdb) and multiple annual analytical results Scribe projects (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 website[8]. 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

[8] http://www.ertsupport.org/scribe_home.htm

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 via email to the EPA Region 8 Data Manager (Mosal.Jeffrey@epa.gov). It is the responsibility of the EPA Region 8 Data Manager to notify the appropriate entity (e.g., field, Troy SPF, 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.

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 Manager (Jo Nell Mullins), with support from the CDM Smith QAC (Terry Crowell). As noted previously, no field surveillance or audit will be performed during this limited sampling program. However, the EPA RPM and QATS contractor will be notified by the FTL of any significant deficiencies in field data acquisition processes.

Laboratory system assessments/audits will be coordinated by the EPA QATS contractor. Performance assessments for the laboratories may be accomplished by submitting blind reference material (i.e., performance evaluation samples). These assessment samples are samples with known concentrations that are submitted to the laboratories without identifying them as such to the laboratories. Performance assessments will be 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 in the applicable field or laboratory logbooks and a verbal report will be provided to the appropriate manager (e.g., the FTL or LC). In the event major corrective actions or changes are necessary, the SAP/QAPP must be revised and approved by the same authorities who approved the original document, prior to the changes being implemented. Major actions are those that may affect the quality or objectives of the investigation. EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

In addition, when modifications to this SAP/QAPP are required, either for field or laboratory activities, a ROM must be completed by field staff and approved by the EPA prior to implementation.

C2. Reports to Management

No regularly-scheduled written reports to management are planned as part of this project. However, QA reports will be provided to management for routine audits and whenever quality problems are encountered. Field staff will note any quality problems on FSDSs or in field logbooks. Further, the CDM Smith Project Manager will inform EPA project management upon encountering quality issues that cannot be immediately corrected. Weekly reports and change request forms are not required for work performed under this SAP/QAPP.

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 Region 8 Data Manager (Mosal.Jeffrey@epa.gov), who will then notify the appropriate entity (field or analytical 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 and evaluation of results for both field and laboratory QC samples, such as field and laboratory blank samples, as well as various types of recount and repreparation 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., repreparation 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, a detailed manual data verification effort will be performed for 10% of all 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 benchsheets, and verification of the transfer of results from the benchsheets 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 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 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 the issue 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 ensuring that verification status is electronically tracked in the project database, including 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 (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 should 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* (CDM Smith 2011) 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 a 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 field QAC 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 investigation, 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	Review results for TEM recounts and repreparations 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.
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).

ASTM = American Society of Testing and Materials
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

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Sampling and Analysis Plan/Quality Assurance Project Plan
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Libby Asbestos Site, Operable Unit 1
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FIGURES

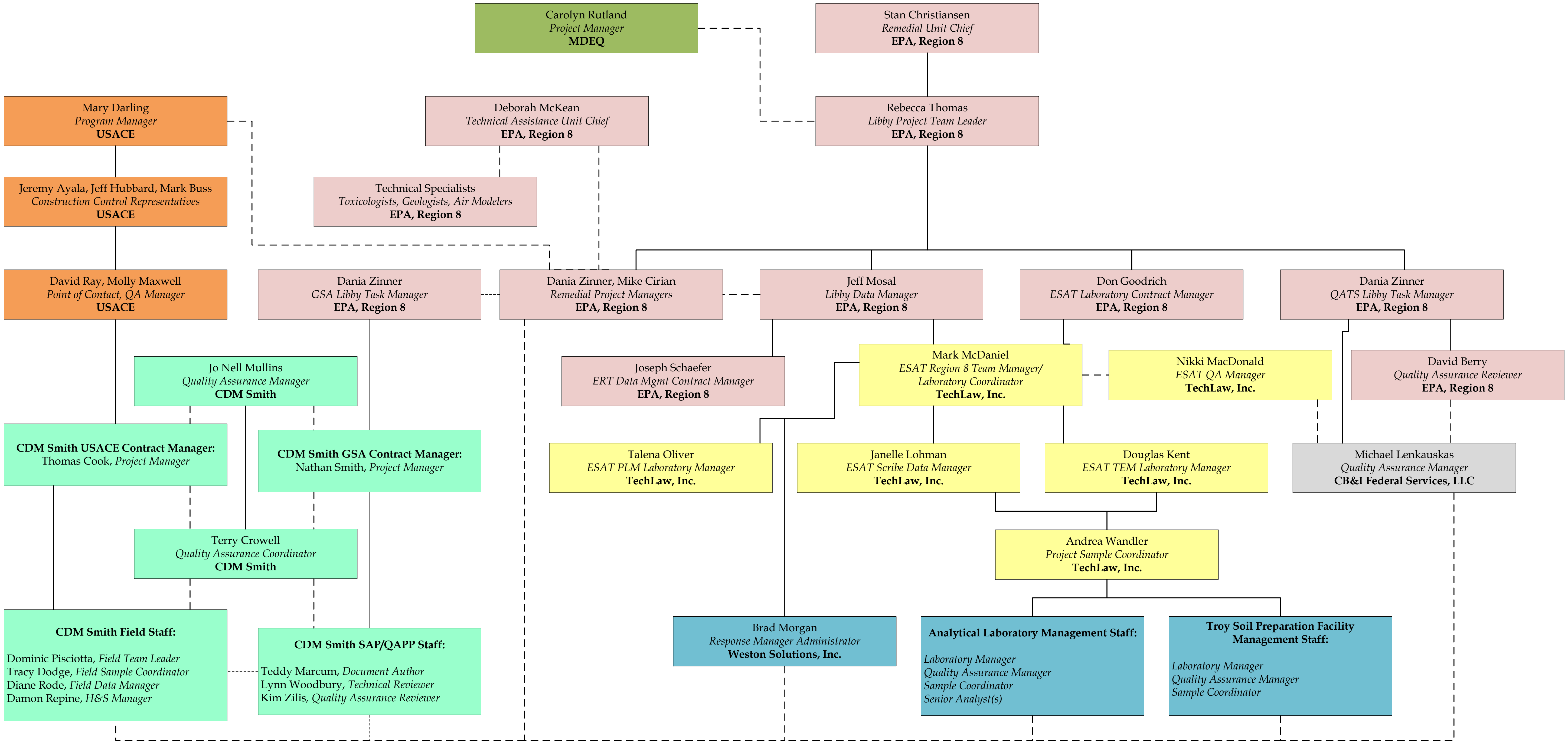

Figure A-1. General Organizational Chart for the OU1 Post-Construction ABS Study

EPA Region 8 Staff
CDM Smith Staff
CB&I Staff
USACE Staff
TechLaw Staff
Lines of authority
MDEQ Staff
TechLaw Subcontractors
Lines of communication

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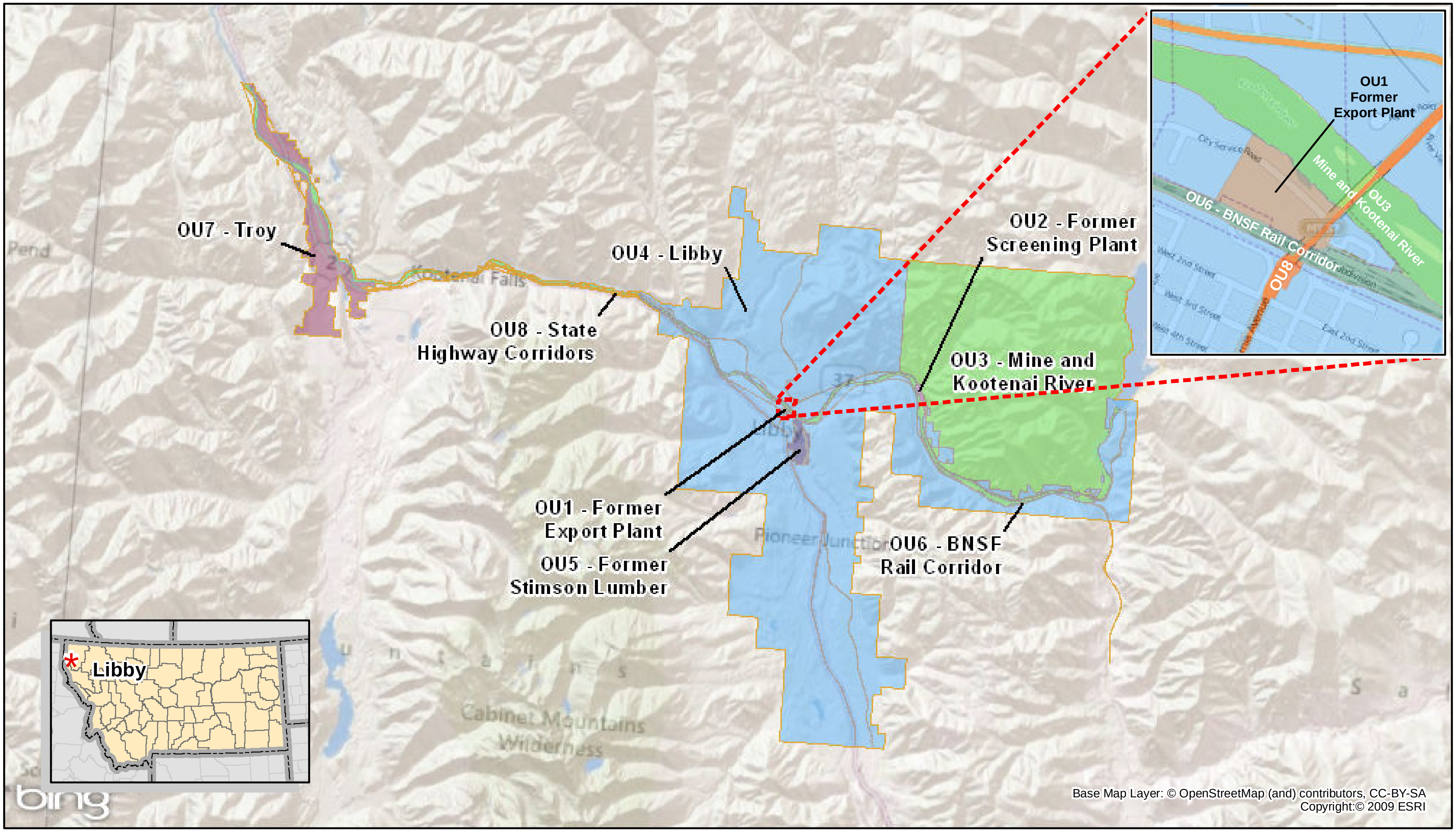

N

0 2.5 5 10
Miles
1 inch = 5 miles

Legend

- NPL Boundary
- OU1 - Former Export Plant
- OU2 - Former Screening Plant
- OU3 - (Study Area) Mine and Kootenai River
- OU4 - Libby
- OU5 - Former Stimson Lumber
- OU6 - BNSF Rail Corridor
- OU7 - Troy
- OU8 - State Highway Corridors

Figure A-2
Operable Units
Libby Asbestos Superfund Site
Lincoln County, Montana

CDM Smith

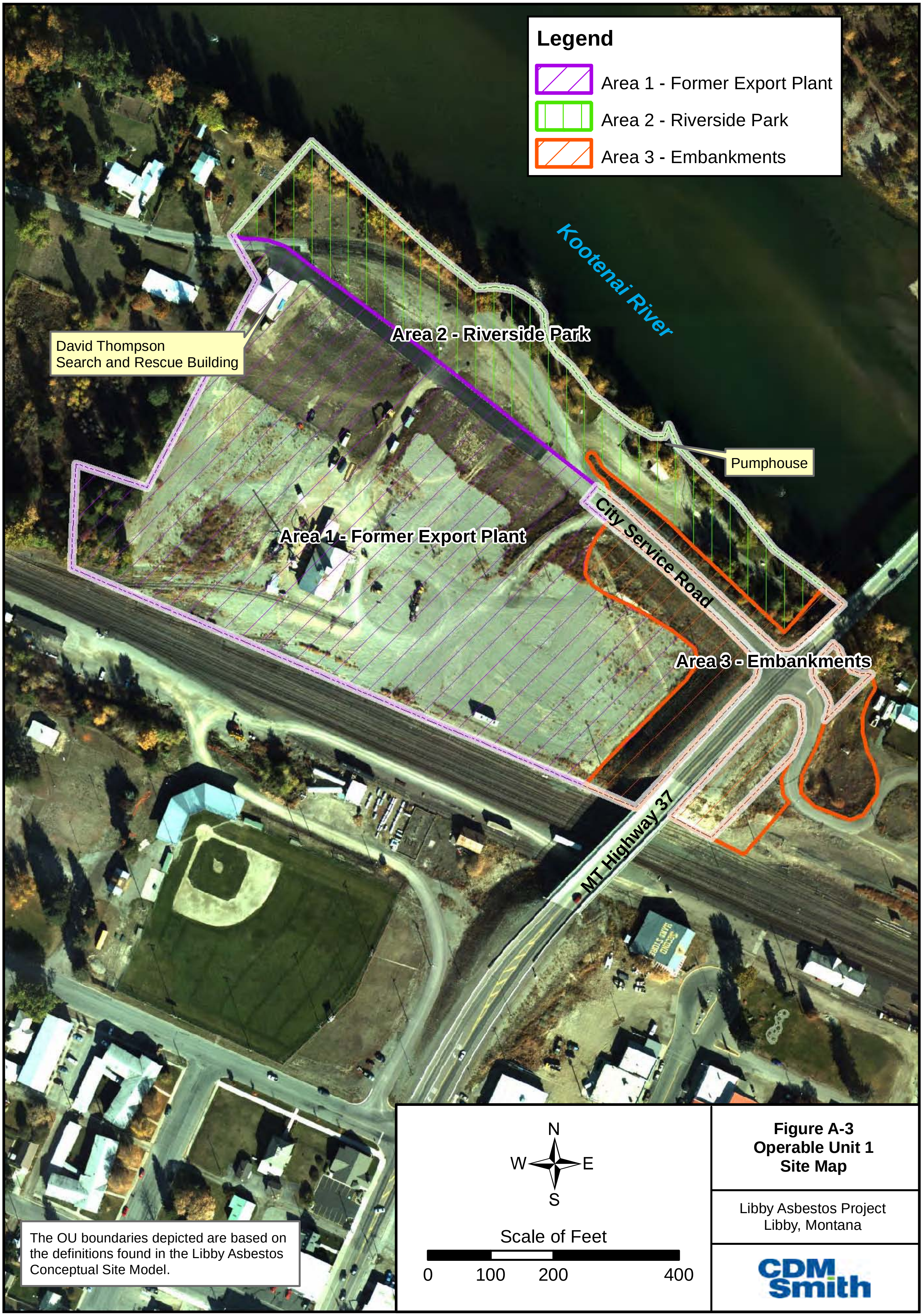

Figure A-3
Operable Unit 1
Site Map

Libby Asbestos Project
Libby, Montana

CDM Smith

SCALE IN FEET
25 0 50

OU1 ABS AREA
FIGURE B-1
LIBBY ASBESTOS SUPER FUND SITE
LINCOLN COUNTY, MONTANA

CDM Smith
CDM Federal Programs
60 Port Boulevard
Libby, MT 59923
Tel: (406) 293-8595

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APPENDICES

Sampling and Analysis Plan/Quality Assurance Project Plan
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Appendix A
Data Quality Objectives (DQOs)

APPENDIX A
Data Quality Objectives: OU1 Post-Construction ABS

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 decision-making (EPA 2001, 2006).

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

A.1 Step 1: State the Problem

Construction of the remedial action to address Libby amphibole (LA) contamination in Operable Unit 1 (OU1) of the Libby Asbestos Superfund Site (Site) is complete. However, there is no measured data to support a post-construction human health risk assessment to confirm the effectiveness of the remedy. In particular, data are needed to evaluate potential exposures to City workers that mow and maintain the lawns in the Riverfront Park and individuals that may recreate at the park. Individuals may be exposed to LA that is released to air during activities in this area. These inhalation exposures may pose a risk of cancer and/or non-cancer effects.

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

The goal of this study is to collect outdoor air data to be used in a post-construction human health risk assessment for the OU1. These data will be used to estimate exposure and risk from LA to individuals from inhalation exposures under post-construction conditions. 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 OU1.

A.3 Step 3: Identify Information Inputs

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

A.3.1 ABS Air Concentrations of LA

The information needed to characterize human exposures in OU1 consists of reliable measurements of LA concentrations in air under realistic and representative exposure scenarios that are characteristic of source (soil) disturbance activities engaged in by individuals in OU1. The collection of air samples under conditions simulated to mimic disturbance activities is referred to as “activity-based sampling”, or ABS. These ABS air samples will be analyzed for LA and the resulting concentrations will be used to estimate potential exposures and risks in a post-construction human health risk assessment.

Disturbance Activity

People may disturb soil or other LA-containing source materials in the OU1 by a variety of different activities. It is not feasible to evaluate every possible type of disturbance, so ABS should be performed using selected scenarios that are considered to be realistic and representative examples of disturbances that could be performed in OU1. One such disturbance scenario considered to be realistic examples of disturbances that might occur in OU1 is a mowing scenario as part of lawn maintenance activities in Riverfront Park. Another disturbance scenario performed as part of the of lawn maintenance activities includes lawn edging and weed trimming. It is likely that City workers will engage in soil disturbance activities at a higher frequency and intensity than recreational visitors (i.e., a worker ABS activity scenario is expected to yield higher LA air concentrations than a recreational visitor ABS activity scenarios).

Type of Air Sample

Experience at Libby and at other 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 2007), especially if the person is engaged in an activity that disturbs an asbestos source such as contaminated soil. 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.

Target Analyte List

ABS air samples should be analyzed for LA using transmission electron microscopy (TEM). Because asbestos toxicity depends on the particle size and mineral type, results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, because it is possible that there could be various sources of LA present in soils, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded. This requirement is based on the observation of Meeker *et al.* (2003) that most particles from the Libby ore body contain detectable levels of both sodium and potassium, whereas other potential sources of amphibole fibers may not.

A.3.2 Other Data

Release of LA from soil into air is expected to depend on several environmental factors that may tend to vary over time. These factors may include meteorological conditions (temperature, wind), soil moisture content, and amount and type of ground cover. It may be helpful to interpret ABS air concentrations as a function of these environmental factors. Therefore, measurements of soil moisture and a qualitative estimate of the vegetative condition of the ground cover should be collected at the time ABS is conducted. In addition, meteorological weather station data should be downloaded from the National Oceanic Atmospheric Administration (NOAA) stations in Libby for days when ABS activities are scheduled.

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 Libby Asbestos Superfund Site is located in northwestern Montana. OU1 of the Site includes areas affected by contamination released from the former W.R. Grace Export Plant. The former Export Plant is situated on the south side of the Kootenai River, just north of the downtown area of the City of Libby, Montana. OU1 includes the embankments of Montana Highway 37, the former Export Plant, and Riverside Park. The property is bounded by the Kootenai River on the north, Highway 37 on the east, the Burlington Northern Santa Fe (BNSF) railroad thoroughfare on the south, and State of Montana property on the west (see **Figure A-2** in the main document).

OU1 covers roughly 17 acres and is divided into three areas (Area 1, Area 2, and Area 3) (see **Figure A-3** in the main document). Area 1 (12 acres) is the location of the former Export Plant. Area 2 consists of 4.7 acres adjacent to the Kootenai River is the former Riverside Park. Area 3, the embankments, is less than 1 acre in size and is owned and maintained by the Montana Department of Transportation (MDT). Areas 1 and 2 are owned by the City of Libby and have been developed into the Riverfront Park serving a variety of recreational visitors. The mowing and weed trimming ABS scenarios will take place in the grassy areas within Areas 1 and 2 (see **Figure B-1** in the main document). Riverfront Park is about 17 acres in size of which about 12 acres are grass and other landscaping materials such as areas of wildflowers. The main features of the park include two boat ramps, a pavilion with surrounding lawn areas, picnic tables, and a pump house.

A.4.2 Temporal Bounds

In general, it is expected that human exposures to LA in outdoor air are more likely to occur when snow cover is limited or absent, and that releases will tend to be higher during dry months in the summer or fall than wet months in the winter or spring. Based on this, ABS should be performed in the summer or early fall. In addition, in order to help ensure that data are not biased low, ABS sampling should not occur if rainfall or irrigation in the past 36 hours has exceeded ¼ inch, if measured soil moisture conditions indicate the average volumetric water content (VWC) is greater than 50 percent, or if site conditions are windy.

A.5 Step 5: Define the Analytic Approach

ABS data collected as part of this study will be used to estimate exposure and risk from LA to support risk management decision-making for OU1. 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 following sections describe how cancer risks and non-cancer HQs will be calculated.

A.5.1 Estimation of Cancer Risk

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

$$Risk = EPC * TWF_c * IUR_{LA}$$

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 (PCM or PCM-equivalent [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.

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

where:

ET = Average exposure time (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

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

A.5.2 Estimation of Non-Cancer Hazard Quotient

The basic equation for characterizing non-cancer risk from LA using EPA's 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 (PCM or 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 (hrs/day)

EF = Average exposure frequency (days/year)

ED = Exposure duration (years)

RFC_{LA} = LA-specific lifetime reference concentration (LA PCM s/cc)

A.5.3 Decision Rule

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 a risk level lower than 1E-04 is unacceptable and that remedial action is warranted where there are uncertainties in the risk assessment results.

A.6 Step 6: Specify Acceptance Criteria

As noted above, ABS data collected as part of this study will be used to estimate risks to support risk management decision-making. In making decisions about human health risks in OU1, two types of decision errors are possible – false negative and false positive.

- A *false negative decision error* occurs when a risk manager decides an area is safe when it is actually not safe.

- A *false positive decision error* occurs when a risk manager decides an area is unsafe when it really is safe.

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 2010a). However, equations and functions in ProUCL are not designed for asbestos datasets and application of ProUCL to asbestos datasets is not recommended (EPA 2008). 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. Because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize the risk of false positive decision errors.

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

The following sections present key aspects of the ABS study design that will yield data that will address the DQOs specified in Steps 1-6 above.

A.7.1 Study Design Considerations

Sampling Events

As noted above, because it is not possible at present to quantify the uncertainty in the mean of an asbestos dataset as a function of the number of samples, it is not possible to calculate a minimum number of samples required to minimize decision errors. The uncertainty around the mean depends on sample size and on the underlying variability. There is no information on the level of variability in measured LA air concentrations under ABS scenario conditions in OU1.

In the absence of information, to ensure that reliable estimates of long-term average concentrations may be computed from individual short-term measurements of air concentrations during soil disturbance activities, this ABS effort will seek to perform three sampling events for the ABS area. If the collected data show there is high variability across measured ABS air concentrations, additional sampling may be necessary to provide a reliable basis for calculating the long-term average exposure concentration in the risk assessment. However, the need for additional data will depend upon the degree of variability across samples and the proximity of the mean concentration to a decision threshold.

ABS Air Sampling Approach

The 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 (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 target analytical sensitivity. 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.

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[1]. If the low volume filter is deemed to be overloaded, an indirect preparation (with ashing) may be performed.

TEM Stopping Rules for ABS Air Samples

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

[1] 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*. 2011).

1. The target analytical sensitivity (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

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 air 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:

$$RBC(cancer) = Maximum\ Acceptable\ Cancer\ Risk / (TWF_c * IUR_{LA})$$

For cancer, the maximum acceptable cancer risk is a risk management decision. For the purposes of establishing an adequate target sensitivity, a value of 1E-05 is assumed. The proposed LA-specific IUR is 0.17 (PCM s/cc)$^{-1}$.

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

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

For non-cancer, the maximum acceptable HQ is 1. The proposed LA-specific RfC is 0.00002 LA PCM s/cc.

Exposure Parameters. The exposure parameters needed to calculate TWF are not known with certainty, so the following RME exposure parameters for OU1 were selected based on professional judgment:

Scenario	ET (hrs/day)	EF (days/yr)	ED (yrs)
Mowing	6 [a]	13 [b]	15 [c]
Weed Trimming	1[c]	13 [b]	15 [c]

[a] Assumes 2 acres per hour are mowed. It is estimated that the entire grassy area of the park could be mowed in 6 hours.
[b] Assumes park is mowed once every other week during the spring and summer (April through September)
[c] Assumed value based on professional judgment.

Based on these parameters, the calculated TWFs and RBCs for cancer and non-cancer are as follows:

Scenario	TWF		RBC (PCME s/cc)	
	Cancer	Non-cancer	Cancer	Non-cancer
Mowing	0.0019	0.0022	0.031	0.0090
Weed Trimming	0.00032	0.00037	0.18	0.054

Because the non-cancer RBC is lower than the cancer RBC, the non-cancer RBC is used to derive the TAS, as follows.

<u>Step 2: Determining the Target Analytical Sensitivity</u>

The 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 / 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:

Probability of detection = 1 - Poisson(0,Target Count)

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

Mowing Scenario TAS = 0.009 / 3 structures = 0.003 cc^{-1}
Weed Trimming Scenario TAS = 0.054 / 3 structures = 0.018 cc^{-1}

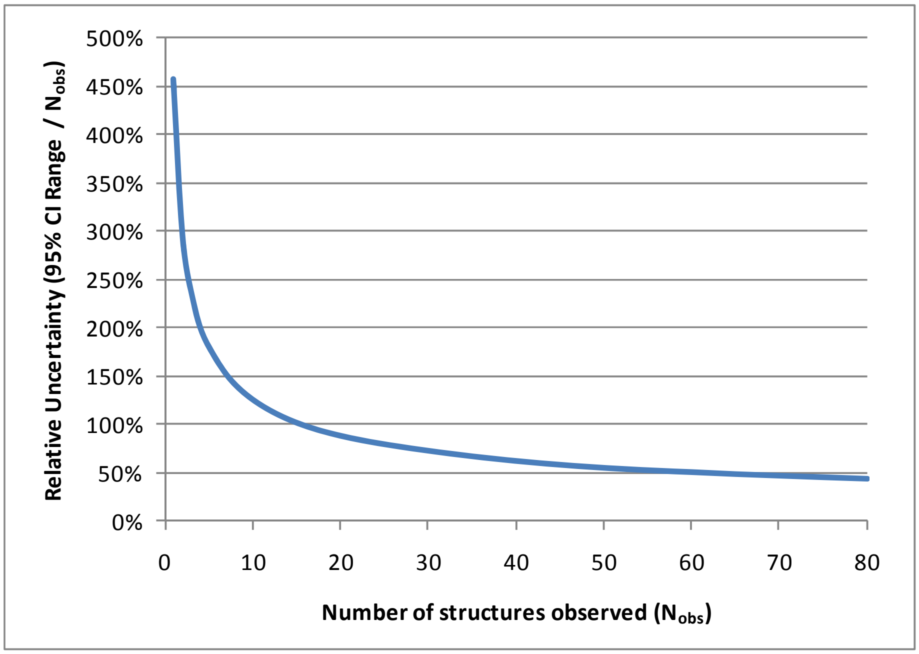
Maximum Number of LA Structures

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:

Lower bound (2.5%) = ½ · CHIINV(0.975, 2 · $N_{observed}$ + 1)
Upper bound (97.5%) = ½ · CHIINV(0.025, 2 · $N_{observed}$ + 1)

As $N_{observed}$ increases, the absolute width of the CI range increases, but the relative uncertainty (expressed as the CI range divided by $N_{observed}$) 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 TAS is calculated as:

GOx = EFA / (TAS · Ago · V · 1000 · f)

where:

EFA = Effective filter area (assumed to be 385 square millimeters [mm^2])

TAS = Target analytical sensitivity $(cc)^{-1}$

Ago = Grid opening area (assumed to be 0.01 mm^2)

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)

The number of grid openings needed to achieve the TAS will vary depending upon which filter is able to be utilized in the analysis (i.e., the HV filter or the LV filter). The following table presents the GOx for each ABS scenario to achieve the TAS for each filter type assuming that the filter is able to be prepared directly (i.e., f = 1).

Scenario	Estimated Sample Duration (minutes)	Pump type	Flow Rate (L/min)	Sample Air Volume (L)	GOx
Mowing with riding lawn mower	120	HV	5.5	660	19
		LV	2	240	54
Mowing with walk behind lawn mower	60	HV	5.5	330	39
		LV	2	120	107
Weed Trimming	60	HV	5.5	330	6
		LV	2	120	18

If an indirect preparation is necessary, the GOx 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 this event, it is possible that the GOx to achieve the TAS may be cost or time prohibitive. In order to limit the maximum effort expended on any one sample, a maximum filter area examined of 10 mm^2 is identified for this project. Assuming that each grid opening has an area of about 0.01 mm^2, this would correspond to about 1,000 grid openings.

Summary of TEM Stopping Rules

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

1. Examine a minimum of two grid openings from each of two grids.

2. Continue examining grid openings until one of the following is achieved:

a. The TAS is achieved.

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, the analyst will complete the examination of the final grid opening and stop.

A.7.2 Refining the Study Design

In accordance with the EPA DQO process, it is expected that the ABS program described in this document may be modified as deemed necessary to ensure that the data are representative. For example, the sampling durations and pump flow rates may be modified if a high frequency of filter overloading is reported. Any changes from the procedures specified in this governing plan should be documented and approved by EPA prior to implementation.

REFERENCES

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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).

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
ABS Script

APPENDIX C
OU1 Post-Construction ABS Script

Two types of activity-based sampling (ABS) scenarios will be conducted at Operable Unit 1 (OU1) as part of the post-construction sampling. ABS activities will be performed to simulate mowing lawn areas and trimming lawn edges and weeds in Riverfront Park, including areas within Area 1 and Area 2. The following section describes the specific activities that will be performed by the actors completing these ABS scenarios.

Different areas of the park require different types of lawn maintenance equipment. Because some equipment may create more soil disturbance than other types of equipment (e.g., mower vs. weed whacker), this ABS scenarios consider the various equipment that may be used in maintaining various areas in the park. Although City workers may use riding lawn mowers to mow some areas of the park, the ABS script will use "walk-behind" push mowers. The use of walk-behind mowers is considered to be a conservative option to evaluate potential exposures. Visual observations have noted that dust generation is higher for walk-behind mowers compared to riding mowers and a walk-behind mower operator is nearer to the ground surface.

Walk-Behind Mower

During the mowing activity, two actors will operate gas-powered walk-behind lawn mowers (bag-less, side discharge, 3- to 5-horsepower mower). The actors will adjust the height of the blades to be approximately 2 to 2.5 inches above the ground surface. One actor will mow the infield level area of the park (see **Figure B-1** in the main document) mowing in a straight line when possible, covering the entire length of the grassy area of the park continuing to mow back and forth until as much of the lawn area is mowed as possible in the time allotted. The time needed to mow the lawn areas of OU1 is not known with certainty. The ABS time interval for the actor mowing the infield will be two hours; the two-hour sampling event will be completed in six 20-minute sampling intervals with a break period separating each sampling interval. The length of the break period should be based on the health and safety of the actor at the time of the sampling event.

The second actor will mow areas other than the infield, including areas near the pavilion and near the edges of the parking lots, continuing to mow until as much of these areas are mowed as possible in the time allotted. The ABS time interval for this actor will be one hour. The one-hour sampling event will be completed in three 20-minute intervals with a break period separating each sampling interval. The length of the break period should be based on the health and safety of the actor at the time of the sampling event. This actor will also operate a weed edger/trimmer (i.e., weed whacker) after the one-hour mowing ABS interval is completed.

Weed-whacker

After the one-hour walk-behind lawn mowing ABS interval is completed, the actor will change out the air cassette filters, check pump flows, and then begin performing edge trimming and weed-whacking activities. The actor will use a weed-whacker to trim the edges of the grassy areas and to cut down weeds or grass in areas inaccessible to a mower (e.g., edge of lawn, around the pump house) that the power mowers are unable to reach. The ABS time interval for the actor operating the weed-whacker will be one hour. The one-hour sampling event will be completed in three 20-minute intervals with a break period separating each sampling interval. The length of the break period should be based on the health and safety of the actor at the time of the sampling event.

A schematic drawing of OU1 will be provided and the actors should note on this figure the approximate areas that were mowed and weed-whacked. Once the sampling intervals have been completed, the sampling pumps may be turned off and the air cassettes can be removed. Sampling pump flows should be checked at the beginning and end of the ABS scenario.

A total of three mowing events will be performed, separated in time by approximately two weeks (i.e., every other week). If all grassy areas within OU1 are not mowed during the first sampling event, subsequent sampling events should begin where the previous event ended, to ensure that the entire area is represented by the ABS activities and the resulting data are representative of potential exposures within OU1.

Sampling and Analysis Plan/Quality Assurance Project Plan
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Appendix D
Analytical Requirements Summary Sheet
[POSTOU1-0613]

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 #POSTOU1-0613
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Sampling and Analysis Plan/Quality Assurance Project Plan: 2013 Post-Construction Activity-Based Sampling, Operable Unit 1

SAP Date (Revision): June 20, 2013 (Revision 0)

EPA Technical Advisor: Dania Zinner (303-312-7122, Zinner.Dania@epa.gov)
(contact to advise on DQOs of SAP related to preparation/analytical requirements)

Sampling Program Overview: This program will conduct activity-based sampling in Areas 1 and 2 of OU1. As part of this program, ABS air samples will be collected and analyzed for asbestos by TEM for a mowing and weed trimming ABS scenario. Personal air samples will also be collected for H&S monitoring and analyzed by PCM.

Sample ID Prefix: RP-_ _ _ _ _

Estimated number and timing of field samples:
All samples will be collected in June - July 2013 timeframe (one ABS every other week starting the week of June 24th).

>> ABS Air, mowing = 6 samples + field QC samples
>> ABS Air, weed trimming = 3 samples + field QC samples

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

<table>
<tr><th rowspan="3">Medium Code</th><th rowspan="3">Medium, Sample Type</th><th colspan="4">Preparation Details</th><th colspan="3">Analysis Details</th><th rowspan="3">Applicable Laboratory Modifications (current version of)</th></tr>
<tr><th rowspan="2">Investi-gative?</th><th colspan="2">Indirect Prep? [b]</th><th rowspan="2">Filter Archive?</th><th rowspan="2">Method</th><th rowspan="2">Recording Rules</th><th rowspan="2">Analytical Sensitivity/Prioritized Stopping Rules</th></tr>
<tr><th>With Ashing</th><th>Without Ashing</th></tr>
<tr><td>A</td><td>Air, ABS Mowing</td><td rowspan="2">Yes</td><td rowspan="2">Yes[a], if material is overloaded (>25%) or unevenly loaded on filter</td><td rowspan="2">No</td><td rowspan="2">Yes</td><td rowspan="2">TEM – Modified ISO 10312, Annex E (Low Mag, 5,000X)</td><td rowspan="2">All PCME asbestos[c];
L: > 5 µm
W: ≥ 0.25 µm
AR: ≥ 3:1</td><td rowspan="2">Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved:
i) the target analytical sensitivity is achieved [d]
ii) 25 PCME LA structures are recorded
iii) 10 mm^2 of filter has been examined</td><td rowspan="2">LB-000016, LB-000029, LB-000066, LB-000067, LB-000085</td></tr>
<tr><td>B</td><td>Air, ABS Weed trimming</td></tr>
</table>

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investigative?	Indirect Prep? [b] With Ashing	Indirect Prep? [b] Without Ashing	Filter Archive?	Method	Recording Rules	Analytical Sensitivity/Prioritized Stopping Rules	
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 indirect preparation details.
[c] If observed, chrysotile and other amphibole asbestos should be recorded. Recording of chrysotile can stop after 25 chrysotile structures have been recorded (finish GO where 25th chrysotile found).
[d] The target analytical sensitivity for the mowing scenario is 0.003 cc^{-1} and the target analytical sensitivity for the weed-trimming scenario is 0.018 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? With Ashing	Indirect Prep? Without Ashing	Archive?	Method	Recording Rules	Stopping Rules	
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	6/20/2013	N/A

Analytical Laboratory Review Sign-off:

☐ EMSL – Libby [sign & date: ________________]
☐ EMSL – Cinnaminson [sign & date: ________________]
☐ EMSL – Beltsville [sign & date: ________________]
☐ EMSL – Denver [sign & date: ________________]
☐ ESAT [sign & date: ________________]
☐ Hygeia [sign & date: ________________]
☐ RESI [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.]