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

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

Sampling and Analysis Plan/Quality Assurance Project Plan
Nature and Extent of LA Contamination in the Forest
Libby Asbestos Site, Operable Unit 4

Revision 0 – August 2012

Work Assignment No.:	**329-RICO-08BC**
	Libby Asbestos Superfund Project, OU4 Remedial Investigation/Feasibility Study
EPA Work Assignment Manager:	**Victor Ketellapper**
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Prepared for:
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Revision 0 – August 2012

Approved by: _____ Date: 8/7/12
Nathan Smith
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REVISION LOG:

Revision No.	Date	Description
0	8/7/12	---

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List of Acronyms and Abbreviations

%	percent
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHISQ	chi-squared
CI	confidence interval
cm^{-2}	per square centimeter
COC	chain-of-custody record
DQO	data quality objective
EDD	electronic data deliverable
EDS	energy dispersive spectroscopy
EDXA	energy dispersive x-ray analysis
EPA	U.S. Environmental Protection Agency
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
f/cc	fibers per cubic centimeter
FSDS	field sample data sheet
FTL	field team leader
g	gram
g^{-1}	per gram
GIS	geographic information system
GPS	global positioning system
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
H&S	Health and Safety
HDPE	high density polyethylene
ID	identification
IDW	investigation-derived waste
LA	Libby amphibole
LADT	Libby Asbestos Data Tool
LC	laboratory coordinator
MDEQ	Montana Department of Environmental Quality

N	number
'N/A'	not applicable
NIST	National Institute of Standards and Technology
NPL	National Priorities List
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OU3	Operable Unit 3
PCM	phase contrast microscopy
PLM	polarized light microscopy
QA	quality assurance
QAM	quality assurance manager
QAPP	quality assurance project plan
QA/QC	quality assurance/quality control
QATS	Quality Assurance Technical Support
QC	quality control
RPM	Regional Project Manager
ROM	Record of Modification
s/cm^2	structures per centimeter squared
s/g	structures per gram
SAP	sampling and analysis plan
SAED	selective area electron diffraction
Shaw	Shaw Environmental, Inc.
Site	Libby Asbestos Superfund Site
SOP	standard operating procedure
SPF	sample preparation facility
SRM	standard reference materials
STEL	short-term exposure limit
TAS	target analytical sensitivity
TEM	transmission electron microscopy
TWA	time-weighted average
USFS	United States Forest Service
USGS	United States Geological Survey
VWC	volumetric water content

A Project Management

A3. Distribution List

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

U.S. Environmental Protection Agency, Region VIII
1595 Wynkoop Street
Denver, Colorado 80202-1129

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

EPA Information Center – Libby
108 East 9th Street
Libby, Montana 59923

- Mike Cirian, Cirian.Mike@epa.gov (1 hard copy, electronic copy)

Montana Department of Environmental Quality
1100 North Last Chance Gulch
Helena, Montana 59601

- Carolyn Rutland, CRutland@mt.gov (electronic copy)
- John Podolinsky, JPodolinsky@mt.gov (electronic copy)

TechLaw, Inc.
ESAT, Region VIII
16194 West 45th Drive
Golden, Colorado 80403

- Doug Kent, Kent.Doug@epa.gov (electronic copy)

CDM Smith – Libby Field Office
60 Port Boulevard, Suite 201
Libby, Montana 59923

- Dominic Pisciotta, pisciottaDM@cdmsmith.com (5 hard copies, electronic copy)
- Kara McKenzie, mckenzieKE@cdmsmith.com (electronic copy)

CDM Smith – Denver Office
555 17th Street, Suite 1100
Denver, Colorado 80202

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

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

A4. Project Task Organization

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

A4.1 Project Management

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

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

A4.2 Technical Support

A4.2.1 SAP/QAPP Development

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

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

A4.2.2 Field Sampling Activities

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

- Nathan Smith, Project Manager
- Steve Holmes, Field Team Leader
- Tracy Dodge, Sample Coordinator
- Scott Miller, Field Data Manager
- Terry Crowell, Quality Assurance Manager
- Damon Repine, Health and Safety Manager

A4.2.3 Asbestos Analysis

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

A4.2.4 Data Management

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

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

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

A4.3 Quality Assurance

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

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

A5. Problem Definition/Background

A5.1 Site Background

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

Epidemiological studies revealed that workers at the mine had an increased risk of developing asbestos-related lung disease (McDonald *et al.* 1986, Amandus and Wheeler 1987, Amandus *et al.* 1987, 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). Although the mine has ceased operations, historic or continuing releases of LA from mine-related materials could be serving as a source of on-going exposure and risk to current and future residents and workers in the area. The Site was listed on the National Priorities List (NPL) in October 2002.

A5.2 Reasons for this Project

Previous investigations conducted at the Site have demonstrated that LA is present in

environmental source media (e.g., soil, tree bark, duff material) at locations in and around the mine. Sampling of soil, tree bark, and duff from Operable Unit 3 (OU3), the mine and forested areas surrounding the mine, occurred as part of the *Phase I Sampling and Analysis Plan for OU3* (EPA 2007). Results of this sampling revealed that LA contamination extends well beyond areas that were historically actively mined. This contamination is likely a result of aerial deposition. Additionally, a study was performed at the Upper Flower Creek Timber Sale Site located south of the town of Libby to investigate potential levels of LA contamination (Tetra Tech 2011). Results of this study revealed that LA is present at detectable levels in tree bark and duff. Because LA contamination has been demonstrated to extend beyond areas where mining operations took place, the extent of LA contamination in the Libby Valley is unknown. Therefore, the purpose of this study is to characterize the nature and extent of LA contamination in the forested areas surrounding Libby.

A5.3 Applicable Criteria and Action Limits

At the Libby Site, the EPA has developed action levels and cleanup criteria for LA that are applicable to emergency response actions performed at residential/commercial properties (EPA 2003). However, these criteria are not applicable to locations outside of the Site. In addition, final action levels for the Site will not be developed until completion of the remedial investigation/feasibility study and the publication of the record of decision. Thus, there are no LA-specific criteria or action limits that apply to this sampling program.

Personal air monitoring of sampling personnel will be performed in accordance with Occupational Safety and Health Administration (OSHA) requirements. In accordance with these requirements, samples will be analyzed for asbestos by phase contrast microscopy (PCM) and compared to the OSHA limits for workplace exposures. The short-term (15-minute) exposure limit (STEL) is 1.0 fiber per cubic centimeter of air (f/cc), and the long-term time-weighted average (TWA) exposure limit is 0.1 f/cc.

A6. Project/Task Description

A6.1 Task Summary

Basic tasks that are required to implement this SAP/QAPP include collecting duff and tree bark samples from within a two mile buffer of the NPL boundary, with the exception of the area located to the east of Kootenai Falls, and analyzing these samples for asbestos. The area east of Kootenai Falls will be sampled as part of an effort conducted specifically to support OU7. These basic tasks are described in greater detail in subsequent sections of this SAP/QAPP.

A6.2 Work Schedule

The work schedule for performing these tasks begins with collection of duff and tree bark samples from locations identified this study. It is anticipated that this task will begin in September 2012. Sample analysis and data evaluation and interpretation tasks will be performed over the fall of 2012.

A6.3 Locations to be Evaluated

Location selection for the collection of duff and tree bark samples is described in Section B1.1.

A6.4 Resources and Time Constraints

The EPA has introduced both resource and time constraints to the scope of this sampling program. As noted above, the sampling is scheduled to occur in September 2012. The intent is to collect samples during the warmer months when travel to the various sampling locations is not impeded by snowfall. Due to the amount of funding, this sampling program will be limited to approximately fifty samples per medium.

A7. Quality Objectives and Criteria

A7.1 Data Quality Objectives

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

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

A7.2 Performance Criteria

Because one goal of this study is to provide data for the purposes of making comparisons to corresponding media collected at the Libby Site, the performance criteria and analytical requirements for this study are based on the requirements specified in other studies of duff and tree bark. These requirements are specified as part of the DQOs (see **Appendix A**). The analytical requirements for LA measurements established in Section B4 ensure that results from

this study will be directly comparable to results from historical (and planned future) sampling efforts.

A7.3 Precision

The precision of asbestos measurements is determined mainly by the number (N) of asbestos fibers counted in each sample. The coefficient of variation resulting from random Poisson counting error is equal to $1/N^{0.5}$. In general, when good precision is needed, it is desirable to count a minimum of 3-10 fibers per sample, with counts of 20-25 fibers per sample being optimal to limit uncertainty due to analytic counting error.

Field duplicates of duff and tree bark samples will be collected (see Section B5.1.5). Analysis of these field duplicates will provide a measure of the precision of the sampling and analysis process. TEM recount, repreparation, and laboratory duplicate analyses will also be performed (see Section B5.2.4) to provide information on analysis reproducibility and precision.

A7.4 Bias and Representativeness

To the extent feasible, samples should be collected and analyzed in accordance with procedures that have been performed in previous sampling efforts of duff and tree bark. This will ensure that the results of this study are representative and appropriate for comparison to other data sets.

A7.5 Completeness

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

A7.6 Comparability

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

A7.7 Method Sensitivity

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

A8. Special Training/Certifications

A8.1 Field

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

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

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

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

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

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

A8.2 Laboratory

A8.2.1 Certifications

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

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

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

A8.2.2 Laboratory Team Training/Mentoring Program

<u>Initial Mentoring</u>

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

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

Site-Specific Reference Materials

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

Regular Technical Discussions

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

Professional/Technical Meetings

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

A8.2.3 Analyst Training

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

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

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

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

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

A9. Documentation and Records

A9.1 Field

Field teams will record sample information on the most current version of the appropriate Site-specific field sample data sheets (FSDSs)[1]. Section B3.1.2 provides detailed information on the documentation requirements for FSDS forms. In brief, the FSDS forms document the unique sample identifier assigned to every sample collected as part of this program. In addition, the FSDSs provide information on whether the sample is representative of a field sample or a field-based QC sample (e.g., field blank, field duplicate).

A9.2 Laboratory

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

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

A9.3 Logbooks and Records of Modification/Deviations

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

B Data Generation and Acquisition

B1. Study Design

B1.1 Sampling Locations

A total of fifty locations were selected within the two mile buffer extending beyond the NPL boundary located east of Kootenai Falls. Sampling locations were placed in areas that were accessible via United States Forest Service (USFS) roads and that appeared to have adequate tree cover (based on a cursory review of aerial images). Actual sampling locations may be adjusted in the field based on local features. To the extent possible, the precise sampling location should prefer generally open areas that are not likely to have been substantially shielded from airborne deposition of asbestos by local features. **Figure B-1** identifies the selected sampling locations. **Appendix C** provides detailed topographic maps of each sampling location, including information on service roads that may be used to access each location.

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

B1.2 Sampling Design

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

Sampling will begin with the collection of one tree bark composite sample from the sample location. A total of fifty tree bark composite samples will be collected.

Following bark collection, one duff composite sample will be collected near each tree that was sampled for tree bark. A total of fifty duff composite samples will be collected.

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

B1.3 Study Variables

For ease of implementation, duff samples will be collected from the same general area where tree bark samples are collected.

B1.4 Critical Measurements

The critical measurement associated with this project is the measurement of the levels of LA in tree bark as surficial loading structures per centimeter squared (s/cm^2) and duff as concentration structures per gram (s/g) from locations within two miles of the NPL boundary and east of Kootenai Falls. The analysis of LA may be achieved using several different types of microscope, but the EPA generally recommends using TEM because this technique has the ability to clearly distinguish asbestos from non-asbestos structures, and to classify different types of asbestos (i.e., LA, chrysotile). In addition, analysis by TEM provides structure-specific dimensions that allow for the estimation of PCM-equivalent[2] (PCME) concentrations, which is the concentration metric necessary to estimate exposure and risks. Thus, all analyses for this study will be performed by TEM.

B1.5 Data Reduction and Interpretation

Data collected as part of this study can be used to support evaluations that will provide information on the spatial extent of LA contamination in tree bark and duff and the nature of the LA relative to that which has been measured in corresponding media at the Site. These evaluations may be made using a variety of methods, ranging from simple visual comparisons using graphical plots to statistical comparisons using the Poisson ratio test (Nelson 1982).

B2. Sampling Methods

B2.1 Sample Collection

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

As part of this investigation, personal air samples will also be collected for ongoing health and safety monitoring. Personal air samples will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-10, *Sampling of Asbestos Fibers in Air* (see **Appendix B**). The health and safety samples will be collected using a low volume sampling pump. To be consistent with other studies for which health and safety samples are collected, 'PA-EXC' or 'PA-TWA' will be selected in the Sample Air Type field of the FSDS for personal air excursion samples and personal air time-weighted average samples, respectively. These samples will be collected and analyzed in accordance with the *Response Action SAP* (CDM Smith 2011) and will represent both the TWA and STEL sampling periods.

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

B2.1.1 Tree Bark

Tree bark samples will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**), with the following project modifications:

- Preference should be given to trees with rough bark over trees with smoother bark, since it is expected that rough bark will tend to capture and retain airborne asbestos fibers more efficiently that trees with smooth bark. All bark samples will be collected from the side of the tree facing toward the mine site, from a height of about 4-5 feet above ground.
- Trees selected for sampling will be Douglas fir with a diameter of at least 8 inches. If these trees are not available near the selected sample location, the sampling team will preferentially select trees in the area with a large diameter and rough bark.
- Three different trees should be selected for sampling for each sampling location. A bark sample should be collected from each tree and placed together in a zip-top bag.
- It is not anticipated that the same trees will need to be located for future sampling activities, so flagging tape/ID tags will not be left on the trees. GPS coordinates will be collected for each bark sample location.
- Bark sample information will be recorded on the soil FSDS (the soil FSDS is designed to accommodate multiple media).
- The collection of tree age cores is not necessary for this project.

In brief, a hole saw and chisel will be used to collect a circular bark sample from each of three trees, which will be composited into a single sample for analysis of LA by TEM.

B2.1.2 Duff

Samples of duff material will be collected, handled, and documented in general accordance with Site-specific SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix B**), with the following project modifications:

- Duff material will be collected in close proximity to the three trees selected for tree bark sampling.
- Enough material will be collected from each sub-location such that the material from the three sub-locations fills a 1-gallon zip-top bag.
- Sample information will be recorded on a soil FSDS (the soil FSDS is designed to accommodate multiple media).

In brief, at each specified sampling point, any fresh or partially decayed organic debris (e.g., twigs, leaves, pine needles) will be collected by hand from the soil surface, taking care to ensure that the top layer of soil beneath the organic debris is not included in the duff material sample.

B2.2 Global Positioning System Coordinate Collection

Global positioning system (GPS) location coordinates will be recorded in basic accordance with Site-specific SOP CDM-LIBBY-09, *GPS Coordinate Collection and Handling* (see **Appendix B**). For this investigation, GPS coordinates will be collected as follows:

- Tree Bark – collect GPS coordinates from a location immediately adjacent to the selected tree.
- Duff – GPS coordinates are not required as the coordinates collected for tree bark will be in close proximity to duff sampling locations.

GPS coordinates will be collected as Sample Points, requiring the input of sample identification (ID) (also referred to as index ID) and location ID. Since multiple samples may be attributed to one area, for this sampling program the index ID will be input as 'N/A', for not applicable.

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

B2.3 Equipment Decontamination

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

B2.4 Handling Investigation-derived Waste

Any disposable equipment or other IDW will be handled in general conformance with Site-specific SOP EPA-LIBBY-2012-05, *Guide to Handling of Investigation-Derived Waste* (see **Appendix B**). In brief, IDW will be double bagged in clear 6-mil polypropylene bags with 'IDW' written, in letters at least 3-inches high, in indelible ink on at least two sides of the outer bag. All IDW generated during this sampling program will remain in the custody of the sampling team until the team returns to Libby where the IDW will enter the waste stream at the local class IV asbestos landfill.

B3. Sample Handling and Custody

B3.1 Sample Identification and Documentation

B3.1.1 Sample Labels

Samples will be labeled with sample ID numbers supplied by field administrative staff and will be signed out by the sampling teams. The labels will be affixed to the inside of both the inner and outer sample bags and the sample ID number will be written in indelible ink on the outside of each bag.

Sample ID numbers will identify the samples collected during this sampling effort using the following format:

NE-#####

where:

NE = Prefix that designates samples collected under this SAP/QAPP
= A sequential five-digit number

Care should be taken not to duplicate Sample ID numbers that have been used for other nature and extent sampling efforts that have the same Sample ID prefix.

B3.1.2 Field Sample Data Sheets

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

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

relinquished to the field sample coordination staff, the FSDSs are again checked for accuracy and completeness when data are input into the local Scribe field database.

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

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

B3.1.3 Field Logbooks

The field logbook is an accounting of activities at the Site and will duly note problems or deviations from the governing documents. Field logbooks will be maintained in general conformance with Site-specific SOP EPA-LIBBY-2012-01, *Field Logbook Content and Control* (see **Appendix B**).

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

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

B3.1.4 Photographs

Photographic documentation will be collected with a digital camera in general conformance to

SOP EPA-LIBBY-2012-02, *Photographic Documentation of Field Activities* (see **Appendix B**). Photographs should be taken to document representative examples of sampling locations and any other special conditions or circumstances that arise during sampling.

Electronic captions will be used to describe the photographs instead of maintaining photographic logs in daily logbook entries.

Photograph file names will be in the format:

Location ID_NEF_date

where:

NEF indicates Nature and Extent in the Forest

The date is formatted as MM-DD-YY

B3.2 Field Sample Custody

All teams will ensure that samples, while in their possession, are maintained in a secure manner to prevent tampering, damage, or loss. All samples and FSDSs will be relinquished by field staff to the field sample coordinator or a designated secure sample storage location at the end of each day.

B3.3 Chain-of-Custody Requirements

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

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

A member of the sample coordination staff will manually enter sample information from the hard copy FSDS into the local Scribe field project database using a series of standardized data entry forms developed in Microsoft Access by ESAT, referred to as the sample Data Entry Tool, or the "DE Tool". The DE Tool has a variety of built-in QC functions that improve accuracy of data entry and help maintain data integrity. After the data entry is checked against the hard copy FSDSs (by a different sample coordination staff member than completed the original data

entry), the DE Tool is used to prepare an electronic COC. A three-page carbon copy COC will be generated from the electronic COC. The field sample coordinator will retain one hard copy of the COC for the project file; the other two hard copies of the COC will accompany the sample shipment.

The field sample coordinator will note the analytical priority level for the samples (based on consultation with the LC) at the top of the COC. A copy of the investigation-specific Analytical Requirements Summary Sheet (see **Appendix D**) will also accompany each COC.

If any errors are found on a COC after shipment, the hard copy of the COC retained by the field sample coordinator will be corrected with a single strikeout, initial, and date. A copy of the corrected COC will be provided to the LC for distribution to the appropriate laboratory. It is the responsibility of the field data manager to make any corrections to the local Scribe field project database. Sample and COC information will be published to Scribe.NET regularly from the local Scribe field project database by the field data manager (see Section B10.1 for additional details).

B3.4 Sample Packaging and Shipping

Samples will be packaged and shipped in general accordance with SOP EPA-LIBBY-2012-07, *Packaging and Shipping of Environmental Samples* (see **Appendix B**).

A custody seal will be placed over at least two sides of the shipping cooler and then secured by tape. Prior to sealing the shipping container, the sample coordinator will perform a final check of the contents of the shipment with the COC, sign and date the designated spaces at the bottom of the COC. The field sample coordinator will then place the custody seals on the shipping container.

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

For hand-deliveries, samples will be packaged for transit such that they are contained and secure (i.e., will not be excessively jostled). Clean plastic totes with the lids secured or sample coolers may be used for this purpose. For samples requiring shipment, an established overnight delivery service provider (e.g., Federal Express) will be used.

B3.5 Holding Times

In general, there are no holding time requirements for asbestos. Because sample preparation (see Section B4.1) will include techniques to address any issues related to holding time for the media (i.e., ashing of tree bark and duff samples will address the growth of organic material

that may occur between sample collection and sample analysis), there are no holding time requirements for samples collected as part of this sampling program.

B3.6 Archival and Final Disposition

All samples will be maintained in storage at the Troy SPF or analytical laboratory unless otherwise directed by the EPA. When authorized by the EPA, the laboratory will be responsible for proper disposal of any remaining samples, sample containers, shipping containers, and packing materials in accordance with sound environmental practice, based on the sample analytical results. The laboratory will maintain proper records of waste disposal methods, and will have disposal company contracts on file for inspection.

B4. Analytical Methods

B4.1 Analytical Methods and Requirements

This section discusses the analytical methods and requirements for samples collected in support of this sampling program. This section includes detailed information on the analysis of duff and and tree bark, as well as the data reporting requirements, sample holding times, and custody procedures.

An analytical requirements summary sheet (**NEFOREST-0812**), which details the specific preparation and analytical requirements associated with this sampling program, is provided in **Appendix D**. The analytical requirements summary sheet will be reviewed and approved by all participating laboratories in this sampling program prior to any sample handling. A copy of this analytical requirements summary sheet will be submitted with each COC.

The personal air samples collected for the on-going health and safety monitoring will be analyzed in accordance with the *Response Action SAP* (CDM Smith 2011). In brief, air samples will be prepared and analyzed by PCM in accordance with NIOSH Method 7400, Issue 2.

B4.1.1 Duff

Sample Preparation

Duff samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-11, *Sampling and Analysis of Duff for Asbestos* (see **Appendix B**). In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. The resulting filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Any remaining ash material will be archived for possible future analysis.

For 10% of the duff samples, two additional ash aliquots will be prepared to filters and analyzed to gain an understanding of the within-sample variability. These samples will be selected *post hoc* (i.e., after the results have been received for the field samples) by the FTL (or their designee) so that a range of duff concentrations are represented.

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-11 and the most recent versions of Libby Laboratory Modifications[3] LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of duff materials are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (1E+07 per gram dry weight [g^{-1}]) is achieved.
    b. 50 LA structures have been observed.
    c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

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

The results for each duff analysis will be expressed in terms of LA structures per gram duff (s/g) (dry weight).

B4.1.2 Tree Bark

Sample Preparation

Tree bark samples will be prepared and analyzed in basic accordance with the procedures specified in SOP EPA-LIBBY-2012-12, *Sampling and Analysis of Tree Bark for Asbestos* (see **Appendix B**), with the following project modifications:

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

- Only one 0.25 gram aliquot of the resulting ash residue (rather than the total mass) will be filtered.

In brief, each sample is dried and ashed, and an aliquot of the resulting ash residue is acidified, suspended in water, and filtered. The resulting filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Any remaining ash material will be archived for possible future analysis.

For 10% of the tree bark samples, two additional ash aliquots will be prepared to filters and analyzed to gain an understanding of the within-sample variability. These samples will be selected *post hoc* by the FTL (or their designee) so that a range of tree bark levels are represented.

Analysis Method and Counting Rules

Grids will be examined by TEM using high magnification (~20,000x) in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by SOP EPA-LIBBY-2012-12. In brief, all fibrous amphibole structures that have appropriate SAED patterns and EDXA spectra, and having length ≥ 0.5 um and an aspect ratio (length: width) ≥ 3:1, will be recorded. If observed, chrysotile structures should be recorded using the same procedures.

Stopping Rules

The stopping rules for the TEM analysis of tree bark are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity (100,000 per square centimeter [cm^{-2}]) is achieved.
    b. 50 LA structures have been observed.
    c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

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

The results for each tree bark analysis will be expressed in terms of LA structures per cm^2 (s/ cm^2) of tree bark (i.e., a surface area loading).

B4.1.3 Equipment Rinsate Water

Sample Preparation

All equipment rinsate water samples (see Section B5.1.5) should be prepared for asbestos analysis in basic accordance with the techniques in EPA Method 100.2, as modified by Libby Laboratory Modification LB-000020A. In brief, all water samples will be prepared using an ozone/ultraviolet treatment that oxidizes organic matter that is present in the water or on the walls of the bottle, destroying the material that causes clumping and binding of asbestos structures. Following treatment, an aliquot of water (generally about 50 milliliters) will be filtered through a 25-millimeter diameter polycarbonate filter with a pore size of 0.1 µm with a mixed cellulose ester filter (0.45 µm pore size) used as a support filter.

Analysis Method

Approximately one quarter of the filter will be used to prepare a minimum of three grids using the grid preparation techniques described in Section 9.3 of ISO 10312:1995(E). Grids will be examined by TEM in basic accordance with the recording procedures described in ISO 10312:1995(E), as modified by the most recent versions of Libby Laboratory Modifications LB-000016, LB-000029, LB-000066, LB-000067, and LB-000085.

Counting Rules

All structures with fibrous morphology, an x-ray diffraction pattern consistent with amphibole asbestos, a energy dispersive spectrum consistent with LA, length greater than or equal to 0.5 µm, and an aspect ratio (length:width) greater than or equal to 3:1 will be counted and recorded. These counting rules will enable the calculation of water concentrations based on both total LA and LA structures longer than 10 µm. If observed, chrysotile structures will be recorded, but chrysotile structure counting may stop after 25 structures have been recorded.

TEM Stopping Rules

The TEM stopping rules for equipment rinsate water samples from this investigation are specified below and were selected to be consistent with the analytical requirements specified in other water sampling efforts conducted at the Site. The stopping rules are as follows:

1. Count a minimum of two grid openings from each of two grids.
2. Continue counting until one of the following is achieved:
    a. The target analytical sensitivity of 50,000 L^{-1} has been achieved.
    b. 25 LA structures have been observed.
    c. A total filter area of 1.0 mm^2 has been examined (this is approximately 100 grid openings).

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

B4.2 Analytical Data Reports

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

B4.3 Laboratory Data Reporting Tools

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

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

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

Note: ESAT is in the process of developing a new Site-specific analytical results reporting tool, referred to as the Libby Asbestos Data Tool (LADT). This tool is a relational Microsoft® Access database with a series of standard data entry forms specific to each analytical method. The LADT creates a Microsoft® Excel export file that can be directly uploaded into an analytical Scribe project database (see Section B10.4). Laboratories have the option of using LADT as a data reporting method instead of the Libby-specific EDDs.

B4.4 Analytical Turn-around Time

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

B4.5 Custody Procedures

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

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

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

B5. Quality Assurance/Quality Control

B5.1 Field

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

B5.1.1 Training

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

B5.1.2 Modification Documentation

Minor deviations (i.e., those that will not impact data quality or usability) encountered in day-to-day field work will be noted in the field logbook. Major deviations from this SAP/QAPP that modify the sampling approach and associated guidance documents will be recorded on a field ROM form (see **Appendix E**). The field ROM forms will be used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation work that have the potential to impact data quality or usability. ROMs are completed by the FTL overseeing the investigation/activity, or by assigned field or technical staff. As modifications to governing documents are implemented, the FTL will communicate the changes to the field teams conducting activities associated with the modification.

Each completed field ROM is assigned a unique sequential number (e.g., LFO-000026) by the CDM Smith field QAM. A ROM tracking log for all field modifications is maintained by the field QAM. This tracking log briefly describes the ROM being documented, as well as ROM author, the reviewers, and date of approval. Once a form is prepared, it is submitted to the appropriate EPA RPM for review and approval. Copies of approved ROMs are available in the Libby Field eRoom.

B5.1.3 Field Surveillances

Field surveillances consist of periodic observations made to evaluate continued adherence to investigation-specific governing documents. It is not anticipated that a field surveillance will be performed for this investigation. However, field surveillances may be conducted if field processes are revised or other QA/QC procedures indicate potential deficiencies.

B5.1.4 Field Audits

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

B5.1.5 Field QC Samples

Field QC samples are collected to help ensure that field samples are not contaminated from exogenous sources during sample collection, and to help evaluate the precision of field sample

analytical results. Field QC samples are assigned unique field identifiers and are submitted to the analytical laboratory along with the associated field samples.

Duff

Only one type of field QC sample will be collected as part of the duff sampling portion of this program – field duplicates. Field blanks for duff are not required for this sampling program.

Field duplicate samples of duff material will be collected as part of this sampling program at a rate of 5%. The duff field duplicate should be collected at the same approximate locations as the duff sampling points as the parent sample (i.e., within 12 inches of the parent sampling points). It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given a unique sample number, and field personnel will record the sample number of the associated co-located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% confidence interval (CI) (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

Tree Bark

Two types of field QC samples may be collected as part of the tree bark sampling portion of this program – equipment rinsates and field duplicates. Field blanks for tree bark are not required for this sampling program.

<u>Equipment Rinsates</u>

Equipment rinsates are collected to evaluate potential contamination that arises to due inadequate decontamination of sampling equipment. Equipment rinsates will only be collected if non-dedicated field sampling equipment (i.e., hole saws, chisels) are utilized. Following decontamination efforts, the decontaminated equipment (i.e., hole saw, chisel) should be rinsed with clean water (e.g., store-bought drinking water), and the resulting rinsate should be collected in a high density polyethylene (HDPE) container. One equipment rinsate blank should be collected per equipment decontamination effort. It is the responsibility of each field team to collect the appropriate number of equipment rinsate blanks. Equipment rinsate blanks should be labeled with a unique sample number and submitted for analysis by TEM.

Analysis of equipment rinsate blanks will be delayed until analytical results for the tree bark field samples have been received and reviewed. If there were detectable levels of LA observed in the tree bark samples collected on a particular day, the associated equipment rinsate will be analyzed to ensure results are not influenced by cross-contamination.

If any asbestos structures are observed on an equipment rinsate, the FTL and/or laboratory manager will be notified and will take appropriate measures to ensure staff are employing proper sample handling techniques. In addition, a qualifier of "EB" will be added to the related field sample results in the project database to denote that the associated equipment rinsates had asbestos structures detected.

Field Duplicates

Field duplicate samples of tree bark will be collected as part of this sampling program at a rate of 5%. Field duplicates for tree bark are collected from the same tree as and in close proximity to (within 6 inches) the parent field sample. The field duplicate is collected using the same collection technique as the parent sample. It is the responsibility of the FTL to ensure that the field duplicate is collected. The field duplicate is given unique sample number, and field personnel will record the sample number of the associated co located sample in the parent sample number field of the FSDS. The same station location is assigned to the field duplicate sample as the parent field sample. Field duplicates will be sent for analysis by the same method as field samples and are blind to the analytical laboratories (i.e., the laboratory cannot distinguish between field samples and field duplicates).

Field duplicate results will be compared to the original parent field sample using the Poisson ratio test using a 90% CI (Nelson 1982). Because field duplicate samples are expected to have inherent variability that is random and may be either small or large, typically, there is no quantitative requirement for the agreement of field duplicates. Rather, results are used to determine the magnitude of this variability to evaluate data usability.

B5.2 Analytical Laboratory

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

B5.2.1 Training/Certifications

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

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

B5.2.2 Modification Documentation

All deviations from project-specific and method guidance documents will be recorded on the Laboratory ROM Form (see **Appendix E**). The ROM will be used to document all permanent and temporary changes to analytical procedures. ROMs will be completed by the appropriate laboratory or technical staff. As ROMs are completed, it is the responsibility of the LC to communicate any changes to the project laboratories. When the project management team determines the need, this SAP/QAPP will be revised to incorporate necessary modifications. Copies of approved ROMs for this SAP/QAPP will be made available in the Libby Lab eRoom.

B5.2.3 Laboratory Audits

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

<u>External Audits</u>

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

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

the protocols detailed in the formal method, how well the analysts follow the laboratory-specific method SOPs, and how the analysts respond to method-specific questions.

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

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

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

Internal Audits

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

B5.2.4 Laboratory QC Analyses

General Requirements

The Libby-specific QC requirements for TEM analyses of asbestos are patterned after the requirements set forth by NVLAP. In brief, there are three types of laboratory-based QC analyses for TEM – laboratory blanks, recounts, and repreparations. Detailed information on the Libby-specific requirements for each type of TEM QC analysis, including the minimum frequency rates, selection procedures, acceptance criteria, and corrective actions are provided in the most recent version of Libby Laboratory Modification LB-000029.

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

Duff and Tree Bark-specific Requirements

In addition to the laboratory-based QC analyses discussed above, TEM analyses of tree bark and duff have additional QC analyses that are required, including drying blanks and filtration blanks, and laboratory duplicates. Because three replicate filters will be prepared and analyzed for 10% of the duff and tree bark samples, no laboratory duplicate analyses will be required for this sampling effort. Detailed information on the Libby-specific requirements for each type of TEM QC analysis is provided in the medium-specific SOPs (i.e., EPA-LIBBY-2012-11 and EPA-LIBBY-2012-12). It is the responsibility of the laboratory manager to ensure that the proper number of TEM QC analyses is completed.

B6/B7. Instrument Maintenance and Calibration

B6/B7.1 Field Equipment

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

B6/B7.2 Laboratory Instruments

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

B8. Inspection/Acceptance of Supplies and Consumables

B8.1 Field

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

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

- Field logbook – Used to document field sampling activities and any problems in sample collection or deviations from the investigation-specific QAPPs. See Section B3.1.3 for standard procedures for field logbooks.

- Field sample data sheets (FSDSs) – FSDSs forms that are used to document sample details (i.e., sampling location, sample number, medium, field QC type, etc.). See Section B3.1.2 for standard procedures for the completion of FSDSs.

- Sample number labels – Sample numbers are sequential numbers with investigation-specific prefixes. Sample number labels are pre-printed and checked out to the field teams by the FTL or their designee. To avoid potential transcription errors in the field, multiple labels of the same sample number are prepared – one label is affixed to the collected sample, one label is affixed to the hard copy FSDS form. Labels may also be affixed to the field logbook.

- Indelible ink pen, permanent marker – Indelible ink pens are used to complete required manual data entry of information on the FSDS and in the field logbook (pencil may not be used). Permanent markers may also be used to write sample numbers on the sample containers.

- Personal Protective Equipment - As required by the HASP.

- Land survey map or aerial photo – Used to identify appropriate sampling locations. In some cases, sketches may be added to the map/photo to designate sampling and visual inspection locations and other site features.

- Digital camera – Used to document sampling locations and conditions. See Section B3.1.4 for standard procedures in photographic documentation.

- Global positioning system (GPS) unit, measuring wheel, stakes – Used to identify and mark sampling locations. See B2.2 for standard procedures in GPS documentation.

- Zip-top bags – Zip-top bags are used as sample containers for most types of environmental samples. Sample number labels will be affixed to the bags or the sample number will be hand-written in permanent marker on the bags.

- Decontamination equipment – Used to remove any residual asbestos contamination on reusable sampling equipment between the collection of samples. See Section B2.3 for standard decontamination procedures.

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

- Tree bark sampling equipment: aerosol hairspray, battery-powered drill, 2-inch diameter hole saw, chisel

B8.2 Laboratory

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

B9. Non-direct Measurements

The EPA has performed several investigations at the Site to evaluate levels of LA in tree bark and duff material. Tree bark and duff sample results from these sampling programs may be compared to existing and future Libby data sets for these environmental media.

Data users will utilize the appropriate project databases to access data for comparison. See Sections B10.4 and B10.5 for additional information on project databases and data reporting. Only those data that have undergone data verification and validation (see Section D2) and been evaluated with regard to data usability (see Section D3) should be utilized for the purposes of making comparisons.

B10. Data Management

The following subsections describe the field and analytical laboratory data management procedures and requirements for this investigation. These subsections also describe the project databases utilized to manage and report data from this investigation. Detailed information

regarding data management procedures and requirements can be found in the *EPA Data Management Plan* for the Libby Asbestos Superfund Site (EPA 2012).

B10.1 Field Data Management

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

The field data manager utilizes a "local" field Scribe project database (i.e., LibbyCDM_Field.mdb) to maintain field sample information. The term "local" denotes that the database resides on the server or personal computer of the entity that is responsible for the creating/managing the database. It is the responsibility of the field data manager to ensure that all local field Scribe project databases are backed-up nightly to a local server.

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

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

B10.2 Analytical Laboratory Data Management

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

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

The ESAT project database manager utilizes a local analytical Scribe project database (i.e., LibbyLab2012.mdb) to maintain analytical results information. The EDDs are uploaded directly into the analytical Scribe project database. It is the responsibility of the ESAT project data

manager to publish analytical results information from the local analytical Scribe database to Scribe.NET.

B10.3 Libby Project Database

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

All data collected for this investigation will be maintained in Scribe. As discussed above, data will be are captured in various Scribe project databases, including a field Scribe project (i.e., LibbyCDM_Field.mdb) and an analytical results Scribe project (i.e., LibbyLab2012.mdb).

B10.4 Data Reporting

Data users can access data for the Libby project through Scribe.NET. To access data, a data user must first download the Scribe application from the EPA ERT website[4]. The data user must then subscribe to each of the published Scribe projects for the Site using login and password information that are specific to each individual Scribe project. Scribe subscriptions for the Libby project are managed by ERT. Using the Scribe application, a data user may download a copy of any published Scribe project database to their local hard drive. It is the responsibility of the data user to regularly update their local copies of the Libby Scribe projects via Scribe.NET.

The Scribe application provides several standard queries that can be used to summarize and view results within an individual Scribe project. However, these standard Scribe queries cannot be used to summarize results across multiple Scribe projects (e.g., it is not possible to query both the "LibbyCDM_Field" project and the "LibbyLab2012" project using these standard Scribe queries).

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

Alternatively, data users may download copies of multiple published Scribe project databases for the Site and utilize Microsoft Access to create user-defined queries to extract the desired

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

data across Scribe projects. This requires that the data user is proficient in Microsoft Access and has an intimate knowledge of proper querying methods for asbestos data for the Site.

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

C Assessment and Oversight

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

C1. Assessment and Response Actions

C1.1 Assessments

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

Laboratory system assessments/audits will be coordinated by the EPA. Performance assessments for the laboratories may be accomplished by submitting blind reference material (i.e., performance evaluation samples). These assessment samples are samples with known concentrations that are submitted to the laboratories without identifying them as such to the laboratories. Performance assessments will be coordinated by the EPA.

C1.2 Response Actions

Corrective response actions will be implemented on a case-by-case basis to address quality problems. Minor actions taken to immediately correct a quality problem will be documented in the applicable field or laboratory logbooks and a verbal report will be provided to the appropriate manager (e.g., the FTL or EPA LC). Major corrective actions will be approved by the EPA Remedial Project Manager and the appropriate manager prior to implementation of the change. Major response actions are those that may affect the quality or objective of the investigation. EPA project management will be notified when quality problems arise that cannot be corrected quickly through routine procedures.

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

C2. Reports to Management

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

D Data Validation and Usability

D1. Data Review, Verification and Validation

D1.1 Data Review

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

D1.2 Criteria for LA Measurement Acceptability

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

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

D2. Verification and Validation Methods

D2.1 Data Verification

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

For analytical laboratories that utilize the Libby-specific EDD spreadsheets, data checking of reported analytical results begins with automatic QC checks that have been built into the spreadsheets. In addition to these automated checks, a detailed manual data verification effort will be performed for 10% of all samples and TEM analytical results collected as part of this

sampling effort. This data verification process utilizes Site-specific SOPs (see **Appendix B**) developed to ensure TEM results and field sample information in the project databases is accurate and reliable:

- EPA-LIBBY-09 – *SOP for TEM Data Review and Data Entry Verification* – This Site-specific SOP describes the steps for the verification of TEM analyses, based on a review of the laboratory benchsheets, and verification of the transfer of results from the benchsheets into the project database.

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

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

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

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

D2.2 Data Validation

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

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

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

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

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

The QATS contractor will also prepare an annual addendum to the *Quality Assurance and Quality Control Summary Report for the Libby Asbestos Superfund Site* (CDM Smith 2011) to summarize results of the quarterly data validation efforts. This addendum should include a summary of any data qualifiers that are to be added to the project database to denote when results do not meet NFG guidelines and/or project-specific acceptance criteria. This addendum should also include recommendations for Site QA/QC program changes to address any data quality issues.

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

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

D3. Reconciliation with User Requirements

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

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

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

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Sampling and Analysis Plan/Quality Assurance Project Plan
Nature and Extent of LA Contamination in the Forest
Libby Asbestos Site, Operable Unit 4

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TABLES

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

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

ASTM = American Society of Testing and Materials
LA = Libby amphibole
QATS = Quality Assurance Technical Support
ROM = record of modification
SOP = standard operating procedure
TEM = transmission electron microscopy

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Sampling and Analysis Plan/Quality Assurance Project Plan
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FIGURES

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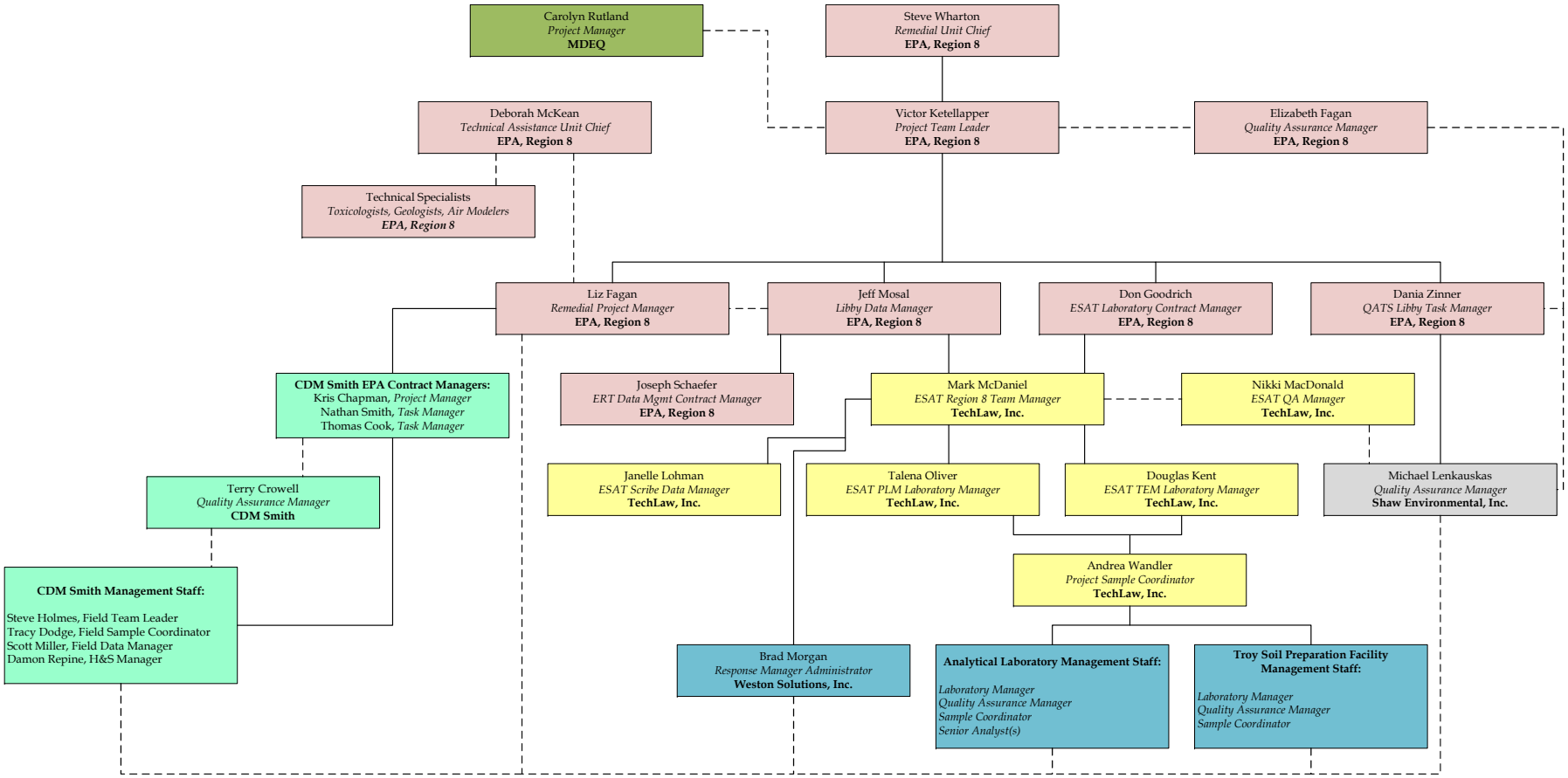
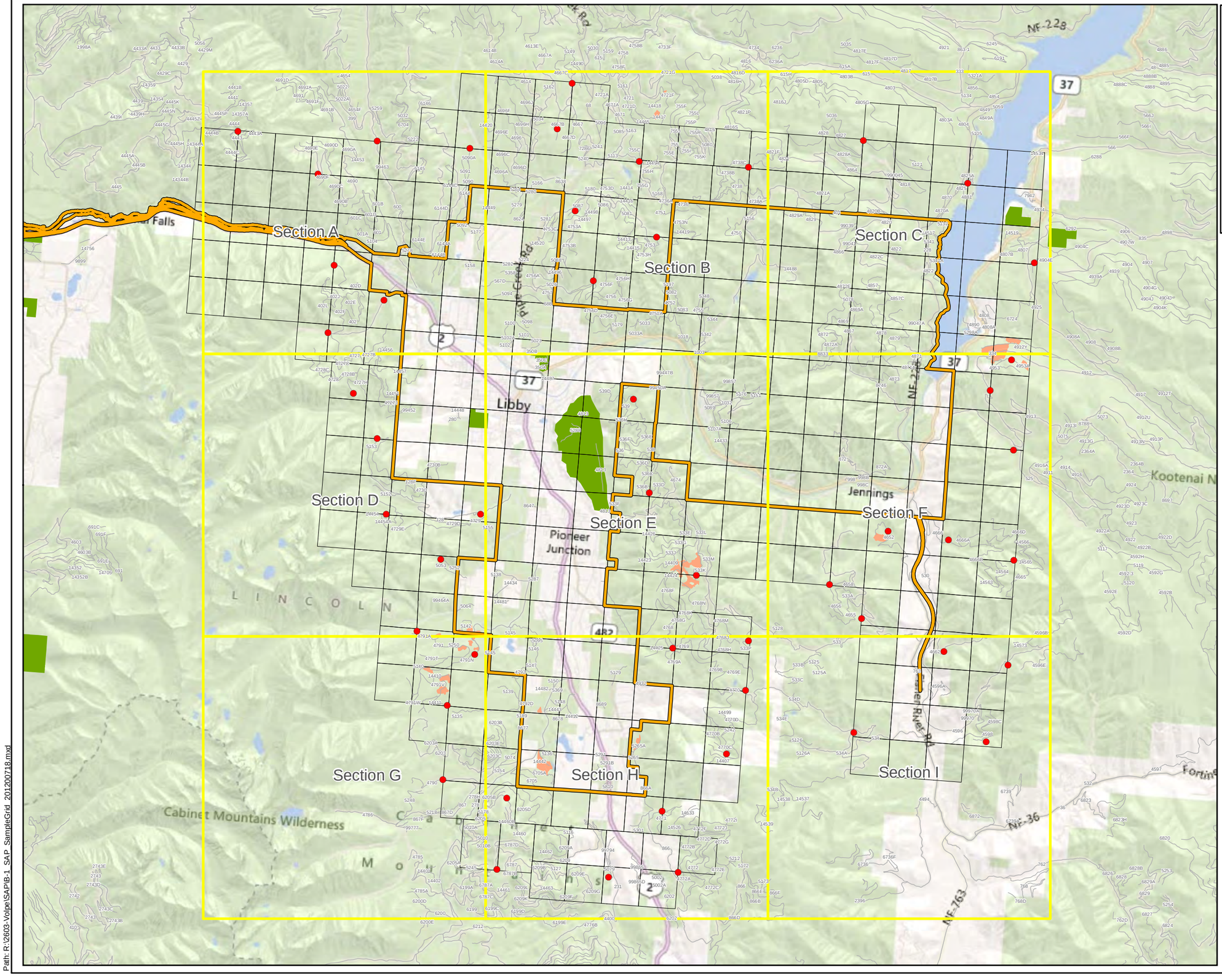


Figure A-1. Organizational Chart for the Nature and Extent in the Forest Sampling Program



Legend

- Sampling Locations
- Forest Service Roads
- Libby Asbestos NPL Boundary
- Two Mile Buffer Along the NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Maps Index

* See Appendix C for Detailed Maps

N
W E
S

Miles

0 1.25 2.5 5

1 inch = 2.5 miles

Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011);
Base - Microsoft Bing (2011)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

For Official Use Only

Figure B-1

Tree Bark and Duff Sampling Locations

CDM Smith

Path: R:\2603-Volpe\SAP\B-1_SAP_SampleGrid_20120718.mxd

Sampling and Analysis Plan/Quality Assurance Project Plan
Nature and Extent of LA Contamination in the Forest
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Appendix A
Data Quality Objectives (DQOs)

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Appendix A
Data Quality Objectives for the
Nature and Extent of LA in the Forest Study

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

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

A.1 Step 1: State the Problem

Previous investigations conducted at the Site have demonstrated that LA is present in environmental source media (e.g., soil, tree bark, duff material) at locations in and around the mine. Sampling of soil, tree bark, and duff from Operable Unit 3 (OU3), the mine and forested areas surrounding the mine, occurred as part of the *Phase I Sampling and Analysis Plan for OU3* (EPA 2007). Results of this sampling revealed that LA contamination extends well beyond areas that were historically actively mined. This contamination is likely a result of aerial deposition. Additionally, a study was performed at the Upper Flower Creek Timber Sale Site located south of the town of Libby to investigate potential levels of LA contamination (Tetra Tech 2011). Results of this study reveal that LA is present at detectable levels in tree bark and duff. Because LA contamination has been demonstrated to extend beyond areas where mining operations took place, the extent of LA contamination is unknown. Therefore, the purpose of this study is to characterize the nature and extent of LA contamination in the forested areas surrounding Libby.

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

The goal of this study is to measure LA levels in duff materials and tree bark from locations just outside the NPL boundary for the Site, which can provide information on the spatial extent of LA contamination and the nature of LA levels relative to those measured in corresponding media at the Site. Results may used by risk managers to provide information on potential exposures in the forested areas surrounding Libby compared to the forested areas surrounding the mine.

A.3 Step 3: Identify Information Inputs

The information needed consists of reliable measurements of LA levels in duff materials and

tree bark.

Type of Sample

Samples should be collected using a sampling design that allows for estimation of the average level of LA in duff or tree bark from the collection area (i.e., a single multi-point composite sample or multiple single-point samples from which a mean can be calculated). In addition, samples should be collected in a manner that is equivalent to the sample collection methods used in previous sampling efforts (e.g., OU3 Phase I sampling effort). For duff, results should provide an estimate of the level (e.g., asbestos structures per gram of dried duff [s/g, dry weight]) of LA in duff. For tree bark, results should provide an estimate of the level of LA loading on the tree bark surface (e.g., asbestos structures per cm^2 of area [s/cm^2]).

Analysis Method

Samples should be analyzed for LA using transmission electron microscopy (TEM). Because it is possible that, if present, the asbestos observed in the areas of interest may be different from the type of asbestos derived from the Libby ore body at the mine site, TEM analysis results should include the size attributes (length, width) of each asbestos structure observed, along with the mineral classification (LA, other amphibole, chrysotile). In addition, information on the sodium and potassium content of each LA structure observed, as determined by energy dispersive spectroscopy (EDS), should also be recorded. This requirement is based on the observation of Meeker *et al*. (2003) that most particles from the Libby ore body contain detectable levels of both sodium and potassium, whereas other potential sources of amphibole fibers may not.

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

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

A.4.1 Spatial Bounds

This study should seek to collect data on LA concentrations in duff and tree bark from locations within a two mile buffer just outside the NPL boundary. The study area should encompass the circumference of the entire NPL boundary, with the exception of the area east of Kootenai Falls. Sampling of this area will be completed as part of investigations specific to Operable Unit 7. Although it is not necessary that sampling locations for each medium (duff and tree bark) be co-located, to limit level of effort in the field, duff should be collected in close proximity to the trees that are selected to be sampled for tree bark.

A.4.2 Temporal Bounds

It is not thought that the asbestos levels in duff or tree bark are likely to be highly time-variable in a static environment. Thus, the time of the field sampling effort is primarily dependent upon ease of site access and sample collection (i.e., it is easier to collect samples in the summer than in the winter).

A.5 Step 5: Define the Analytic Approach

Data collected as part of this study can be used to support evaluations that will provide information on the spatial extent of LA contamination in tree bark and duff and the nature of the LA relative to that which has been measured in corresponding media at the Site.

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

A.6 Step 6: Specify Acceptance Criteria

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

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

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

Sampling Locations

Sampling locations should surround the entire perimeter of the NPL boundary within the two mile buffer area, with the exception of the area located to the east of Kootenai Falls. Locations should be placed such that there is adequate coverage of the perimeter (the actual number of locations will be primarily dictated by available resources). Sampling locations should be placed in areas that were accessible via forest service roads and that appeared to have adequate tree cover (based on a cursory review of aerial images).

TEM Stopping Rules

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

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

Because one of the goals of this study is to collect data that can be compared to data collected as part of previous studies, the stopping rules for each medium are set equal to those utilized in previous studies. The following table summarizes the stopping rules for each medium.

Medium	TEM Stopping Rules			Previous Study Source
	Target Analytical Sensitivity	Maximum Structures Observed	Maximum Area Examined	
Tree Bark	100,000 cm^{-2}	50 total LA structures	1 mm^2 (100 GOs)	OU3 Phase I SAP (EPA 2007), Flower Creek SAP (MDEQ 2011)
Duff	1E+07 g^{-1}	50 total LA structures	1 mm^2 (100 GOs)	OU3 Phase I SAP (EPA 2007), Flower Creek SAP (MDEQ 2011)

A.7.6 Refining the Study Design

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

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

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

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Sampling and Analysis Plan/Quality Assurance Project Plan
Nature and Extent of LA Contamination in the Forest
Libby Asbestos Site, Operable Unit 4
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Appendix B
Standard Operating Procedures (SOPs)

SOP ID	SOP Description
Field Procedures	
EPA-LIBBY-2012-01	Field Logbook Content and Control
EPA-LIBBY-2012-02	Photographic Documentation of Field Activities
EPA-LIBBY-2012-04	Field Equipment Decontamination
EPA-LIBBY-2012-05	Handling Investigation-Derived Waste
EPA-LIBBY-2012-06	Sample Custody
EPA-LIBBY-2012-07	Packaging and Shipping of Environmental Samples
EPA-LIBBY-2012-10	Sampling of Asbestos Fibers in Air
EPA-LIBBY-2012-11	Sampling and Analysis of Duff for Asbestos
EPA-LIBBY-2012-12	Sampling and Analysis of Tree Bark for Asbestos
CDM-LIBBY-09	GPS Coordinate Collection and Handling
Laboratory Procedures	
EPA-LIBBY-08	Indirect Preparation of Air and Dust Samples for Analysis by TEM
Data Verification Procedures	
EPA-LIBBY-09	TEM Data Review and Data Entry Verification
EPA-LIBBY-11	FSDS Data Review and Data Entry Verification

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

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

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Nature and Extent of LA Contamination in the Forest
Libby Asbestos Site, Operable Unit 4

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Appendix C
Detailed Map Locations

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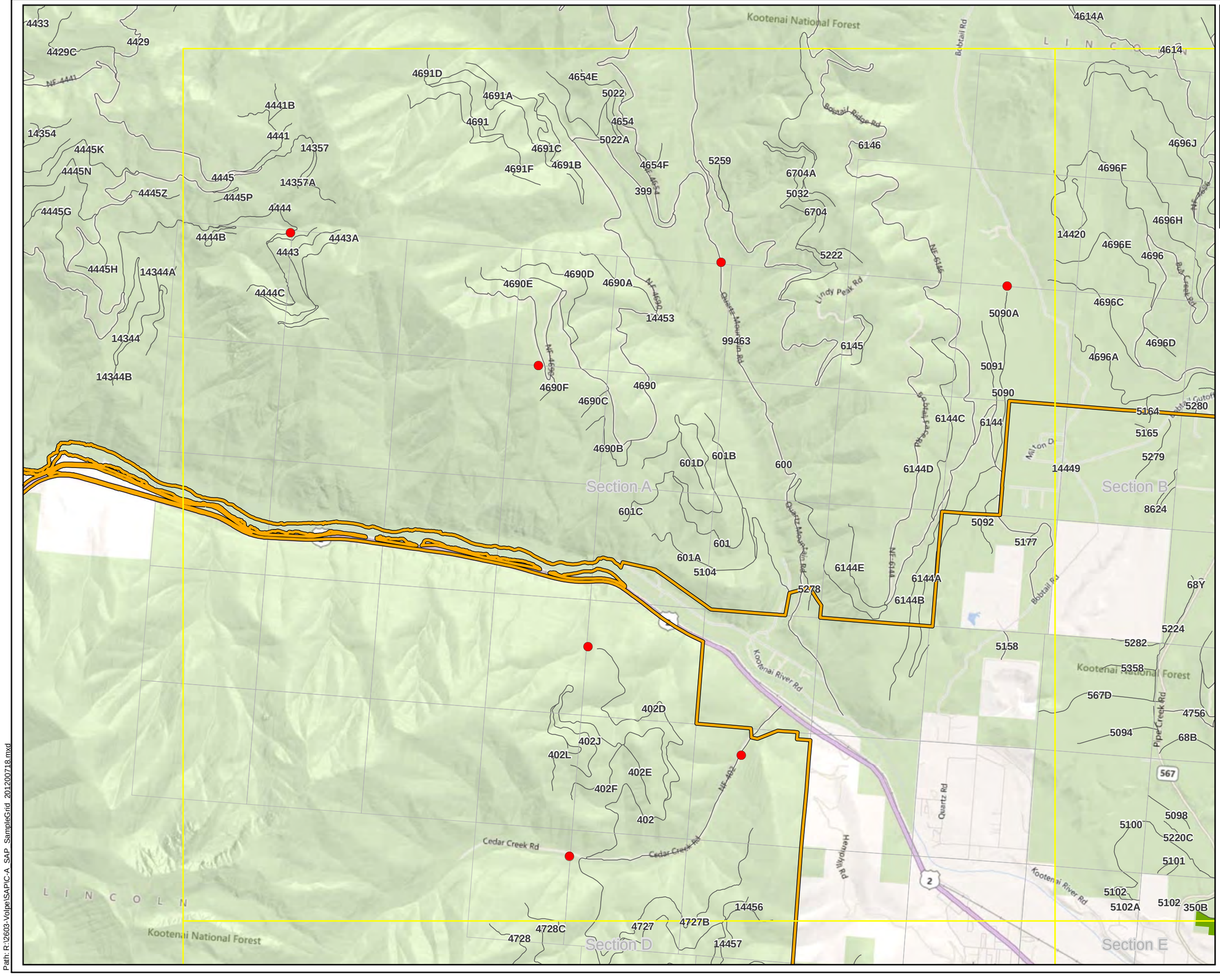

Legend

- Sampling Locations
- Forest Service Roads
- Two Mile Buffer Along the NPL Boundary
- Libby Asbestos NPL Boundary
- DNRC Timber Sales
- DNRC Precommercial Tree Thinning
- Detailed Maps Index

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Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011);
Base - Microsoft Bing (2011)

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Appendix C
Figure A

Tree Bark and Duff
Sampling Locations

CDM Smith

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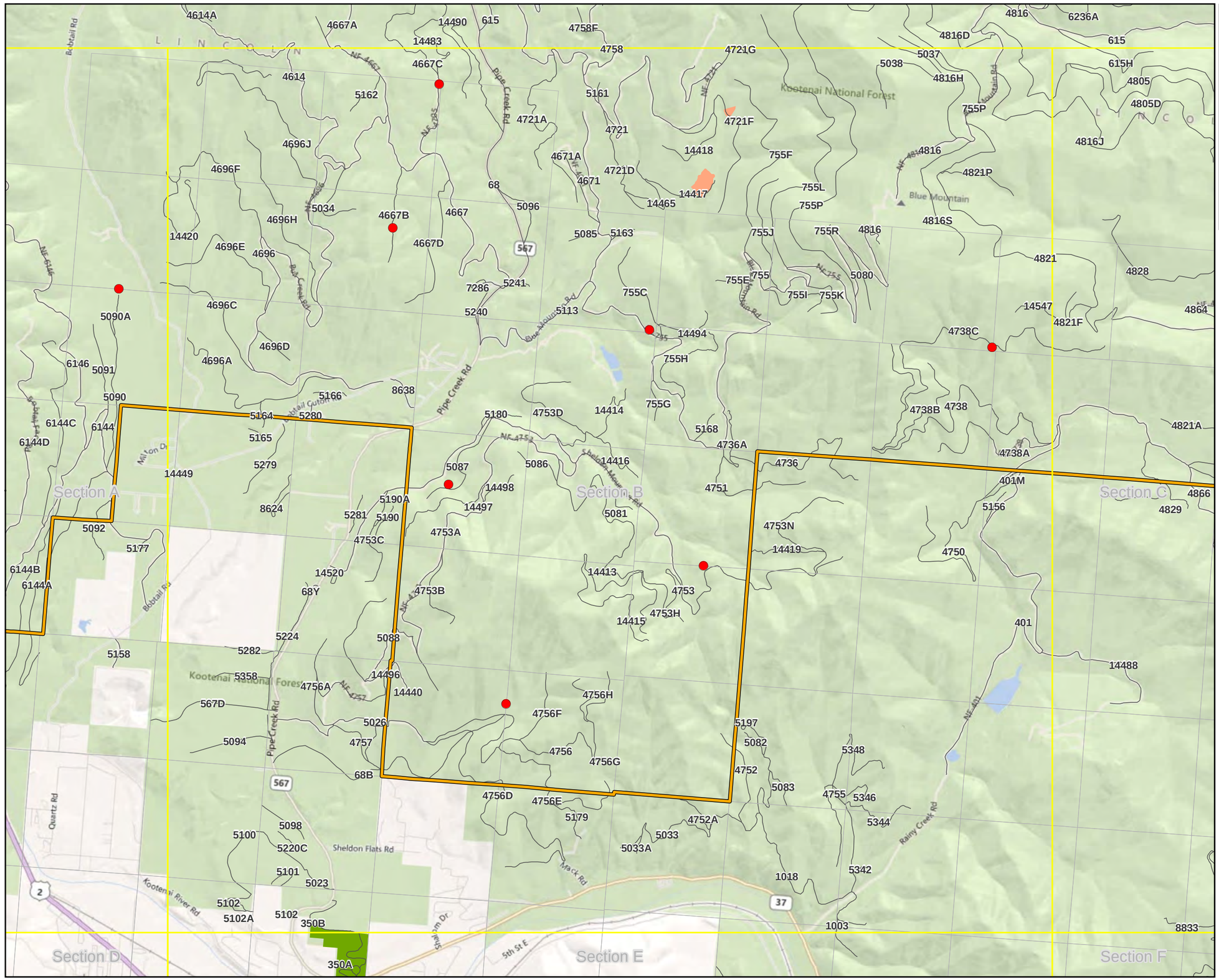

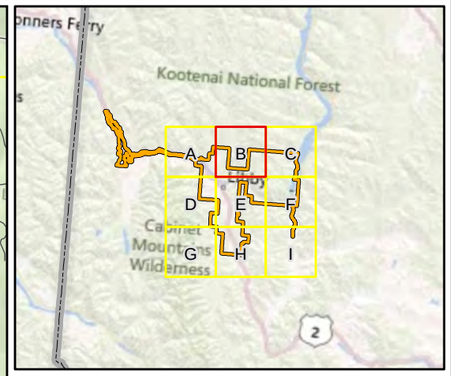

Legend

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Appendix C
Figure B

Tree Bark and Duff
Sampling Locations

CDM Smith

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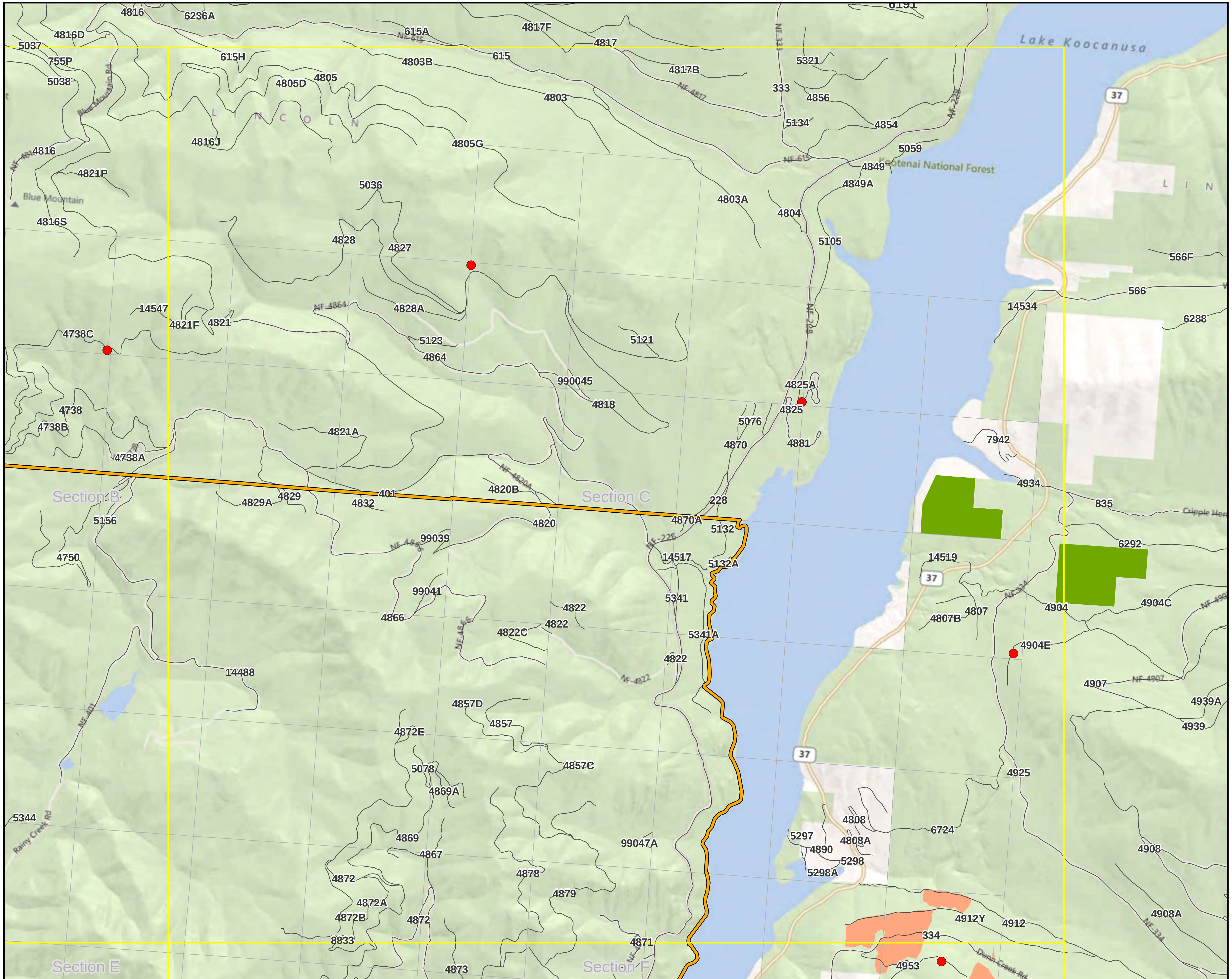

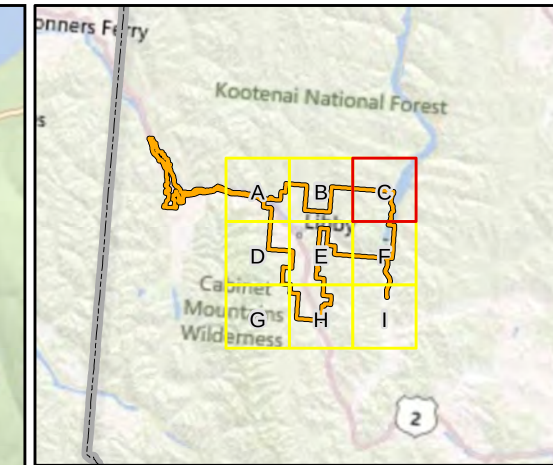

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Appendix C
Figure C

Tree Bark and Duff
Sampling Locations

CDM Smith

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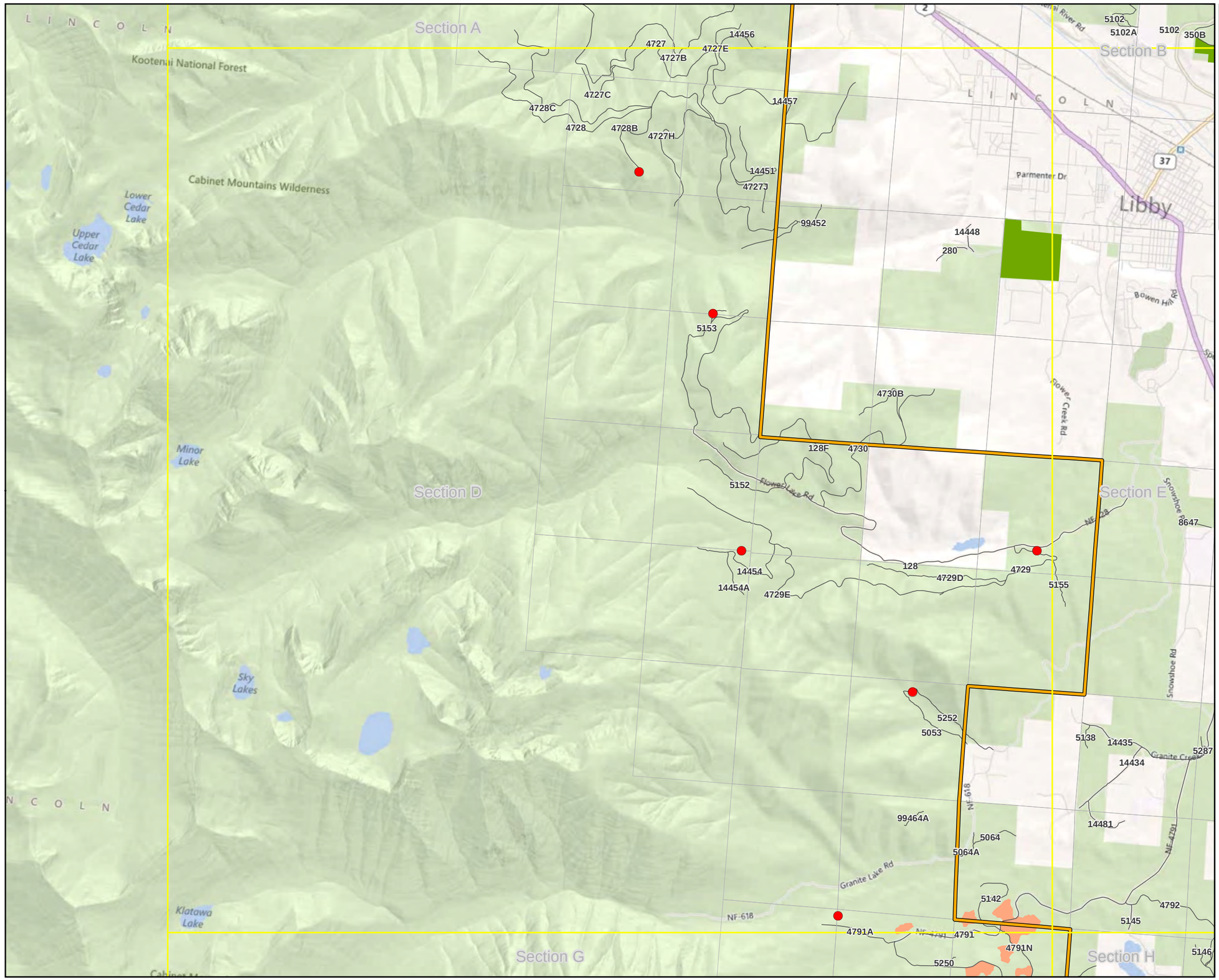

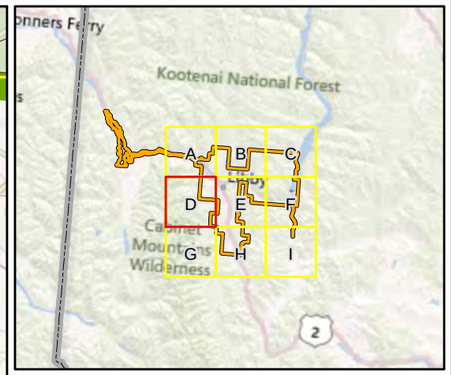

Legend

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Appendix C
Figure D

Tree Bark and Duff
Sampling Locations

CDM Smith

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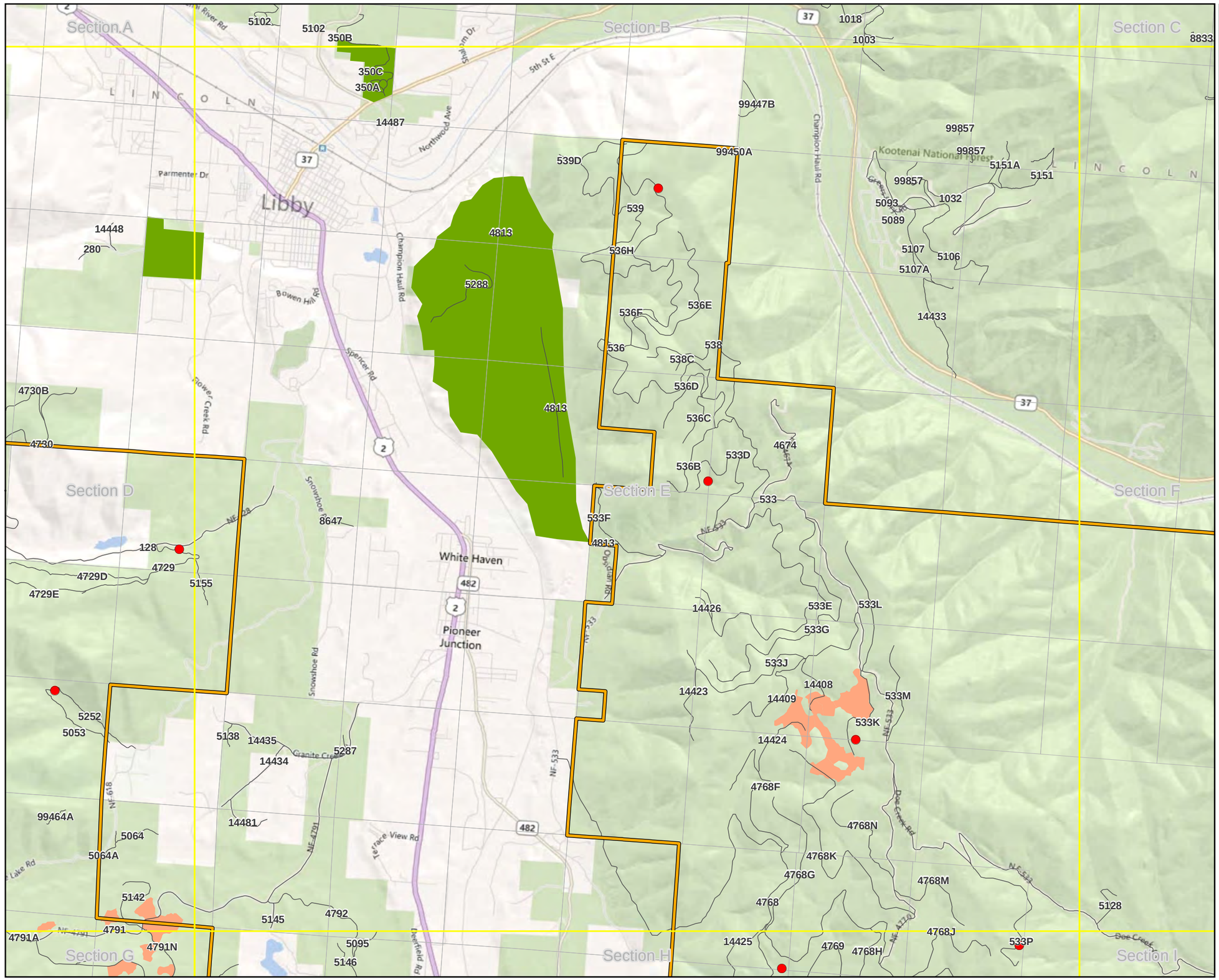

Data Sources:
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Timber Sales and Precommercial Tree Thinning - MT DNRC (2011);
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Appendix C
Figure E

Tree Bark and Duff Sampling Locations

CDM Smith

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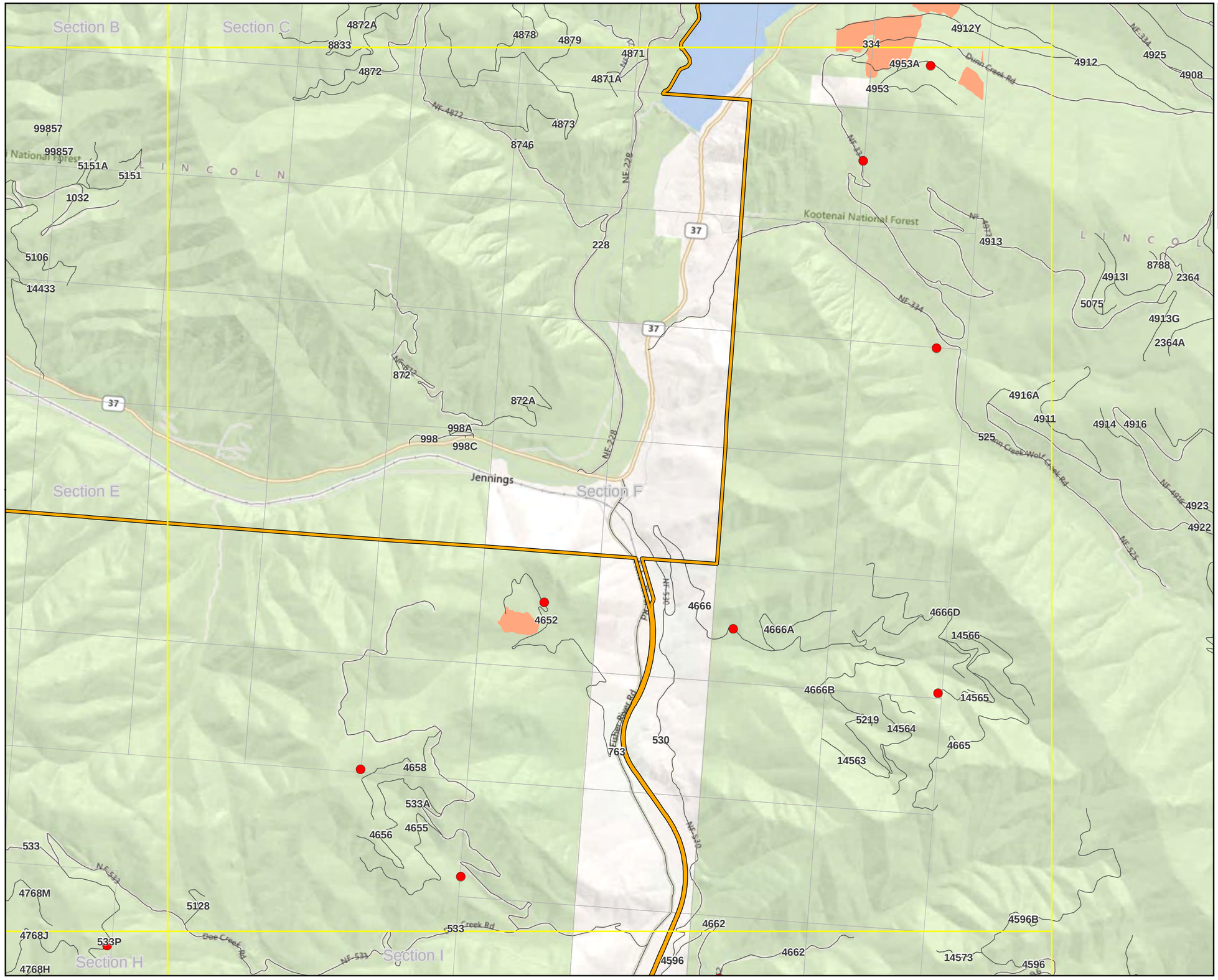
Section B
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Data Sources:
NPL Boundary - U.S. EPA Region 8 (2011);
Timber Sales and Precommercial Tree Thinning - MT DNRC (2011);
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Appendix C
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Tree Bark and Duff
Sampling Locations
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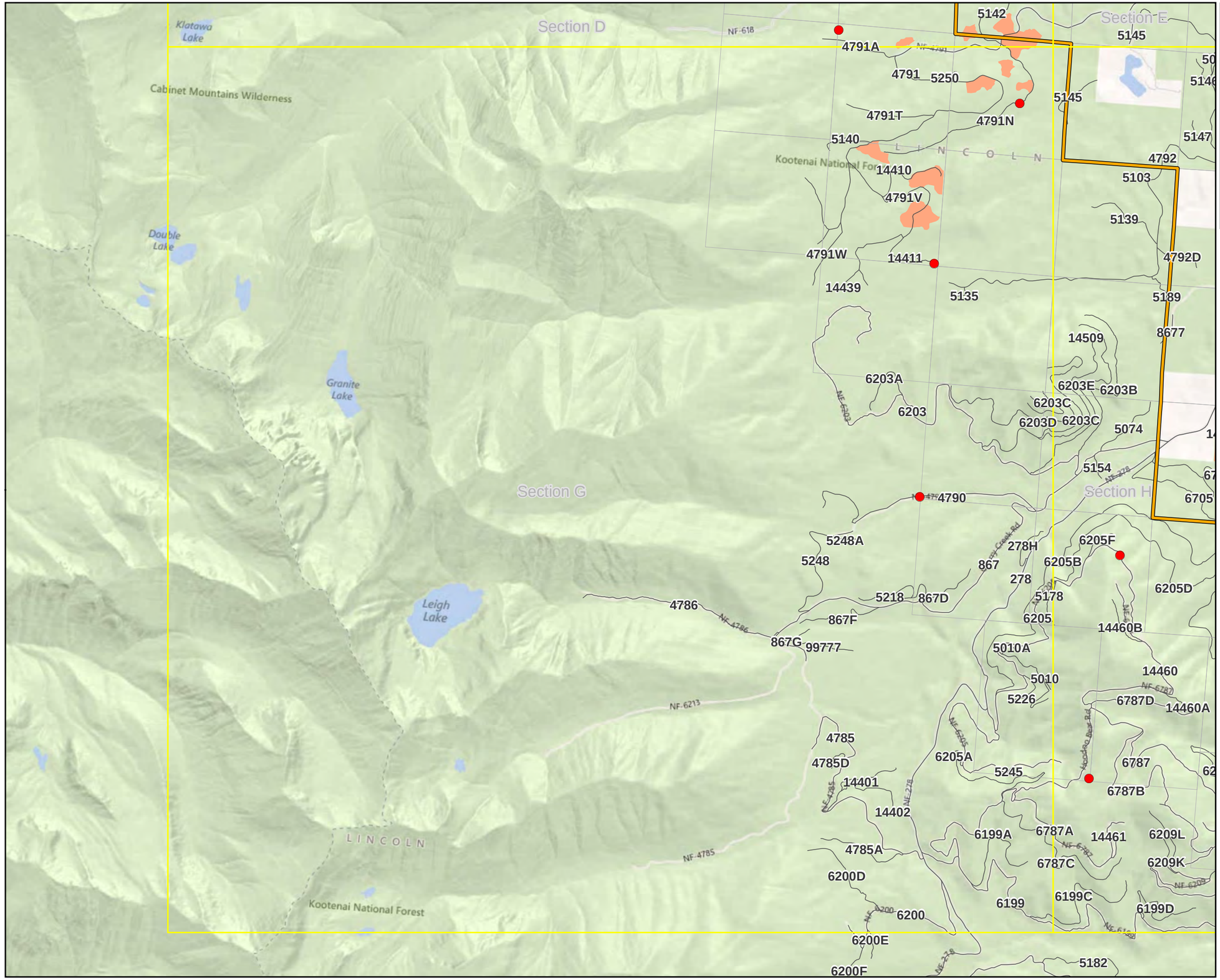

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- Sampling Locations
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Appendix C
Figure G

Tree Bark and Duff
Sampling Locations

CDM Smith

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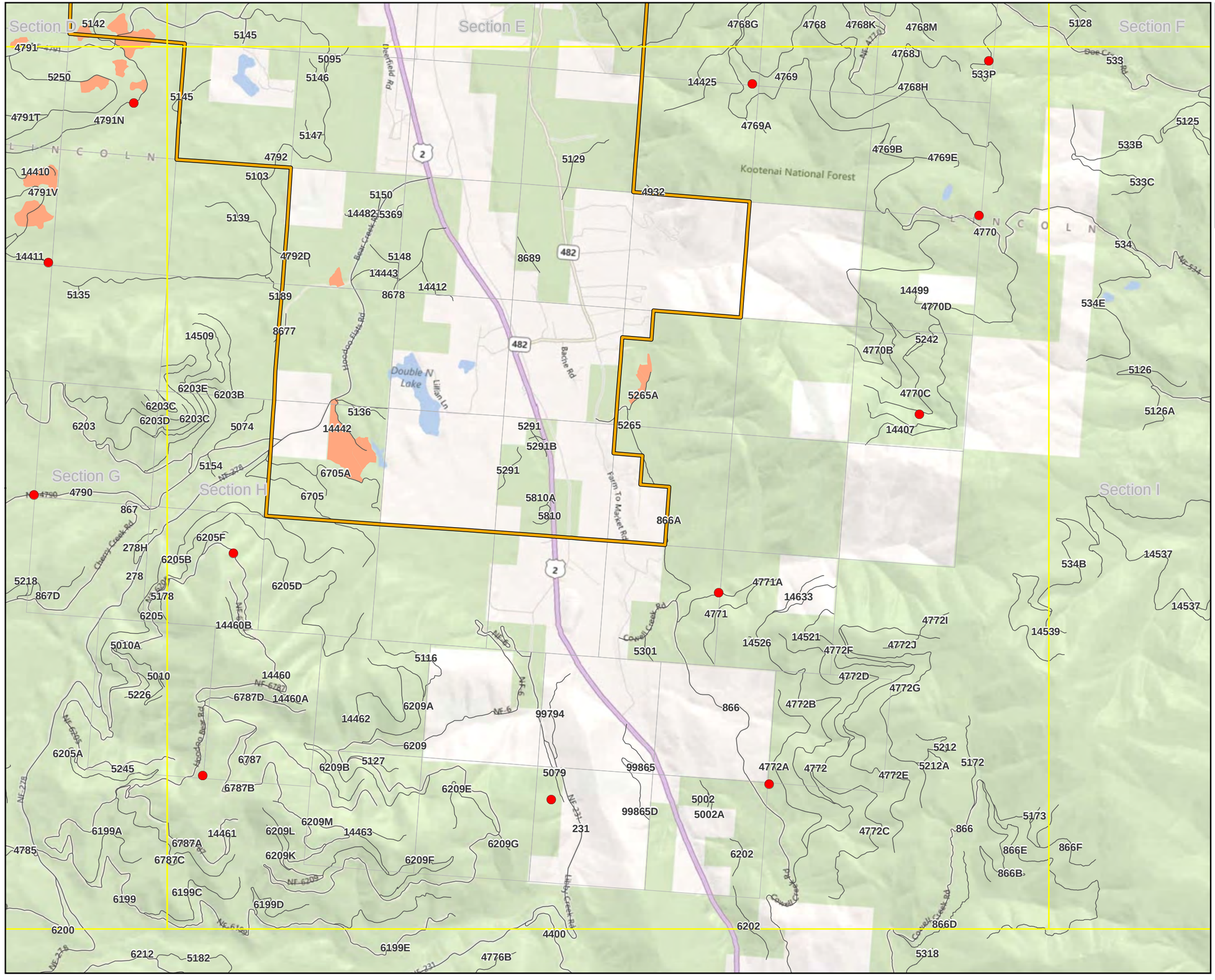

Legend

- Sampling Locations
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Appendix C
Figure H

Tree Bark and Duff
Sampling Locations

CDM Smith

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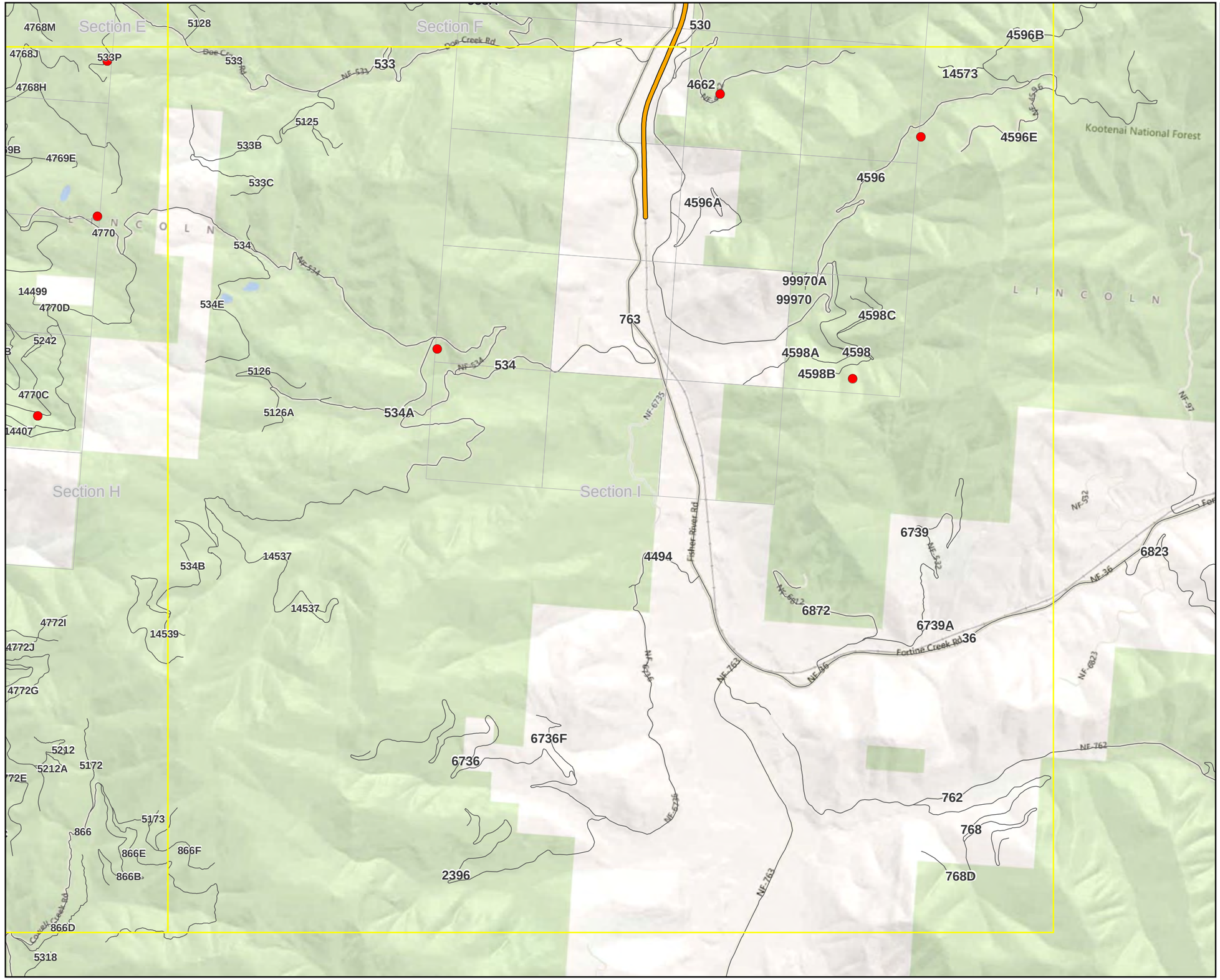

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Appendix C
Figure I

Tree Bark and Duff
Sampling Locations

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Sampling and Analysis Plan/Quality Assurance Project Plan
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Appendix D
Analytical Requirements Summary Sheet
[NEFOREST-0712]

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

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Sampling and Analysis Plan/Quality Assurance Project Plan
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Appendix E
Record of Modification (ROM) Forms

[An example of each ROM template is provided.]

The most recent version of the field ROM is provided electronically in the Libby Field eRoom (https://team.cdm.com/eRoom/R8-RAC/Libby).

The most recent version of the SPF and analytical laboratory ROMs are provided electronically in the Libby Lab eRoom (https://team.cdm.com/eRoom/mt/LibbyLab).

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