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March 6, 2014

Ref: 8EPR-SR

Mr. Mike Noble, TAG Chairman
Libby, MT 59923

Re: Libby OU2 – Post Construction Risk Assessment Response to Comments

Dear Mr. Noble:

This letter is in response to the comments provided by the LATAG on the Interim Post-Construction Human Health Risk Assessment for Operable Unit 2 of the Libby Asbestos Superfund Site. This report has been finalized and is enclosed. A memorandum responding to comments from Montana DEQ, the Asbestos Technical Review Workgroup, and the Libby Asbestos Technical Advisory Group is also enclosed.

Please feel free to contact me at (303) 312-7122 or by email at zinner.dania@epa.gov, if you have any questions or comments regarding this letter.

Sincerely,

Dania Zinner
Remedial Project Manager
Libby Asbestos Site

Enclosures

cc: Rebecca Thomas, USEPA Region 8

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Interim Post-Construction Human Health Risk Assessment

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

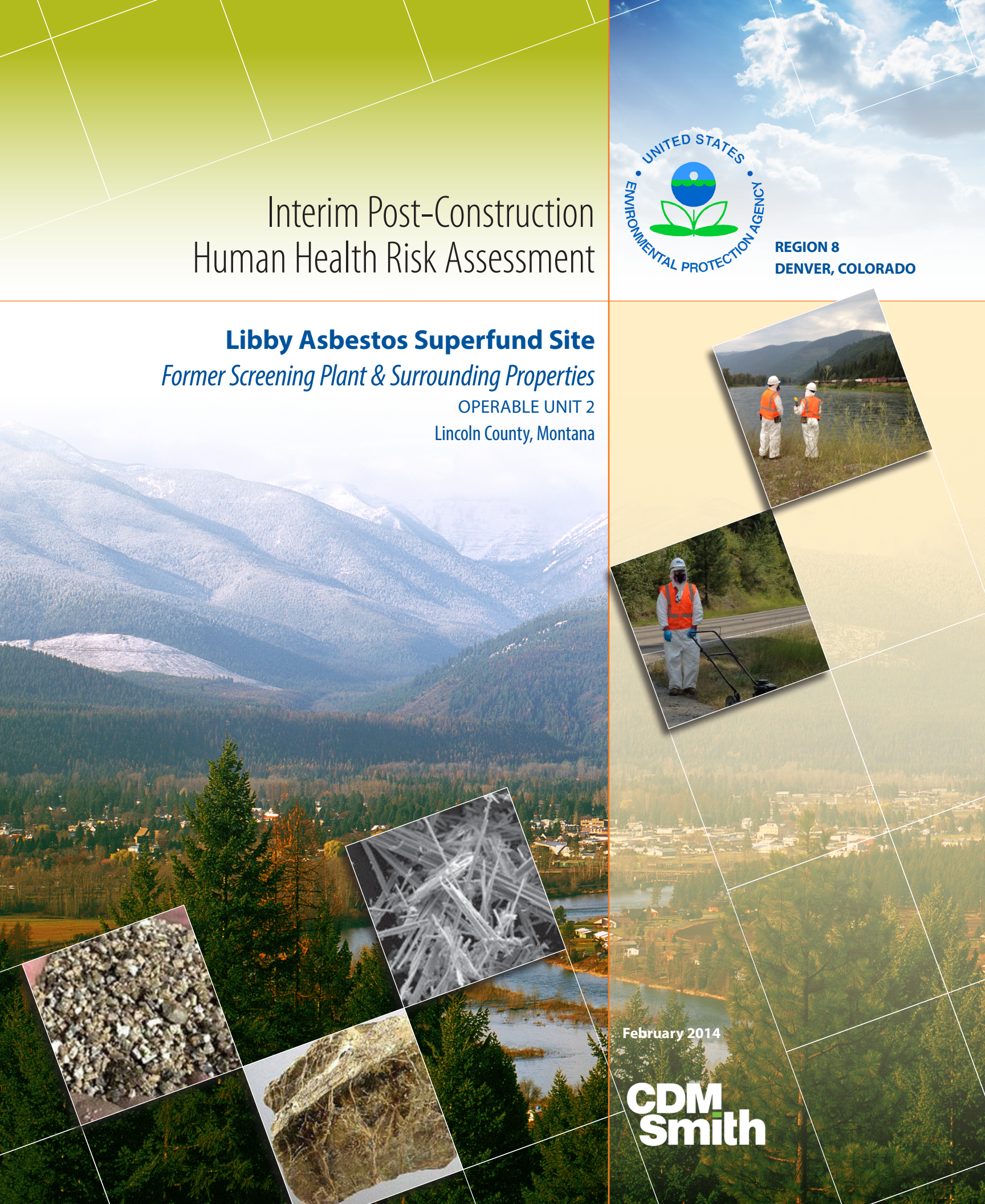
REGION 8
DENVER, COLORADO

Libby Asbestos Superfund Site

Former Screening Plant & Surrounding Properties

OPERABLE UNIT 2

Lincoln County, Montana



February 2014

CDM Smith

Libby Asbestos Superfund Site
The Former Screening Plant and Surrounding Properties
Operable Unit 2
Lincoln County, Montana

Interim Post-Construction Human Health Risk Assessment

EPA Contract No. EP-S8-11-02

Task Order No.: 0005
EPA RPM: Dania Zinner

February 2014

Prepared for:

U.S. Environmental Protection Agency
Region 8
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Libby Asbestos Superfund Site
The Former Screening Plant and Surrounding Properties
Operable Unit 2
Lincoln County, Montana

Interim Post-Construction Human Health Risk Assessment

EPA Contract No. EP-S8-11-02
Task Order No. 0005

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Acronyms

%	percent
µm	micrometers
95UCL	95% upper confidence limit
ABS	activity-based sampling
Ago	area of grid opening
ATS	American Thoracic Society
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
CB&I	CB&I Federal Services, LLC
cc^{-1}	per cubic centimeter
CDM Smith	CDM Federal Programs Corporation
CH	chrysotile asbestos
CHISQ	Chi-square
COC	chain of custody
CSM	conceptual site model
CTE	central tendency exposure
DQA	data quality assessment
DQO	data quality objective
ED	exposure duration
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EF	exposure frequency
EFA	effective area of the filter
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERS	Environmental Resource Specialist
ET	exposure time
F	f-factor
FSDS	Field Sample Data Sheet
GO	grid opening
GPS	Global Positioning System
Grace	W.R. Grace
HHRA	human health risk assessment
HQ	hazard quotient
IC	institutional control
ICIAP	Institutional Control Implementation and Assurance Plan
ID	identification
IRIS	Integrated Risk Information System
ISO	International Organization of Standardization
IUR	inhalation unit risk
L	liters
L/min	liters per minute
LA	Libby Amphibole Asbestos

LFO	Libby Field Office
MDT	Montana Department of Transportation
mm^2	square millimeters
NAM	non-asbestos material
NAS	National Academy of Sciences
NTP	National Toxicology Program
NVLAP	National Voluntary Laboratory Accreditation Program
OA	other amphibole-type asbestos
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
OU2	Operable Unit 2
PCM	phase contrast microscopy
PCME	phase contrast microscopy-equivalent
PE	Performance Evaluation
PLM-VE	polarized light microscopy using visual area estimation
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QATS	Quality Assurance Technical Support
QC	quality control
RfC	reference concentration
RME	reasonable maximum exposure
ROD	Record of Decision
ROM	record of modification
ROW	right-of-way
s/cc	structures per cubic centimeter
SAED	selected area electron diffraction
SAP	sampling and analysis plan
Shaw	Shaw Environmental & Infrastructure Group
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
TEM	transmission electron microscopy
TWF	time-weighting factor
VWC	volumetric water content
WHO	World Health Organization

Executive Summary

This document presents the interim human health risk assessment (HHRA) for exposures to asbestos under post-construction conditions at Operable Unit 2 (OU2) for the Libby Asbestos Superfund Site. This HHRA summarizes the results of the 2012 post-construction outdoor air investigation at OU2, and uses these data to estimate the residual exposure and risk from inhalation of asbestos. Once the site-wide risk assessment has been completed the selected remedy for OU2 will be revaluated.

ES.1 Site Description

Libby is a community in northwestern Montana that is located near a former open-pit vermiculite mine. Vermiculite from this mine contains varying concentrations of a form of asbestos referred to as Libby amphibole (LA). OU2 includes areas that were affected by contamination released from the former W.R. Grace Screening Plant. Subareas within OU2 include the former Screening Plant (Subarea 1), the Flyway (Subarea 2), a privately-owned property (Subarea 3), and the Rainy Creek Road frontages (Subarea 4) (Figure ES-1).

ES.2 Basis for Concern

Historical mining, milling, and processing operations, as well as bulk transfer of mining-related materials, tailings, and waste to locations throughout Libby Valley, are known to have resulted in releases of vermiculite and LA-containing wastes to the environment. Due primarily to a concern for risk of adverse effects in humans from inhalation exposure to LA, the U.S. Environmental Protection Agency (EPA) listed the Libby Asbestos Superfund Site on the National Priorities List in October 2002.

Vermiculite was transported from the mine to OU2 by truck, sorted, and bulk material stored in two sheds at the facility. Because of concerns for exposure of humans to asbestos at OU2, EPA has conducted extensive actions to remove the mine-related waste materials and contaminated soils at this OU. With the exception of three areas located in the Flyway along the Kootenai River and near the Highway 37 right-of-way (ROW), surface soils have been remediated over almost the entire area of OU2. This HHRA will be used by EPA to determine whether additional actions are needed at OU2 to ensure remedy protectiveness from potential LA exposure.

ES.2.1 Outdoor Air ABS Investigation

The purpose of the 2012 sampling investigation was to collect data to support a post-construction risk assessment to assist in the evaluation of effectiveness of the remedy. The sampling investigation included the collection of personal air samples under conditions simulated to mimic the types of activities and exposures that may occur in the OU2 Flyway. This type of sampling is referred to as "activity-based sampling" or ABS.

Under current site conditions, a range of different human receptors may be exposed to contaminants in OU2. Because not all possible scenarios can be evaluated the exposure scenarios chosen to be most representative of soil-disturbing activities at OU2 are potential exposures to Montana Department of Transportation (MDT) workers that mow the ROW in the Flyway and individuals that may recreate or trespass (either intentionally or inadvertently) along the Kootenai River bank in the Flyway.

For the mowing ABS scenario, an actor wearing a personal air monitor mowed the ROW using a walk-behind rotary mower making four passes over the ROW. A total of three mowing ABS events were performed in the summer of 2012 separated in time by one week. No LA structures were observed in any of the mowing ABS air samples that were collected as part of this investigation.

For the hiking ABS scenario, two actors wearing personal air monitors hiked along the river frontage stopping at obvious areas of river access when encountered. A total of three hiking ABS events were performed in late August 2012. No LA structures were observed in any of the hiking ABS air samples that were collected as part of this investigation.

In addition to collecting air samples, sampling team members continually inspected the ground surface within the ABS area for the presence of visible vermiculite throughout the duration of the ABS activity. No visible vermiculite was observed in either the mowing or hiking ABS areas.

A data adequacy evaluation of the data collected as part of the OU2 post-construction ABS investigation showed that results were of acceptable quality, and considered to be reliable and appropriate for their intended use.

ES.2.2 Exposure Assessment

Two areas within the Flyway were evaluated in this HHRA – the Highway 37 ROW and the Kootenai River frontage. Portions of these areas have not been remediated and thus have the maximum potential for exposure (i.e., "worst case"). Residual contamination remains at varying depths over a considerable portion area of OU2. Institutional controls (ICs) have been developed to ensure the protectiveness of the remedy; therefore, potential exposure pathways associated with exposure to residual contamination at depth are considered incomplete and not evaluated in this HHRA. For the ROW, the exposure population of primary interest is MDT workers that mow the vegetation along the highway. For the Kootenai River frontage, the exposure population of primary interest is individuals that may recreate or trespass (either intentionally or inadvertently) along the Kootenai River banks within this frontage area. The principal exposure route of interest for both populations is inhalation of outdoor air during disturbances of potential source materials (e.g., asbestos-contaminated soil) (Figure ES-2).

EPA has not established default parameters that are applicable for the mowing and hiking scenarios of potential concern in OU2. Therefore, for the purposes of this risk assessment, exposure parameters for each exposure scenario were selected based on professional judgment to represent reasonable maximum exposure values.

The exposure point concentration (EPC) utilized in the risk estimates was the sample mean for each ABS area. No LA structures were observed in any mowing or hiking ABS samples; therefore, EPCs for each exposure area were zero.

ES.2.3 Toxicity Assessment

Many epidemiological studies have reported increased mortality from cancer in workers exposed to asbestos, especially from lung cancer and mesothelioma. Based on these findings, and supported by extensive carcinogenicity data from animal studies, EPA has classified asbestos as a known human carcinogen and an inhalation unit risk value for asbestos is reported in EPA's Integrated Risk Information System (IRIS).

Exposure to asbestos may induce several non-cancer affects in the lungs, heart, kidney, and immune system. However, at present, there is no inhalation reference concentration available in IRIS for the assessment of non-cancer risks from airborne asbestos exposure.

ES.2.4 Risk Characterization

For both exposure scenarios, all ABS air samples were non-detect for LA. Hence, the resulting cancer risks are also zero (Table ES-1). Since cancer risks are zero, these data show that exposures from post-construction outdoor soil disturbances in OU2 are below a level of potential concern for both MDT workers and recreational visitors/trespassers. ICs will be used to minimize potential risks posed to people from LA remaining in subsurface soils and to ensure that the selected remedy is not damaged.

ES.2.5 Uncertainty Assessment

Although EPA has used the best available science to evaluate potential risks from LA asbestos at OU2, there are number of sources of uncertainty in the risk calculations presented in this HHRA. Confidence in quantitative estimates of potential risks to humans may be limited due to uncertainties in the exposure and toxicity assessments. Most uncertainties are addressed by making assumptions or deriving estimates that are intentionally conservative, and that are more likely to overestimate than underestimate risks.

For the purposes of this HHRA, alternate risk estimates were calculated to address two key sources of uncertainty. First, EPA has recently proposed draft LA-specific toxicity values for estimating both cancer risks and non-cancer hazards. These toxicity values are currently being reviewed, but the draft values were utilized in uncertainty assessment to provide an estimate of potential risks based on the draft LA-specific toxicity values. Second, there is no EPA-approved method for calculating an upper-bound concentration for asbestos datasets where all samples in the dataset are non-detect (i.e., have a count of zero). The uncertainty assessment provided an estimate of potential risks based on a conservative estimate of the "upper-bound" concentration on the true mean. These alternate risk estimates showed that, even when risks were calculated based on the LA-specific toxicity values and using upper-bound concentrations, both cancer and non-cancer risk estimates are below a level of concern (Table ES-2). Thus, uncertainties in the HHRA are not likely to alter risk conclusions with regard to potential asbestos exposures in OU2.

ES.3 Summary and Conclusions

There are several locations within Subarea 2 (Flyway) where soils have not been remediated. These locations were the focus of the post-construction sampling investigation and risk assessment for OU2. Risks were assessed for MDT workers that mow the ROW in the Flyway and for individuals that recreate or trespass (either intentionally or inadvertently) along the Kootenai River bank in the Flyway. Based on the data collected from the 2012 outdoor ABS sampling investigation, it is concluded that risks from outdoor exposures at the Flyway are at or below EPA's acceptable risk range, even when based on upper-bound exposure estimates and the draft LA-specific toxicity values. The Site-wide HHRA for the Libby Asbestos Superfund Site will include risk calculations for OU2 that are based on the final LA-specific toxicity values. In addition, EPA will consider the total cumulative risks to individuals in the final risk management decision process for the Libby Site.

TABLE ES-1

ESTIMATED RISKS FROM MOWING AND HIKING EXPOSURES IN OU2 (SUBAREA 2)

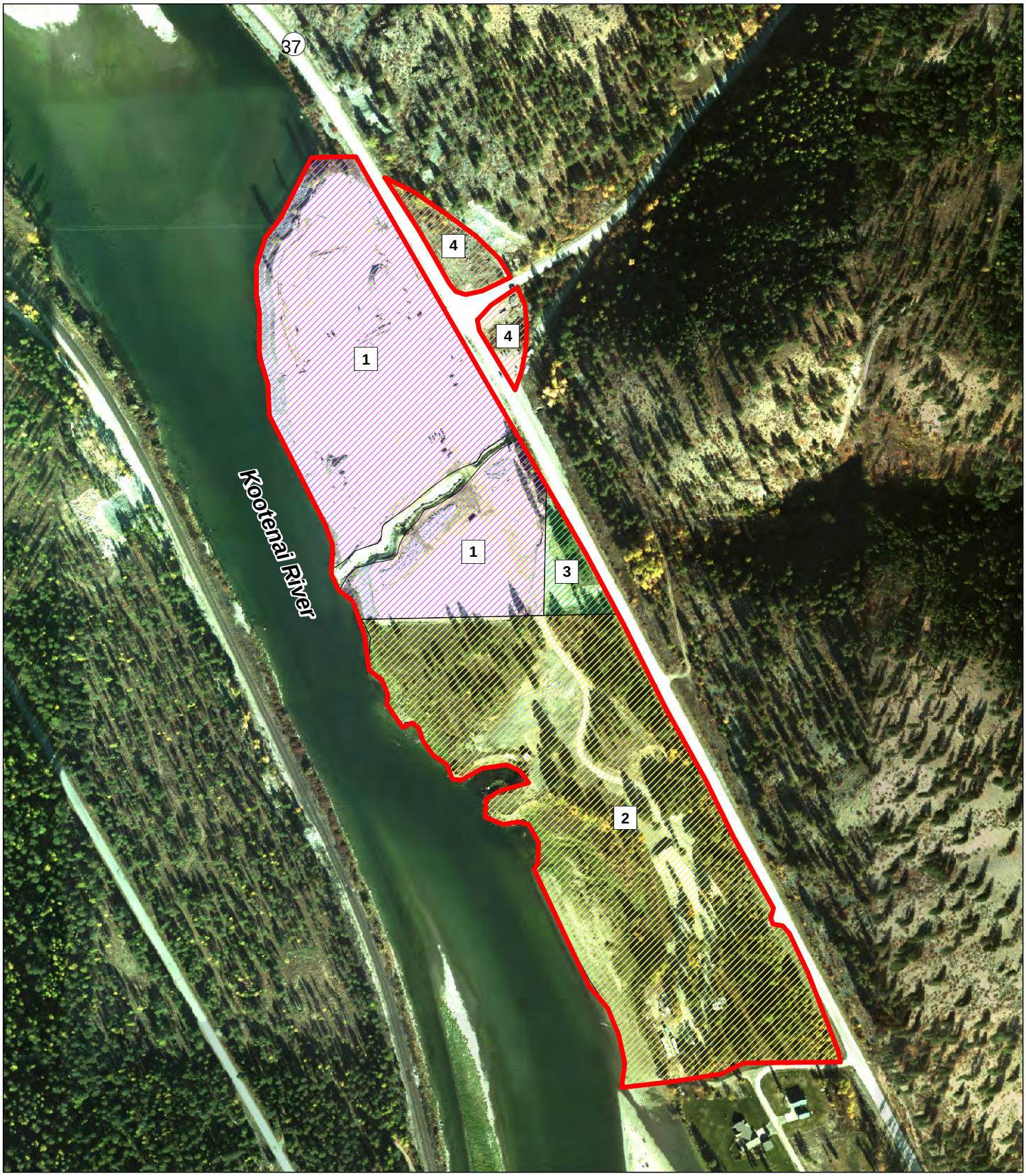
Scenario	EPC (PCME LA s/cc)	Cancer		
		TWF	IUR (PCM s/cc)$^{-1}$	Cancer Risk
Mowing	0	0.00057	0.056	0E+00
Hiking	0	0.0023	0.11	0E+00

EPC = exposure point concentration
(s/cc)$^{-1}$ = risk per structures per cubic centimeter
IUR = inhalation unit risk
LA = Libby amphibole
PCM = phase contrast microscopy
PCME = phase contrast microscopy equivalent
s/cc = structures per cubic centimeter
TWF = time-weighting factor

TABLE ES-2
ESTIMATED RISKS FROM MOWING AND HIKING EXPOSURES IN OU2 (SUBAREA 2)
BASED ON UPPER-BOUND EPCS AND LA-SPECIFIC TOXICITY VALUES

Scenario	Upper-Bound EPC (PCME LA s/cc)	Cancer			Non-Cancer		
		$TWF_{LA,\ cancer}$	IUR_{LA} $(PCM\ s/cc)^{-1}$	Cancer Risk	$TWF_{LA,\ non\text{-}cancer}$	RfC_{LA} (PCM s/cc)	Non-Cancer HQ
Mowing	< 0.018	0.00012	0.17	< 4E-07	0.00014	0.00002	< 0.1
Hiking	< 0.0048	0.0010	0.17	< 8E-07	0.0011	0.00002	< 0.3

$(s/cc)^{-1}$ = risk per structures per cubic centimeter
EPC = exposure point concentration
HQ = hazard quotient
IUR = inhalation unit risk
LA = Libby amphibole
PCME = phase contrast microscopy
PCME = phase contrast microscopy equivalent
RfC = reference concentration
s/cc = structures per cubic centimeter
TWF = time-weighting factor



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Feet

1 inch = 400 feet

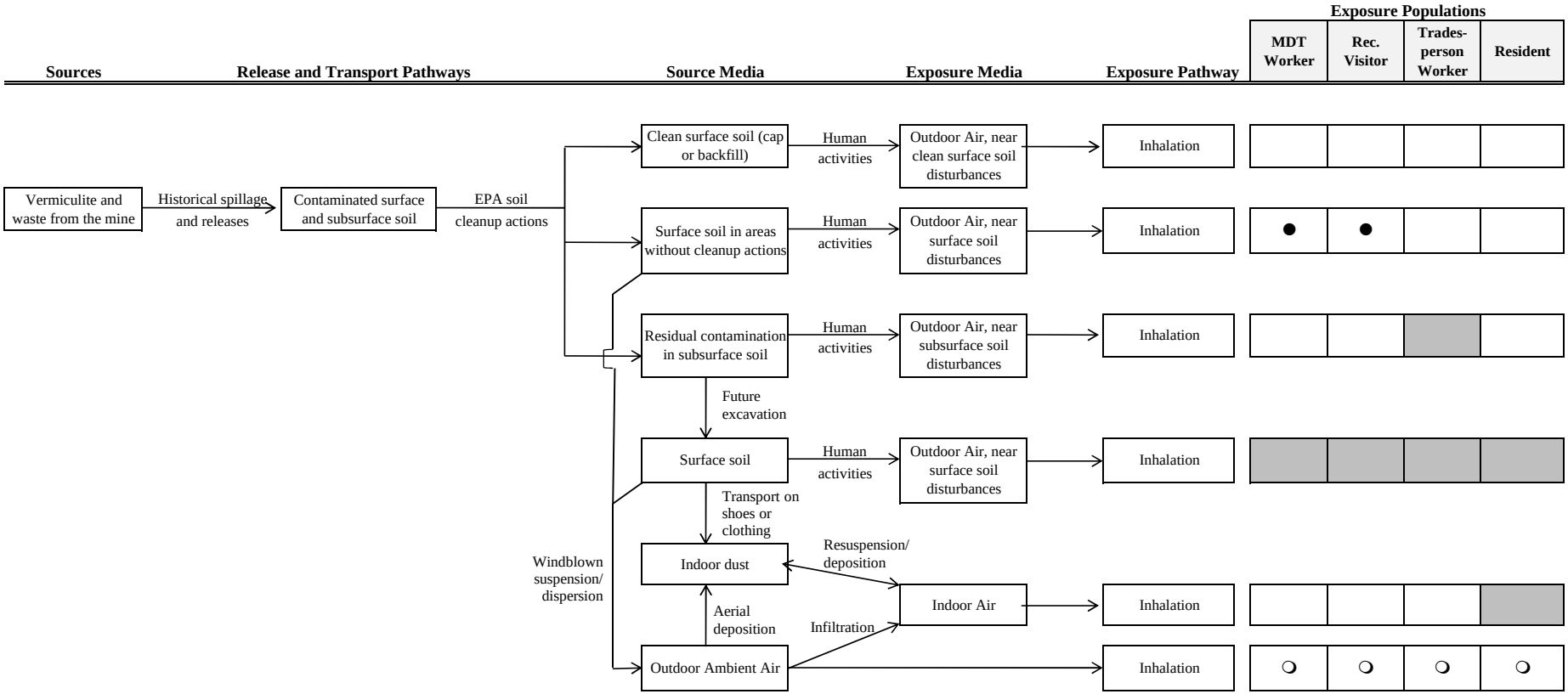
Legend

- OU2 Boundary
- Subarea 1- Former Screening Plant
- Subarea 2 - Flyway
- Subarea 3 - Private Property
- Subarea 4 - Rainy Creek Road Frontages

Figure ES-1
OU2 Site Layout
Libby Asbestos Superfund Site
Lincoln County, Montana

CDM Smith

FIGURE ES-2
CONCEPTUAL SITE MODEL FOR CURRENT AND FUTURE INHALATION EXPOSURES TO ASBESTOS AT OU2
Libby Asbestos Superfund Site, Operable Unit 2



KEY:

●	Exposure pathway is complete and will be evaluated quantitatively in the interim HHRA.
	Exposure pathway could become complete (if excavation uncovers subsurface soils with residual contamination); not evaluated quantitatively in the interim HHRA.
❍	Exposure pathway is complete, but expected to be minor; not evaluated quantitatively in the interim HHRA.
	Exposure pathway is not complete or negligible.

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Section 1

Introduction

1.1 Site Background

Libby is a community in northwestern Montana that is located near a former open-pit vermiculite mine. Vermiculite from this mine contains varying concentrations of a form of asbestos referred to as Libby amphibole (LA). 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. Historical mining, milling, and processing operations, as well as bulk transfer of mining-related materials, tailings, and waste to locations throughout Libby Valley, are known to have resulted in releases of vermiculite and LA-containing wastes to the environment.

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, historical 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) (Figure 1-1). Operable Unit 2 (OU2) includes areas that were affected by contamination released from the former Grace Screening Plant. Subareas within OU2 include the former Screening Plant (Subarea 1), the Flyway (Subarea 2), a privately-owned property (Subarea 3), and the Rainy Creek Road frontages (Subarea 4) (Figure 1-2). The Kootenai Development Corporation Bluffs, located across the Kootenai River from the former Screening Plant, was removed from OU2 and is now part of OU4.

Because of concerns for exposure of humans to contamination in OU2, EPA has taken extensive actions to remove the mine-related waste materials and contaminated soils at OU2. Exposure to the contamination was largely mitigated by removal of surface soils and the extensive cap placed across the OU2 site during removal activities prior to the Record of Decision (ROD), with the exception of two isolated locations within the Flyway (Subarea 2), which were remediated in 2010. Residual contamination remains at varying depths over a considerable portion area of OU2. The location of protective covers and remedy components at OU2 is shown in Figure 1-3. Details of investigation and remediation activities conducted at each OU2 subarea are provided in the *Final OU2 Remedial Investigation Report* (EPA 2009), the *OU2 Record of Decision* (EPA 2010) and the *Final Remedial Action Report, Former Screening Plan and Surrounding Properties, Operable Unit 2* (EPA 2012a). Each subarea is described briefly below.

1.1.1 Subarea 1: Former Screening Plant

The former Screening Plant is located approximately 5 miles northeast of Libby on the east side of the Kootenai River (Figure 1-2). The area is approximately 21 acres in size, and is bordered by Highway 37 to the northeast, the privately owned property to the southeast, Flyway property to the south, and the Kootenai River to the west. Subareas 1 and 4 are currently owned by the same private party and are jointly referred to as the Parker Property. The Montana Highway 37 right-of-way (ROW) adjacent to Subarea 1 is referred to as Montana Land Property.

From 1975 to 1990, the Screening Plant was used by Grace to screen mined vermiculite by size and grade. The vermiculite was transported from the mine to the Screening Plant by truck, sorted, and bulk material stored in two sheds at the facility. The vermiculite was then loaded onto a conveyor system and transported across the Kootenai River to an unloading station.

From 1993 to 1999, the former Screening Plant was used as a fully-operational retail nursery business (Raintree Nursery) where plants, flowers, and trees were grown, stored, and sold. The owners of the property lived on the site in a one-story structure that served both as an office and a residence.

Due to the LA contamination associated with vermiculite from the mine, the former Screening Plant has undergone extensive investigation and removal actions since EPA began emergency response activities in Libby in 1999. All buildings in Subarea 1, including the former residence on the Parker Property, were demolished in 2000 and 2001. Response activities have included the excavation and removal of contaminated soils to a depth of about 3 to 4 feet in most areas. Most confirmation soil samples contained LA (levels ranged from <1% to 8%), indicating that contamination remains at depth. The remaining contaminated soil was covered with geotextile and then backfilled with clean soil. Additional excavation was conducted along the northern portion of the Subarea 1 adjacent to the Kootenai River; afterwards this area was covered with rip-rap and geotextile. Restoration included placement, compaction, and grading of fill to provide adequate drainage. Other areas remediated in Subarea 1 included areas along the lower reach of Rainy Creek and along the highway ROW.

The property is currently privately owned and is being used for residential purposes. The current residence on the Parker Property was built in 2010, after all removal activities within this subarea were completed. It is anticipated that the property will continue to be used for residential and/or commercial purposes.

1.1.2 Subarea 2: Flyway

The Flyway is comprised of approximately 19 acres located northeast of Libby, immediately south of the former Screening Plant. The Flyway is bounded by Highway 37 to the northeast, a residential subdivision to the south, the Kootenai River to the southwest, and the former Screening Plant and private property to the north (Figure 1-2). The Flyway is accessed through a gated entrance to the adjacent private property off Highway 37. The Flyway area includes the Highway 37 ROW, which is adjacent to the west side of Highway 37. The ROW is used and maintained by Montana Department of Transportation (MDT).

When owned by Grace, the Flyway housed a pump that was used during vermiculite mining operations to convey water from the Kootenai River to the mine site. The pumphouse, located close to the Kootenai River, has since been abandoned and the pump is no longer functional. The interior insulation of this metal structure was removed and all parts of the building were washed. The empty structure was left on-site for possible future use.

In 1999, when the EPA first visited the property, the Flyway was found to contain several vermiculite piles. One portion of the property had been covered with imported fill material and it was suspected that vermiculite-containing material had been moved from the former Screening Plant and used as fill material to level parts of the Flyway where drainages existed. Following investigation work performed as a part of the Libby emergency response, several soil removal activities were conducted (both by Grace and EPA) for the Flyway and the Highway 37 ROW. Contaminated soil was removed to a depth of 12 inches below ground surface (bgs) to a maximum depth of 4 feet bgs in many areas of the Flyway (see Figure 1-3). Excavations were backfilled to grade using materials from a local EPA-approved fill source and hydroseeded. There are several locations within the Flyway where soils have not been remediated; these locations were the focus of the post-construction sampling investigation and risk assessment for OU2 (see Figure 4-1).

The Flyway is currently vacant, undeveloped land and at this time, there are no plans to develop this property.

1.1.3 Subarea 3: Private Property

Subarea 3 is a small section of the Wise property and consists of an approximate 1-acre parcel situated between the former Screening Plant and the Flyway, and bordered by Highway 37 to the northeast (Figure 1-2). The Highway 37 ROW adjacent to Subarea 3 is referred to as Montana Land Property. A continuation of the ROW in the Flyway subarea, this ROW is also used and maintained by the MDT.

Under Grace's ownership, the property was likely used for vermiculite mining-related activities, such as the storage or staging of equipment and materials. In recent history, portions of the property were used for equipment decontamination during remediation work at the former Screening Plant and the Flyway (the property was vacant and not in use at the time of removal activities). The property was subsequently evaluated by EPA and soil removal activities were conducted in 2005. Soil was removed to a depth of 12 inches throughout Subarea 3. Confirmation soil samples were collected from the excavation bottom to depths between 2 and 14 inches bgs. Of 17 confirmation soil samples collected, one sample contained LA (<1%). Following excavation and confirmation soil sampling, the area was restored by backfilling to grade using EPA approved fill sources and hydroseeded. The location of protective covers and remedy components in Subarea 3 is shown in Figure 1-3.

The private property is currently vacant, undeveloped land. At this time, the owners have no plans to develop this property.

1.1.4 Subarea 4: Rainy Creek Road Frontages

The Rainy Creek Road frontages are currently privately owned and lie immediately north and south of Rainy Creek Road on the east (i.e., mine) side of Highway 37 (Figure 1-2). As noted above, Subareas 1 and 4 are currently owned by the same private party and are jointly referred to as the Parker Property. The Highway 37 ROW adjacent to Subarea 4 is referred to as Montana Land Property. The Rainy Creek Road frontages were evaluated by EPA and soil removal activities were conducted in 2004 and 2006. Removal activities consisted of approximately a 2-foot excavation along the ROW; the excavation was backfilled using 18 inches of common fill and 6 inches of topsoil. All disturbed areas were hydroseeded. In 2006, while excavating to repair a damaged water line at the north frontage, a contractor observed vermiculite. The contaminated soil (40 cubic yards) was excavated, and the damaged water line was repaired and surrounded with sand. The excavation was backfilled and covered with topsoil. Figure 1-3 shows the location of protective covers and remedy components for Subarea 4.

The Rainy Creek Road frontages are currently vacant, undeveloped land. It is anticipated that the property will remain as such.

1.2 Purpose of This Document

This HHRA presents an interim evaluation of potential human health risks in OU2; the final risk assessment for OU2 will be included in the Site-wide HHRA. This document summarizes the results of the 2012 post-construction outdoor air investigation at OU2, and uses these data to estimate the residual exposure and risk from inhalation of LA. Specifically, results are used to evaluate potential exposures to MDT workers that mow the ROW in the Flyway and individuals that may recreate or trespass (either intentionally or inadvertently) along the Kootenai River bank in the Flyway. These findings will be used by EPA to determine whether additional actions are needed at OU2 to ensure remedy protectiveness from potential LA exposure.

1.3 Document Organization

In addition to this introduction, this report is organized as follows:

- **Section 2 -** The section presents a summary of the 2012 post-construction investigation of outdoor air.
- **Section 3 -** The section presents results of the data quality assessment, including a summary of program audits, modifications, data verification efforts, evaluation of quality control samples, and overall data adequacy.
- **Section 4 -** The section presents a post-construction risk assessment for OU2.
- **Section 5 -** The section provides full citations for all analytical methods, site-related documents, and scientific publications referenced in this document.

All referenced tables, figures, and appendices are provided at the end of this document (or are provided electronically).

Section 2

Outdoor Air ABS Investigation Summary

Because the construction of the remedial action at OU2 has been completed, the purpose of the 2012 sampling investigation was to collect data to support a post-construction risk assessment to assist in the evaluation of effectiveness of the remedy. Because Subarea 1 (former Screening Plant), Subarea 3, and Subarea 4 (Rainy Creek Road frontages) are all privately-owned, and the owners opted not to participate in post-construction sampling activities, the focus of the post-construction sampling investigation was on Subarea 2 (Flyway) in areas that have not been remediated and thus have the maximum potential for exposure (i.e., "worst case"). Data were collected to evaluate potential exposures to MDT workers that mow the ROW in the Flyway and individuals that may recreate or trespass (either intentionally or inadvertently) along the Kootenai River bank in the Flyway. 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 non-cancer effects.

The sampling investigation included the collection of personal air samples under conditions simulated to mimic the types of activities and exposures that may occur in OU2. This type of sampling is referred to as "activity-based sampling", or ABS. These ABS air samples were analyzed for asbestos to provide measured data of LA concentrations in ABS air.

Detailed information on the outdoor air study design and investigation-specific data quality objectives (DQOs) are provided in the *OU2 2012 Post-Construction Activity-Based Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)* (EPA 2012b). An overview of the study design, sampling and analysis methods, data reduction methods, and results for this investigation are discussed in detail below.

2.1 Study Summary

2.1.1 Outdoor Activity Scenarios and Sampling Locations

Two ABS scenarios representative of activities that may take place in OU2 were evaluated as part of this sampling investigation. Scenario 1 was conducted to determine possible exposures to MDT workers that mow the ROW on the west side of Highway 37 (see Figure 2-1). The ROW has approximately 1,500 feet of road frontage. Scenario 2 was conducted to evaluate possible exposure levels to individuals that recreate (e.g., hiking) or otherwise trespass along river frontage in the Flyway adjacent to the Kootenai River (see Figure 2-1). The river frontage within the Flyway is approximately 2,100 feet.

2.1.2 Air Sample Collection and Analysis

2.1.2.1 Outdoor ABS Air Sampling

Outdoor ABS air samples were collected, handled, and documented in general accordance with site-specific standard operating procedure (SOP) EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air*. Because release of LA from soil to air is suspected to be diminished in cases where the soil moisture is high, a field evaluation of soil moisture content was performed prior to all ABS events (see Section 2.1.3.2). If the mean soil volumetric water content (VWC) was greater than 50%, if rainfall in the past 36 hours exceeded ¼ inch, or if site conditions were windy, ABS was not performed.

Mowing

The SAP/QAPP (EPA 2012b) provides a detailed description of the ABS script for the mowing ABS scenario (Scenario 1). In brief, an actor (EPA contractor) wearing a personal air monitor mowed the ROW using a walk-behind rotary mower. The type of mowing equipment used for the ABS differs from the commercial mowers used by MDT workers, but because MDT had completed mowing activities at the ROW for the season, and due to safety concerns for EPA contractors using MDT equipment, this alternate mowing scenario was used. In addition, based on visual observations by EPA contractors of mowing activities performed using different types of mowers, it appears that walk-behind mowers have a higher potential for dust generation (and hence asbestos release) than riding mowers. Furthermore, the 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 use of a walk-behind mower would be representative of the high-end of potential mowing exposures.

A total of three mowing ABS events were performed separated in time by one week. Mowing Event 1 was conducted during the afternoon on August 21, 2012; Event 2 and Event 3 were conducted during the morning on August 31 and September 8, 2012, respectively. During each mowing ABS event, four passes were made over an area of approximately 430 feet by 6 feet, taking 12-17 minutes to complete. Photographs of an actor mowing the ROW and a view of the ROW are presented in Figure 2-2.

During each mowing ABS event, two replicate ABS air samples were collected – one with a high volume pump and one with a low volume pump. The appropriate flow rate for each sampling pump was optimized to achieve the highest sample air volume possible without causing the filter to become overloaded. The high volume pump flow rate was 5.5 liters per minute (L/min) and the low volume pump flow rate was 2.0 L/min. Only one of the two air filters for each ABS sample, either the high volume or the low volume, was analyzed by transmission electron microscopy (TEM). Thus, a total of six air filters were generated, three of which were analyzed and the other filters were archived. For the mowing ABS scenario (Scenario 1), the target analytical sensitivity for the TEM analysis was 0.047 per cubic centimeter $(cc)^{-1}$.

Hiking

The SAP/QAPP (EPA 2012b) provides a detailed description of the ABS script for the recreational visitor/trespasser hiking ABS scenario (Scenario 2). In brief, two actors (EPA contractors), each wearing a personal air monitor, hiked along the river frontage stopping at obvious areas of river access when encountered. Actors switched places (leading/following) every five minutes for a total duration of 30 minutes. The ABS hiking events were conducted in late summer to maximize the inclusion of locations that are seasonally submerged. However, some of the areas that are seasonally submerged are also heavily vegetated which precluded access by the ABS actors to all portions of these areas. Figure 2-3 shows actors performing the hiking ABS scenario.

A total of three hiking ABS events were performed. All three hiking ABS events were performed sequentially on the morning of August 21, 2012, with each ABS event taking place along different paths/routes, traversing both above and below the high water mark along the river frontage. During each hiking ABS event, two replicate ABS air samples were collected for each actor – one with a high volume pump and one with a low volume pump. However, only one of the two air filters for each ABS sample, either the high volume or the low volume, was analyzed by TEM and the other samples were archived. Thus, a total of 12 air filters were generated, six of which were analyzed and six were archived. For the recreational ABS scenario (Scenario 2), the target analytical sensitivity for the TEM analysis was 0.0058 cc^{-1}.

2.1.2.2 Sample Documentation, Handling, and Custody Methods

All ABS air samples collected were identified with sample identification (ID) numbers that included an investigation-specific prefix of "FA" (e.g., FA-00001) to designate that these samples were collected as part of the Flyway ABS investigation. Data on the sample type, location, collection method, and collection date of all samples were recorded both in a field logbook maintained by the field sampling team and on a field sample data sheet (FSDS) designed to facilitate data entry into the Libby Scribe project database (see Section 2.1.2.6). All samples collected in the field were maintained under chain of custody (COC) during sample handling, preparation, shipment, and analysis. Field documentation is provided in Appendix B.

2.1.2.3 Analytical Methods

ABS air filters were prepared for analysis by TEM in accordance with the direct preparation method provided in International Organization for Standardization (ISO) method 10312:1995(E) (ISO 1995). Two filters were collected for each ABS actor during each sampling event – a high volume filter and a low volume filter. In all cases, the high volume filter was analyzed and the low volume filter was archived.

Air samples were analyzed by TEM in basic accordance with the counting and recording rules specified in ISO 10312:1995(E) (ISO 1995), and the investigation-specific counting rule modifications specified in the SAP/QAPP (EPA 2012b). In brief, when a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. The mineral type of each asbestos structure was determined by selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS), and each structure was assigned to one of the following four categories – LA, other amphibole-type asbestos (OA), chrysotile asbestos (CH), or non-asbestos material (NAM). Attributes for all countable structures (including non-LA asbestos types) were recorded on the laboratory bench sheets and the electronic results spreadsheets.

Examination of TEM grid openings continued until one of the analysis stopping rules is achieved. The analytic stopping rules for the TEM analysis were specified in the SAP/QAPP (EPA 2012b). In all cases, the air samples achieved the target analytical sensitivity.

2.1.2.4 Analytical Results

The concentration of asbestos in air in a given sample is given by:

$$\text{Air Concentration (s/cc)} = N \cdot S$$

where:

N = Number of asbestos structures observed in the sample

S = Sensitivity (cc^{-1}) for the sample

For air, the sensitivity is calculated as:

$$S = \frac{EFA}{GO \cdot Ago \cdot V \cdot 1000 \cdot F}$$

where:

S = Sensitivity for air (cc^{-1})

EFA	=	Effective area of the filter (mm^2)
GO	=	Number of grid openings examined
Ago	=	Area of a grid opening (mm^2)
V	=	Volume of air passed through the filter (L)
1000	=	Conversion factor (cc/L)
F	=	Fraction of primary filter deposited on secondary filter (indirect preparation only)

For the purposes of estimating potential human health risks (see Section 4), the concentration of asbestos in air must be expressed in units of phase contrast microscopy (PCM) structures per cubic centimeter of air (s/cc). This is because the current risk models for estimation of risks from inhalation exposure to asbestos (EPA 2008) is based on cumulative exposure expressed as PCM s/cc-yrs. Estimates of concentration used in this report are based on the PCM-equivalent (PCME) structures observed during the TEM analysis. In the PCM method (NIOSH 7400), a fiber is counted if it has a length of 5 micrometers (µm) or longer and an aspect ratio (length:width) of at least 3:1. Although there is no thickness rule specified in the PCM method, particles thinner than about 0.25 µm are not usually detectable by PCM. Hence, the TEM counting rules[1] for PCME are: length > 5 µm, width ≥ 0.25 µm, aspect ratio ≥ 3:1.

In this report, ABS air concentrations are reported as PCME LA structures per cubic centimeter (s/cc).

2.1.2.5 Results Reporting

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each analytical method and each medium. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. The data entry forms contain a variety of built-in quality control functions that improve the accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby Scribe project database.

2.1.2.6 Data Management

Sample and 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.

Because data for the Libby Site are maintained in multiple Scribe projects (e.g., analytical data are managed in annual projects, field information is managed in a project separate from the analytical information), the data have been combined into one Microsoft Access® database by CDM Smith. This database is a compilation of tables from multiple Scribe projects. Raw data summarized in this report

[1] Note that the PCME counting rule for width does not include an upper width cut-off of 3 µm, per EPA (2008), because particles wider than 3 µm are counted by PCM NIOSH 7400. Thus, to ensure comparability between the exposure concentrations and the toxicity values, no upper width restriction is applied.

were downloaded from Scribe.NET on 4/22/2013, into the Access database. A frozen copy of the Access database is provided in Appendix A of this report. Any changes made to these Scribe projects since this download will not be reflected in the Access database.

2.1.3 Soil Condition Evaluation

2.1.3.1 Visible Vermiculite Status

Because the ABS areas evaluated were representative of the extent of the exposure locations for each receptor population, it is not necessary to try to utilize soil data to estimate ABS air concentrations for unsampled locations. Thus, soil samples were not collected as part of this investigation. However, during ABS efforts, sampling teams continually inspected the ground surface within the ABS area for the presence of visible vermiculite throughout the duration of the ABS activity. Vermiculite from Libby generally contains LA (EPA 2004). Consequently, the presence of visible vermiculite in soil at the Libby Site has been taken as a potentially useful indicator of the presence of LA. A semi-quantitative estimate (none, low, moderate, high) of the amount of visible vermiculite observed was documented in the comments section of the FSDS, as well as within the field logbook.

2.1.3.2 Soil Moisture

In order to determine if soil conditions were appropriate to conduct ABS, soil moisture was measured from 10 locations (0-3 inches below ground surface) within each ABS area using a soil moisture meter. ABS activities were not performed if the mean VWC was greater than 50%, or if the VWC for any of the measurement points was greater than 75%. The 10 soil moisture readings for each area were recorded in the field logbook and the mean VWC was recorded on the ABS Property Background and Sampling Form.

2.1.3.3 Vegetation Condition and Cover

A qualitative estimate of the extent of vegetative cover and vegetation condition of the ROW was determined at the start of each mowing ABS event (Scenario 1) and recorded on the FSDS. Because the hiking ABS (Scenario 2) was performed along hiking trails and paths where vegetation is expected to be limited, estimates of vegetative condition and cover were not deemed necessary for this scenario.

The vegetative condition of the ABS area was qualitatively ranked as either poor, good, or lush. Differences in the vegetative condition across the ABS area before and after the ABS were documented on the FSDS. The extent of vegetative cover in the ABS area was assigned a score based on percentage of coverage as follows:

Score	Vegetative Cover Extent
1	less than 5 percent cover
2	5 to 25 percent cover
3	25 to 50 percent cover
4	50 to 75 percent cover
5	more than 75 percent cover

2.2 Results

2.2.1 ABS Air Results

Table 2-1 summarizes the LA results for outdoor air, stratified by outdoor activity. Detailed results for all outdoor air samples are provided in Appendix C; raw grid opening- and structure-specific data are available in the Access database (Appendix A). As shown, LA was not observed in any of the nine outdoor ABS air samples that were collected as part of this investigation.

2.2.2 Soil Condition Results

Table 2-2 presents the soil VWC measurements for each ABS area. As shown, for the mowing ABS area, individual point VWC values ranged as high as 12.4% (Event 1) with mean VWC below 7% for all events. For the hiking scenario, because all three events occurred on the same morning, soil moisture was recorded only once. Individual VWC values and ranged as high as 11% with a mean VWC of 5.7%. These levels were well below the VWC thresholds established for conducting ABS.

No visible vermiculite was observed in either the mowing or hiking ABS areas. The field team assigned a vegetative cover score of 5 for the mowing ABS area, indicating that more than 75% of the area was covered with vegetation. However, the vegetation condition was rated as poor during all mowing ABS events. No differences in the condition of vegetation were noted across the mowing ABS area. As noted above, because the hiking ABS was performed along hiking trails and paths where vegetation is expected to be limited, estimates of vegetative condition and cover were not deemed necessary for this scenario.

Section 3

Data Quality Assessment

Data quality assessment (DQA) is the process of reviewing data to establish their quality and to determine if any data limitations may influence result interpretation (EPA 2006). Data quality may be evaluated by a variety of metrics. The following sections describe the quality assurance (QA) procedures and quality control (QC) measures that were employed during the OU2 sampling investigation to ensure resulting data were of high quality. The adequacy of the data is also evaluated with respect to the quality metrics and DQOs established in the SAP/QAPP (EPA 2012b).

3.1 Oversight

3.1.1 Field Surveillance

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. Field surveillance was conducted during this sampling investigation on August 21, 2012, by CDM Smith. This surveillance reviewed ABS activities for the first mowing event and all three hiking events, including sampling preparation, site reconnaissance, soil moisture testing, global positioning system (GPS) point collection, equipment calibration and decontamination procedures, and personal protective equipment (PPE). In addition, a review of field documentation, including field logbook entries, FSDS forms, and ABS area sketches was performed.

The results of this field surveillance are summarized in the *Field Surveillance Report* (CDM Smith 2012a). In brief, the surveillance concluded that the field team was well-prepared to execute field activities in an efficient manner. Three deficiencies were noted with respect to performance of soil moisture testing using the "hand squeeze appearance method", the lack of documentation for the lot blank, and the lack of field logbook documentation of names and company affiliations of the field team members. These deviations were either documented in a Libby field record of modification (ROM) form (see LFO-000169) or rectified immediately in the field. No deficiencies were observed the day of the surveillance that would be expected to negatively impact the collected ABS air data.

3.1.2 Laboratory Audits

Laboratory audits are conducted to evaluate laboratory personnel to ensure that samples are handled and analyzed in accordance with the investigation-specific documents and analytical method requirements (or approved Libby laboratory modification forms) and that reported analytical results are correct and consistent. All aspects of sample handling, preparation, and analysis are evaluated. If any issues are identified, laboratory personnel are notified and retrained.

A series of laboratory audits were performed in May-September of 2012 to evaluate all of the Libby laboratories. Detailed audit findings for each laboratory are documented in separate laboratory-specific audit reports (Shaw Environmental & Infrastructure Group [Shaw] 2012a-f). No critical deficiencies were noted during the 2012 laboratory audits that would be expected to impact data quality for TEM analyses.

3.2 Modifications

During any sampling investigation, deviations from the original SAP/QAPP may occur and/or it may be necessary to modify procedures identified in the original SAP/QAPP to optimize sample collection. At the Site, all field and laboratory modifications are recorded in site-specific modification forms. These forms provide a standardized format for tracking procedural changes in sample collection and analysis and allow project managers to assess potential impacts on the quality of the data being collected.

Appendix D provides copies of all applicable modifications associated with this investigation.

As noted above, one Libby field ROM (LFO-000169) was instituted for the OU2 post-construction ABS investigation following the completion of the field surveillance. None of the deviations identified in this field ROM are expected to negatively impact data quality or usability. No laboratory modifications were instituted for analyses conducted in support of this investigation.

3.3 Data Review and Verification

The Libby Scribe project databases have a number of built-in quality control checks to identify unexpected or unallowable data values during upload into the database. Any issues identified by these automatic upload checks were resolved by consultation with the field teams and/or analytical laboratory before entry of the data into the database. After entry of the data into the database, several additional data verification steps were taken to ensure the data were recorded and entered correctly.

In order to ensure that the database accurately reflects the original hard copy documentation, all data downloaded from the database were examined to identify data omissions, unexpected values, or apparent inconsistencies. In addition, 10% of all samples and analytical results underwent a detailed verification. In brief, verification involves comparing the data for a sample in the database to information on the original hard copy FSDS form or the original hard copy analytical bench sheets for that sample. A summary of the data verification effort and findings is presented below.

Hard copy FSDS forms were reviewed in accordance with Libby-specific SOP EPA-LIBBY-11 for two ABS air samples. One non-critical issue was identified; the Personnel Task (i.e., hiking, mowing) recorded on the FSDS form was not entered in the project database. This issue was resolved by field personnel and the necessary corrections were made to the project database.

In addition, the TEM analysis results for these ABS air samples were reviewed in accordance with Libby-specific SOP EPA-LIBBY-09. One discrepancy was identified; the analysis achieved an even lower analytical sensitivity than was required (i.e., the analysis achieved a sensitivity of 0.0058 cc^{-1} when only 0.047 cc^{-1} was actually required). No negative data quality implications were associated with this discrepancy. One non-critical issue was identified in which the analyst name on the benchsheet was incorrectly transferred to the EDD. This issue was resolved by the analytical laboratory, the necessary correction was made to the EDD, and results were re-loaded to the project database.

Appendix E presents a summary of the findings of the FSDS and TEM verification for this investigation. All issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification. All tables, figures, and appendices (including all hard copy documentation and the database [provided in Appendix A and Appendix B, respectively]) generated for this report reflect corrected data.

3.4 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 is performed by the EPA Quality Assurance Technical Support (QATS) contractor (CB&I Federal Services, LLC [CB&I]), with support from technical support staff familiar with investigation-specific data reporting, analytical methods, and investigation requirements. For the Libby project, data validation of TEM results is performed in accordance with Libby-specific SOPs that were developed based the draft *National Functional Guidelines (NFG) for Asbestos Data Review* (EPA 2011a).

The EPA QATS contractor prepares an annual summary of the program-wide assessment of QA/QC. This annual addendum provides detailed information on the validation procedures performed and provides a narrative on the quality assessment for each type of analysis (e.g., PCM, TEM), including the data qualifiers assigned and the reason(s) for these qualifiers to denote when results do not meet acceptance criteria. This annual summary details any deficiencies, required corrective actions, and makes recommendations for changes to the QA/QC program to address any data quality issues.

Copies of the program-wide QA/QC summary reports (CDM Smith 2012b; CB&I 2013) are located on the Libby Lab eRoom.

3.5 Quality Control Evaluation

A number QC samples were collected as part of the OU2 post-construction ABS sampling investigation to help ensure the quality of the results. QC samples included both field-based samples and laboratory-based samples. Results for each type of sample are discussed below.

3.5.1 Field Quality Control

Two types of field QC samples were collected as part of this outdoor ABS program – lot blanks and field blanks.

Lot blanks are collected to ensure air samples for asbestos analysis are collected on asbestos-free filters. Only filter lots with acceptable lot blank results (i.e., no asbestos structures detected) were placed into use for this outdoor ABS effort.

Field blanks are collected to evaluate potential contamination introduced during sample collection, shipping and handling, or analysis. For this investigation, field blanks for ABS air were collected at a rate of one field blank per ABS team per day. A total of three field blanks were analyzed by TEM (one for each day of sampling). No asbestos structures were observed on any field blanks. These results support the conclusion that inadvertent contamination of air samples with LA is not of significant concern, either in the field or the laboratory.

3.5.2 Laboratory Quality Control

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by the National Voluntary Laboratory Accreditation Program (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.

Laboratory QC analyses will evaluated by the EPA QATS contractor on a program-wide basis rather than on an investigation-specific basis. This is because the number of laboratory QC samples directly related to this investigation is too limited to draw meaningful conclusions regarding overall laboratory data quality. A program-wide QA/QC summary report covering all samples collected and analyzed in 2010-2012 is currently in preparation (CB&I 2013). Information regarding program-wide data quality for the TEM laboratories will be provided in this report.

3.6 Data Adequacy Evaluation

Data adequacy is evaluated by comparing the data obtained to the DQOs and the sampling and analysis requirements specified in investigation-specific SAP/QAPP (EPA 2012b).

3.6.1 Spatial and Temporal Representativeness

In accordance with the SAP/QAPP, outdoor samples were collected from locations within the Flyway of OU2 where actual exposures may occur. Based on this, the ABS data collected for both scenarios are considered to be spatially representative.

ABS air samples for this investigation were collected during August and September of 2012. Samples were collected during the time of year (July-September) that is expected to represent the high-end of the LA-releasability from soil. Because releasability from soil to air in the summer may be higher than at other times of year when the ground is frozen or snow-covered (typically November through March), concentration values obtained from this investigation may be somewhat higher compared to long-term average concentrations.

3.6.2 Sample Completeness

Completeness is defined as the fraction of planned samples that were successfully collected and analyzed. For outdoor samples, it was expected that 6 samples would be collected for the mowing scenario, of which 3 would be analyzed. For the hiking scenario it was expected that 12 samples would be collected, of which 6 would be analyzed. As seen in Table 2-1, the number of expected samples collected and successfully analyzed was achieved for all scenarios (i.e., 100% completeness).

3.6.3 Sample Duration

As specified in the SAP/QAPP, a specific time limit was not specified for the mowing soil disturbance activity. Instead, the ABS activity was to last as long as it necessary to mow the entire ABS area regardless of the sampling duration. Actual sampling times for the mowing outdoor ABS samples ranged from 12 to 17 minutes, with an average of 15 minutes. Because the entire ROW was to be mowed regardless of time, the outdoor ABS samples collected are considered representative for the purposes of evaluating MDT worker exposures along the ROW.

The hiking scenario was planned to span a 30-minute time interval. Actual sampling times for the hiking outdoor ABS samples were 30 minutes in all three events. These sampling durations are considered to be long enough to ensure representativeness of the hiking areas along the Kootenai River within the Flyway.

3.6.4 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 sample were encountered that had a true concentration equal to that level of concern, it would be quantified with reasonable accuracy.

As specified in the SAP/QAPP, the target analytical sensitivity for each ABS scenario was derived by calculating a risk-based concentration (RBC) using the draft LA-specific toxicity values (EPA 2011b) and assuming a target cancer risk of 1E-05 and target non-cancer hazard quotient (HQ) of 1. The RBCs were derived based on reasonable maximum exposure (RME) parameters that are equivalent to those utilized in this HHRA (see Section 4.1.3). The target analytical sensitivity was determined by dividing the RBC for each scenario by 3, which ensures that a sample with a true air concentration equal to the RBC will have a 95% probability of detection. As specified in the SAP/QAPP, the target analytical sensitivity was 0.047 cc^{-1} for mowing ABS air samples and 0.0058 cc^{-1} for hiking ABS air samples.

Table 2-1 summarizes the analytical sensitivities achieved for all outdoor ABS air samples. As seen, all mowing ABS air samples achieved the target sensitivity of 0.047 cc^{-1}; in fact, two of the samples achieved an even lower analytical sensitivity than was required. All of the hiking ABS air samples achieved the target sensitivity of 0.0058 cc^{-1}.

3.6.5 Evenness of Filter Loading

The TEM analysis of filters generated for ABS air examines only a portion of the total filter. For the purposes of computing concentration in the ABS air sample, it is assumed that the filter is evenly loaded. The assessment of filter loading evenness is evaluated using a Chi-square (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the reported result may not be representative of the true concentration in the sample, and the results should be given low confidence. An evaluation of filter loading for the ABS air samples from this study showed that, since no structures were observed in any analysis, all filters passed the CHISQ test for evenness. Thus, it is concluded that uneven filter loading is not of significant concern for the ABS air samples analyzed in this study.

3.7 Data Quality Conclusions

Taken together, these results indicate that data collected as part of the OU2 post-construction ABS investigation are of acceptable quality and are considered to be reliable and appropriate for their intended use.

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Section 4

Risk Assessment

This section presents an evaluation of the human health risks associated with LA exposures in outdoor air at OU2. These risk calculations are only for exposures to workers and recreational visitors/trespassers that occur within OU2. Exposures that may occur outside of OU2 are not considered in this document, but will be evaluated in the Site-wide cumulative human health risk assessment and in final risk management decision-making for the Site.

4.1 Exposure Assessment

4.1.1 Current Soil Conditions

As described in the *Final OU2 Remedial Investigation Report* (EPA 2009), with the exception of three areas, surface soils have been remediated over almost the entire area of OU2. The three exceptions are located within the Flyway (shown by areas with green shading in Figure 4-1) and include the following:

- A small area along the Kootenai River frontage, south of the confluence with Rainy Creek. This area is seasonally submerged. Any LA contamination that might have existed in this area is expected to either be washed away by the river flow, or else buried beneath sediment deposits. Soil samples collected in this area as part of an investigation conducted in July of 2010 were primarily non-detect for LA by polarized light microscopy using visual area estimation (PLM-VE); one soil sample was reported as containing trace levels of LA by PLM-VE.
- A larger area along the river in the southern portion of the Flyway. Most of this area is also seasonally submerged, although a narrow portion along the eastern boundary is not. A number of soil samples have been collected along this narrow strip (see Figure 4-1), and all were non-detect for LA PLM-VE.
- An area in the southeast corner of the Flyway, near the Highway 37 ROW. Surface soils in this area were not remediated because no soil samples collected in the area exceeded the trigger[2] for action (≥ 1%). However, one sample did reveal a low level (<1%) of LA in soil (see Figure 4-1).

Even though cleanup actions taken at OU2 often involved removing contaminated soils to depths of up to 4 feet, there are a number of areas where residual contamination remains at various depths below the surface (see Figure 2-3 in EPA 2009). Remaining contaminated soil at depth was covered with geotextile covers and fill after soil removal actions. Restoration activities included placement of cover and seeding or re-vegetation, and in some cases, placement of rip-rap and/or erosion control matting. These measures control erosion of contaminated soil by wind and water from source locations to prevent the spread of contamination to other locations. ICs have been (or will be) finalized to limit uses that will damage the remedy, thereby minimizing risks posed to human receptors from remaining LA in subsurface soil. ICs currently in place limit excavations at OU2. Any excavation requires a call to U-Dig to identify buried utilities and, for an excavation within Superfund Site boundaries, a call to U-Dig prompts the Environmental Resource Specialist (ERS) program to identify

[2] The trigger for removal of 1% LA does not imply that materials less than 1% have no associated risk.

the potential for residual asbestos contamination on the property. Proprietary controls (i.e., an environmental covenant) prohibiting activities that may compromise the effectiveness of the selected remedy is in place for Subarea 2. In addtion, encroachment and permitting ICs have been established to protect the selected remedy for the MDT ROW. All ICs for OU2 have not finalized at this time; however, final ICs for OU2 will be compiled in an Institutional Control Implementation and Assurance Plan (ICIAP).

To ensure long-term effectiveness and permanence of the selected remedy, monitoring, inspections, maintenance, and reviews will be conducted. During the site inspections, current site conditions, including drainage, signs of erosion and integrity of the cover, will be observed and documented. Damage to covers and backfilled areas identified during routine site inspections will be repaired to eliminate exposure of underlying contamination. Monitoring of the ICs will include evaluations of the effectiveness of the ICs implemented by the ICIAP. Five-year site reviews will be conducted by the EPA (as required by the National Contingency Plan [NCP]) to ensure that the remedy as implemented and maintained continues to be protective of human health and the environment.

4.1.2 Exposure Areas, Populations, and Pathways

As discussed above, OU2 includes areas that were affected by contamination released from the former Grace Screening Plant. Subareas within OU2 include the former Screening Plant (Subarea 1), the Flyway (Subarea 2), a privately-owned property (Subarea 3), and the Rainy Creek Road frontages (Subarea 4) (see Figure 1-2). Because of concerns for exposure of humans to contamination in OU2, EPA has taken extensive actions to remove mine-related waste materials and contaminated soils. In areas that have been remediated, and where surface soil is either capped or backfilled with clean soil, there are no complete exposure pathways to LA at present. However, as described above, there are several areas within the Flyway where soils have not been remediated. These areas were the focus of the post-construction risk assessment for OU2 (see Figure 2-1).

There are two areas within the Flyway that were evaluated in this risk assessment – the Highway 37 ROW and the Kootenai River frontage. For the ROW, the exposure population of primary interest is MDT workers that mow the vegetation along the highway. For the Kootenai River frontage, the exposure population of primary interest is individuals that may recreate or trespass (either intentionally or inadvertently) along the Kootenai River banks within this frontage area.

The principal exposure route of interest for both populations is inhalation of outdoor air in the breathing zone of the exposed individual during disturbances of potential source materials (e.g., asbestos-contaminated soil).

Figure 4-2 presents a conceptual site model (CSM) for human exposure to LA in the Flyway. The CSM presents a graphical illustration of the ways in which people may be exposed to LA that is attributable to mining operations in OU2. As shown, there are two complete exposure pathways that will be evaluated quantitatively in this risk assessment:

- Inhalation exposures of MDT workers to outdoor air during activities that would disturb surface soil (i.e., mowing the ROW)
- Inhalation exposures of recreational visitors to outdoor air during activities that would disturb surface soil (i.e., hiking)

Although exposure to outdoor ambient air is a complete exposure pathway, exposures are expected to be minor (EPA 2009).

Note that if future excavation or construction activities occur in areas where residual contamination remains at depth, a number of potential exposure pathways might become complete, including: a) exposure of tradespersons (excavation workers) during and after the subsurface soil excavation work, and b) exposure of residents, workers, or visitors to releases from post-construction subsurface soil contamination. It is presumed that disturbances of residual LA contamination in subsurface soils have the potential to result in significant exposures and risks. However, as discussed in Section 4.1.1, ICs have been developed to ensure the protectiveness of the remedy and therefore exposure pathways associated with residual contamination at depth are considered incomplete and not evaluated in this HHRA.

4.1.3 Exposure Parameters

Not all individuals within a population will have equal exposures to asbestos. This is because different individuals will have differing values for exposure. To account for this variability in exposure between different individuals, EPA focuses on individuals who have central tendency exposures (CTE) and on those who have reasonable maximum exposures (RME). For the purposes of this risk assessment, risk calculations are performed first based on RME. CTE calculations are only performed if resulting risks based on RME exceed a level of potential concern.

The scenario-specific exposure parameters needed to calculate risks for the mowing and hiking scenarios are not known with certainty. EPA has not established default parameters that are applicable for any of these exposure scenarios of potential concern in OU2. Therefore, for the purposes of this risk assessment, exposure parameters for each exposure scenario were selected based on professional judgment to represent RME values. Outdoor exposure assumptions for MDT workers and recreational visitors/trespassers were developed to be representative for the types of activities that take place at OU2 and the times of the year these activities would take place.

The exposure frequency for MDT workers assumes that workers mow the ROW at OU2 once a month for one hour during the summer from May through September, for a total of five hours per year. Although an MDT worker may mow ROWs more than five hours per year as part of their job, the ROW in OU2 is only about 1,500 feet in length; therefore, only a small fraction of an MDT worker's time is expected to be spent mowing within OU2. The exposure duration assumed for MDT workers is 15 years.

Recreational users are assumed to hike twice a month for two hours per day during the summer from May through September, for a total of ten days per year within OU2. While individuals in Libby may recreate more than ten days per year, given the small spatial extent of the frontage area along the Kootenai River in OU2, only a fraction of this time is expected to be spent hiking within OU2. The exposure duration used in the HHRA for hikers is 30 years.

Table 4-1 provides exposure parameters for MDT workers and recreational visitors/trespassers for OU2 that will be used to quantitatively evaluate each exposure scenario in this risk assessment. Uncertainties associated with these assumptions are discussed in Section 4.5.

4.1.4 Exposure Point Concentrations

An exposure point is a location where exposure and risk are to be evaluated, and an exposure point concentration (EPC) is an estimate of the long-term average concentration of LA in air at that location, expressed as PCM or PCME s/cc. For outdoor exposures, each ABS study area was treated as an exposure point.

Ideally, the EPC used in the risk calculations for each exposure location would be the true average concentration within the exposure area, averaged across the exposure duration. However, the true average concentration at a location can only be approximated from a finite set of measurements, and the observed sample mean might be either higher or lower than the true mean.

To minimize the chances of underestimating the true level of exposure and risk, EPA generally recommends that risk calculations be based on the 95% upper confidence limit (95UCL) of the sample mean (EPA 1992). However, because there is no EPA-approved method for calculating the 95UCL for an asbestos dataset, risk calculations presented in this report utilize the sample mean (EPA 2008). The sample mean is an unbiased estimate of the true concentration, but the true concentration may be either higher or lower. However, the potential magnitude of the difference between the sample mean and the true mean cannot presently be quantified. One possibility is to use the maximum and mean concentration as EPCs to capture the potential variability in the sample results; however, this approach does not capture the variability due to analytic uncertainty (i.e., Poisson counting error).

Note that, when computing the mean of a set of air samples, all samples with a count of zero structures are evaluated using a concentration value of zero (EPA 2008). This is important, because assigning any value greater than zero to such samples will tend to bias the sample mean high (EPA 1999; 2008).

Table 4-2 presents the EPCs for each exposure population that will be used in the risk assessment.

4.2 Toxicity Assessment

4.2.1 Cancer

Many epidemiological studies have reported increased mortality from cancer in workers exposed to asbestos, especially from lung cancer and mesothelioma. Based on these findings, and supported by extensive carcinogenicity data from animal studies, EPA has classified asbestos as a known human carcinogen (EPA 1993).

4.2.1.1 Lung Cancer

Exposure to asbestos is associated with increased risk of developing all major histological types of lung carcinoma (adenocarcinoma, squamous cell carcinoma, and oat-cell carcinoma) (Agency for Toxic Substances and Disease Registry [ATSDR] 2001). The latency period for lung cancer generally ranges from about 10 to 40 years (ATSDR 2001). Early stages are generally asymptomatic, but as the disease develops, patients may experience coughing, shortness of breath, fatigue, and chest pain. Most lung cancer cases result in death. The risk of developing lung cancer from asbestos exposure is substantially higher in smokers than in non-smokers (Selikoff *et al.* 1968; Doll and Peto 1985; ATSDR 2001; National Toxicology Program [NTP] 2005).

4.2.1.2 Mesothelioma

Mesothelioma is a tumor of the thin membrane that covers and protects the internal organs of the body, including the lungs and chest cavity (pleura), and the abdominal cavity (peritoneum). Exposure to asbestos is associated with increased risk of developing mesothelioma (ATSDR 2001). The latency period for mesothelioma is typically around 20-40 years (Lanphear and Buncher 1992; ATSDR 2001; Mossman *et al.* 1996; Weill *et al.* 2004). By the time symptoms appear, the disease is most often rapidly fatal (British Thoracic Society 2001).

4.2.1.3 Other Cancers

A number of studies suggest asbestos exposure may increase risk of cancer at various gastrointestinal sites (EPA 1986). National Academy of Science (NAS 2006) reviewed evidence regarding the role of asbestos in gastrointestinal cancers primarily following occupational exposures (these are assumed to be primarily by the inhalation route). NAS concluded that data are "suggestive, but insufficient" to establish that asbestos exposure causes stomach or colorectal cancer. Data on esophageal cancer are mixed and were regarded as "inadequate to infer the presence or absence of a causal relationship to asbestos exposure".

Data on risks of gastrointestinal cancer following ingestion-only exposure are more limited. Some researchers (Conforti *et al.* 1981; Kjaerheim *et al.* 2005) have reported a significant correlation between oral exposure to asbestos in drinking water and the risk of gastrointestinal cancer. However, the World Health Organization (WHO 1996) concluded that data are not adequate to support the hypothesis that an increased cancer risk is associated with the ingestion of asbestos in drinking water.

NAS (2006) reviewed available data on the relationship between asbestos exposure and laryngeal cancer and concluded that the data were "sufficient to infer a causal relationship between asbestos and laryngeal cancer." NAS (2006) concluded that data are "suggestive but not sufficient to infer a causal relationship between asbestos exposure and pharyngeal cancer."

Excess deaths from kidney cancer among persons with known exposure to asbestos have been reported by a number of researchers (Selikoff *et al.* 1979; Enterline *et al.* 1987; Puntoni *et al.* 1979). A review by Smith *et al.* (1989) evaluated these studies and concluded that asbestos should be regarded as a probable cause of human kidney cancer.

4.2.1.4 Inhalation Unit Risk (IUR)

The IUR for asbestos reported in IRIS is 0.23 PCM s/cc^{-1} (EPA 2008). However, the IUR value reported in IRIS is suitable only for application to a continuous lifetime exposure scenario (i.e., exposure that begins at birth and continues until death). For "less-than-lifetime" exposure scenarios, the IUR term varies as a function of age at first exposure and exposure duration (EPA 2008). Therefore, an IUR value is computed for each unique exposure scenario to match the exposure period of interest (i.e., age of first exposure and exposure duration). Appendix E of EPA (2008) details how to derive "less-than-lifetime" IUR values. Table E-4 of EPA (2008) is a matrix table that provides IUR values for a series of exposure duration and age at first exposure conditions. Table 4-3 presents the age- and duration-specific IUR values for each exposure population evaluated in this risk assessment.

4.2.2 Non-cancer

4.2.2.1 Asbestosis

Asbestosis is a chronic pneumoconiosis associated with inhalation exposure to asbestos. It is characterized by the gradual formation of scar tissue in the lung parenchyma. Initially the scarring may be minor and localized within the basal areas, but as the disease develops, the lungs may develop extensive diffuse alveolar and interstitial fibrosis (American Thoracic Society [ATS] 1986).

Build-up of scar tissue in the lung parenchyma results in a loss of normal elasticity in the lung which can lead to the progressive loss of lung function. The initial symptoms of asbestosis are shortness of breath, particularly during exertion. People with fully developed asbestosis tend to have increased difficulty breathing that is often accompanied by coughing or rales. In severe cases, impaired respiratory function can lead to death.

Asbestosis generally takes a long time to develop, with a latency period from 10 to 20 years. Mossman and Churg (1998) suggest that latency is inversely proportional to exposure level. The disease may continue to progress long after exposure has ceased (ATSDR 2001). The progression of the disease after cessation of exposure also appears to be related to the level and duration of exposure (ATS 2004).

4.2.2.2 Pleural Abnormalities

Exposure to asbestos may induce the following types of abnormality in the pleura (the membrane surrounding the lungs):

- Pleural effusions are areas where excess fluid accumulates in the pleural space. Most pleural effusions last several months, although they may be recurrent (Lockey *et al.* 1984).
- Pleural plaques are acellular collagenous deposits, often with calcification. Pleural plaques are the most common manifestations of asbestos exposure (ATSDR 2001; ATS 2004).
- Diffuse pleural thickening is a non-circumscribed fibrous thickening of the visceral pleura with areas of adherence to the parietal pleura. Diffuse thickening may be extensive and cover a whole lobe or even an entire lung. Infolding of thickened visceral pleura may result in collapse of the intervening lung parenchyma (rounded atelectasis). Gevenois *et al.* (1998) and Schwartz *et al.* (1991) report that diffuse pleural thickening may occur as a result of pleural effusions.

Pleural effusions and plaques are generally asymptomatic, although rarely they may be associated with decreased ventilatory capacity, fever, and pain (Bourbeau *et al.* 1990). Diffuse pleural thickening can cause decreased ventilatory capacity (Baker *et al.* 1985; Churg 1986; Jarvholm and Larsson 1988). Severe effects are rare, although Miller *et al.* (1983) reported on severe cases of pleural thickening that lead to death.

The latency period for pleural abnormalities is usually about 10 to 40 years (ATS 2004), although pleural effusions may occasionally develop as early as one year after first exposure (Epler and Gaensler 1982).

4.2.2.3 Other Non-Cancer Effects

Some epidemiological studies provide evidence that chronic exposure to asbestos can increase the risk of several other types of non-cancer effects including cor pulmonale (right-sided heart failure), retroperitoneal fibrosis (a fibrous mass in the back of the abdomen that blocks the flow of urine from the kidneys to the bladder), depressed cell-mediated immunity (ATSDR 2001), and autoimmune disease (Pfau *et al.* 2005; Noonan *et al.* 2006).

4.2.2.4 Reference Concentration (RfC)

At present, there is no inhalation RfC available in IRIS for the assessment of non-cancer risks from airborne asbestos exposure.

4.3 Basic Equations

The basic equations for evaluating potential cancer risks and non-cancer hazards from inhalation exposures to asbestos are provided below.

4.3.1 Cancer

EPA has developed a method for estimating excess lifetime cancer risk[3] due to inhalation exposure to asbestos. The basic equation used to estimate excess lifetime cancer risk is (EPA 2008):

$$\text{Risk} = \text{EPC} \cdot \text{TWF} \cdot \text{IUR}$$

where:

Risk = Lifetime excess risk of developing cancer (lung cancer or mesothelioma) as a consequence of 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 = Time-weighting factor. 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.

IUR = Inhalation unit risk $(\text{PCM s/cc})^{-1}$

4.3.2 Non-Cancer

The basic equation for characterizing non-cancer hazards from inhalation exposures to asbestos is as follows:

$$\text{HQ} = \text{EPC} \cdot \text{TWF} / \text{RfC}$$

where:

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

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

TWF = Time-weighting factor

RfC = Reference concentration (PCM s/cc)

As noted above, at this time there is no inhalation RfC available in IRIS for the assessment of non-cancer risks from airborne asbestos exposure.

4.3.3 Equation Inputs

4.3.3.1 Exposure Point Concentration (EPC)

The EPC values used in the risk estimates are specific to each exposure area and population. As discussed above, the EPC is calculated as the mean concentration across all ABS air samples, expressed as PCME LA s/cc, collected for each exposure area. Table 4-2 presents the EPCs for each exposure area.

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[3] Note that excess cancer risk can be expressed in several formats. A cancer risk expressed in a scientific notation format as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000 or 10^{-4}. For the purposes of this document, all cancer risks are presented in a scientific notation format (i.e., 1E-06).

4.3.3.2 Time Weighting Factor (TWF)

The value of the TWF ranges from zero to one, and describes the average fraction that exposure occurs in the time interval being evaluated.

When calculating risks based on the IUR, the equation for TWF is (EPA 2008):

$$TWF = ET/24 \cdot EF/365$$

where:

ET = Average exposure time (hours per day) on days when exposure is occurring

EF = Average exposure frequency (days per year) in years when exposure is occurring

Note that exposure duration is not included in the TWF equation. This is because the IUR incorporates exposure duration in the derivation of the IUR value (see Section 4.2.1).

Table 4-1 provides RME exposure parameters for MDT workers and recreational visitors/trespassers for OU2. Table 4-4 presents the TWF values that will be used to quantitatively evaluate each exposure scenario in this risk assessment.

4.3.3.3 Inhalation Unit Risk (IUR)

As discussed above, an IUR value is computed for each unique exposure scenario to match the exposure period of interest (i.e., age of first exposure and exposure duration). Appendix E of EPA (2008) details how to derive "less-than-lifetime" IUR values. Table 4-3 presents the age- and duration-specific IUR values for each exposure population evaluated in this risk assessment.

4.4 Risk Characterization

Two areas within the Flyway (Subarea 2) were evaluated in this HHRA - the Highway 37 ROW and the Kootenai River frontage (see Figure 2-1). These areas have not been remediated and thus have the maximum potential for exposure (i.e., "worst case"). The exposure population of primary concern for the ROW was MDT workers who mow the vegetation along the highway. For the Kootenai River frontage, the exposure population of concern was individuals that recreate or trespass along the Kootenai River banks within this frontage area. The principal exposure route of interest for both populations was inhalation of outdoor air in the breathing zone of the exposed individual during disturbances of potential source materials (e.g., asbestos-contaminated soil).

Although residual contamination remains at varying depths over a considerable portion of OU2 exposure pathways associated with LA contamination at depth were considered incomplete and not evaluated. This determination is based on the numerous ICs in place to ensure the protectiveness of the selected remedy, thereby eliminating exposure to LA contamination remaining at depth. It is presumed that, if ICs are not maintained, disturbances of residual LA contamination in subsurface soils have the potential to result in significant exposures and risks.

Table 4-5 summarizes cancer risk estimates for MDT workers and recreational visitors/trespassers exposed to outdoor air at OU2. As shown, for both exposure scenarios all ABS air samples were non-detect for LA. Hence, the EPCs and resulting risks are also zero.

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 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.

Since cancer risks are zero, these data show that exposures from outdoor soil disturbances in OU2 are below a level of potential concern for both MDT workers and recreational visitors/trespassers. These results support the conclusion that cleanup actions at OU2 were effective in limiting LA exposures to levels that are below a level of concern. The uncertainty assessment (see Section 4.5 below) provides a further evaluation of potential risks, including an evaluation of "upper-bound" risk estimates in cases where the EPC is zero and potential hazards based on draft LA-specific toxicity criteria.

4.5 Uncertainty Assessment

Although EPA has used the best available science to evaluate potential risks from LA asbestos at OU2, there are number of sources of uncertainty in the risk calculations presented in this report. The most important of these are discussed in more detail below.

Because of these uncertainties, all risk values presented here should be considered to be approximate, and actual risks may be either higher or lower than estimated. However, despite the uncertainties, the results support the conclusion that potential risks are below a level of concern in OU2.

4.5.1 Uncertainty in Toxicity Values Used in Risk Characterization

As noted above, there is currently no RfC for asbestos in IRIS. However, EPA has recently proposed an LA-specific IUR and RfC for use in estimating cancer risks and non-cancer hazards from exposures to LA in air (EPA 2011b). These LA-specific values were derived based on LA-specific exposure and toxicity information and are currently undergoing review in accordance with the IRIS review process. The draft LA-specific IUR is 0.17 PCM LA s/cc^{-1} and the draft LA-specific RfC is 0.00002 PCM LA s/cc. The LA-specific toxicity values used in this interim HHRA are draft values that are subject to change in the future in response to comments from the Scientific Advisory Board. The Site-wide HHRA for the Libby Asbestos Superfund Site will include risk calculations for OU2 that are based on the final LA-specific toxicity values.

The approach for estimating potential risks using the LA-specific toxicity values differs somewhat from the approach described in EPA (2008). For the LA-specific IUR, less-than-lifetime exposures are evaluated by adjusting the respective TWF (i.e., IUR is not adjusted to be age or exposure duration-specific). In addition, when evaluating exposures based on the LA-specific toxicity values, the TWF equation differs for cancer and non-cancer because the interval over which exposure duration is calculated is from age 0 to age 70 for cancer and age 0 to age 60 for non-cancer (because the RfC based on cumulative lifetime exposure lagged by 10 years). The equation for TWF is:

$$TWF_{cancer} = ET/24 \cdot EF/365 \cdot ED/70$$

$$TWF_{non\text{-}cancer} = ET/24 \cdot EF/365 \cdot ED/60$$

where:

ET = Average exposure time (hours per day)

EF = Average exposure frequency (days per year)

ED = Exposure duration (years)

Cancer risk estimates and non-cancer HQs based on the LA-specific toxicity values are shown in Table 4-6. As shown, for MDT workers and recreational visitors/trespassers, because the EPC is zero, both cancer risks and non-cancer HQs are zero. Thus, these data show that, even based on the LA-specific toxicity values, exposures from outdoor soil disturbances in OU2 are below a level of potential concern for both MDT workers and recreational visitors/trespassers.

4.5.2 Uncertainty in True Long-Term Average LA Concentrations in Air

Concentrations of LA in ABS air (especially outdoor ABS air) are inherently variable, so estimates of mean exposure concentrations are subject to uncertainty arising from random variation between individual samples ("sampling uncertainty"). This sampling uncertainty is compounded by the effect of analytical measurement error. That is, for each air sample collected, the number of asbestos structures observed during the analysis is a random variable that is characterized by the Poisson distribution:

$$\text{Count}_{\text{observed}} \sim \text{POISSON}\ (\text{Concentration}_{\text{true}} \cdot \text{Volume Analyzed})$$

In general, the relative magnitude of the uncertainty due to Poisson variation tends to be largest for small counts, and decreases as count increases. The overall uncertainty in a measured concentration is the combination of the sampling error and the Poisson measurement error. The magnitude of the potential error cannot be estimated because appropriate statistical methods are not yet available to calculate the 95UCL for asbestos datasets (EPA 2008).

4.5.3 Uncertainty in the EPC Due to Non-Detect Datasets

A special case arises when all of the samples in a dataset are non-detect (i.e., have a count of zero). The calculated mean of the data set is zero, but the true concentration may be greater than zero. For the purposes of this uncertainty assessment, alternate risk estimates were evaluated for data sets with all zero counts by calculating the mean analytical sensitivity, and setting the EPC equal to one structure times the mean sensitivity. For example, if the mean sensitivity were 0.001 cc^{-1}, the EPC would be evaluated as < 0.001 s/cc. Although not statistically rigorous, this value may reasonably be thought of as a conservative "upper-bound" on the true mean.

Table 4-7 summarizes the cancer risk estimates and non-cancer HQs for MDT workers and recreational visitors/trespassers exposed to outdoor air at OU2 based on the upper-bound EPC. In this table, Panel A presents cancer risk estimates based on the IRIS IUR and Panel B presents cancer risk estimates and non-cancer HQs based on the LA-specific toxicity values. As shown, cancer risks are at or below EPA's acceptable risk range (1E-04 to 1E-06) and non-cancer HQs are less than 1 for both exposure scenarios regardless of the basis of the toxicity values. These results support the conclusion that, even when based on upper-bound estimates, exposures from outdoor soil disturbances in OU2 are below a level of potential concern for both MDT workers and recreational visitors/trespassers.

Note that risk estimates based on the LA-specific toxicity values should be considered as draft estimates and subject to change pending the finalization of the LA-specific toxicity values.

4.5.4 Uncertainty in Human Exposure Patterns

Risk calculations require knowledge of the duration, frequency, and age at which exposure occurs. Exposure parameters for MDT workers and recreational visitors/trespassers were assumed using professional judgment based on typical activities that take place at OU2 and are believed to be

reasonable and site-specific. However, the true parameters for any individual may be either higher or lower than the values assumed, so risks to individuals may vary from the values reported.

4.5.5 Uncertainty in Age-Dependent Factors

In some cases, children are more susceptible to the effects of a toxic chemical than adults. In the case of asbestos, the existing risk models do predict higher risks to children than adults (assuming equal exposures). However, the potency factors used to support these risk calculations are all based on studies in adults, and it is unknown whether or not age-dependent differences in physiology might increase childhood susceptibility to asbestos.

4.5.6 Uncertainty in the Cancer Exposure-Response Relationship

Although the IRIS method is currently the only approach approved by EPA for estimating cancer risks from inhalation of asbestos (EPA 2008), there are some uncertainties and potential limitations to the use of this method, as follows:

- The potency factors derived by EPA (1986) are based on measures of exposure expressed as PCM fibers, without any distinction of mineral type (chrysotile, amphibole). There is on-going debate regarding whether there is a difference in the relative cancer potencies of the various mineral types. In particular, the carcinogenic potential of chrysotile asbestos relative to amphibole asbestos is a controversial issue. Based on lung burden studies, mechanistic studies, and some epidemiological data, some researchers (e.g., Hodgson and Darnton 2000; Mossman *et al.* 1990; McDonald and McDonald 1997) propose that amphibole fibers are more potent inducers of mesothelioma, and potentially of lung cancer, than chrysotile. Other studies have confirmed the carcinogenic potency of chrysotile (Smith and Wright, 1996; Kanarak, 2011). Because the potency factors are consensus values that are derived from studies that include occupational exposures to chrysotile alone, amphibole alone, and a mixture of amphibole and chrysotile, it is expected that the IRIS potency factors are intermediate between the values for amphibole and chrysotile.

- To the extent that the particle size distributions vary between workplaces (i.e., the ratio is not constant between the concentration of PCM fibers and the concentrations of other size ranges with differing potencies), the IRIS approach cannot account for these differences, and may either underestimate or overestimate risk.

- The IRIS values are based on observations in workers, and may not address differences in susceptibility between different types of populations (e.g., children, women).

- The IRIS values represent the central tendency estimates of the potency factors, not an upper-bound on the values. Thus, the true potency factors might be either higher or lower than the values selected.

- The unit risks derived by EPA (1986) are based on mortality statistics from the 1970s. Thus, they may not be applicable to populations that are exposed to asbestos today. In particular, as life expectancy has increased, risks from asbestos exposure also tend to increase. Thus, risk estimates based on the IRIS method may be somewhat low.

4.5.7 Uncertainty Associated with Cumulative Exposures

MDT workers and recreational visitors/trespassers may be exposed to LA not only at OU2 but at other locations as well. EPA will consider the total cumulative risks to individuals in the final risk management decision process for the Libby Site.

4.6 Summary and Conclusions

EPA has taken extensive actions to clean up the mine-related waste materials and contaminated soils in OU2 because of concerns for exposure of humans to contamination. The primary objective of the OU2 post-construction investigation and risk assessment was to determine if residual LA poses unacceptable risks to individuals at OU2 under post-construction conditions.

Because Subarea 1 (former Screening Plant), Subarea 3, and Subarea 4 (Rainy Creek Road frontages) are all privately-owned, and the owners have opted not to participate in post-construction sampling activities, no quantitative evaluation of potential residual risks is possible. However, most of these subareas have been remediated and surface soil is either capped or backfilled with clean soil; thus, there are no complete site-related contaminant exposure pathways to LA expected in these subareas at present. ICs will be used to minimize potential risks posed to people from LA remaining in subsurface soils and to ensure that the selected remedy remains protective.

As described above, there are several locations within Subarea 2 (Flyway) where soils have not been remediated. These locations were the focus of the post-construction sampling investigation and risk assessment for OU2. Risks were assessed for MDT workers that mow the ROW in the Flyway and for individuals that recreate or trespass (either intentionally or inadvertently) along the Kootenai River bank in the Flyway. Based on the data collected from the 2012 outdoor ABS sampling investigation, it is concluded that residual risks from outdoor exposures at the Flyway are at or below EPA's acceptable risk range, even when based on LA-specific toxicity values and upper-bound concentration estimates. As noted above, the Site-wide HHRA for the Libby Asbestos Superfund Site will include risk calculations for OU2 that are based on the final LA-specific toxicity values. Additionally, EPA will consider the total cumulative risks to individuals in the final risk management decision process for the Libby Site.

Section 5

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Tables

TABLE 2-1
2012 OU2 (SUBAREA 2) POST-CONSTRUCTION OUTDOOR ABS AIR RESULTS

Scenario 1: Workers mowing along the right-of-way on the west side of Highway 37

ABS Event	Sample Date/Time	Index IDs for ABS Air Samples		Achieved Sensitivity $(cc)^{-1}$ [a]	Number of PCME LA Structures Observed [b]	PCME LA Air Conc. (s/cc) [b]	Poisson 95% Upper Confidence Limit (s/cc) [c]
		HV Filter	LV Filter				
Event 1	8/21/12 2:33 PM	FA-00014	FA-00015	0.0057	0	0.00	0.017
Event 2	8/31/12 7:44 AM	FA-00017	FA-00018	0.044	0	0.00	0.13
Event 3	9/8/12 7:38 AM	FA-00020	FA-00021	0.0054	0	0.00	0.016

Scenario 2: Recreational Visitors hiking in the Flyway adjacent to Kootenai River

ABS Event	Sample Date/Time	Index IDs for ABS Air Samples		Achieved Sensitivity $(cc)^{-1}$ [a]	Number of PCME LA Structures Observed [b]	PCME LA Air Conc. (s/cc) [b]	Poisson 95% Upper Confidence Limit (s/cc) [c]
		HV Filter	LV Filter				
Actor 1							
Event 1	8/21/12 9:37 AM	FA-00002	FA-00003	0.0045	0	0.00	0.014
Event 2	8/21/12 10:14 AM	FA-00006	FA-00007	0.0053	0	0.00	0.016
Event 3	8/21/12 10:51 AM	FA-00010	FA-00011	0.0047	0	0.00	0.014
Actor 2							
Event 1	8/21/12 9:37 AM	FA-00004	FA-00005	0.0046	0	0.00	0.014
Event 2	8/21/12 10:14 AM	FA-00008	FA-00009	0.0047	0	0.00	0.014
Event 3	8/21/12 10:51 AM	FA-00012	FA-00013	0.0047	0	0.00	0.014

[a] Target analytical sensitivity was 0.046 cc^{-1} for the mowing scenario and 0.0058 cc^{-1} for the hiking scenario.

[b] All results are based on analysis of the HV filters.

[c] Calculated as = S · ½ · CHIINV[0.05, (2 · N + 2)]

(where S is the achieved sensitivity and N is the number of structures observed)

% = percent

ABS = Activity-based sampling

cc = cubic centimeter

Conc. = concentration

HV = High volume

ID = Identification number

LA = Libby amphibole

LV = Low volume

PCME = phase contrast microscopy equivalent

s/cc = structures per cubic centimeter

TABLE 2-2
2012 OU2 (SUBAREA 2) POST-CONSTRUCTION OUTDOOR ABS SOIL MOISTURE RESULTS

ABS Area	ABS Event	Soil Volumetric Water Content (VWC) (%)											
		1	2	3	4	5	6	7	8	9	10	*Mean*	*Maximum*
Mowing	Event 1	4.5	4.2	7.4	12.4	4.8	3.3	4.9	5	4.8	6.4	*5.8*	*12.4*
	Event 2	3.1	3.6	1.3	1.2	2.4	1.6	1.0	5.2	4.8	5.5	*3.0*	*5.5*
	Event 3	3.0	7.2	4.9	6.6	7.2	6.6	6.6	6.6	8.7	4.4	*6.2*	*8.7*
Hiking	Events 1-3	3.3	3.3	7.9	9.7	9.6	11	3.4	2.6	1.9	4.5	*5.7*	*11.0*

TABLE 4-1
EXPOSURE PARAMETERS FOR OU2 POPULATIONS

Exposed Population	Exposure Scenario	Exposure Time (hours/day)	Exposure Frequency (days/year)	Age at first exposure (years)	Exposure Duration (years)
MDT Worker	Mowing the right-of-way in the Flyway	1	5	18	15
Recreational Visitor/ Trespasser	Hiking along the Kootenai River in the Flyway	2	10	10	30

MDT = Montana Department of Transportation

TABLE 4-2
EXPOSURE POINT CONCENTRATIONS FOR OU2

Exposed Population	Exposure Scenario	Number of ABS Samples Collected	Number of Samples Analyzed	Number of Samples with LA Detected	Exposure Point Concentration (EPC) (PCME LA s/cc)
MDT Worker	Mowing the right-of-way in the Flyway	6	3	0	0
Recreational Visitor/ Trespasser	Hiking along the Kootenai River in the Flyway	12	6	0	0

ABS = activity-based sampling
LA = Libby amphibole
MDT = Montana Department of Transportation
PCME = phase contrast microscopy equivalent
s/cc = structures per cubic centimeter

TABLE 4-3

AGE- AND DURATION-DEPENDANT IUR VALUES FOR OU2 POPULATIONS

Exposed Population	Exposure Scenario	Age at first exposure (years)	Exposure Duration (years)	IURa,d $(PCM\ s/cc)^{-1}$
MDT Worker	Mowing the right-of-way in the Flyway	18	15	0.056
Recreational Visitor/ Trespasser	Hiking along the Kootenai River in the Flyway	10	30	0.11

$(s/cc)^{-1}$ = risk per structures per cubic centimeter
IURa,d = age- and duration-dependant inhalation unit risk
MDT = Montana Department of Transportation
PCM = phase contrast microscopy

TABLE 4-4
TIME-WEIGHTING FACTORS FOR OU2 POPULATIONS

Exposed Population	Exposure Scenario	Exposure Time (hours/day)	Exposure Frequency (days/year)	Time-Weighting Factor (TWF)
MDT Worker	Mowing the right-of-way in the Flyway	1	5	0.00057
Recreational Visitor/ Trespasser	Hiking along the Kootenai River in the Flyway	2	10	0.0023

MDT = Montana Department of Transportation

TABLE 4-5

ESTIMATED RISKS FROM MOWING AND HIKING EXPOSURES IN OU2

Scenario	Exposure Point Concentration (EPC) (PCME LA s/cc)	Cancer		
		TWF	IURa,d $(PCM\ s/cc)^{-1}$	Cancer Risk
Mowing	0	0.00057	0.056	0E+00
Hiking	0	0.0023	0.11	0E+00

$(s/cc)^{-1}$ = risk per structures per cubic centimeter
IUR = inhalation unit risk
LA = Libby amphibole
PCM = phase contrast microscopy
PCME = phase contrast microscopy equivalent
s/cc = structures per cubic centimeter
TWF = time-weighting factor

TABLE 4-6

ESTIMATED RISKS FROM MOWING AND HIKING EXPOSURES IN OU2 BASED ON LA-SPECIFIC TOXICITY VALUES

Scenario	Exposure Point Concentration (EPC) (PCME LA s/cc)	Cancer			Non-Cancer		
		$TWF_{LA,cancer}$	IUR_{LA} $(PCM\ s/cc)^{-1}$	Cancer Risk	$TWF_{LA,\ non\text{-}cancer}$	RfC_{LA} (PCM s/cc)	Non-Cancer HQ
Mowing	0	0.00012	0.17	0E+00	0.00014	0.00002	0.0
Hiking	0	0.0010	0.17	0E+00	0.0011	0.00002	0.0

$(s/cc)^{-1}$ = risk per structures per cubic centimeter
EPC = exposure point concentration
HQ = hazard quotient
IUR = inhalation unit risk
LA = Libby amphibole
PCME = phase contrast microscopy
PCME = phase contrast microscopy equivalent
RfC = reference concentration
s/cc = structures per cubic centimeter
TWF = time-weighting factor

TABLE 4-7
ESTIMATED RISKS FROM MOWING AND HIKING EXPOSURES IN OU2
BASED ON UPPER-BOUND EPCS

Panel A: Based on IRIS Toxicity Values

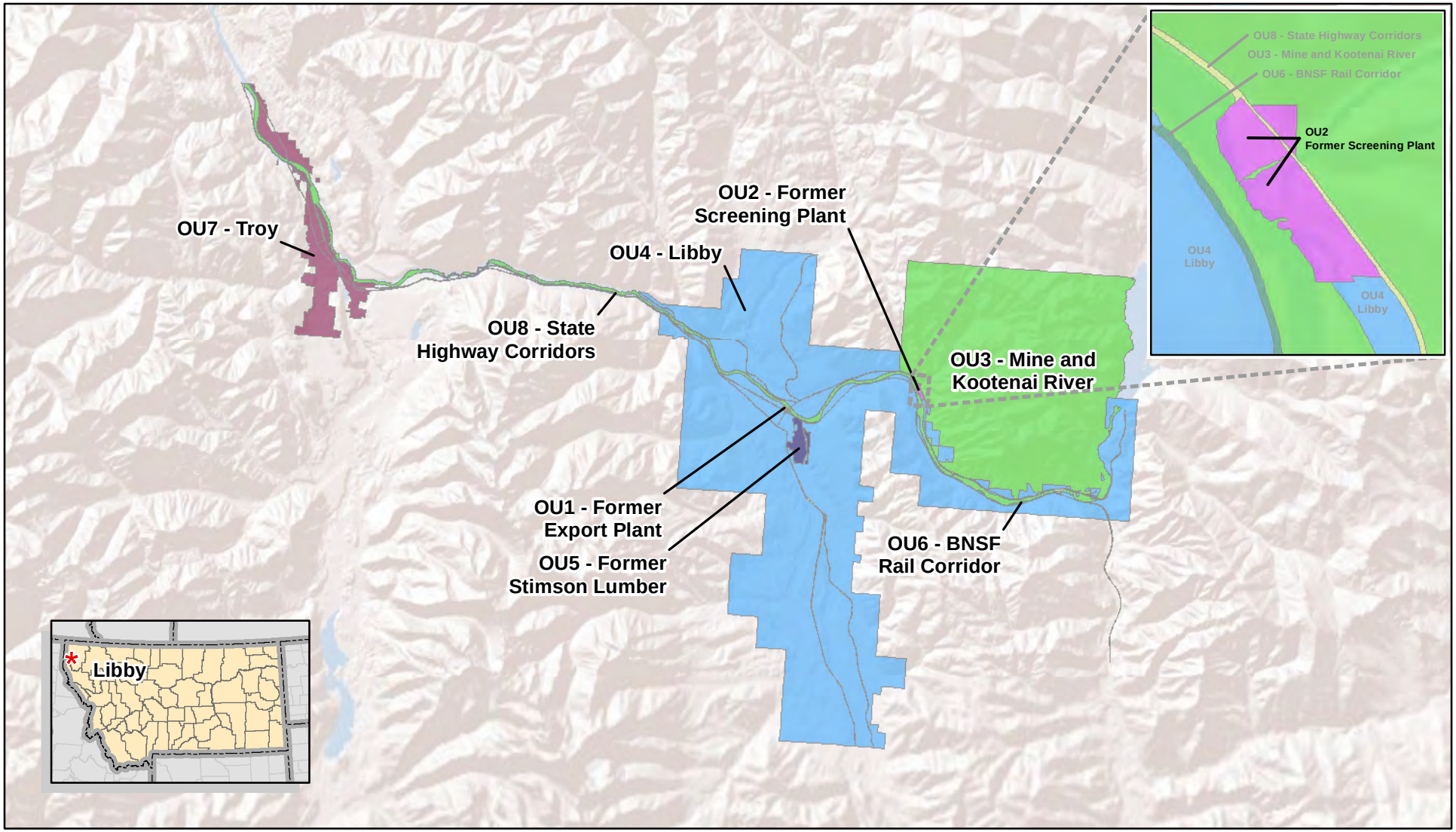
Scenario	Upper-Bound EPC (PCME LA s/cc)	Cancer		
		TWF	IURa,d $(PCM\ s/cc)^{-1}$	Cancer Risk
Mowing	< 0.018	0.00057	0.056	< 6E-07
Hiking	< 0.0048	0.0023	0.11	< 1E-06

Panel B: Based on LA-specific Toxicity Values

Scenario	Upper-Bound EPC (PCME LA s/cc)	Cancer			Non-Cancer		
		$TWF_{LA,\ cancer}$	IUR_{LA} $(PCM\ s/cc)^{-1}$	Cancer Risk	$TWF_{LA,\ non\text{-}cancer}$	RfC_{LA} (PCM s/cc)	Non-Cancer HQ
Mowing	< 0.018	0.00012	0.17	< 4E-07	0.00014	0.00002	< 0.1
Hiking	< 0.0048	0.0010	0.17	< 8E-07	0.0011	0.00002	< 0.3

$(s/cc)^{-1}$ = risk per structures per cubic centimeter
EPC = exposure point concentration
HQ = hazard quotient
IUR = inhalation unit risk
LA = Libby amphibole
PCME = phase contrast microscopy
PCME = phase contrast microscopy equivalent
RfC = reference concentration
s/cc = structures per cubic centimeter
TWF = time-weighting factor

Figures



N

0 12,500 25,000 50,000

Feet

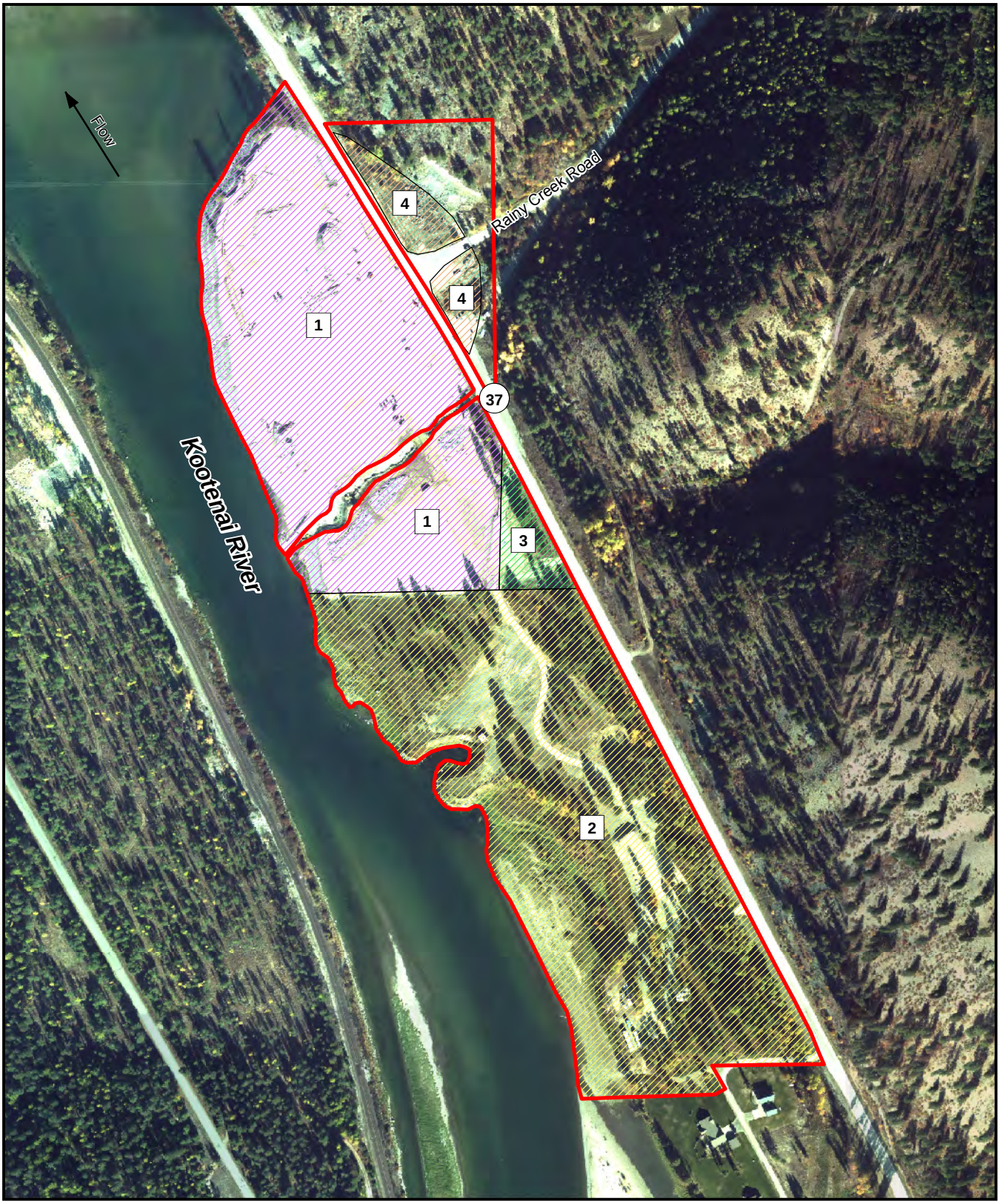
1 inch = 25,000 feet

Legend

- 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 1-1
Operable Units
Libby Asbestos Superfund Site
Lincoln County, Montana

CDM Smith



Legend

- OU2 Boundary
- Subarea 1 - Former Screening Plant
- Subarea 2 - Flyway
- Subarea 3 - Private Property
- Subarea 4 - Rainy Creek Road Frontages

N

0 200 400 800
Feet

1 inch = 400 feet

Figure 1-2
OU2 Site Layout
Libby Asbestos Superfund Site
Lincoln County, Montana

CDM Smith

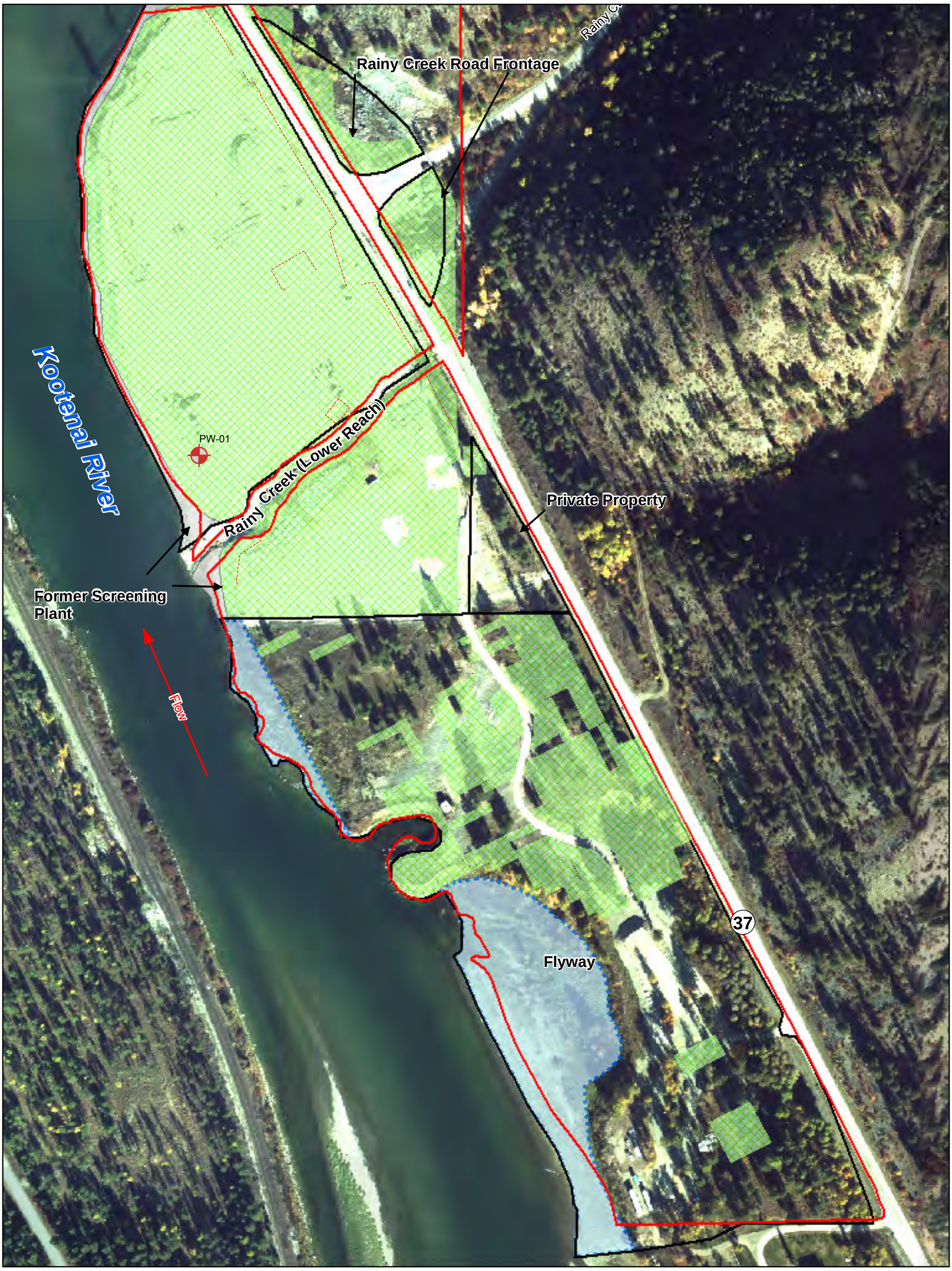


Figure 1-3
Location of Protective Covers
and
Remedy Components at OU2
Libby Asbestos Superfund Site
Lincoln County, Montana

CDM Smith

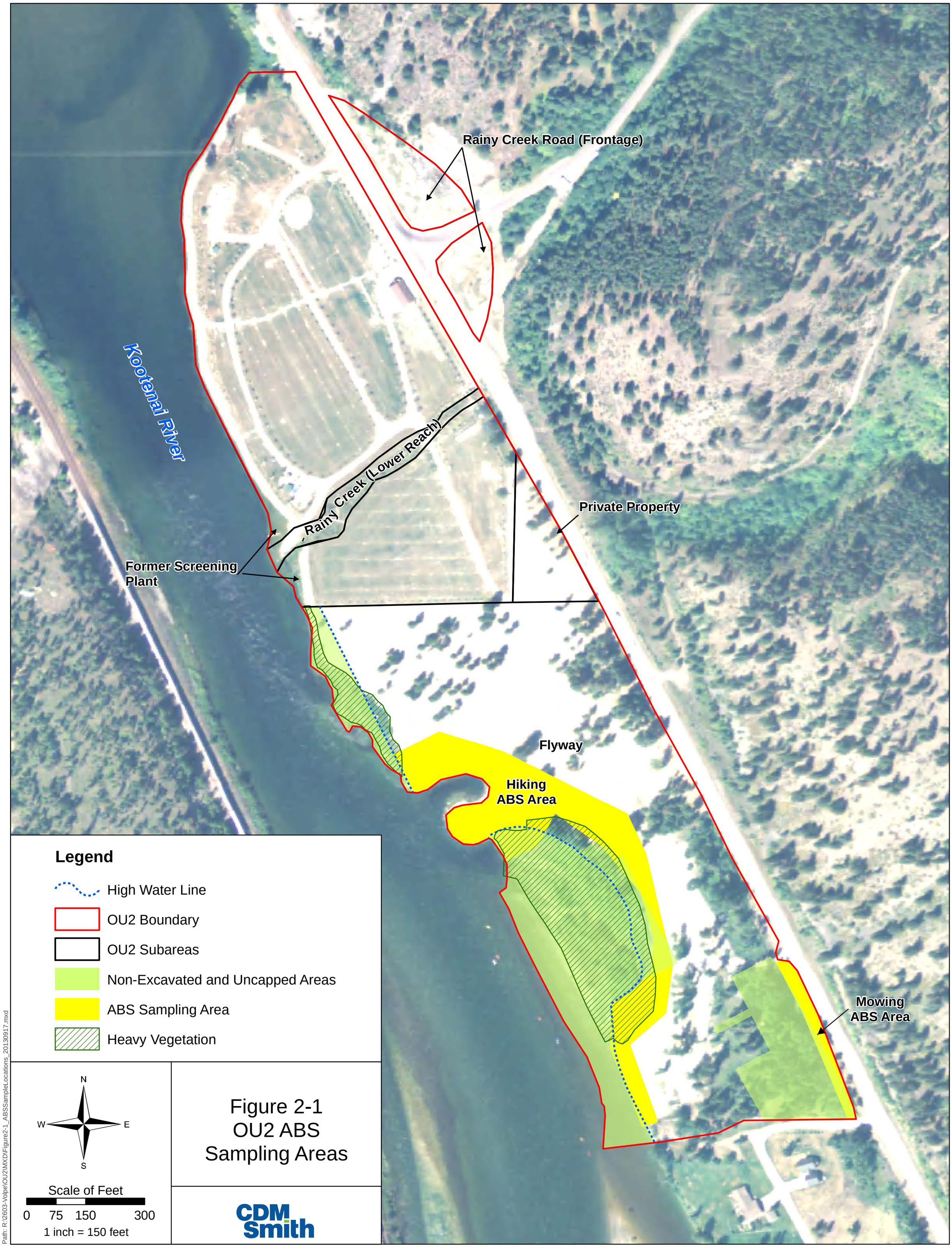


Figure 2-1
OU2 ABS
Sampling Areas

Path: R:\2603-Volpe\OU2\MXD\Figure2-1_ABSSampleLocations_20130917.mxd

CDM Smith

Figure 2-2
Mowing the ROW Scenario Photographs
Libby Asbestos Superfund Site, Operable Unit 2

CDM Smith

Figure 2-3
ABS Hiking Scenario Photographs
Libby Asbestos Superfund Site, Operable Unit 2

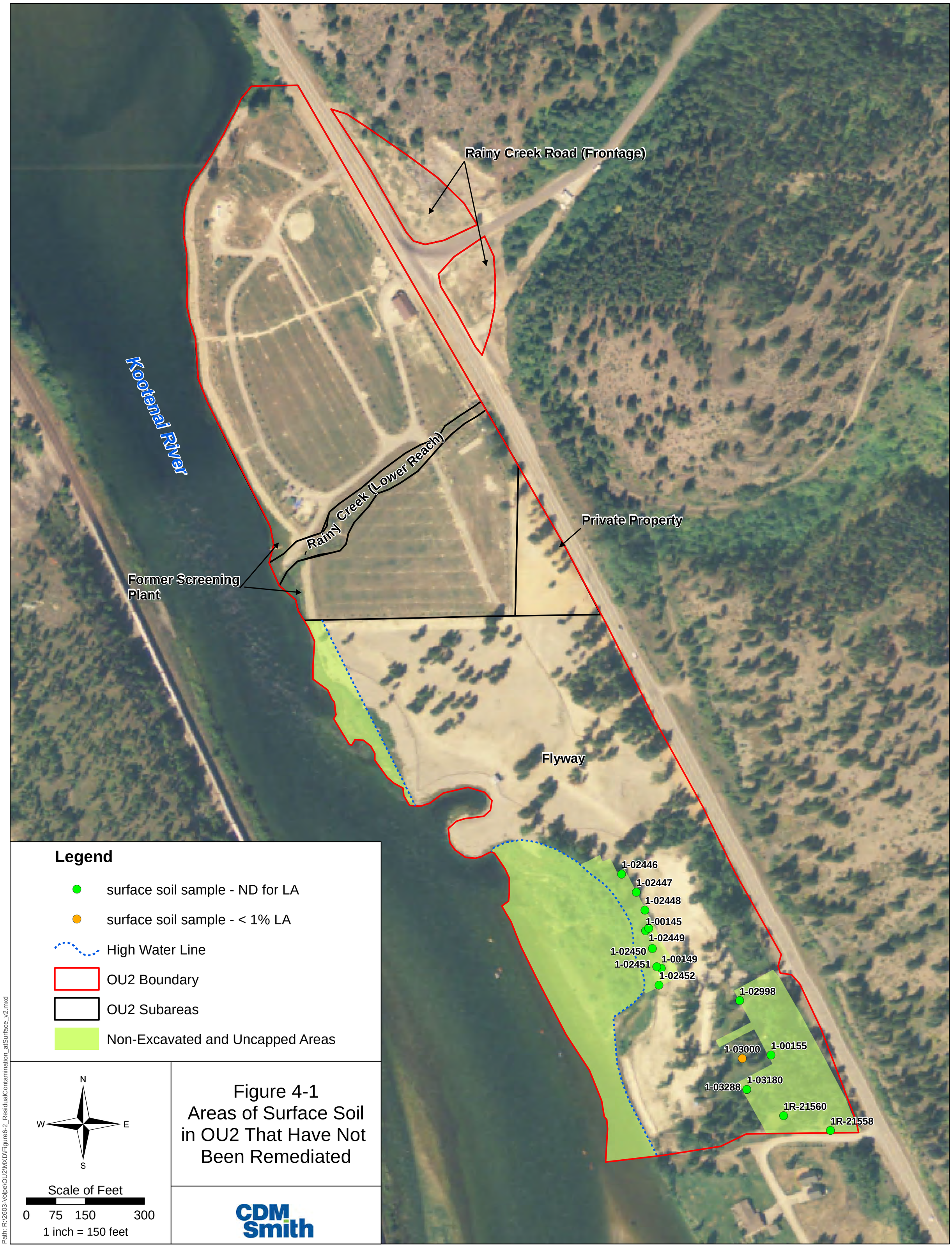
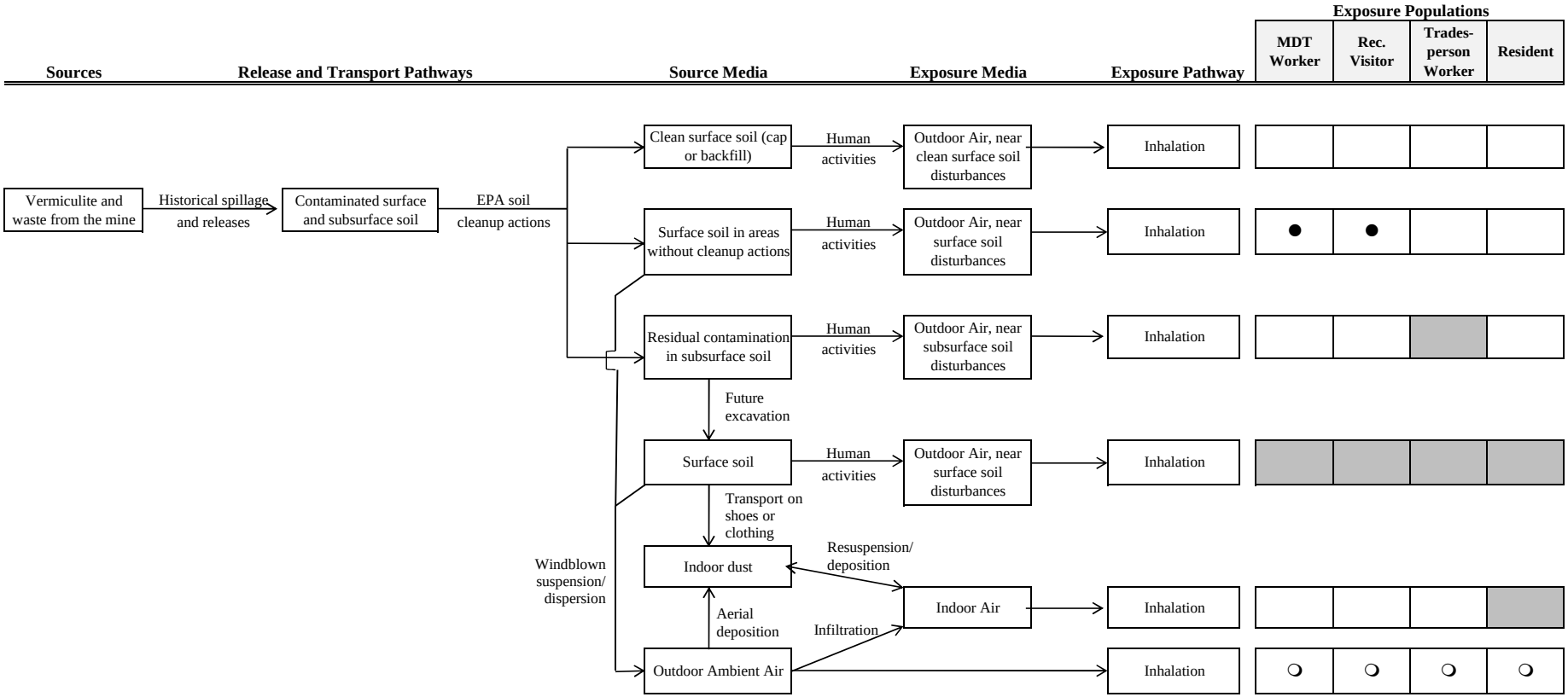


Figure 4-1
Areas of Surface Soil in OU2 That Have Not Been Remediated

Path: R:\2603-Volpe\OU2\MXD\Figure6-2_ResidualContamination_atSurface_v2.mxd

FIGURE 4-2
CONCEPTUAL SITE MODEL FOR CURRENT AND FUTURE INHALATION EXPOSURES TO ASBESTOS AT OU2
Libby Asbestos Superfund Site, Operable Unit 2



KEY:

●	Exposure pathway is complete and will be evaluated quantitatively in the interim HHRA.
	Exposure pathway could become complete (if excavation uncovers subsurface soils with residual contamination); not evaluated quantitatively in the interim HHRA.
❍	Exposure pathway is complete, but expected to be minor; not evaluated quantitatively in the interim HHRA.
	Exposure pathway is not complete or negligible.

Appendices

Appendix A

OU2 Database

(Provided electronically as of a Scribe download performed 3/5/14)

Appendix B

Field Documentation Summary

Event ID FA-080012

Libby Soil-like Sample & Location
Field Sample Data Sheet

FSDS # **S - 105806**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-6 Sampler(s)** S Holmes, A Tanimoto

	Data Item	1	2	3
*	**Location ID**	XX-013699	XX-013700	
*	**Is this a new Location**	(Yes) No Revised *If No, "Z" through location section*	(Yes) No Revised *If No, "Z" through location section*	Yes No Revised *If No, "Z" through location section*
*	**Location Type**	NA	NA	
*	**Location Description**	NA	NA	
	Location Area (ft^2)	150000	2500	
	Location Comment			
	Location Comment2			
*	**Visible Vermiculite**	N___ L___ M___ H___	N___ L___ M___ H___	N___ L___ M___ H___
*	**Soil Depth Top**	Inches	Inches	Inches
*	**Soil Depth Bottom**	Inches	Inches	Inches
	Visible Vermiculite SubLocation			
	Visible Vermiculite Comments			
	Sample Collected	Yes (No) *If No, "Z" through sample section*	Yes (No) *If No, "Z" through sample section*	Yes No *If No, "Z" through sample section*
	Matrix if other than Soil	~~Tree bark Duff Other~~ _____	~~Tree bark Duff Other~~ _____	Tree bark Duff Other _____
*	**Sample ID**			
*	**Sample Time**			
*	**ABS**	N Y	N Y	N Y
*	**Sample Venue**	Indoor Outdoor NA	Indoor Outdoor NA	Indoor Outdoor NA
*	**Sample PrePostClear**	NA Pre Post Clear: 1st 2nd 3rd 4th 5th 6th 7th	NA Pre Post Clear: 1st 2nd 3rd 4th 5th 6th 7th	NA Pre Post Clear: 1st 2nd 3rd 4th 5th 6th 7th
*	**Sample Type**	FS FD Other_____	FS FD Other_____	FS FD Other_____
	Sample Parent ID			
*	**Composite**	Y N	Y N	Y N
*	**Sample / VV Aliquots**	30 Other _____ 0	30 Other _____ 0	30 Other _____ 0
	Sample Location Description			
	Sample Field Comments			

AH 8/21/12

V 120726 ***Required Field** **List company after Sampler(s) if not "CDM Smith" "Soil Depth Top" & "Soil Depth Bottom" refer to VV &/or sample

For Field Team Completion: Completed by: AH QC by: _____ | For Data Entry: Entered by: _____ QC by: _____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101171**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes A Tarumoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	AD-000593	XX-013699 →	→
*	**Sample ID**	**FA- 00001**	**FA- 00002**	**FA- 00003**
*	**ABS**	N (Y)	N (Y)	N (Y)
*	**Sample Venue**	Indoor Outdoor Both (NA)	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	(NA) Pre Post
*	**Sample Type**	FS (FB) LB DB Other____	(FS) FB LB DB Other____	(FS) FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*		FA-00003	
*	**Sample Location Description**	Blank	NA	NA
*	**Personnel Information:** ID 87958 Name Stephen Holmes Task Hiking			
*	**Sample Air Type**	(NA) PA-EXC PA-TWA PA-ABS	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	(NA) LV HV	NA LV (HV)	NA (LV) HV
*	**Flow Meter Type**	(NA) Rotameter DryCal	NA (Rotameter) DryCal	NA (Rotameter) DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2	*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*		
*	**Pump ID**		FJL15P-00051	868063
*	**Sample Air Start Date**		08/21/12	08/21/12
*	**Sample Air Start Time**	8/21/12	0937 / 8/21/12	0937 / 8/21/12
*	**Sample Air Start Flow (L/min)**	8/21/12	5.53 / 8/21/12	~~1.99~~ 1.88 / 8/21/12
*	**Sample Air Stop Date**		08/21/12	08/21/12
*	**Sample Air Stop Time**		1007 / 8/21/12	1007 / 8/21/12
*	**Sample Air Stop Flow (L/min)**		~~5.43~~ ~~5.22~~ 8/21/12 / 8/21/12	1.88 / 8/21/12
*	**Pump Fault**	No (NA) Yes	(No) NA Yes	(No) NA Yes
	Sample Total Time (min)	0		
	Sample Quantity (L)	0		
	Sample Field Comments		Event 1, Actor 1 No VV	Event 1, Actor 1 No VV
	Archive?	Yes No	Yes No	Yes No

V120120 ***Required Field** **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: 8/21 QC by: 8/21 | For Data Entry: Entered by:_____ QC by:_____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101172**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes, A Tarumoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	XX-013699 →		
*	**Sample ID**	**FA- 00004**	**FA- 00005**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	FA-00005		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87075 Name Asami Tarumoto Task Hiking			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	~~NA PA-EXC PA-TWA~~ PA-ABS
*	**Sample Air Volume Type** *(If both HV & LV are collected)*	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	NA Rotameter DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2		*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*	
*	**Pump ID**	FJL15P-00039	868045	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	0937	0937	
*	**Sample Air Start Flow (L/min)**	5.53	1.99	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1007	1007	
*	**Sample Air Stop Flow (L/min)**	5.22	1.99	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Event 1, Actor 2 No VV	Event 1, Actor 2 No VV	
	Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: AT QC by: SH | For Data Entry: Entered by:_____ QC by:_____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101173**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes, A Tarumoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	XX-013699 →		
*	**Sample ID**	**FA- 00006**	**FA- 00007**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	FA-00007		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87958 Name Stephen Holmes Task Hiking			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	~~NA PA-EXC PA-TWA PA-ABS~~
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	~~NA Rotameter DryCal~~
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2			*(For Blanks "2" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*
*	**Pump ID**	FJL15P-00051	868063	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1014	1014	
*	**Sample Air Start Flow (L/min)**	5.43	1.88	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1044	1044	
*	**Sample Air Stop Flow (L/min)**	5.22	1.88	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Event 2, Actor 1 No VV	Event 2, Actor 1 No VV	
	Archive?	Yes No	Yes No	Yes ~~No~~

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by:_____ QC by:_____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101174**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes, A Tarumoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	XX-013699 →	→	
*	**Sample ID**	**FA- 00008**	**FA- 00009**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	FA-00009		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87075 Name Asami Tarumoto Task Hiking			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA PA-ABS
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	NA Rotameter DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2	*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*		
*	**Pump ID**	FJL15P-00039	868045	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1014	1014	
*	**Sample Air Start Flow (L/min)**	5.22	1.99	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1044	1044	
*	**Sample Air Stop Flow (L/min)**	5.22	2.09	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Event 2, Actor 2 No VV	Event 2, Actor 2 No VV	
	Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by:_____ QC by:_____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101175**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes A Tanimoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	XX-013699 →	→	
*	**Sample ID**	**FA- 00010**	**FA- 00011**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	FA-00011		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87958 Name Stephen Holmes Task Hiking			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA PA-ABS
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	NA Rotameter DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2		*(For Blanks "2" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*	
*	**Pump ID**	FJL15P-00037	868063	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1051	1051	
*	**Sample Air Start Flow (L/min)**	5.22	1.88	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1121	1121	
*	**Sample Air Stop Flow (L/min)**	5.33	1.99	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Event 3, Actor 1 No VV	Event 3, Actor 1 No VV	
	Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: AJ QC by: SH | For Data Entry: Entered by:_____ QC by:_____

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101176**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 10369 Pgs 4-5 Sampler(s)** S Holmes, A Tarumoto

	Data Item	1	2	3
*	**Location ID** (To assign NEW locations - complete location section on Soil & Location FSDS)	XX-013699	→	
*	**Sample ID**	**FA- 00012**	**FA- 00013**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID (HV Parent ID = LV Sample ID)	FA-00013		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87075 Name Asami Tarumoto Task Hiking			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	NA ~~PA-EXC PA-TWA PA-ABS~~
*	**Sample Air Volume Type** (if both HV & LV are collected)	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	NA Rotameter DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2		(For Blanks "2" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")	
*	**Pump ID**	FJL15P-00039	868045	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1051	1051	
*	**Sample Air Start Flow (L/min)**	5.22	2.09	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1121	1121	
*	**Sample Air Stop Flow (L/min)**	5.22	2.09	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Event 3, Actor 2 No VV	Event 3, Actor 2 No VV	
	Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by: QC by:

Event ID FA - 080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101177**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs ~~4~~ 5 6 (8/21/12) Sampler(s)** S Holmes, A Tanimoto

	Data Item	1	2	3
*	**Location ID** *(To assign NEW locations - complete location section on Soil & Location FSDS)*	XX-013700	→	
*	**Sample ID**	**FA- 00014**	**FA- 00015**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID *(HV Parent ID = LV Sample ID)*	FA-00015		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87958 Name Stephen Holmes Task Mowing			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	~~NA PA-EXC PA-TWA PA-ABS~~
*	**Sample Air Volume Type** *(if both HV & LV are collected)*	NA LV (HV)	NA (LV) HV	NA ~~LV~~ (8/21/12) HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	~~NA Rotameter DryCal~~
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2			*(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")*
*	**Pump ID**	FOLISP-00037	868063	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1433 ~~(8/21/12)~~	1433 ~~(8/21/12)~~	
*	**Sample Air Start Flow (L/min)**	5.54 ~~(8/21/12)~~	1.99 ~~(8/21/12)~~	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1450 ~~(8/21/12)~~	1450 ~~(8/21/12)~~	
*	**Sample Air Stop Flow (L/min)**	5.22 ~~(8/21/12)~~	2.09 ~~(8/21/12)~~	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Vegetative cover score: ~~4~~ 5 (8/21/12) Vegetative condition poor No VV.		
	Archive?	Yes No	Yes No	~~Yes~~ No

V120120 ***Required Field** **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by:_____ QC by:_____

XX-013699 HIKING EVENTS 1,2,3 8/21/2012

Flyway (Subarea 2) - OU2 Site Layout
ABS Area Sketch

HIKED AREA

AD-000593 KDC FLYWAY

XX-013700 DOT MOWING EVENT 1 8/21/2012

Flyway (Subarea 2) - OU2 Site Layout
ABS Area Sketch

MOWED AREA (6 FT WIDE)

AD-000593

KDC FLYWAY

USACE/Libby Asbestos Project Logbook: 101369
Date: 08/21/12 Address: KDC Flyway AD-000593
Author: A Tarumoto Weather: Overcast 60F.
Personnel: S Holmes, A Tarumoto (CDM Smith)
ABS Scenario: Hiking, Mowing
PPE: Level C, Modified Level D Event: Hiking 1-3; Mowing 1
GPS Unit: Trimble GeoXH GeoExplorer 3000 S/N 17091 w/GeoBeacon
Soil Moisture Meter: Delta T Devices HH2 S/N 53-074 w/Theta Probe ML2X
All activities completed in accordance w/governing document
OU 2, Sampling and Analysis Plan 2012 Post-Construction
Activity-based Sampling, Revision 0, August 2012.

0747 ABS team arrive onsite with T. Crowell (CDM Smith), who will conduct field surveillance.

0755 Collect air blank FA-00001 on cassette lot 25518. in AD-000593. FSDS PA-101171. Assign location ID XX-013699 to Hiking ABS area and XX-013700 to Mowing ABS area. Soil moisture reading from Hiking ABS area: 3.3, 3.3, 7.9, 9.7, 9.6, 11.0, 3.4, 2.6, 1.9, 4.5 → Average VWC 5.7%. Soil moisture defrueency appeared to be in 75-100% range during VWC readings. Take site photos. Calibrate pumps with rotometer 121636-2. Actor 1 S Holmes HV FA-00002 FJL15P-00051 5.53 L/min. LV SKC 868063 ~~1.98~~ 1.99 L/min. FA-00003. FSDS PA-101171. A Vivian (CDM Smith) set up trafficsign. Actor 2 A Tarumoto HV FA-00004 FJL15P-00037 5.53 L/min. LV FA-00005 SKC 868045 ~~1.98~~ 1.99 L/min. FSDS PA-101172. All GPS saved under FA082112A. S Holmes and A Tarumoto don Level C PPE.

8/21/12

0937 Begin hiking ABS event 1. Actors switch positions every 5 min. Collect GPS during activity. No VV.

1007 Hiking ABS event 1 complete. Actor 1 HV 5.43 L/min. LV 1.88 L/min. Actor 2 HV 5.22 L/min. LV 1.99 L/min. ~~Cap S~~ Turn off pumps and cap samples. Attach new sample cassettes for event 2. Actor 1 HV FA-00006. LV FA-00007. Actor 2 HV FA-00008 LV FA-00009. Same pumps as event 1 used.

1014 Begin hiking ABS Event 2. Actors switch positions every 5 min. Collect GPS during activity. No VV.

1044 Hiking ABS event 2 complete. Actor 1 HV 5.22 L/min. LV 1.88 L/min. FJL15P-00051 not working properly. Switch pump to FJL15P-00037 for Event 3. Actor 2 HV 5.22 L/min. LV 2.09 L/min. Turn off pumps and cap samples. Attach new cassette to pumps for Event 3. FJL15P-00037 calibrated to 5.22 L/min.

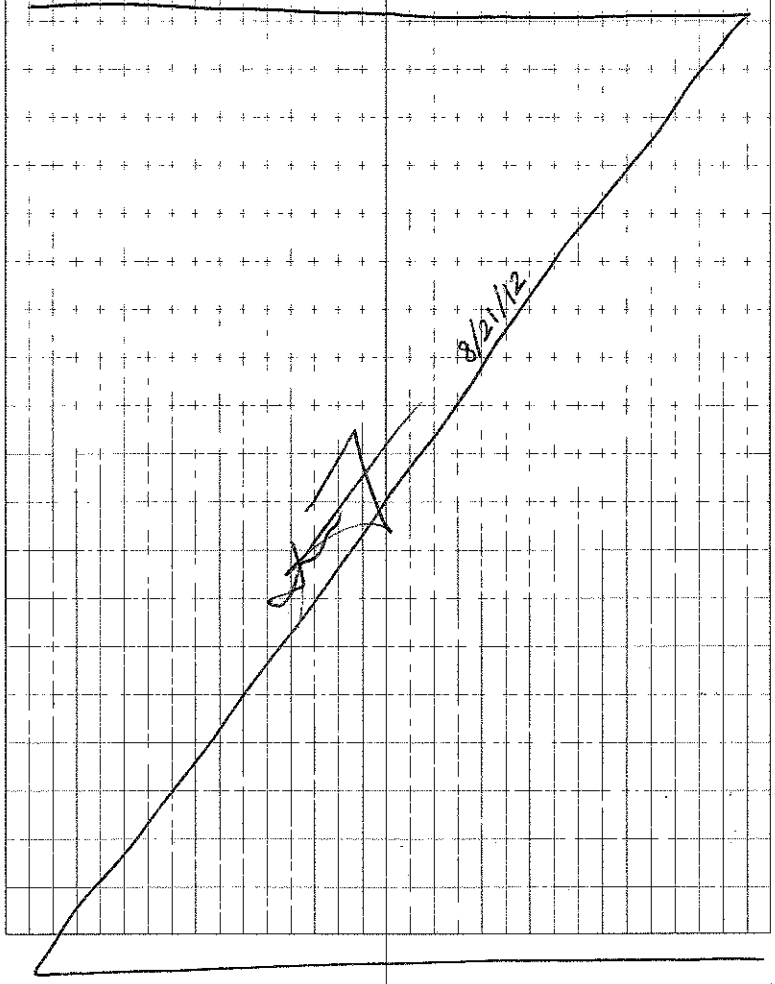
1051 Begin hiking ABS Event 3. Actors switch positions every 5 min. Collect GPS during activity. No VV

1121 Hiking ABS Event 3 complete. Actor 1 HV 5.33 L/min LV 1.99 L/min. Actor 2 HV 5.22 L/min. LV 2.09 L/min. Turn off pumps and cap cassettes. Decon all samples and equipment. S Holmes and A Tarumoto doff Level C. IDW placed in ACM bag. No VV.

8/21/12

Lightning/thunder and rain start.
1145 Team & T Crowell leave site.
1330 ABS team onsite. FSDS 3-105806 has location IDs.
1400 T Crowell onsite. Soil moisture measurement for mowing ABS area: 4.5%, 4.2%, 7.4%, 12.4%, 4.8%, 3.3%, 4.9%, 5.0%, 4.8%, 6.4%. → Average 5.8%.
Vegetative cover ~80%. Vegetative condition poor.
No VV. Calibrate pumps using rotometer 121636-2
HV FA-00014 5.54 L/min. LV FA-00015 1.99 L/min.
1433 Begin mowing activity between driveway into Flyway and River Run Lane, approx. 430 ft by 6 ft area.
Mowing ABS samples recorded on PA-101177.
1450 Mowing activity complete. 4 passes made with mower.
HV 5.22 L/min. LV 2.09 L/min. Turn off pump.
1455 A Vivian onsite to collect traffic sign.
1510 A Vivian off site. Decon all samples and equipment.
IDW placed in ACM bag.
1515 T Crowell off site. Site sketch made.
Late Entry - Hiking ABS on FSDS PA-101173 & 101174 for Event 2; PA-101175 & 101176 for Event 3.
Samples locked in truck.
1520 ABS team off site.
1645 Samples relinquished to sample coordination secure cabinet at CDM Smith office. 8/21/12

Late Entry: Rainfall amount before Hiking or Mowing ABS less than 1/4 inch within past 36 hours.
Mowing area soil moisture deficiency hand test result: 75-100% moisture deficient.



EPA Libby Asbestos Project Logbook 101357 08/21/12

<Abbreviations>

%	percent
&	and
ABS	activity-based sampling
ACM	asbestos containing material
Avg	average
Decon	decontaminate
EXC	excursion
FSDS	field sample data sheet
GPS	global positioning system
HV	high volume
ID	identification
IDW	investigation derived waste
L/min	liters per minute
LV	low volume
OU	operating unit
PA	personal air
OSHA	Occupational Safety and Health Administration
S/N	serial number
TWA	time-weighted average
VWC	volumetric water content
w/	with
PPE	personal protective equipment

USACE/Libby Asbestos Project Logbook: 101369
Date: 8/31/12 Address: KDC Flyway
Author: K. Anderson Weather:
Personnel: Steve Holmes (CDM Smith)
ABS Scenario: Mowing
PPE: C Event: 2
GPS Unit: Trimble GeoXH GeoExplorer 3000 S/N 17091 w/GeoBeacon
Soil Moisture Meter: Delta T Devices HH2 S/N 53-074 w/Theta Probe ML2X
All activities completed in accordance w/governing document
OU 2, Sampling and Analysis Plan 2012 Post-Construction
Activity-based Sampling, Revision 0, August 2012.

0703 ABS team onsite. FSDS# PA-101178.
Soil Moisture Measurement
for Mowing 3.1%, 3.6%, 1.3%, 1.2%
2.4%, 1.6%, 1.0%, 5.2%, 4.8%, 5.5% Average
Vegetative cover ~80%. Vegetative
Condition poor. Calibrate pumps
using rotometer 121636-2.
NO VV. HV- FA-00017, LV-FA-00018.
HV 5.6 l/pm, LV 2.09 l/pm.
0744 began mowing activity between
driveway into Flyway & River Run Lane.
approx 430ft by 6ft area. Reference
FSDS# PA-101178..
0756 mowing activity complete. 4 passes
Made with mower. Post calibrated &
Decon all samples and equipment
IDW placed in ACM bag. 0808- off site
0830- ~~Re~~ locked samples in cabinet
in sample coord. office ~~8/30/12~~

USACE/Libby Asbestos Project Logbook: 101369
Date: 9.8.12 Address: KDC Flyway
Author: K. Anderson Weather:
Personnel: R. Wood. (CDM Smith)
ABS Scenario: Mowing
PPE: C Event: 3
GPS Unit: Trimble GeoXH GeoExplorer 3000 S/N 17091 w/GeoBeacon
Soil Moisture Meter: Delta T Devices HH2 S/N 53-074 w/Theta Probe ML2X
All activities completed in accordance w/governing document
OU 2, Sampling and Analysis Plan 2012 Post-Construction
Activity-based Sampling, Revision 0, August 2012.

0710-ABS Team onsite. Reference FSDS# PA-101180 for location & Sample ID's. Soil Moisture Measurements for mowing were collected. 3.0%, 7.2%, 4.9%, 6.6%, 7.2% 6.6%, 6.6%, 6.6%, 8.7%, 4.4% = 6.18 Average. Vegetative cover is 80% & Vegetative Condition is poor. Calibrated pumps using rotometer 121636-2. No VV was observed.
0738-began Mowing activity between driveway into Flyway & River Run lane in an area approx 430ft x 6ft.
0752-Mowing activity complete with 4 passes with mower. Post calibrated pumps and decon equipment. Actor doffed PPE & discarded in Acm bag. 0820-off site.
0900-Samples locked in cabinet in Sample Coord. office.

KA 9/8/12

CDM Federal Programs Corporation

FIELD SURVEILLANCE REPORT

Date of Report: August 27, 2012

Contract/Project No./Title: EPA Contract No. EP-W-05-049 (SAP/QAPP development) and USACE Contract No. W9128F-11-D-0023 Task Order 2 (SAP/QAPP execution)

Organization: CDM Federal Programs Corporation (CDM Smith)

Date Conducted: August 21, 2012 **Location:** Libby, Montana

Conducted by: Terry Crowell

Personnel Contacted: Jo Nell Mullins (QA Director), Bob Alexander (QA Coordinator), Nate Smith (EPA WA PM); Tommy Cook (USACE TO PM); Asami Tanimoto (FTL); Steve Holmes (Field Team Member); Damon Repine (H&S Manager)

Controlling Documents/Procedures Applicable to Surveillance (Indicate Specific Sections): CDM Smith Accident Prevention Plan (June 2011); Sampling and Analysis Plan/Quality Assurance Project Plan for 2012 Post-construction Activity-based Sampling, Libby Asbestos Site, Operable Unit 2 (Revision 0, August 2012), Section B2 (Sampling Methods), Section B3 (Sample Handling and Custody), and ABS scripts for mowing and hiking; project-specific SOPs to include: EPA-LIBBY-2012-01 – Field Logbook Content and Control; EPA-LIBBY-2012-04 – Field Equipment Decontamination; EPA-LIBBY-2012-05 – Handling IDW; EPA-LIBBY-2012-10 – Sampling of Asbestos Fibers in Air.

Activities/Documentation Reviewed: Sampling preparation, including site reconnaissance, soil moisture evaluation, GPS point collection, equipment calibration, and donning PPE; sampling activities for the three hiking events and the first of the three mowing events; personal and equipment decontamination procedures; and copies of all related field documentation, including logbook entries, field sample data sheets (FSDSs), and ABS area sketches.

Proficiencies: It was clear that the project team were well prepared to execute field activities and divided up field tasks in order to be most efficient. Both team members were actively engaged throughout the entire field surveillance process, asking questions and completing field activities in accordance with guidance documents and procedures. Prior to field work, the FTL had clarified several items in the SAP/QAPP with project management and notified the auditor of the approved changes,

which were subsequently observed to be documented appropriately (via a Libby Field Record of Modification [ROM] to the client). Following review of field documentation, the FTL responded to follow-up questions in a timely and cooperative manner.

Observations: See Field Surveillance logbook (attached) entry for 8/21/12.

Deficiencies: 1) Soil moisture evaluation using the hand method (Section B2.1.2 of the SAP/QAPP) was not observed to have been performed. 2) No documentation related to the lot blank was provided. 3) The names and company affiliations of the person to whom (or alternatively, the location where) samples were relinquished was not documented in the logbook.

Corrective action (CA) taken to address each deficiency. Describe objective evidence observed or reviewed that demonstrates CA was implemented: 1) The auditor brought these deficiencies to the attention of field staff following completion of collecting soil moisture readings using the soil moisture meter. Field staff explained that ground materials were extremely dry and loose when inserting the probe at every location where a soil moisture reading was collected (the dry conditions were also observed by the auditor); therefore, a hand test would certainly have supported the soil moisture deficiency needed for ABS sampling. Deviation documented via ROM. 2) The FTL explained that the unused cassettes for sampling were provided by onsite CDM Smith staff responsible for lot-blank testing the project supply of unused cassettes. The lot blank sample results were subsequently provided to the auditor. Deviations were documented via ROM. 3) Logbook entries were revised to designate that samples were relinquished to the secure sample cabinet at the CDM Smith office.

Further CA required for uncorrected deficiencies? (Y / N) If YES, attach Corrective Action Request (CAR) form.

Prepared by:

Terry Crowell

Approved by:

Jo Nell Mullins

Headquarters QA Director

cc: Geoff McKenzie, Program Manager
Thomas Cook, Project Manager
Jo Nell Mullins, HQ QA Director
Terry Crowell, QAC
HQ QA Files, Oak Ridge
Project Files, Libby

Logbook #101368 EPA/USACE Libby Asbestos Project 3
OU2 Post-construction ABS

8/21/12 Field Surveillance

0747 Notes by Terry Crowell (COM Smith). Arrived onsite at the KDC Flyway along with the field team to conduct a field surveillance of OU2 post-construction activity-based sampling. Work to be performed in accordance with the OU2 Post-construction Activity-based sampling SAP/QAPP, Revision 0, August 2012. Weather is clear, calm (no winds), and 53°F. Staff to be surveilled include Asami Tantimoto (COM Smith) (FTL) and Steve Holmes (COM Smith). Note that most observations associated with this surveillance will be documented on separate forms (e.g. Surveillance Checklist).

0805 Observe Steve taking ~~appropriate~~ TC 8/21/12 soil moisture readings.

0837 Observe Asami taking ~~appropriate~~ TC 8/21/12 photo documentation (pre-sampling conditions). Meanwhile, Steve is setting up a decontamination area

TC 8/21/12

Logbook# 101368

at one end of the hiking scenario ~~or~~ TC 8/21/12 area.

0845 observe pump (air) calibration.

0911 Observe completion of field logbook by team and donning PPE for ABS activities. Don sampling equipment.

0937 Observe team initiate samples and begin ABS hiking scenario, which is the first of three hiking events that will take place today.

1005 Observe team switching leader/follower roles at 5 minute intervals in accordance with the SAP/QAPP ABS hiker script. Also note that GPS coordinates are being collected along the hiking path.

1008 Observe post-sampling ~~calibration~~ TC 8/21/12 flow rate check of air sampling pumps. Team then switches cassettes and gets ready for second hiking event. ~~Pre-calibration~~ Flow rate check TC 8/21/12 and sampling take place.

1019 Observe hiking along different path than first event. Team periodically stops and "scopes out" a fishing

TC 8/21/12

logbook #401368

location.

1023 late entry: all personnel, including myself, in appropriate level of PPE: samplers are in level C with 1/2 face respirator and I'm in modified Level D.

1049 Event 2 sampling (hiker scenario) is complete. Team ~~post calibrated pumps~~ checks flow rates TC 8/21/12, switched cassettes, and ~~pre-calibrated~~ prepares TC 8/21/12 pumps for Event 3.

1057 observe team traversing the Flyway, alternating leader/follower positions.

1101 Note 4-wheeler arriving into the Flyway trailer area w/ three people aboard in tyvek and full-face respirators. Abundant levels of dust from the dirt road are observed.

1121 Event 3 complete (hiker). Post-calibration is conducted. Personal PPE is doffed and equipment decontamination is observed.

1145 Offsite for lunch / work at office.

~~TC~~ 8/21/12

~~1415~~ 1400 Onsite to observe mowing scenario.

TC 8/21/12

TC 8/21/12

Logbook
#101368

Only one mowing scenario will take place today, since the events need to be separated by a minimum of one week.

1424 Donning PPE, preparing paperwork, ~~pre-calibrating~~ 8/22/12 and pumps, collecting GPS coordinates along extent of ROW (Highway 37) to be mowed.

1435 Observe mowing scenario.

1457 mowing scenario complete, Decon following post-calibration and sample collection.

1515 Debrief team on proficiencies/deficiencies (no deficiencies noted in the field).

*8/21/12 significant leave site.

8/21/12

CDM Smith - Libby Field Office

CHAIN OF CUSTODY RECORD

Priority # H-2 **No: 22803**

From: 60 Port Blvd Ste 201, Libby MT 59923
AirBill: NA
No of Samples: 7

Libby Asbestos Investigation EPA Region 8
CarrierName: hand delivered
DateShipped: 8/~~22~~/2012 23 8/23/12

Send To: EMSL27
107 W 4th Street
Libby, MT 59923

271200821

Sample #	Tag	Sample Date	Matrix	Vol/L Area/cm2	Filter Pore Size (um)	TAT Days	Analyses	LV ID	Media Code	Comments
FA-00001	AL1	8/21/2012 RKM	Air	0	0.8	1	PCM-7400		E	
FA-00001	AL2	8/21/2012	Air	0	0.8	60	TEM-ISO		D	
FA-00002	AL2	8/21/2012	Air	164	0.8	60	TEM-ISO	FA-00003	B	
FA-00002	AL1	8/21/2012	Air	164	0.8	1	PCM-7400	FA-00003	C	
FA-00003	AL1	8/21/2012	Air	58	0.8	1	Archive		C	
FA-00003	AL2	8/21/2012	Air	58	0.8	60	Archive		B	
FA-00004	AL1	8/21/2012	Air	161	0.8	1	PCM-7400	FA-00005	C	
FA-00004	AL2	8/21/2012	Air	161	0.8	60	TEM-ISO	FA-00005	B	
FA-00005	AL1	8/21/2012	Air	60	0.8	1	Archive		C	
FA-00005	AL2	8/21/2012	Air	60	0.8	60	Archive		B	
FA-00006	AL1	8/21/2012	Air	160	0.8	1	PCM-7400	FA-00007	C	
FA-00006	AL2	8/21/2012	Air	160	0.8	60	TEM-ISO	FA-00007	B	
FA-00007	AL1	8/21/2012	Air	56	0.8	1	Archive		C	
FA-00007	AL2	8/21/2012	Air	56	0.8	60	Archive		B	

Special Notes: POSTOU20812 - Rev 0

SAMPLES TRANSFERRED FROM COC #:

Relinquished by (Signature and Company)	Date/Time	Received by (Signature and Company)	Date/Time	Sample Condition Upon Receipt
Tracy Sedge CDMSmith	8/23/12 1309	R.K. Mahony EMSC	8/23/12 1309	OK Accept

SAP/QAPP REQUIREMENTS SUMMARY #POSTOU2-0812
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Sampling and Analysis Plan/Quality Assurance Project Plan, 2012 Post-Construction Activity-Based Sampling, Operable Unit 2

SAP Date (Revision): August 2012 (Revision 0)

EPA Technical Advisor: Rebecca Thomas (303-312-6552, Thomas.Rebecca@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 the Flyway of OU2. As part of this program, ABS air samples will be collected and analyzed for asbestos by TEM for two different ABS scenarios (mowing, hiking). Personal air samples will also be collected for H&S monitoring and analyzed by PCM.

Sample ID Prefix: FA-_ _ _ _ _

Estimated number and timing of field samples:
All samples will be collected in August-September 2012 timeframe (exact dates have not yet been determined).
>> ABS Air, mowing = 3 samples + field QC samples
>> ABS Air, hiking = 6 samples + field QC samples

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

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
A	Air, ABS Mowing	Yes	Yes, if material is overloaded (>25%) or unevenly loaded on filter	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	All PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) the target sensitivity is achieved ii) 25 PCME LA structures are recorded iii) 2.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
B	Air, ABS Hiking								

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

(a) The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
(b) See most current version of SOP EPA-LIBBY-08 for preparation details.
(c) If observed, chrysotile and other amphibole asbestos should be recorded. Recording of chrysotile can stop after 25 chrysotile structures have been recorded (finish GO where 25th chrysotile found).
(d) Target analytical sensitivity for mowing scenario is 0.047 cc^{-1} and for hiking scenario is 0.0058 cc^{-1}.

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

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

Analytical Laboratory Quality Control Sample Frequencies:

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

PCM (l): Blind Recounts – 10%

(k) See LB-000029 for selection procedure and QC acceptance criteria
(l) See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	8/17/2012	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: Douglas_Kent_10_July_2012]
- ☐ 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.]

CDM Smith - Libby Field Office

CHAIN OF CUSTODY RECORD

Priority # H-2

No: 22804

From: 60 Port Blvd Ste 201, Libby MT 59923

AirBill: NA

No of Samples: 8

Libby Asbestos Investigation EPA Region 8

CarrierName: hand delivered

DateShipped: 8/~~22~~23/2012 8/23/12

271200828

Send To: EMSL27
107 W 4th Street
Libby, MT 59923

Sample #	Tag	Sample Date	Matrix	Vol/L Area/cm2	Filter Pore Size (um)	TAT Days	Analyses	LV ID	Media Code	Comments
FA-00008	AL1	8/21/2012	Air	157	0.8	1	PCM-7400	FA-00009	C	
FA-00008	AL2	8/21/2012	Air	157	0.8	60	TEM-ISO	FA-00009	B	
FA-00009	AL2	8/21/2012	Air	61	0.8	60	Archive		B	
FA-00009	AL1	8/21/2012	Air	61	0.8	1	Archive		C	
FA-00010	AL1	8/21/2012	Air	158	0.8	1	PCM-7400	FA-00011	C	
FA-00010	AL2	8/21/2012	Air	158	0.8	60	TEM-ISO	FA-00011	B	
FA-00011	AL1	8/21/2012	Air	58	0.8	1	Archive		C	
FA-00011	AL2	8/21/2012	Air	58	0.8	60	Archive		B	
FA-00012	AL1	8/21/2012	Air	157	0.8	1	PCM-7400	FA-00013	C	
FA-00012	AL2	8/21/2012	Air	157	0.8	60	TEM-ISO	FA-00013	B	
FA-00013	AL1	8/21/2012	Air	63	0.8	1	Archive		C	
FA-00013	AL2	8/21/2012	Air	63	0.8	60	Archive		B	
FA-00014	AL2	8/21/2012	Air	91	0.8	60	TEM-ISO	FA-00015	A	
FA-00014	AL1	8/21/2012	Air	91	0.8	1	PCM-7400	FA-00015	C	
FA-00015	AL1	8/21/2012	Air	35	0.8	1	Archive		C	
FA-00015	AL2	8/21/2012	Air	35	0.8	60	Archive		A	

Special Notes: POSTOU20812 - Rev 0

SAMPLES TRANSFERRED FROM COC #:

Relinquished by (Signature and Company)	Date/Time	Received by (Signature and Company)	Date/Time	Sample Condition Upon Receipt
Tracy Dodge CDMSmith 8/23/12	1310	R.K. Mahoney EMSL 8/23/12	1310	OK Accept

SAP/QAPP REQUIREMENTS SUMMARY #POSTOU2-0812
SUMMARY OF PREPARATION AND ANALYTICAL REQUIREMENTS FOR ASBESTOS

Title: Sampling and Analysis Plan/Quality Assurance Project Plan, 2012 Post-Construction Activity-Based Sampling, Operable Unit 2

SAP Date (Revision): August 2012 (Revision 0)

EPA Technical Advisor: Rebecca Thomas (303-312-6552, Thomas.Rebecca@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 the Flyway of OU2. As part of this program, ABS air samples will be collected and analyzed for asbestos by TEM for two different ABS scenarios (mowing, hiking). Personal air samples will also be collected for H&S monitoring and analyzed by PCM.

Sample ID Prefix: FA-_ _ _ _ _

Estimated number and timing of field samples:
All samples will be collected in August-September 2012 timeframe (exact dates have not yet been determined).
>> ABS Air, mowing = 3 samples + field QC samples
>> ABS Air, hiking = 6 samples + field QC samples

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

Medium Code	Medium, Sample Type	Preparation Details				Analysis Details			Applicable Laboratory Modifications (current version of)
		Investi-gative?	Indirect Prep? (b)		Filter Archive?	Method	Recording Rules (c)	Analytical Sensitivity/Prioritized Stopping Rules (d)	
			With Ashing	Without Ashing					
A	Air, ABS Mowing	Yes	Yes, if material is overloaded (>25%) or unevenly loaded on filter	No	Yes	TEM – Modified ISO 10312, Annex E *(Low Mag, 5,000X)*	All PCME asbestos; L: > 5 µm W: ≥ 0.25 µm AR: ≥ 3:1	Count a minimum of 2 grid openings in 2 grids, then continue counting until one is achieved: i) the target sensitivity is achieved ii) 25 PCME LA structures are recorded iii) 2.0 mm^2 of filter has been examined	LB-000016, LB-000029, LB-000066, LB-000067, LB-000085
B	Air, ABS Hiking								

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

(a) The high volume filter will be analyzed in preference to the low volume filter if direct preparation is possible. If the high volume filter is overloaded, use the low volume filter. If the low volume filter is overloaded, prepare indirectly (with ashing), calculate number of grid openings to analyze to reach target analytical sensitivity, and contact EPA project managers or their designate before proceeding with analysis.
(b) See most current version of SOP EPA-LIBBY-08 for preparation details.
(c) If observed, chrysotile and other amphibole asbestos should be recorded. Recording of chrysotile can stop after 25 chrysotile structures have been recorded (finish GO where 25th chrysotile found).
(d) Target analytical sensitivity for mowing scenario is 0.047 cc^{-1} and for hiking scenario is 0.0058 cc^{-1}.

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

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

Analytical Laboratory Quality Control Sample Frequencies:

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

PCM (l): Blind Recounts – 10%

(k) See LB-000029 for selection procedure and QC acceptance criteria
(l) See NIOSH 7400 for QC acceptance criteria

Requirements Revision:

Revision #:	Effective Date:	Revision Description
0	8/17/2012	N/A

Analytical Laboratory Review Sign-off:

- ☐ EMSL – Libby [sign & date:]
- ☐ EMSL – Cinnaminson [sign & date:]
- ☐ EMSL – Beltsville [sign & date:]
- ☐ EMSL – Denver [sign & date:]
- ☒ PSAT [sign & date: Douglas Kent 10 July 2012]
- ☐ 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.]

Appendix C

Outdoor ABS Air Data Summary

APPENDIX C.1

OU2 POST-CONSTRUCTION ABS PERSONAL AIR SAMPLE RESULTS

ABS Information				Sample Information							Analysis Information								Results			
																			N LA Structures		LA Air Conc.	
Receptor Type	ABS Scenario Description	Script	Event	Sample Date	Index ID	Person	Sample Duration (min)	Flow Rate (L/min)	Vol (L) check	Volume Collected (L)	Laboratory	Analysis Date	Prep Method	EFA (mm^2)	GO Size (mm^2)	GOs Counted	F Factor	Sensitivity $(cc)^{-1}$	Total	PCME	Total	PCME
MDT Worker	Mowing ROW	Scenario 1	1	8/21/2012	FA-00014	1	17	5.4	91	91	EMSL27	8/30/12	D	385	0.013	57	1	5.71E-03	0	0	0.0	0.0
			1	8/21/2012	FA-00015	1	17	2.0	35	35	---	---	---	---	---	---	---	---	---	---	---	---
			2	8/31/2012	FA-00017	1	12	5.6	68	68	EMSL27	9/13/12	D	385	0.013	10	1	4.36E-02	0	0	0.0	0.0
			3	8/31/2012	FA-00018	1	12	2.1	25	25	---	---	---	---	---	---	---	---	---	---	---	---
			3	9/8/2012	FA-00020	1	14	5.6	79	79	EMSL27	9/13/12	D	385	0.013	70	1	5.36E-03	0	0	0.0	0.0
			3	9/8/2012	FA-00021	1	14	2.1	29	29	---	---	---	---	---	---	---	---	---	---	---	---
Recreational Visitors	Hiking in the Flyway adjacent to the Kootenai River	Scenario 2	1	8/21/2012	FA-00002	1	30	5.5	164	164	EMSL27	9/5/12	D	385	0.013	40	1	4.51E-03	0	0	0.0	0.0
			1	8/21/2012	FA-00003	1	30	1.9	58	58	---	---	---	---	---	---	---	---	---	---	---	---
			1	8/21/2012	FA-00004	2	30	5.4	161	161	EMSL27	9/5/12	D	385	0.013	40	1	4.60E-03	0	0	0.0	0.0
			1	8/21/2012	FA-00005	2	30	2.0	60	60	---	---	---	---	---	---	---	---	---	---	---	---
			2	8/21/2012	FA-00006	1	30	5.3	160	160	EMSL27	9/6/12	D	385	0.013	35	1	5.29E-03	0	0	0.0	0.0
			2	8/21/2012	FA-00007	1	30	1.9	56	56	---	---	---	---	---	---	---	---	---	---	---	---
			2	8/21/2012	FA-00008	2	30	5.2	157	157	EMSL27	8/29/12	D	385	0.013	40	1	4.72E-03	0	0	0.0	0.0
			2	8/21/2012	FA-00009	2	30	2.0	61	61	---	---	---	---	---	---	---	---	---	---	---	---
			3	8/21/2012	FA-00010	1	30	5.3	158	158	EMSL27	8/29/12	D	385	0.013	40	1	4.69E-03	0	0	0.0	0.0
			3	8/21/2012	FA-00011	1	30	1.9	58	58	---	---	---	---	---	---	---	---	---	---	---	---
			3	8/21/2012	FA-00012	2	30	5.2	157	157	EMSL27	8/29/12	D	385	0.013	40	1	4.72E-03	0	0	0.0	0.0
			3	8/21/2012	FA-00013	2	30	2.1	63	63	---	---	---	---	---	---	---	---	---	---	---	---

--- filter was not analyzed
cc = cubic centimeter
D = Direct
EFA = Effective area of the filter
GO = Grid openings
L = Liter
L/min = Liters per minute
MDT = Montana Department of Transportation
mm^2 = square millimeters
PCME = phase contrast microscopy equivalent
ROW = Right of Way

Appendix D

Field and Laboratory Modifications

Record of Modification to Documents Governing Field Activities Libby Asbestos Project

Form No. LFO-000169

Instructions to Requester: Email draft modification form to the contacts at bottom of form for review and approval. File approved copy with the CDM Smith Quality Assurance Coordinator (QAC) at the Libby Field Office (LFO). The QAC will distribute approved copies and maintain the originals at the LFO.

Requester: Asami Tanimoto Title: Field Team Lead

Company: CDM Smith Date: August 23, 2012

Governing document (title and approved date) or SOP (title and SOP number): Sampling and Analysis Plan/Quality Assurance Project Plan: 2012 Post-Construction Activity-Based Sampling, Revision 0 – August 2012

Field logbook and page number where modification is documented (or attach associated correspondence): Logbook #101369

Description of modification (attach additional sheets if necessary; include revised text for all document or SOP sections that are affected by the modification): See Attachment 1

Implication(s) of modification (if applicable, attach a list of affected property addresses or sample IDs): See Attachment 1

Duration of modification (cicle one):

Temporary Date(s): _____

Permanent Effective Date: August 21, 2012

Data Quality Indicator (indicate one; reference the definitions below for direction on selecting data quality indicators): See Attachment 1

DATA QUALITY INDICATOR DEFINITIONS

Reject - Samples associated with this modification form are not useable. The conditions outlined in the modification form adversely effect the associated sample to such a degree that the data are not reliable.

Low Bias - Samples associated with this modification form are useable, but results are likely to be biased low. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated low.

Estimate - Samples associated with this modification form are useable, but results should be considered approximations. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimates.

High Bias - Samples associated with this modification form are useable, but results are likely to be biased high. The conditions outlined in the modification form suggest that associated sample data are reliable, but estimated high.

No Bias - Samples associated with this modification form are useable as reported. The conditions outlined in the modification form suggest that associated sample data are reliable as reported.

CDM Technical Review and Approval: Lynn Woodley Date: 10/25/12
(CDM Project Manager or designate)

EPA Review and Approval: Rebecca J. Thomas Date: 10/31/12
(USEPA RPM or designate)

LFO-000169: Attachment 1

Sections A6.2 (Page 17)
Logbook 101369 **Pages** 8-9
Date(s): 8/31/12, 9/8/12
Description of modification: Events 2 and 3 of the mowing scenario will be completed in late August/early September to maintain at least a week between sampling events. Sampling dates will meet the meteorological and soil moisture requirements.
Implications of modification: There are no anticipated negative implications of this modification.
Data Quality Indicator: No Bias

Sections B2.1 (Page 27)
Logbook 101369 **Pages** 4-7
Date(s): 8/21/12
Description of modification: Instead of collecting additional low volume sample for health and safety, personal air samples collected for mowing and hiking ABS will also be analyzed for health and safety using PCM.
Implications of modification: There are no anticipated negative implications of this modification.
Data Quality Indicator: No Bias

Sections B2.1.2 (Page 27)
Logbook 101369 **Pages** 4-7
Date(s): 8/21/12
Description of modification: ABS Property Background Form was not used to record soil moisture as the form has been developed in the past to record information on residential properties. Soil moisture readings were recorded in the logbook.
Implications of modification: There are no anticipated negative implications of this modification.
Data Quality Indicator: No Bias

Sections B5.1.5 (Page 40)
Logbook 101369 **Pages** 4-7
Date(s): 8/21/12
Description of modification: Two boxes of air cassette lot number 25518 were set aside from project supply by Nic Pisciotta (CDM Smith). Lot blank for these air cassettes were previously analyzed and results verified.
Implications of modification: There are no anticipated negative implications of this modification.
Data Quality Indicator: No Bias

Sections Appendix C
Logbook 101369 **Pages** 4-7
Date(s): 8/21/12
Description of modification: Mowing was done on an area approximately 430 feet by 6 feet between the driveway into the Flyway and River Run Lane. Four passes were made to cover this area. GPS points were taken at both ends of the area. The remaining right of way had a steeper terrain and did not appear to be mowed by DOT.
Implications of modification: There are no anticipated negative implications of this modification.
Data Quality Indicator: No Bias

Appendix E

Data Verification Reports

Data Verification Summary Report
Post-Construction Human Health Risk Assessment
Operable Unit 2, Libby Asbestos Superfund Site

April 2013

Contract No. EP-S8-11-02
Task Order No. 00005

Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by:

CDM Federal Programs Corporation
555 17th Street, Suite 1100
Denver, Colorado 80202

CONTENTS

Field Sample Information Data Transfer Verification Report

TEM Consistency Review and Data Transfer Verification Report

FIELD SAMPLE INFORMATION DATA TRANSFER VERIFICATION REPORT

Project/Dataset Description: Libby Asbestos Superfund Site, Operable Unit 2 (OU2), 2012 Post-Construction Human Health Risk Assessment

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

As specified in the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for the OU2 Post-Construction Activity-Based Sampling Study, a verification of 10% of the field sample data sheet (FSDS) information was performed for activity-based sampling air samples in basic accordance with Standard Operating Procedure EPA-LIBBY-11 (revision 0). The two air samples selected for field sample data verification were the same samples selected for analytical data verification.

One non-critical discrepancy was identified in which the Personnel Task (i.e., hiking, mowing) recorded on the FSDS form was not entered in the project database. This issue has been resolved by field personnel and the necessary corrections have been made to the project database.

The Data Verification Coordinator has performed a check for one of the two samples verified to ensure that any potential issues were identified correctly. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE VERIFICATION

There is no need to perform future review or verification efforts for this dataset. In addition, there are no negative data quality implications because the issue discovered during the verification effort was a non-critical, non-systematic issue and has been resolved.

Data Verifier: _____ ***Date:*** _____

Data Verification Coordinator: _____ ***Date:*** _____

Verification Data Manager*:_____ ***Date:*** _____

****The Verification Data Manager acknowledges that all issues discovered during the verification process have been resolved and that the following criteria have been met:***

--All necessary corrections have been made to the field sample documentation forms utilized in the verification (FSDS forms, field logbooks, COC forms, etc.).
--The corrected field sample documentation forms have been re-submitted to the appropriate parties (as specified in the governing project documents).
--All necessary corrections have been made to the project database.

SAMPLE SELECTION

A verification of sample information was performed for the two air samples that were selected for analytical verification for this dataset.

DATA TRANSFER VERIFICATION RESULTS

Number of samples verified: 2

Number of samples with data transfer issues identified: 1 (50% of total samples verified)

The type and number of discrepancies are summarized in the table below.

Data Field with Discrepancy	Number of Discrepancies
Personnel Task	1

A subsequent investigation of all samples in this dataset was performed to check for accuracy of the Personnel Task field. No additional discrepancies were noted.

Do the issues identified appear to be associated with a particular field member or sample dataset?

☐ Yes ☒ No If yes, identify the field member and/or dataset: N/A

Comments: Attachment 1A (Data Summary Table for Air Samples) and Attachment 1B (Sample Pump Information for Air Samples) contain the details of the verification. Attachment 2 contains the field documentation forms that were used for this verification effort.

ATTACHMENT 1A. DATA SUMMARY TABLE FOR AIR SAMPLES

DVC - 5%	Sample ID	Matrix	Field Data Sheet	Sample Date	Property ID	Field Logbook	Field Logbook Page	Sampler	Location ID	Sample ABS (Y/N)	Sample Venue	Sample PrePostClear	Sample Type	Sample Parent ID	Personnel ID	Personnel Task	Air Type	Air Volume Type	Air Flow Meter Type	Field Comments	Filter Diameter	Filter Pore Size	Verifier's Company	Verifier's Name	Comment	Correction Date
LCW	FA-00002	Air	PA-101171	8/21/2012	AD-000593	101369	4-5	Tanimoto A |CD	XX-013699	Yes	Outdoor	NA	Field Sample	FA-00003	87958	Hiking	PA-ABS	HV	Rotometer	Event 1, Actor 1; No VV	25	0.8	CDM Smith	N. Ross	Personnel Task is null in database; should be Hiking according to FSDS.	2/12/2013
	FA-00014	Air	PA-101177	8/21/2012	AD-000593	101369	6	Tanimoto A |CD	XX-013700	Yes	Outdoor	NA	Field Sample	FA-00015	87958	Mowing	PA-ABS	HV	Rotometer	Vegetative cover score: 5; Vegetative condition: I	25	0.8	CDM Smith	N. Ross		

ATTACHMENT 1B. SAMPLE PUMP INFORMATION FOR AIR SAMPLES

DVC - 5%	Sample Number	Start Date & Time	Start Flow (L/min)	Stop Date & Time	Stop Flow (L/min)	Volume Interval	Verifier's Company	Verifier's Name	Comment	Correction Date
LCW	FA-00002	8/21/12 9:37	5.53	8/21/12 10:07	5.43	164.4	CDM Smith	N. Ross		
	FA-00014	8/21/12 14:33	5.54	8/21/12 14:50	5.22	91.5	CDM Smith	N. Ross		

ATTACHMENT 2 – FIELD DOCUMENTATION FORMS

Event ID FA-080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101171**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs 4-5 Sampler(s)** S Holmes A Tanimoto

Data Item	1	2	3
* **Location ID** (To assign NEW locations - complete location section on Soil & Location FSDS)	AD-000593	XX-013699	→
* **Sample ID**	**FA- 00001**	**FA- 00002**	**FA- 00003**
* **ABS**	N (Y)	N (Y)	N (Y)
* **Sample Venue**	Indoor Outdoor Both (NA)	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA
* **Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	(NA) Pre Post
* **Sample Type**	FS (FB) LB DB Other____	(FS) FB LB DB Other____	(FS) FB LB DB Other____
Sample Parent ID (HV Parent ID = LV Sample ID)		FA-00003	
* **Sample Location Description**	Blank	NA	NA
* **Personnel Information:** ID 87958 Name Stephen Holmes Task Hiking			
* **Sample Air Type**	(NA) PA-EXC PA-TWA PA-ABS	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)
* **Sample Air Volume Type** (if both HV & LV are collected)	(NA) LV HV	NA LV (HV)	NA (LV) HV
* **Flow Meter Type**	(NA) Rotameter DryCal	NA (Rotameter) DryCal	NA (Rotameter) DryCal
* **Cassette Lot No** 25518 **Flow Meter ID** 121636-2		(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")	
* **Pump ID**		FJL15P-00051	868063
* **Sample Air Start Date**		08/21/12	08/21/12
* **Sample Air Start Time**		0937	0937
* **Sample Air Start Flow (L/min)**		5.53	~~1.99~~ 1.98
* **Sample Air Stop Date**		08/21/12	08/21/12
* **Sample Air Stop Time**		1007	1007
* **Sample Air Stop Flow (L/min)**		~~5.43~~ ~~5.22~~	1.88
* **Pump Fault**	No (NA) Yes	(No) NA Yes	(No) NA Yes
Sample Total Time (min)	0		
Sample Quantity (L)	0		
Sample Field Comments		Event 1, Actor 1 No VV	Event 1, Actor 1 No VV
Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm, Pore Size=.8µ

For Field Team Completion: Completed by: AT QC by: SH | For Data Entry: Entered by: ____ QC by: ____

LCW NW

Event ID FA - 080012

Libby Personal Air Sample
Field Sample Data Sheet

FSDS # **PA - 101177**

Address KDC Flyway

Date 08/21/12

Property ID: AD- 000593 Logbook # 101369 Pgs ~~4~~ 5 6 Sampler(s)** S Holmes, A Tanimoto

	Data Item	1	2	3
*	**Location ID** (To assign NEW locations - complete location section on Soil & Location FSDS)	XX-013700	→	
*	**Sample ID**	**FA- 00014**	**FA- 00015**	
*	**ABS**	N (Y)	N (Y)	N Y
*	**Sample Venue**	Indoor (Outdoor) Both NA	Indoor (Outdoor) Both NA	Indoor Outdoor Both NA
*	**Sample PrePostClear**	(NA) Pre Post	(NA) Pre Post	NA Pre Post
*	**Sample Type**	(FS) FB LB DB Other____	(FS) FB LB DB Other____	FS FB LB DB Other____
	Sample Parent ID (HV Parent ID = LV Sample ID)	FA-00015		
*	**Sample Location Description**	NA	NA	
*	**Personnel Information:** ID 87958 Name Stephen Holmes Task Mowing			
*	**Sample Air Type**	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA (PA-ABS)	NA PA-EXC PA-TWA PA-ABS
*	**Sample Air Volume Type** (if both HV & LV are collected)	NA LV (HV)	NA (LV) HV	NA LV HV
*	**Flow Meter Type**	NA (Rotameter) DryCal	NA (Rotameter) DryCal	NA Rotameter DryCal
*	**Cassette Lot No** 25518 **Flow Meter ID** 121636-2		(For Blanks "Z" through "Pump ID" to "Sample Air Stop Flow" then circle NA for "Pump Fault" & enter 0 for "Sample Total Time")	
*	**Pump ID**	FJL15P-00037	868063	
*	**Sample Air Start Date**	08/21/12	08/21/12	
*	**Sample Air Start Time**	1433	1433	
*	**Sample Air Start Flow (L/min)**	5.54	1.99	
*	**Sample Air Stop Date**	08/21/12	08/21/12	
*	**Sample Air Stop Time**	1450	1450	
*	**Sample Air Stop Flow (L/min)**	5.22	2.09	
*	**Pump Fault**	(No) NA Yes	(No) NA Yes	No NA Yes
	Sample Total Time (min)			
	Sample Quantity (L)			
	Sample Field Comments	Vegetative cover score: 4.5 Vegetative condition poor No VV.		
	Archive?	Yes No	Yes No	Yes No

V120120 *Required Field **List company after Sampler(s) if not "CDM Smith" Filter Diameter = 25mm; Pore Size=.8µ

For Field Team Completion: Completed by: [illegible] QC by: [illegible] | For Data Entry: Entered by: ____ QC by: ____

Project/Dataset Description: Libby Asbestos Superfund Site, Operable Unit 2 (OU2), Post-Construction Human Health Risk Assessment

SUMMARY OF FINDINGS AND DATA QUALITY IMPLICATIONS

As specified in the Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) for the OU2 Post-Construction Activity-Based Sampling Study, a verification of 10% of the activity-based sampling (ABS) air sample results analyzed by transmission electron microscopy (TEM) International Organization for Standardization (ISO) 10312 was performed. This verification effort was based on the Libby Scribe databases and the final laboratory reports as provided by TechLaw in accordance with Standard Operating Procedure EPA-LIBBY-09 (revision 2).

One discrepancy was identified in which the target analytical sensitivity (TAS) reported by the laboratory was incorrect based on the TAS specified in the SAP/QAPP. This has the potential to cause negative data quality implications if the achieved sensitivity for the analysis did not reach the TAS. For this analysis, the TAS identified by the laboratory (0.0058 cc^{-1}) on the benchsheet and recorded in the electronic data deliverable (EDD) was lower than the required TAS specified in the SAP/QAPP (0.047 cc^{-1}). Thus, the analysis achieved an even lower analytical sensitivity than was required and no further action was warranted.

One non-critical issue was identified in which the Analyst Name on the benchsheet was incorrectly transferred to the EDD.

Both issues have been resolved by the analytical laboratory and the necessary corrections have been made to the EDDs and loaded to the project database.

The Data Verification Coordinator has performed a check for one of the two the analyses verified to ensure that any potential issues were identified correctly. No deficiencies were noted.

RECOMMENDATIONS FOR FUTURE REVIEW AND VERIFICATION

There is no need to perform future review or verification efforts for this dataset. In addition, there are no negative data quality implications because the issues discovered during the verification effort were non-critical, non-systematic issues and have been resolved.

TEM CONSISTENCY REVIEW AND DATA TRANSFER VERIFICATION REPORT

Data Verifier: _____ ***Date:*** _____

Data Verification Coordinator: _____ ***Date:*** _____

Verification Data Manager*:_____ ***Date:*** _____

****The Verification Data Manager acknowledges that all issues discovered during the verification process have been resolved and that the following criteria have been met:***

- All necessary corrections have been made to the laboratory EDD.
- The corrected laboratory EDD has been re-submitted by the analytical laboratory to the appropriate parties (as specified in the governing project documents).
- The corrected laboratory EDD has uploaded to the project database.
- All necessary corrections have been made to the hand-written laboratory benchsheet.
- The corrected hand-written laboratory benchsheet has been re-submitted by the analytical laboratory to the appropriate parties.

TEM ISO 10312 SELECTION AND CONSISTENCY REVIEW RESULTS

Analyst, Lab	Number of TEM ISO 10312 Analyses			Number of TEM ISO 10312 Analyses Selected for Review		
	Detect	Non-Detect	Total	Detect	Non-Detect	Total
R. Pescador	0	9	9	0	1	1
Total	0	9	9	0	1	1

	Goal	Actual
Selected Total	1	2*
Selected Detects	0	0
Selected Non-Detects	0	2*

*Note: one sample was selected from the mowing scenario and one sample selected from the hiking scenario

Detailed summary of bench sheet consistency review –

Number of analyses reviewed: 2 (100% of total analyses selected)

If not all analyses could be reviewed, provide a brief explanation for why: N/A

Number of analyses with recording issues identified: 0 (0% of total analyses reviewed)

DATA TRANSFER VERIFICATION RESULTS

Number of analyses verified: 2 (100% of total analyses selected)

Number of analyses with data transfer issues identified: 1 (50% of total analyses verified)

Types of data transfer issues identified:

- Incorrect target analytical sensitivity
- Incorrect transfer of Analyst Name from benchsheet to EDD

A subsequent investigation of all samples in this dataset was performed to check for accuracy of the target analytical sensitivity field. No additional discrepancies were noted.

Do the data transfer issues identified appear to be associated with a particular analyst or laboratory?

☐ Yes ☒ No

Comments: Attachment 1A (Data Summary of Analytical and Result Information) and 1B (Data Summary of Structure Information) contain the details of the verification findings along with the corrected data. Attachment 2 contains the laboratory benchsheets that were used for this verification effort, including the data verifier's notes, and all corrections received from the laboratory.

ATTACHMENT 1A. DATA SUMMARY OF ANALYTICAL AND RESULT INFORMATION

DVC - SN	Samp No	File Revision No	Lab ID	Instrument	Mag Low	GO Size	EFA	Tag	Analysis Quantity	Analysis Quantity Units	Receipt Date	Lab Job Number	Lab SampleID	Number Grid Prep	Preparer Name	Prep Date	Analyst Name	Analysis Date	Prep Method	Loose Material	Analysis Method	Est Filter Loading	F Factor	Analysis Comments	Recording Rules			Stopping Rules			Grid Openings Counted		STRUCTCNTPCME			Sensitivity		STRUCTCONCPCME			Stopping Rule Achieved	Maximum area examined	Verifier's Company	Verifier's Name	Comment	Correction Date
																									Min AR Low	Min Length Low	Min Width Low	Target Sens	Max Area Examined	Target N Strucs	Chrys Low	LA/OA Low	LA	OA	CH	LA/OA	CH	LA	OA	CH						
	FA-00002	0	EMSL27	JEOL 100 CX II (27-2)	4800	0.013	385	AL2	164	L	8/23/2012	271200821	271200821-0002	5	D. Barney	8/28/2012	R. Pescador	9/5/2012	Direct	No	TEM-ISO	2	1	Analysis by Annex E (low mag.)	3:1	5	0.25	0.0058	2	25	40	40	0	0	0	0.0045145	0.0045145	0	0	0	sensitivity	0.5	CDM Smith	N. Ross		
EF	FA-00014	1	EMSL27	JEOL 100 CX II (27-2)	4800	0.013	385	AL2	91	L	8/23/2012	271200828	271200828-0007	5	D. Barney	8/28/2012	E. Wyatt-Pescador	8/30/2012	Direct	No	TEM-ISO	8	1	Analysis by Annex E (low mag.) Correction 1 on 3/1/2013 revi	3:1	5	0.25	0.047	2	25	57	57	0	0	0	0.0057095	0.0057095	0	0	0	sensitivity	0.7	CDM Smith	N. Ross	Target sensitivity should be 0.047, not 0.0058 on the benchsheet and in the EDD according to the Media Code "A" on the chain-of-custody. Analyzed by is E. Wyatt-Pescador, not R. Pescador according to benchsheet.	3/8/2013

ATTACHMENT 1B. DATA SUMMARY OF STRUCTURE INFORMATION

Samp No	StructureID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length	Width	AR	Mineral Class	Mineral Desc	EDXA Observation	Structure Identification	Chrysotile Count	Low Mag	Structure Comment	Verifier's Company	Verifier's Name	Comment	Correction Date	DVC - 5%
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_1	1	I1	D1	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_2	2	I1	D2	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_3	3	I1	D3	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_4	4	I1	D4	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_5	5	I1	D5	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_6	6	I1	D6	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_7	7	I1	D7	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_8	8	I1	D8	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_9	9	I1	D9	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_10	10	I1	D10	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_11	11	I1	F1	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_12	12	I1	F3	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_13	13	I1	F5	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_14	14	I1	F7	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_15	15	I1	F9	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_16	16	I1	H2	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_17	17	I1	H4	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_18	18	I1	H6	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_19	19	I1	H8	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_20	20	I1	H10	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_21	21	I3	E2	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_22	22	I3	E4	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_23	23	I3	E6	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_24	24	I3	E8	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_25	25	I3	E10	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_26	26	I3	F1	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_27	27	I3	F3	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_28	28	I3	F5	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_29	29	I3	F7	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_30	30	I3	F9	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_31	31	I3	G2	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_32	32	I3	G4	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_33	33	I3	G6	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_34	34	I3	G8	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_35	35	I3	G10	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_36	36	I3	H1	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_37	37	I3	H3	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_38	38	I3	H4	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_39	39	I3	H6	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00002	271200821-0002_Direct_NotQC_TEM-ISO_40	40	I3	H8	ND										Yes	Yes		CDM Smith	N. Ross			
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_1	1	T1	D1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_2	2	T1	D2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_3	3	T1	D3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_4	4	T1	D4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_5	5	T1	D5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_6	6	T1	D6	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_7	7	T1	D7	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_8	8	T1	D8	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_9	9	T1	D9	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_10	10	T1	D10	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_11	11	T1	E1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_12	12	T1	E2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_13	13	T1	E3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_14	14	T1	E4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_15	15	T1	E5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_16	16	T1	E6	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_17	17	T1	E7	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_18	18	T1	E8	ND										Yes	Yes		CDM Smith	N. Ross			EF

ATTACHMENT 1B. DATA SUMMARY OF STRUCTURE INFORMATION

Samp No	StructureID	Row Index	Grid	Grid Opening	Structure Type	Primary	Total	Length	Width	AR	Mineral Class	Mineral Desc	EDXA Observation	Structure Identification	Chrysotile Count	Low Mag	Structure Comment	Verifier's Company	Verifier's Name	Comment	Correction Date	DVC - 5%
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_19	19	T1	E9	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_20	20	T1	E10	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_21	21	T1	F1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_22	22	T1	F2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_23	23	T1	F3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_24	24	T1	F4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_25	25	T1	F5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_26	26	T1	F6	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_27	27	T1	F7	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_28	28	T1	F8	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_29	29	T1	F9	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_30	30	T1	F10	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_31	31	T3	C1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_32	32	T3	C2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_33	33	T3	C3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_34	34	T3	C4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_35	35	T3	C5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_36	36	T3	C6	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_37	37	T3	C7	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_38	38	T3	C8	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_39	39	T3	C9	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_40	40	T3	C10	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_41	41	T3	D1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_42	42	T3	D2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_43	43	T3	D3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_44	44	T3	D4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_45	45	T3	D5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_46	46	T3	D6	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_47	47	T3	D7	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_48	48	T3	D8	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_49	49	T3	D9	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_50	50	T3	D10	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_51	51	T3	E1	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_52	52	T3	E2	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_53	53	T3	E3	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_54	54	T3	E4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_55	55	T3	E5	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_56	56	T3	F4	ND										Yes	Yes		CDM Smith	N. Ross			EF
FA-00014	271200828-0007_Direct_NotQC_TEM-ISO_57	57	T3	F6	ND										Yes	Yes		CDM Smith	N. Ross			EF

ATTACHMENT 2 – TEM LABORATORY BENCHSHEETS

Revised

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	4,800 x HIGH (LOW)
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Primary filter area (mm2)	385
Secondary Filter Area (mm2)	360
Category (Field, Blank)	Field
Primary filter pore size (um)	0.8

EPA Sample Number:	FA-00014
Tag:	AL-1/2 MS 9/11/12
Matrix (A=Air, D=Dust, DF = Dustfall):	A
Air volume (L), dust area (cm2), or dustfall container area (cm2)	91. 9/6/12
Date received by lab	8/23/2012
Lab Job Number:	271200828
Lab Sample Number:	271200828-0007
Number of grids prepared	5
Prepared by	D. Barney
Preparation date	8/28/2012
EPA COC Number:	22804
Secondary filter pore size (um)	0.2

Analyzed by:	E.Wyatt-Pescador
Analysis date	8/30/2012
Method (D=Direct, I=Indirect, IA=Indirect-ashed)	D
If sample type = air, is there loose material or debris in the cowl? (Yes, No)	No
Analysis Method (TEM-ISO, TEM-AHERA, TEM-ASTM)	TEM-ISO
Grid storage location	2712-LIB-92
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Interlab)	Not QC
Estimated Particulate Loading (%)	8

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right——>

Recording Rules:

Minimum Aspect Ratio (circle one):	none (≥ 3:1) ≥ 5:1
Minimum Length (um):	> 5
Minimum Width (um):	0.25

Stopping Rules:

Target Sensitivity:	0.047 MS 3/1/13 ~~0.0058~~
Max Area Examined:	2
Target # of Structures:	25

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class (see below)				Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
T1	D1	ND																
	D2	ND																
	D3	ND																
	D4	ND																
	D5	ND																
	D6	ND																
	D7	ND																
	D8	ND																
	D9	ND																
	D10	ND																

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

F-factor Calculation:

Indirect Prep Inputs

	Fraction of primary filter used for indirect prep or ashing *[For dust and dustfall, enter 1.0]*
	First resuspension volume or rinsate volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution

Inputs for Serial Dilutions

	Second resuspension volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution
	Third resuspension volume (mL)
	Volume applied to secondary filter (mL)

Input for Ashing of Secondary Filter

	Fraction of secondary filter used for ashing

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one):

H Horizontal

(V) Vertical

Are prepped grids acceptable for analysis? (circle one) (Yes) No

If No, explain:

52.DVC-EF

26

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LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	4,800 x HIGH (LOW)
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Primary filter area (mm2)	385
Secondary Filter Area (mm2)	360
Category (Field, Blank)	Field
Primary filter pore size (um)	0.8

EPA Sample Number:	FA-00014	Tag:	AL1/2 MS 11/16/12
Matrix (A=Air, D=Dust, DF = Dustfall):		A	
Air volume (L), dust area (cm2), or dustfall container area (cm2)		9.91	9/6/12
Date received by lab		8/23/2012	
Lab Job Number:		271200828	
Lab Sample Number:		271200828-0007	
Number of grids prepared		5	
Prepared by		D. Barney	
Preparation date		8/28/2012	
EPA COC Number:		22804	
Secondary filter pore size (um)		0.2	

Analyzed by:	E.Wyatt-Pescador
Analysis date	8/30/2012
Method (D=Direct, I=Indirect, IA=Indirect-ashed)	D
If sample type = air, is there loose material or debris in the cowl? (Yes, No)	No
Analysis Method (TEM-ISO, TEM-AHERA, TEM-ASTM)	TEM-ISO
Grid storage location	2712-LIB-92
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Interlab)	Not QC
Estimated Particulate Loading (%)	8

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right---->

Recording Rules:

Minimum Aspect Ratio (circle one):	none / ≥ 3:1 / ≥ 5:1
Minimum Length (um):	> 5
Minimum Width (um):	0.25

Stopping Rules:

Target Sensitivity:	0.0058
Max Area Examined:	2
Target # of Structures:	25

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class (see below)				Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
T1	D1	ND																
	D2	ND																
	D3	ND																
	D4	ND																
	D5	ND																
	D6	ND																
	D7	ND																
	D8	ND																
	D9	ND																
	D10	ND																

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

F-factor Calculation:

Indirect Prep Inputs

	Fraction of primary filter used for indirect prep or ashing *[For dust and dustfall, enter 1.0]*
	First resuspension volume or rinsate volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution

Inputs for Serial Dilutions

	Second resuspension volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution
	Third resuspension volume (mL)
	Volume applied to secondary filter (mL)

Input for Ashing of Secondary Filter

	Fraction of secondary filter used for ashing

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one):
H Horizontal
V Vertical

Are prepped grids acceptable for analysis? (circle one) Yes No
If No, explain:

Target sens should be 0.047 based on media code "A" on COC

0157

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LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID	EMSL27	EPA Sample Number	FA-00014	Lab QC Type	Not QC	Lab Job Number	271200828
Lab Sample Number	271200828-0007	Matrix	A	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	ESAT Archive

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
T1	E1	ND																
	E2	ND																
	E3	ND																
	E4	ND																
	E5	ND																
	E6	ND																
	E7	ND																
	E8	ND																
	E9	ND																
	E10	ND																
	F1	ND																
	F2	ND																
	F3	ND																
	F4	ND																
	F5	ND																

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID	EMSL27	EPA Sample Number	FA-00014	Lab QC Type	Not QC	Lab Job Number	271200828
Lab Sample Number	271200828-0007	Matrix	A	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	ESAT Archive

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
T1	F6	ND																
	F7	ND																
	F8	ND																
	F9	ND																
	F10	ND																
T3	C1	ND																
	C2	ND																
	C3	ND																
	C4	ND																
	C5	ND																
	C6	ND																
	C7	ND																
	C8	ND																
	C9	ND																
	C10	ND																

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID	EMSL27	EPA Sample Number	FA-00014	Lab QC Type	Not QC	Lab Job Number	271200828
Lab Sample Number	271200828-0007	Matrix	A	Analyst Name	E.Wyatt-Pescador	Grid Storage Loc.	ESAT Archive

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
T3	D1	ND																
	D2	ND																
	D3	ND																
	D4	ND																
	D5	ND																
	D6	ND																
	D7	ND																
	D8	ND																
	D9	ND																
	D10	ND																
	E1	ND																
	E2	ND																
	E3	ND																
	E4	ND																
	E5	ND																
	F4	nd																
	F6	nd																

CDM Smith - Libby Field Office

CHAIN OF CUSTODY RECORD

Priority # H-2 **No: 22804**

From: 60 Port Blvd Ste 201, Libby MT 59923

AirBill: NA

No of Samples: 8

Libby Asbestos Investigation EPA Region 8

CarrierName: hand delivered

DateShipped: 8/~~22~~23/2012 8/23/12 27/200828

Send To: EMSL27
107 W 4th Street
Libby, MT 59923

	Sample #	Tag	Sample Date	Matrix	Vol/L Area/cm2	Filter Pore Size (um)	TAT Days	Analyses	LV ID	Media Code	Comments	
✓	FA-00008	AL1	8/21/2012	Air	157	0.8	1	PCM-7400	FA-00009	C		✓
✓	FA-00008	AL2	8/21/2012	Air	157	0.8	60	TEM-ISO	FA-00009	B		✓
✓	FA-00009	AL2	8/21/2012	Air	61	0.8	60	Archive		B		✓
✓	FA-00009	AL1	8/21/2012	Air	61	0.8	1	Archive		C		✓
✓	FA-00010	AL1	8/21/2012	Air	158	0.8	1	PCM-7400	FA-00011	C		✓
✓	FA-00010	AL2	8/21/2012	Air	158	0.8	60	TEM-ISO	FA-00011	B		✓
✓	FA-00011	AL1	8/21/2012	Air	58	0.8	1	Archive		C		✓
✓	FA-00011	AL2	8/21/2012	Air	58	0.8	60	Archive		B		✓
✓	FA-00012	AL1	8/21/2012	Air	157	0.8	1	PCM-7400	FA-00013	C		✓
✓	FA-00012	AL2	8/21/2012	Air	157	0.8	60	TEM-ISO	FA-00013	B		✓
✓	FA-00013	AL1	8/21/2012	Air	63	0.8	1	Archive		C		✓
✓	FA-00013	AL2	8/21/2012	Air	63	0.8	60	Archive		B		✓
→ ✓	FA-00014	AL2	8/21/2012	Air	91	0.8	60	TEM-ISO	FA-00015	A		✓
✓	FA-00014	AL1	8/21/2012	Air	91	0.8	1	PCM-7400	FA-00015	C		✓
✓	FA-00015	AL1	8/21/2012	Air	35	0.8	1	Archive		C		✓
✓	FA-00015	AL2	8/21/2012	Air	35	0.8	60	Archive		A		✓

Special Notes: POSTOU20812 - Rev 0

SAMPLES TRANSFERRED FROM COC #:

Relinquished by (Signature and Company)	Date/Time	Received by (Signature and Company)	Date/Time	Sample Condition Upon Receipt
Tracy Dolge CDSmith 8/23/12	1310	R.K. Mahony EMSL 8/23/12	1310	OK Accept

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID:	EMSL27
Instrument ID	JEOL 100 CX II (27-2)
Voltage (KV)	100
Mag.	4,800 X HIGH LOW
Grid opening area (mm2)	0.013
Scale: 1L =	1
Scale: 1D =	1
Primary filter area (mm2)	385
Secondary Filter Area (mm2)	360
Category (Field, Blank)	Field
Primary filter pore size (um)	0.8

EPA Sample Number:	FA-00002	Tag:	AL/2 MS 11/16/12
Matrix (A=Air, D=Dust, DF = Dustfall):	A		
Air volume (L), dust area (cm2), or dustfall container area (cm2)	164		
Date received by lab	8/23/2012		
Lab Job Number:	271200821		
Lab Sample Number:	271200821-0002		
Number of grids prepared	5		
Prepared by	D. Barney		
Preparation date	8/28/2012		
EPA COC Number:	22803		
Secondary filter pore size (um)	0.2		

Analyzed by:	R. Pescador
Analysis date	9/5/2012
Method (D=Direct, I=Indirect, IA=Indirect-ashed)	D
If sample type = air, is there loose material or debris in the cowl? (Yes, No)	No
Analysis Method (TEM-ISO, TEM-AHERA, TEM-ASTM)	~~TEM-AHERA~~ ISO 11/16/12 MS
Grid storage location	2712-LIB-92
Archive filter(s) storage location	ESAT Archive
Lab QC Type (Not QC, Recount Same, Recount Different, Re-prep, Verified Analysis, Reconciliation, Lab Blank, Interlab)	Not QC
Estimated Particulate Loading (%)	2

F-Factor Calculation (Indirect Preps Only):

Enter data in appropriate cells provided to the right——>

Recording Rules:

Minimum Aspect Ratio (circle one): none ≥ 3:1 ≥ 5:1

Minimum Length (um):	5
Minimum Width (um):	0.25

Stopping Rules:

Target Sensitivity:	0.0058
Max Area Examined:	2
Target # of Structures:	25

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class (see below)				Mineral Desc	EDXA	Sketch/ Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
I1	D1	nd																
	D2	nd																
	D3	nd																
	D4	nd																
	D5	nd																
	D6	nd																
	D7	nd																
	D8	nd																
	D9	nd																
	D10	nd																

F-factor Calculation:

Indirect Prep Inputs

	Fraction of primary filter used for indirect prep or ashing *[For dust and dustfall, enter 1.0]*
	First resuspension volume or rinsate volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution

Inputs for Serial Dilutions

	Second resuspension volume (mL)
	Volume applied to secondary filter (mL) or used for serial dilution
	Third resuspension volume (mL)
	Volume applied to secondary filter (mL)

Input for Ashing of Secondary Filter

	Fraction of secondary filter used for ashing

LA = Libby-type amphibole OA = Other (non-Libby type) amphibole CH = Chrysotile NAM = Non-asbestos material

If sample was analyzed by more than one analyst or across multiple analysis dates, enter analysis details below.

	Analyst #2	Analyst #3
Analyzed by:		
Analysis date:		
Instrument:		

Grid opening traverse direction (circle one): H Horizontal V Vertical

Are prepped grids acceptable for analysis? (circle one) Yes No

If No, explain:

Ø|4Ø

MK

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID	EMSL27	EPA Sample Number	FA-00002	Lab QC Type	Not QC	Lab Job Number	271200821
Lab Sample Number	271200821-0002	Matrix	A	Analyst Name	R. Pescador	Grid Storage Loc.	ESAT Archive

Grid	Grid Opening	Structure Type	No. of Structures		Dimensions		Identification	Mineral Class				Mineral Desc	EDXA	Sketch/Comments	1 = yes, blank = no			CH Not Counted
			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
J1	F1	nd																
	F3	nd																
	F5	nd																
	F7	nd																
	F9	nd																
	H2	nd																
	H4	nd																
	H6	nd																
	H8	nd																
	H10	nd																
J3	E2	nd																
	E4	nd																
	E6	nd																
	E8	nd																
	E10	nd																

LIBBY

TEM Asbestos Structure Count_Air-DustEDD_37e

Laboratory ID	EMSL27	EPA Sample Number	FA-00002	Lab QC Type	Not QC	Lab Job Number	271200821
Lab Sample Number	271200821-0002	Matrix	A	Analyst Name	R. Pescador	Grid Storage Loc.	ESAT Archive

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			Primary	Total	Length	Width		LA	OA	CH	NAM				Sketch	Photo	EDS	
I3	F1	nd																
	F3	nd																
	F5	nd																
	F7	nd																
	F9	nd																
	G2	nd																
	G4	nd																
	G6	nd																
	G8	nd																
	G10	nd																
	H1	nd																
	H3	nd																
	H4	nd																
	H6	nd																
	H8	nd																

Memorandum

To: *Dania Zinner, Rebecca Thomas, David Berry, Deborah McKean (EPA, Region 8)*

From: *Lynn Woodbury, Teddy Marcum*

Date: *February 7, 2014*

Subject: *Final Response to Comments on the Interim OU2 Post-Construction Human Health Risk Assessment*

As requested, CDM Smith has prepared formal responses to comments from Montana Department of Environmental Quality (DEQ), the Asbestos Technical Review Workgroup (TRW), and the Libby Asbestos Technical Assistance Group (LATAG) on the Interim Post-Construction Human Health Risk Assessment for Operable Unit 2 (OU2) of the Libby Asbestos Superfund Site. The purpose of this memorandum is to provide responses from EPA.

Responses to Montana DEQ Comments

1. General Comment: The purpose of this document is to evaluate risks associated with the entire Operable Unit (OU) 2. However, this is inaccurate given that only subarea 2 of OU2 and only some of the potential receptors in the OU are evaluated in the document. The EPA should either use its access authority and perform a comprehensive risk assessment on the entire OU or make changes throughout the document to accurately reflect its scope. If this document is not meant to comprehensively assess the risks associated with the OU, it is unclear what the purpose of the document is.

   Response: The purpose of this human health risk assessment (HHRA) document is to quantify residual exposure and risk from LA to determine whether additional actions are needed at OU2 to ensure protectiveness. As stated in Section 4.1.2 of the HHRA, "…[i]n areas that have been remediated and where surface soil is either capped or backfilled with clean soil, there are no complete exposure pathways to LA at present." With the exception of the Flyway (Subarea 2), surface soils have been remediated over the entire area of OU2, which is why the activity-based sampling (ABS) effort and the risk calculations in this HHRA document focused on potential exposures in the Flyway. Quantitative risk calculations were not necessary for other subareas of OU2 because current or future exposure pathways associated with site-related contaminant exposures to LA have been addressed either as a result of remedial actions and/or with institutional controls (ICs). Thus, despite the fact that quantitative risk calculations are not presented for every subarea, this HHRA is applicable to the entire OU2.

General Comment: The DEQ does not see any reason for there to be a Post-Construction Risk Assessment of OU2 (or OU1). According to the OU2 ROD, ". . . the selected remedy must be reevaluated when the site-wide risk assessment is completed." Furthermore, "(a)n ecological risk assessment is being developed at the mine site, OU3. Once that work is complete, EPA will build upon information gathered during the risk assessment for OU3 to identify potential pathways and receptors to evaluate ecological risk at OU2." (Both citations are from page D-1 of the ROD for OU2). Neither the site-wide risk assessment, the OU3 ecological risk assessment, nor the risk assessment for OU3 is complete. Clearly, it is premature to be performing a risk assessment for OU2.

Response: Because of the reasons noted in the comment, this document is intended to be only an interim evaluation of potential residual human health risks in OU2. The HHRA will be re-titled and the introduction section revised to clarify this point. The final risk assessment for OU2 will be included in the site-wide risk assessment.

2. Figure ES-2/4-2: This figure appears inaccurate. The only receptors evaluated in the document are the MDT worker and the Recreational Visitor to subarea 2. EPA did not evaluate the Tradesperson Worker (although it is unclear, this is apparently meant to be a construction worker potentially exposed to Libby Asbestos (LA) in surface and subsurface soil) or the residents living and potentially working in areas of OU2. EPA should perform a comprehensive risk assessment for all receptors, rather than merely including a figure that gives an inaccurate summary of risk. The figure also gives the mistaken impression that the activity-based sampling (ABS) that was conducted in subarea 2 of OU2 focused on the sections without cleanup actions, which according to the text in section 2.1.1 and Figure 4-1, is not the case. This should be clarified. In addition, please explain somewhere in the document why the construction worker exposure to either surface or subsurface soil is "not evaluated quantitatively at this time" as stated in the footnote even though DEQ has requested this evaluation. If this receptor is not evaluated at this time, please indicate how and when EPA will conduct this evaluation. If the EPA has so far been unable to obtain access to conduct ABS in the other areas of the OU (subareas 1, 3, and 4), it seems unlikely that it will be able to restrict excavation in the OU.

Response: See response to comment #1. Figure 4-2 (ES-2) is accurate in that the HHRA included quantitative risk estimates for two exposure populations – the MDT worker and recreational visitors – from exposures to surface soil disturbances in unremediated areas in the Flyway. These two exposure pathways are identified with a black dot inside a white cell in the conceptual site model (CSM).

The HHRA did not evaluate potential risks to a tradesperson worker from exposure to subsurface soil (or any of the other exposure populations identified with grey cells in the CSM) because this is not a complete exposure pathway under current or future conditions assuming that ICs are followed to maintain the remedy. The CSM and Section 4.1.2 will be modified to ensure the conditional nature of this potential future pathway is clear. The text in Section 4.1.2 will be also revised to discuss the role of ICs in mitigating potential future risks from contaminated subsurface soil.

A new figure will be added to better identify the extent of the ABS areas. This figure will demonstrate that the ABS locations were focused on the unremediated areas in the Flyway (as identified in green in Figure 4-1). Thus, the ABS was indeed focused on sections of OU2 without cleanup actions and Figure 4-2 is not mistaken.

Engineered controls and/or protective covers have been installed throughout OU2, including subareas 1, 3, and 4. ICs will be used to minimize potential risks posed to human receptors from LA remaining in subsurface soils and to ensure that covers are not damaged. These controls may allow residential, commercial, and recreational land use, but will limit uses that might damage the remedy. ICs in place for all of OU2 include a U-Dig notification procedure providing information of "known areas of subsurface vermiculite at OU2" to anyone conducting work on the property (EPA 2010). Proprietary controls (i.e., an environmental covenant) placed in the chain of title prohibiting activities that may compromise the effectiveness of selected remedy are in place for Subarea 2, the Flyway. Encroachment and permitting ICs have been established to protect the selected remedy for the MDT right-of-way (ROW). Additional ICs are being finalized by EPA.

EPA has developed an Interim Institutional Control Implementation and Assurance Plan (ICIAP) to ensure ICs applicable to OU2 are properly documented, implemented, and operate effectively during their entire lifespan (EPA 2012). Long-term operations and maintenance (O&M) and Five-Year Reviews will be conducted indefinitely at OU2 because LA remains on the OU2 site at levels that do not allow for unrestricted use and unlimited exposure.

Cited References:

EPA. 2010. Record of Decision for the Libby Asbestos Superfund Site, The Former Screening Plant and Surrounding Properties, OU2, Libby, MT. May.

EPA. 2012. Interim Final Guidance - Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Superfund, Brownfields, Federal Facility, UST and RCRA Corrective Action Cleanups. December.

3. Page 5, Section 2.1.1: As stated in the previous comment and based upon this text and Figure 4-1, it appears that the majority of the ABS in OU2, subsection 2 was conducted in sections that were remediated, but not in unremediated sections. Figures ES-2 and 4-2, however, appear to indicate that both remediated and unremediated sections were evaluated separately. Please clarify the ABS sampling boundaries, and how those boundaries relate to remediated and unremediated section of subarea 2.

   Response: As noted in the response to comment #2, a new figure will be added to better identify the extent of the ABS areas, which will illustrate that the ABS areas were focused on the unremediated areas in the Flyway.

Figure 4-2 (ES-2) shows remediated soils and unremediated soils separately because the exposure pathways differ for each media type. In the case of remediated soils, because of the cleanup action performed and/or the ICs in place, there are no longer any complete site-related contaminant exposure pathways for any receptors. In the case of unremediated soils, inhalation exposure during surface soil disturbances is identified as complete exposure pathway for MDT workers and recreational visitors and was evaluated quantitatively in the HHRA.

4. Page 6, Section 2.1.2.1, Mowing: DEQ does not believe that walking behind a rotary mower accurately represents exposure of an MDT worker riding a large commercial mower. The rotary mower drastically under-represents the actual exposure the MDT workers may receive. The EPA should conduct appropriate ABS for this receptor.

   Response: EPA Region 8 disagrees with the assertion that a rotary walk-behind mower drastically under-represents exposures from a riding mower. Based on visual observations of mowing activities with different types of mowers, it appears that walk-behind mowers have a higher potential for dust generation (and hence asbestos release) than 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 the measured mowing ABS air concentrations for OU2 would be representative of the high-end of potential mowing exposures.

   [Note: On the 6/18/13 Libby non-construction call, MDEQ representatives acknowledged that use of a walk-behind mower in the post-construction ABS for OU1 rather than a riding mower was appropriate and likely to be conservative.]

5. Page 7, Section 2.1.2.1, Hiking: Please explain why all the air filters were not analyzed (i.e. why filters were archived). Please indicate which 6 of the 12 were analyzed and, in particular, indicate whether any of the high volume pump filters were analyzed.

   Response: As discussed in Section 2.1.2.1, each actor wore two sampling pumps during the ABS event, one with a high flow rate (5.5 L/min) and one with a low flow rate (2.0 L/min), which resulted in the collection of two replicate air filters (i.e., each filter encompasses the same sampling duration but has different total air sample volumes). Because they are replicate filters, it is not necessary to analyze both filters to obtain information on ABS air concentrations. Rather, in accordance with standard procedures utilized at the Libby site, the high volume filter is analyzed in preference and the low volume filter is used as a back-up for the high volume filter (in the event the high volume filter is damaged or cannot be prepared directly).

   As noted in footnote 'b' of Table 2-1 and stated in Section 2.1.2.3, all ABS air results are based on the analysis of the high volume filters.

6. Page 9, Section 2.1.3.1: If EPA will base its decisions on ABS, rather than surface soil sampling, it must conduct appropriate ABS in all areas of concern.

Response: ABS sampling focused on areas in the Flyway where unremediated surface soils remained. Thus, the resulting mowing and the hiking ABS air results are representative of the areas of potential concern for OU2. As noted in the response to comment #2, a new figure will be added to better identify the extent of the ABS areas.

7. Page 18, Section 4.1.1: Please explain how any risks associated with these unremediated areas will be addressed. In addition, please explain how and when risk associated with contamination left in place at depths greater than 4 feet will be evaluated.

   Response: Because the ABS scenarios were focused on the unremediated areas, the resulting measured ABS air concentrations were used to quantify potential exposure and risk from these areas in this HHRA.

   See response to comment #2.

8. Page 19, Section 4.1.2, last paragraph: Again, please explain how and when these receptors will be evaluated.

   Response: See response to comment #2.

9. Page 26, Section 4.4, last paragraph: DEQ disagrees with these conclusions since only one area of OU2 was evaluated, since not all receptors or contaminated media were evaluated, since the ABS activities were not appropriate for the exposure, and no ABS was focused on the unremediated areas.

   Response: See responses to comments #1, #2, #4, and #7.

10. Pages 27-28, Section 4.5: Please clarify that all toxicity information for LA from EPA 2011B and included in the section is considered "DRAFT – DO NOT CITE OR QUOTE" and the EPA has received a number of comments on the information.

    Response: Section 4.5 will be revised to highlight the draft nature of the LA-specific toxicity values and note that the draft values are subject to change in the future in response to comments from the Scientific Advisory Board. The section will be revised to clarify that this is intended to be an interim HHRA and that the Site-wide HHRA for the Libby Asbestos Superfund Site will include risk calculations for OU2 that are based on the final LA-specific toxicity values.

11. Page 30, Section 4.6: For the reasons cited above, DEQ disagrees with these conclusions. Only one area of OU2 was evaluated, not all receptors or contaminated media were evaluated, the ABS activities were not appropriate for the exposure, and no ABS was focused on the unremediated areas. In addition, the EPA did not conduct ABS appropriate for residential exposure in the residential areas and did not include an residential exposure-specific evaluation in the document.

Response: See responses to comments #1, #2, #4, and #7.

As discussed in the OU2 ROD, all buildings in OU2, including the former residence on the Parker Property, were demolished in 2000 and 2001. Response activities included the excavation and removal of contaminated soils to a depth of about 3-4 feet in most areas. The current residence on the Parker Property was built in 2010, after all removal activities within this subarea were completed. Because of the cleanup action performed, there are no longer any complete residential exposure pathways.

12. Table 4-1: Again, it is unclear why all receptors for all areas of OU2 were not evaluated. Please address as specified in previous comments. Please cite an MDT reference for the MDT worker exposure frequency of 5 days/year. This does not seem realistic given the climate and typical MDT activities. In addition, please provide information related to the Recreational Visitor/Trespasser exposure frequency of 10 days/year. It would seem reasonable to assume that nearby residents might use the area more frequently.

    Response: Exposure parameters are only provided in Table 4-1 for receptors where there is a complete exposure pathway identified in the CSM. See response to comment #2.

    The MDT worker exposure frequency of 5 days/year assumes that mowing of the right-of-way (ROW) in OU2 is performed once a month from May through September. It is recognized that an MDT worker may mow ROWs more than 5 hours/year as part of their job, but considering that the ROW in OU2 is only about 1,500 feet in length, only a small fraction of an MDT worker's time is actually spent mowing within OU2. While EPA is not aware of any citable MDT reference to support the exposure assumptions, MDT was provided a copy of the proposed ABS SAP/QAPP prior to the mowing events and they did not indicate that the exposure assumptions that were utilized in establishing analytic requirements (which are equal to those utilized in the HHRA) were inappropriate. Similarly, while individuals in Libby may recreate more than 10 days/year, given the small spatial extent of the frontage area along the Kootenai River in OU2, only a fraction of this time is expected to be spent hiking within OU2. Therefore, EPA Region 8 believes that the exposure parameters selected for use in the HHRA are representative of potential exposures that could occur in OU2.

Responses to Asbestos TRW Comments

1. Several reviewers raised a concern with including the draft toxicity values for Libby Amphibole, even in an uncertainty section. A qualitative statement about these values may be appropriate while the IRIS reviews are ongoing. It may also be appropriate to note that because the draft values are subject to change, the calculations in the OU2 HHRA may also change when the final version is issued.

Response: Section 4.5 already identifies the LA-specific toxicity values as being draft and notes that these values are currently undergoing review in accordance with the IRIS review process. However, this section will be revised to note that the draft values are subject to change in the future in response to comments from the Scientific Advisory Board. The OU2 HHRA will be revised to clarify that this is intended to be an interim HHRA and that the Site-wide HHRA for the Libby Asbestos Superfund Site will include risk calculations for OU2 that are based on the final LA-specific toxicity values.

2. Risk calculations were presented even though asbestos was not detected in the ABS samples collected for this OU. This seemed unusual to the reviewers. Instead of presenting risk calculations, the goal of the sampling could be described, the remedy and future land use could be discussed, and the how the sampling addressed these goals could be discussed. This document is not really a traditional risk assessment, as it's unusual to focus on calculations where nothing was detected. We recommend greater emphasis be placed on the site setting, future land use, the adequacy of the analytical sensitivity relative to the level of concern and how that was determined, the exposure assumptions, the specifics of the remedy that was already implemented, and how 5-year reviews will be conducted. The magnitude of the uncertainty around these items with respect to the broader Libby community should be discussed.

Response: The purpose of this document was to quantify residual exposure and risk from LA to determine whether additional actions are needed at OU2 to ensure protectiveness. As such, it is appropriate to present quantitative risk calculations, even though no asbestos was detected. The HHRA already includes information for most of the topics identified in the comment; as appropriate, the existing discussions will be enhanced to add more detail. Specifics regarding topics related to risk management, such as the selected remedy and how five-year reviews will be conducted, are beyond the scope of the HHRA and already summarized in the OU2 ROD.

3. Someone exposed at OU2 may also have other community exposures. How does this assessment tie into other exposures occurring around Libby? We recommend referencing the overarching document (*e.g.*, a Libby community HHRA) that directs how the risk assessments are being done throughout the Libby community. Another way to address this issue would be to have more conservative target levels that may trigger an action or finding of unacceptable risk.

Response: Cumulative exposures (that span multiple OUs) will be evaluated as part of the Site-wide HHRA for the Libby Asbestos Superfund Site. This report will be modified to clarify the focused scope of the OU2 HHRA and make reference to the Site-wide HHRA for information on other community exposures.

4. Since only a portion of the site was available for sampling, the executive summary, discussion and conclusions should be only applicable to the Flyway (Subarea 2). The report reads as a post-construction risk assessment for OU2, but it really only addresses Subarea 2, the Flyway. We suggest revising the document to be more transparent, explicitly stating that the other subareas of OU2 have not been evaluated and limiting these findings to Subarea 2: the Flyway. Suggest that Section 2, data tables and risk tables all be retitled as "Subarea 2: the Flyway" rather than as "OU2".

Response: As stated in Section 4.1.2, "…[i]n areas that have been remediated and where surface soil is either capped or backfilled with clean soil, there are no complete exposure pathways to LA at present." With the exception of the Flyway (Subarea 2), surface soils have been remediated over the entire area of OU2, which is why the activity-based sampling (ABS) effort and this HHRA document focused on quantifying potential exposures in the Flyway. Quantitative risk calculations were not necessary for other subareas of OU2 because current or future exposure pathways associated with site-related contaminant exposures to LA have been addressed either as a result of remedial actions and/or with institutional controls (ICs). Section 4.1.2 already clearly states this focus on the Flyway. The tables will be modified as appropriate to ensure the extent of the ABS effort and basis of the risk estimates is clear.

5. The report could better address the other areas of OU2 by providing more details regarding the effectiveness of the cleanup in eliminating current and future pathways (depth of fill, type of subsurface barrier, Institutional Controls [ICs] etc.). In text recently developed by the TRW for post-cleanup sampling, we recommended that ABS represent "current and anticipated future" exposure scenarios. This should be discussed and addressed for OU2 to describe the ICs established to prevent exposure to vermiculite/asbestos at various depths and to evaluate expected effectiveness for various anticipated land uses. The document mentions "potential significant exposure pathways if subsurface soil is excavated." A statement is needed to justify why the risk assessment could not/should not evaluate one or more of these scenarios (*e.g.*, these scenarios likely will never occur or institutional control will ensure they don't occur).

Response: The document will be revised as recommended.

6. For the residential pathway, was the home cleaned and/or sampled? If this building was on the site of the former screening plant, one would expect there was significant contamination before soil removal, and therefore a great potential for indoor residual contamination. We recommend that the post-construction risk assessment address the adequacy of the clean-up in and around the residence. (If the building was built after cleanup – then including this information would be useful.)

Response: As discussed in the OU2 ROD, all buildings in OU2 Subarea 1, including the former residence on the Parker Property, were demolished in 2000 and 2001. Response activities included the excavation and removal of contaminated soils to a depth of about 3-4 feet in most areas. The current residence on the Parker Property was built in 2010, after all removal activities within this subarea were completed. The discussion of Subarea 1 in Section 1.1 will be revised to include this information.

7. The report indicates that sections of the Flyway were evaluated for visible vermiculite in lieu of soil samples (Section 2.1.3.1). Although visible vermiculite may be an important factor to prioritize properties for clean-up, it should not replace sampling as an indication of potential for releases of Libby Amphibole (LA). A reader could interpret that lack of visible vermiculite was an indication the area was clean. Information recorded in the field log should be included in the risk assessment.

Response: The evaluation of visible vermiculite was not performed in lieu of soil samples. As stated in Section 2.1.3.1, no soil sampling (or visible vermiculite evaluation) was necessary because the ABS areas evaluated were representative of the extent of the exposure locations for each receptor population. The ABS air samples alone are utilized in the HHRA determining the potential for LA releases. The fact that the risk characterization (Section 4.4) discusses and draws conclusions based only the ABS air sample results, and does not include any statements about visible vermiculite, makes this point clear.

Information on visible vermiculite status, vegetative cover, and vegetative condition (as recorded in the field logbook) is already provided in Section 2.2.

8. Calculation of the risk based on upper bound EPCs is useful and provides a better understanding of the range of potential risk; given that all of the samples were non-detect (ND). We agree that the Framework does indicate that a zero should be used for ND in risk calculations; however, calculation of the level of concern if one fiber is detected, and the meaning of zero fibers, is statistically different and depends upon the analytical sensitivity selected. We suggest adding this information to the uncertainty discussion. The use of the term “upper bound” risk suggests a more formal statistical treatment. We suggest that this be revised to remove “less than” values in the risk assessment. In general, if sufficient information is available to show that the NDs have meaning and are protective based on the analytical sensitivity, then the risk calculations are moot.

Response: The analytical requirements that were specified in the governing ABS SAP/QAPP were determined based on a back-calculation of a risk-based concentration (RBC) using the scenario-specific exposure parameters that were used in the OU2 HHRA (see Table 4-1) and the draft LA-specific toxicity values, assuming a target cancer risk of 1E-05 and target HQ of 1. Details of this calculation were presented in the data quality objectives (Appendix A) of the governing SAP/QAPP. The target analytical sensitivity was derived to ensure that an ABS air sample that had concentration

equal to the RBC would have a high probability of structure detection. As such, the non-detect ABS air results have meaning and are protective. Even so, the purpose of the risk calculations based on "upper-bound" exposure point concentrations (EPCs) was to demonstrate in the HHRA that the non-detect ABS air results have meaning and ABS data were adequate to support decision-making and will not be removed.

EPA Region 8 recognizes that the upper-bound of the Poisson uncertainty range for a count of zero structures is not 1, but is likely to be closer to 2.99, based on the one-sided upper 95% confidence limit of the Poisson distribution (see Section F.4.2 of ISO 10312:1995(E). However, for an "all non-detect" dataset, the probability that the true concentration in every sample within the dataset is actually present at its upper-bound concentration is low. For this reason, the "upper-bound" EPC is calculated based on an assumed structure count of 1, and not 2.99, such that the resulting EPC is a conservative, but still plausible, estimate of the true mean concentration.

The text in this section already acknowledges that the approach for evaluating an upper-bound EPC is not statistically rigorous. The text includes a detailed description and example of how this upper-bound was calculated, which makes it clear that no formal statistical treatment was applied in the derivation of the upper-bound. Thus, EPA Region 8 believes that the "upper-bound" EPCs will not be misconstrued and this terminology will be retained.

9. We suggest more transparent wording regarding the limitations of this assessment in only addressing 2 pathways.

Response: The risk characterization (Section 4.4) will be revised to reiterate the discussion of exposure pathways presented in Section 4.1.2 to ensure that it is clear why this assessment was focused on these two receptor groups.

10. Table 2-1: As only a portion of the filter can be evaluated, the air concentration cannot be reported as zero. The reviewers suggest these be reported as less than the analytical sensitivity. Also, the IUR and RfC units are in PCM fibers. There is no such thing as a "PCM structure". Structure is defined by the TEM counting rules.

Response: Table 2-1 will be modified to include the one-sided upper 95% Poisson confidence limit of the reported air concentration. EPA Region 8 believes that this is the better approach to highlight the analytical uncertainty associated with the reported ABS air concentrations and consistent with Section F.4.2 of the ISO 10312:1995(E) method.

The units for the IUR and RfC will be changed as recommended.

11. Table ES-2 and Section 3.6.4: The analytical sensitivities achieved for mowing and hiking scenarios do not appear to be low enough to determine that risks will not be of concern, especially for non-cancer effects. This may be because the TWFs are based on very limited exposure (few days per year, few hours per event) and this may not be protective of all potential

exposures. However, you may have site-specific information to support these TWFs. If so, the information should be presented in the document. (*e.g.*, if someone visited the site more frequently than what was assumed, then the risk would be greater.) Could more grids have been counted to achieve greater analytical sensitivity? We recommend that uncertainty section discussion be moved forward to describe how use of TWF impacts cancer and noncancer endpoints. ES-2 Figure is a little confusing where it has the surface soil leading to four grey blocks with the black dots. Isn't there a concern that subsurface soil is being excavated? Is this in remediated or non-remediated areas? Also, the detection limit for mowing seems high. We recommend justifying why it was acceptable.

Response: See response to comment #8 regarding the basis of the target analytical sensitivity specified for ABS air samples. As described, the target analytical sensitivity was derived to ensure that an ABS air sample that had concentration equal to the RBC would have a high probability of structure detection. Thus, it is not necessary to examine additional grid openings, since all ABS air samples achieved the target sensitivity and were adequate to support the OU2-specific risk estimates.

The selected exposure parameters were selected using best professional judgment in consideration of site-specific factors. Section 4.1.3 of the HHRA will be modified to include additional details on the basis of the selected exposure parameters. A cross-reference to the discussion of uncertainties associated with exposure parameters and the resulting TWFs used in the HHRA will be provided in this section.

The HHRA did not evaluate potential risk to a tradesperson worker from exposure to subsurface soil (or any of the other exposure populations identified with a black dot inside a grey cell in the CSM) because this is not a complete exposure pathway under current or future conditions assuming that institutional controls (ICs) are followed to maintain the remedy. The CSM will be modified to remove the black dot for these exposure populations to ensure this is clear. The text in Section 4.1.2 will also be revised to discuss the role of ICs in mitigating potential future risks.

12. Section 1.1: It would be helpful if the site summaries included more information on the extent of the remedy, depth of fill, type of cap and information concerning the remaining contamination in the subsurface, and whether or not the residence/garden was cleaned.

Response: As stated in Section 1.1, detailed information on the removal actions conducted in each subarea is provided in the OU2 ROD and the Final Remedial Action Report. This section will be revised to add additional summary information, as appropriate, on the removal actions performed and any contamination remaining in the subsurface soil.

13. Section 2.1.2.4 (page 8): The Framework document recommends using an upper-bound width to define PCME fibers, why hasn't this been used at Libby? We recommend adding a discussion of this deviation from the approach recommended by the Framework and including a section on potential impact on the results.

Response: No upper bound on width was applied in defining PCME because the NIOSH 7400 (Issue 2) method does not include an upper width restriction in the specified counting rules. In fact, Appendix B of NIOSH 7400 specifically includes an illustration of a countable fiber with a diameter (width) greater than 3 µm, with accompanying text that states "There is no upper limit on the fiber diameter in the counting rules." Likewise, the earlier PCM method (P&CAM 239), which was applicable in the 1970s, does not include an upper width boundary. Because the epidemiological exposure dataset that forms the basis of the asbestos toxicity values is based on PCM methods that did not apply an upper width boundary, it is important that exposure estimates used to estimate risk be based on the same counting rules. The text in Section 2.1.2.4 will be modified to provide this justification.

In the case of the OU2 ABS air samples, because no asbestos structures were observed in any sample, this approach has no impact on reported exposure concentrations. In the case of exposure calculations at Libby, this approach tends to decrease exposure concentrations only by a very small amount (of the more than 15,000 LA structures observed in air samples for the Site, less than 1% of these structures had a recorded width greater than 3 µm).

14. Section 3.6.3 (page 16): A sampling duration of 15 minutes seems to be very short. Although someone may only mow for 15 minutes, isn't it possible that they remain in the area longer before and after mowing to get set up and to clean up after? Similarly, for hiking, if someone is walking their dog or playing in the area, they could stay for longer than 30 minutes. The selected activity durations are short and therefore limit estimated exposures. These may not represent RME exposure estimates for the site, based on expected activity. Someone could walk for 30 minutes, or they could be in the area for longer. How robust is the AS based on this TWF? Would it cover a 2 hour or 3 hour exposure? Greater frequency? We recommend that these issues be addressed in the OU2 HHRA.

Response: This comment appears to confuse the ABS air sample collection duration with exposure duration. The ABS air sample collection duration does not need to equal exposure duration provided that the ABS is representative of the exposures that could occur. Although the ABS mowing duration was about 15 minutes, the mowing exposure duration utilized in the HHRA was 1 hour/day, 5 days/year, for 15 years (see Table 4-1). It is true that MDT activities in the ROW may include more than just mowing (e.g., set up, clean up), but it is likely that mowing activities have a higher potential for dust generation (and potential asbestos exposure) than these other activities. The measured mowing ABS air concentration is conservatively applied to the entire MDT exposure duration within OU2. Similarly, although the ABS hiking duration was about 30 minutes, the hiking exposure duration utilized in the HHRA was 2 hours/day, 10 days/year, for 10 years (see Table 4-1). The measured hiking ABS air concentration is applied to the entire hiking exposure duration within OU2. Section 3.6.3 will be modified to ensure that this distinction is clear.

See response to comment #8 regarding the basis of the target analytical sensitivity specified for ABS air samples. The analytic requirements specified in the governing SAP/QAPP were adequate to evaluate exposures based on the TWFs utilized in the HHRA, but may not be adequate if exposures

were to occur more frequently than assumed in the HHRA. Section 3.6.4 will be modified to ensure that the basis of the target analytical sensitivity is clear.

15. Section 4.1.1 (page 18): Is it possible that flooding/erosion could expose vermiculite in the subsurface? The text seems to indicate that LA won't be of concern because it will be either washed away or covered by sediments. Couldn't the LA/vermiculite be carried elsewhere where it becomes available for exposure? We recommend that these issues be addressed in the OU2 HHRA.

Response: Any subsequent exposure will be covered by an IC and/or O&M measures. The ROD included monitoring as a component of the selected remedy to ensure long-term effectiveness and permanence. The remedy performance monitoring strategy includes site inspections and reviews (EPA 2013). During the site inspections, current site conditions — including drainage, signs of erosion, and integrity of the cover — will be observed and documented. Long-term O&M will be performed to maintain the integrity of the remedy components, including protective covers and ICs. As described in the O&M Plan, MDEQ is responsible for long-term O&M of the remedy and repairs. Additionally, five-year reviews of the OU2 site will be performed, since contaminated subsurface soil is left in place below the protective covers and backfilled excavations, which prevents unrestricted use of the OU2 site. The EPA is responsible for performing and funding the five-year reviews as long as they are required.

Finally by definition, an evaluation of potential exposures to LA that has been carried outside of OU2 is outside of the bounds of the OU2 HHRA.

Cited References:

EPA. 2013. Operations and Maintenance Plan, Libby Asbestos Superfund Site, The Former Screening Plant and Surrounding Properties, Operable Unit 2, Lincoln County, Montana, prepared for the EPA by the USACE and CDM Federal Programs Corporation. July.

16. Section 4.1.1, Figure 4-1: It is unclear why areas which are seasonally submerged, cannot be sampled, or would not be available during the seasons they are not submerged. Please clarify.

Response: Areas that are seasonally submerged can indeed be sampled. In fact, the OU2 ABS program was conducted in the late summer, during low flow conditions in the Kootenai River, to maximize the potential for the hiking ABS to include locations that would be seasonally submerged. However, these seasonally submerged areas are also heavily vegetated, which precluded access by the ABS actors to all portions of these areas. The discussion of the hiking ABS in Section 2.1.2.1 will be modified to clarify this point.

17. Section 4.1.1: We suggest a footnote be added clarifying that the 1% trigger for removal does not imply that materials less than 1% have no associated risk.

Response: A footnote will be added as recommended.

18. Section 4.1.4 (page 20): At other sites, we have used the maximum and mean concentrations to capture the potential variability in sample results in the absence of a 95UCL. This could be mentioned here.

Response: The text will be modified as recommended; however, it will be noted that use of maximum concentrations does not capture variability due to analytic uncertainty (i.e., Poisson counting error).

19. Section 4.5 (page 29): We recommend revising the section stating that amphiboles are considered by some to be more potent at inducing mesothelioma. This isn't the official position of the agency and recent papers have confirmed the carcinogenic potency of chrysotile.

Response: Section 4.5 is an uncertainty discussion. As such, it is appropriate to include a discussion of the ongoing debate regarding whether there is a difference in the relative cancer potencies of various mineral types. In order to be more balanced, the text will be modified to note that research has also confirmed the carcinogenic potency of chrysotile (Smith and Wright, 1996; Kanarak, 2011).

Cited References:

Smith, AH and Wright, CC. 1996. Chrysotile asbestos is the main cause of pleural mesothelioma. Am J. Ind. Med. 30{3}:252-266.

Kanarak, MS. 2011. Mesothelioma from chrysotile asbestos; an update. Ann. Epidemiol. 21{9}: 688-697.

20. Table 4-1: A mowing activity of 5 hours per year seems to be extremely limited. It is reasonable that more frequent mowing may occur. Are there data to support this from MDT? Similarly, an assumption of 20 hours per year for recreation seems to be very low. We recommend that these issues be addressed in the OU2 HHRA.

Response: It is recognized that an MDT worker may mow right-of-ways (ROWs) more than 5 hours/year as part of their job, but considering that the ROW in OU2 is only about 1,500 feet in length, only a small fraction of an MDT worker's time is actually spent mowing within OU2. MDT was provided a copy of the proposed ABS SAP/QAPP prior to the mowing events and they did not indicate that the exposure assumptions that were utilized in establishing analytic requirements (which are equal to those utilized in the HHRA) were inappropriate. Similarly, while individuals in Libby may recreate more than 20 hours/year, only a fraction of this time is expected to be spent hiking within OU2. Therefore, EPA Region 8 believes that the exposure parameters selected for use in the HHRA are representative of potential exposures that could occur in OU2.

21. Table 4-3: Include a footnote to Appendix E of the framework as the source of this information.

Response: A footnote will be added as recommended.

22. Appendix C: Are fiber types other than LA reported if observed? If other fibers found, we recommend that an explanation of how these fibers were or were not considered (for someone not that familiar with the past site work who may be aware that other asbestos fiber types could be found in vermiculite).

Response: As noted in Section 2.1.2.3, if observed, chrysotile and other types of amphibole asbestos would have been recorded by the TEM analyst. No asbestos structures of any type were observed in these ABS air samples.

23. More details on receptors and pathways would improve the clarity of the report.

Response: Section 4.1.2 will be revised as recommended.

24. While it is a Remedial Program term ("Post Construction"), a better identifier for this document would be "Post Remediation". Suggest the text clarify that all remediation actions are completed (*e.g.*, ICs and etc.).

Response: As discussed in the OU2 Final Remedial Action Report, "…[w]hen the OU2 post-construction risk assessment is complete, EPA will re-evaluate the remedy to confirm its effectiveness…[and may] take action as necessary to ensure that the soil-to-air pathway is broken." Thus, the status of OU2 is not yet post-remedial; therefore, the term "post-construction" will be retained.

25. A little more description on the remediation performed might be appropriate.

Response: See response to comment #12.

26. In the uncertainty section, the inherent uncertainties associated with sampling and analyses should be included.

Response: The uncertainty assessment already includes a discussion of potential uncertainties related to sampling variability and analytical measurement error (see section titled "Uncertainty in true long-term average LA concentrations in air"). It is not clear from the comment what additional information is being requested.

27. The figure in the narrative might show the mowing and hiking areas more clearly. A few ground level photos would be very helpful.

Response: A map will be added that illustrates where the mowing and hiking ABS activities occurred. A figure will also be added to present example photos of each type of ABS activity.

Responses to LATAG Comments

1. Section ES.2.2, p. ES-2. "Residual contamination remains at varying depths over a considerable portion area of OU2. Institutional controls (ICs) have been developed to ensure the protectiveness of the remedy; therefore, potential exposure pathways associated with exposure to residual contamination at depth are considered incomplete and not evaluated in this HHRA. For the ROW, the exposure population of primary interest is MDT workers that mow the vegetation along the highway." *It would be useful to evaluate other activities that disturb soil at depth in OU2 in addition to mowing and hiking activities.*

Response: See response to Montana DEQ comment #2. It is already presumed that disturbances of residual contamination in subsurface soil have the potential to result in significant exposures and should be avoided, which is why ICs have been developed to mitigate potential future risks from this exposure pathway. Therefore, the EPA does not believe that it is necessary to perform any additional ABS to demonstrate potential exposures from residual contamination in subsurface soil. Section 4.1.2 and Section 4.4 will be modified to ensure the nature of this potentially significant exposure pathway is clear.

2. It is good that ABS sampling was conducted in late summer under dry conditions, representing potentially dusty conditions (worst case scenario).

Response: No response necessary.

3. The draft LA-specific toxicity values were used to calculate exposure estimates in this document.

Response: No response necessary.