Data Summary Report:
Water Source Identification Study

Libby Asbestos Superfund Site
Libby, Montana

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Prepared for:

U.S. ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by:

U.S. Army Corps of Engineers
Omaha District
Offutt AFB, Nebraska 68113

and

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

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Approvals:

Date: 7/9/13

Mike Cirian
Libby Asbestos Superfund Site, EPA Onsite Remedial Project Manager

Date: 7/9/13

Elizabeth Fagen
Libby Asbestos Superfund Site, OU4 Remedial Project Manager

DARLING.MARY.N.1231359717

Digitally signed by DARLING.MARY.N.1231359717
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=DARLING.MARY.N.1231359717
Date: 2013.07.08 09:48:46 -05'00'

Date:

Mary Darling
U.S. Army Corp of Engineers, Program Manager

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List of Acronyms

%	percent
AC	actinolite
Ago	grid opening area
AM	amosite
AN	anthophyllite
AT	actinolite/tremolite
CB&I	CB&I Federal Services, LLC
CDM Smith	CDM Federal Programs Corporation
CH	chrysotile
CHISQ	Chi-square
COC	chain of custody
CR	crocidolite
C_{water}	concentration of LA in water
DQA	data quality assessment
EDD	electronic deliverable document
EDS	energy dispersive spectroscopy
EFA	effective filter area
EPA	U.S. Environmental Protection Agency
ESAT	Environmental Services Assistance Team
FSDS	field sample data sheet
GOx	grid openings counted
gpm	gallon per minute
GPS	global positioning system
HDPE	high-density polyethylene
ID	identification
L	liter
LA	Libby amphibole
LRC	Lower Rainy Creek
MCL	maximum contaminant level
MFL	million fibers per liter
mL	milliliter
mm^2	square millimeters
N	number of asbestos structures counted
NFG	National Functional Guidelines
NAM	non-asbestos material
NaK	sodium and potassium are clearly present
NaX	only sodium is clearly present
NR	non-regulated amphibole
OA	other amphibole-type asbestos
OT	other
OU	Operable Unit

PY	pyroxene
QA	quality assurance
QAPP	quality assurance project plan
QATS	Quality Assurance Technical Support
QC	quality control
ROM	record of modification
S	analytical sensitivity
SAP	sampling and analysis plan
SAED	selected area electron diffraction
Shaw E&I	Shaw Environmental & Infrastructure Group
Site	Libby Asbestos Superfund Site
SPF	Sample Preparation Facility
SOP	standard operating procedure
TEM	transmission electron microscopy
TR	tremolite
UN	unknown
USACE	U.S. Army Corps of Engineers
µm	micrometers
V	volume
WRTA	winchite, richterite, tremolite, and actinolite
XK	only potassium is clearly present
XX	no sodium or potassium for the observed LA structures

1 INTRODUCTION

1.1 Site Background

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

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

1.2 Study Design

Since 1999, EPA has conducted sampling and cleanup activities at the Site related to asbestos related health problems in the Libby population. Water is utilized at the Site as part of a variety of response activities, including dust suppression, personal and equipment decontamination, watering lawns, and washing paved roads. Historically, water for use in these activities was collected from the Kootenai River at the City of Libby pump station located in Operable Unit 1 (OU1). In order to reduce truck traffic within OU1, the City of Libby abandoned this pump station. As a result, it is necessary to identify a new water source for use at the Site.

In October 2011, site managers identified 13 potential water source candidates (see **Figure 1-1**). At the time, there were little to no data on asbestos concentrations for these potential water sources. Thus, the EPA developed a sampling program to measure asbestos concentrations in water for each of these potential water sources. Because asbestos concentrations in water are influenced by flow variations, the sampling program was separated into two phases to ensure data are representative of both low flow (fall - Phase I) and high flow (spring - Phase II) conditions. Prior to the Phase II sampling event, some sampling locations evaluated in Phase I were deleted and other new candidates added (see **Figure 1-1**). The goal of these studies was to adequately characterize asbestos concentrations in each potential water source candidate, such that one or more of the identified sources can be selected as a replacement water source for use at the Site.

Information on these two sampling investigation phases is summarized below and details are provided in the *Water Source Identification Study – Phase I Sampling and Analysis Plan (SAP)* (U.S. Army Corps of Engineers [USACE] and CDM 2011) and the *Water Source Identification Study – Phase II Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP)* (USACE and CDM Smith 2012). **Table 1-1** provides a description of each sampling location. **Figure 1-1** shows the location of each sampling station based on global positioning system (GPS) coordinates collected during sampling.

1.2.1 Phase I Sampling

Phase I of the sampling program was performed in November 2011 in accordance with the *Phase I SAP* (USACE and CDM 2011) and measured asbestos concentrations at each water source candidate location under low flow conditions. The purpose of the Phase I sampling program was to prioritize, but not exclude, potential water sources. If detectable levels of asbestos were present in some water sources and not others, those sources with detectable levels would be placed lower on the prioritized list of potential sources. Surface water samples were collected at each of the following locations[1] as part of the Phase I sampling program (see **Figure 1-1**):

2. Libby Creek, upstream of the OU5 fire pond (SP-145700) - sampling point southeast (upstream) of the flume that feeds the OU5 fire pond.
3. Libby Creek, south of the Libby airport (SP-145702) – sampling point northeast of the Hammer Cutoff Road bridge.
4. Pipe Creek, Kootenai River Road (SP–15707) - sampling point on the west side (upstream) of the Kootenai River Road bridge near the standpipe.
5. Pipe Creek, Bobtail Cutoff Road (SP-145709) – sampling point southeast (upstream) of the Bobtail Cutoff Road bridge.
6. Cedar Creek (SP-145706) – sampling point on the west side (upstream) of the US Highway 2 bridge near the standpipe.
7. Cherry Creek (SP-145703) – sampling point downstream of the Granite Creek Road bridge.
8. Kootenai River, upstream of the confluence with Rainy Creek (SP-145711) – sampling point from pump house at the OU2/Flyway property.
9. Granite Creek (SP-145701) – sampling point on the west side of US Highway 2 bridge southwest side of creek.
10. Flower Creek (SP-145704) – sampling point on the west side (upstream) of the Balsam Street bridge on the west side of the creek.

[1] Location #1 in the SAP (i.e., city pump near Cabinet View Country Club) could not be sampled because the existing pump in the pump house was found to be non-functional, thus this location was excluded from further evaluation.

11. Parmenter Creek (SP-145705) – sampling point at the northwest corner of the Dome Mountain Avenue bridge.
12. Quartz Creek (SP-145708) – sampling point upstream of the Kootenai River Road bridge.
13. J. Neils Park (SP-145710) – sampling point at the well vault standpipe in the southeast corner of the soccer fields on County Park Road.

1.2.2 Phase II Sampling

After the Phase I sampling, site managers determined that locations #3, #7, #10, and #11 were too far from response activities planned for 2012 and excluded them from further evaluation in Phase II. As mentioned previously, location #1 was also excluded because the existing pump in the pump house was found to be non-functional. In the *Phase II SAP/QAPP* (USACE and CDM Smith 2012), site managers identified the following additional water source candidates in Troy (see **Figure 1-1**):

14. Troy county shop hydrant (potable city water)
15. Hydrant located at the corner of West Riverside Avenue across from Roosevelt Park (non-potable water source)

Phase II sampling activities were conducted in May 2012. During the sampling event, the following opportunistic sampling location was added (see **Figure 1-1**):

16. 875 US Highway 2 de-watering pump (OU5)

1.2.3 Sampling Frequency

Asbestos concentrations in water have been shown to be influenced by flow variations at the Site. Based on concentration and flow monitoring conducted at a station in lower Rainy Creek, flow rates and concentrations begin to increase in late April, peak in mid-May, and decrease in late May (see **Figure 1-2**). It was assumed that most of the candidate water sources would follow a similar time trend. The Phase I sampling program included the collection of water samples during low flow conditions (in November 2011) and the Phase II sampling program included the collection of water samples during high flow conditions (in May 2012). These two sampling periods were assumed to provide information on the range of variability of asbestos concentrations in water as a function of flow fluctuations.

During Phase I, a total of six water samples were collected from each candidate source within a two-week period. The first three samples were collected on consecutive days within the first one-week period (e.g., Monday, Tuesday, and Wednesday). The remaining three samples were collected every other day during the following one-week period (e.g., Monday, Wednesday, and Friday).

During Phase II, to ensure that the sampling effort captured the peak run-off period, sampling crews collected samples when flow conditions were observed to be increasing. A visual observation was supplemented with a review of the continuous flow monitoring data from the flume located in lower Rainy Creek (LRC-6) and flow information from the USGS gauging station on the Fisher River[2] [Station Identification (ID) 12302055]. Once flow was observed to be increasing, a total of six water samples were collected from each candidate source within a two-week period. The first three samples were collected on consecutive days within the first one-week period (e.g., Monday, Tuesday, and Wednesday). The remaining three samples were collected every other day during the following one-week period (e.g., Monday, Wednesday, and Friday).

In order to capture potential daily fluctuations in asbestos concentrations as a consequence of flow variations, the sample collection time was varied to best represent potential source water collection times (i.e., the first sample was collected in the morning, the next sample was collected in the afternoon, etc.). Because it is not anticipated that the removal contractor would adjust water collection schedules to accommodate weather events, by analogy, no effort was made to adjust this sampling schedule due to weather events.

[2] http://waterdata.usgs.gov/mt/nwis/

2 DATA MANAGEMENT

2.1 Sample Collection, Documentation, Handling, and Custody

All samples generated as part of this investigation were collected, documented, and handled in accordance with Libby-specific standard operating procedures (SOPs), as specified in the governing SAP/QAPPs (USACE and CDM 2011; USACE and CDM Smith 2012).

2.1.1 Collection Methods

Surface Water

All water samples were collected using the procedures described in SOP EPA-LIBBY-2012-08, *Surface Water Sampling*. In brief, approximately 200-400 milliliters (mL) of water were collected for each sample and placed into a 500-mL capacity high-density polyethylene (HDPE) wide-mouth bottle, or equivalent, container as detailed in Section 5.2.1 of the SOP. Headspace was left in the container to ensure there was ample room at the top of the bottle to accommodate ozone/ultraviolet treatment prior to analysis. To minimize impacts of field collection activities on subsequent downstream sampling efforts, water samples were collected from downstream to upstream.

Flow

Flow measurements with the Marsh-McBirney device were not possible during the high flow sampling event due to unsafe field conditions. Thus, an alternative method was used to estimate flow as documented in the Phase II field logbook. This method utilized stream width and depth measurements in conjunction with a measurement of elapsed time for the water to travel a set distance (i.e., the width of the bridge crossing the tributary). In order to determine the elapsed time for the water to travel a set distance, marshmallows were dropped into the stream and the length of time it took them to travel a designated distance was measured.

2.1.2 Documentation, Handling, and Custody Methods

All surface water samples collected were identified with sample ID numbers that included a program-specific prefix of "1W" (e.g., 1W-00001) if it was collected during Phase I and "2W" (e.g., 2W-00001) if it was collected during Phase II. Data on the sample type, location, collection method, and collection date of all samples were recorded both in a field logbook maintained by the field sampling team and on a field sample data sheet (FSDS) designed to facilitate data entry into the Libby site database (see Section 2.4). All samples collected in the field were maintained under chain of custody (COC) during sample handling, preparation, shipment, and analysis.

2.2 Analytical Results Recording

Standardized data entry spreadsheets (electronic data deliverables, or EDDs) have been developed specifically for the Libby project to ensure consistency between laboratories in the presentation and submittal of analytical data. In general, a unique EDD has been developed for each analytical method and each medium. Each EDD provides the analyst with a standardized laboratory bench sheet and accompanying data entry form for recording analytical data. The data entry forms contain a variety of built-in quality control functions that improve the accuracy of data entry and help maintain data integrity. These spreadsheets also perform automatic computations of analytical input parameters (e.g., sensitivity, dilution factors, and concentration), thus reducing the likelihood of analyst calculation errors. The EDDs generated by the laboratories are uploaded directly into the Libby site database (see Section 2.4).

2.3 Hard Copy Data Management

Hard copies of all FSDSs, field logbooks, and chain of custody forms generated during this investigation are stored in the CDM Smith field office in Libby, Montana. **Appendix A** of this report provides copies of the field documentation for both the Phase I and Phase II investigations.

All analytical bench sheets are scanned and included in the analytical laboratory job reports. These analytical reports are submitted to the Libby laboratory coordinator (i.e., EPA's Environmental Services Assistance Team [ESAT] contractor, TechLaw) and stored electronically. **Appendix B** of this report provides copies of all the analytical laboratory reports for analyses performed as part of the Phase I and Phase II investigations.

2.4 Electronic Data Management

Sample and analytical electronic data are stored and maintained in the Libby Scribe project databases that are housed on a local computer located at the TechLaw office in Golden, Colorado, which is backed up daily to an external hard drive. Raw data summarized in this report were downloaded from Scribe.NET on 06/05/2013, into a Microsoft Access® database by CDM Smith. A frozen copy of this Access database is provided in **Appendix C** of this report.

Because data for the Libby project are maintained in multiple Scribe projects (e.g., analytical data are managed in annual projects, field information is managed in a project separate from the analytical information), the data have been combined into one Access database reflecting a compilation of tables from multiple Scribe projects. Any changes made to these Scribe projects since this download will not be reflected in the Access database.

3 SAMPLE PREPARATION AND ANALYTICAL METHODS

3.1 Analysis of LA in Water

3.1.1 Sample Preparation

All water samples were prepared for asbestos analysis in basic accordance with the techniques in EPA Method 100.2, as modified by Libby Laboratory Record of Modification (ROM)[3] LB-000020A. In brief, all water samples were 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) was filtered through a 25-millimeter diameter polycarbonate filter with a pore size of 0.1-micrometers (µm) with a mixed cellulose ester filter (0.45-µm pore size) used as a support filter.

3.1.2 Analysis Method

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

When a sample is analyzed by TEM, the analyst records the size (length, width) and mineral type of each individual asbestos structure that is observed. Mineral type is determined by selected area electron diffraction (SAED) and energy dispersive spectroscopy (EDS), and each structure is assigned to one of the following four categories:

LA Libby-class amphibole. Structures having an amphibole SAED pattern and an elemental composition similar to the range of fiber types observed in ores from the Libby mine (Meeker *et al.* 2003). This is a solid solution series of minerals including winchite and richterite, with lower amounts of tremolite, magnesio-arfvedsonite, magnesio-riebeckite, and edenite/ferro-edenite. Depending on the valence state of iron, some minerals may also be classified as actinolite.

OA Other amphibole-type asbestos fibers. Structures having an amphibole SAED pattern and an elemental composition that is not similar to fiber types from the Libby mine. Examples include crocidolite, amosite, and anthophyllite. There is presently no evidence that these fibers are associated with the Libby mine.

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

CH Chrysotile fibers. Structures having a serpentine SAED pattern and an elemental composition characteristic of chrysotile. There is presently no evidence that serpentine mineral fibers are associated with the Libby mine.

NAM Non-asbestos material. These may include non-asbestos mineral fibers such as gypsum, glass, or clay, and may also include various types of organic and synthetic fibers derived from carpets, hair, etc. *Recording of NAM structures was not required.*

EDS Data Recording Requirements

Meeker *et al.* (2003) used EDS and electron microprobe analysis to characterize the elemental content of a large number of structures of LA derived from ore samples obtained from the mine, and found substantial variability in the elemental composition between (and sometime even within) individual structures. Based on the elemental composition, LA structures could be classified into several different mineralogical categories, depending on the relative amounts of sodium and potassium. Meeker *et al.* (2003) also observed that most structures from the Libby vermiculite ore body contained detectable levels of both sodium and potassium. In contrast, most commercial forms of actinolite and tremolite usually lack both sodium and potassium (Bern *et al.* 2002).

Based on the expectation that the presence of sodium and potassium is the key to distinguishing between amphibole species at Libby (Meeker *et al.* 2003), at the Libby Site, TEM analysts also record structure-specific information on the elemental composition, as determined by EDS, of all amphibole structures, as follows:

NaK Both sodium and potassium are clearly present
NaX Only sodium is clearly present
XK Only potassium is clearly present
XX Neither sodium nor potassium are clearly present

In addition, TEM analysts are also required to identify a probable mineral classification for all recorded asbestos structures. Mineral classes that that may be assigned include the following:

WRTA – winchite/richterite/tremolite/actinolite
AC – actinolite
TR – tremolite
AT – actinolite/tremolite (too close to call)
AM – amosite
AN – anthophyllite
CH – chrysotile
CR – crocidolite
PY – pyroxene
NR – Non-regulated amphibole

OT - other
UN – unknown

The designation "WRTA" is used to indicate a structure that is consistent with those that are observed in samples from the vermiculite mine in Libby. Structures identified as WRTA, AC, TR, or AT are classified as LA structures.

3.1.3 Counting Rules

All structures with fibrous morphology, an x-ray diffraction pattern consistent with amphibole asbestos, an EDS consistent with asbestos, length greater than or equal to 0.5 µm, and an aspect ratio (length:width) greater than or equal to 3:1 were counted and recorded during the TEM analysis. If observed, chrysotile structures were recorded, but chrysotile structure counting could stop after 50 structures had been recorded. These counting rules enable the calculation of water concentrations based on both total LA and LA structures longer than 10 µm, which is the reporting metric for the purposes of comparison to the drinking water maximum contaminant level (MCL) for asbestos.

3.1.4 TEM Stopping Rules

The TEM stopping rules for all water samples from this investigation were 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 10,000 per liter (L^{-1}) has been achieved.
    b. 100 LA structures have been observed.
    c. A total filter area of 1.0 square millimeters (mm^2) has been examined (this is approximately 100 grid openings).

When one of these criteria was satisfied, the analyst was instructed to complete the examination of the final grid opening and stop.

3.1.5 Calculation of Water Concentration

The concentration of LA in water is given by:

$$C_{water} = N \cdot S / 1E+06$$

where:

C_{water} = Water concentration, expressed as million fibers per liter of water (MFL)
N = Number of LA structures observed

S = Analytical sensitivity (L^{-1})
1E+06 = conversion factor

For water, the analytical sensitivity is calculated as:

$$S = EFA / (GOx \cdot Ago \cdot V)$$

where:

S = Analytical sensitivity $(L)^{-1}$
EFA = Effective area of the filter (mm^2)
GOx = Number of grid openings examined
Ago = Area of a grid opening (mm^2)
V = Volume of water applied to the filter (L)

4 RESULTS

4.1 Raw Data

Tables 4-1 and 4-2 summarize the surface water results for LA for both low flow (Phase I) and high flow (Phase II) conditions, respectively. A map depicting the surface water results for Phase II is provided in **Figure 4-1**. Phase I surface water results were not plotted graphically because there was only one detection during Phase I, and the asbestos structure observed was chrysotile, not LA. A summary of flow information for the Phase II study is provided as **Table 4-3** and shown graphically on **Figure 4-2**. Flow information was not collected in Phase I.

4.2 Interpretation

As shown in **Table 4-1**, LA was not detected in any of the samples analyzed during low flow season (Phase I). Only one sample, Location # 8 (from the Kootenai River adjacent to KDC flyway pumphouse), had a detection of asbestos, and it was identified as being chrysotile.

As shown in **Table 4-2**, with one exception, LA was detected at every location at least once during the six rounds of sampling events for the high flow season (Phase II). No LA was detected in any of the water samples collected from the opportunistic location (#16) in OU5. LA was detected in 25 of the 63 samples collected as part of Phase II. When LA was detected, 1 to 6 LA structures were observed. Only three locations reported LA structures longer than 10 µm (Locations #2, #4, and #15). No locations had measured water concentrations in excess of the drinking water MCL (7 MFL, based on structures longer than 10 µm).

Table 4-4 (Panel A) presents summary statistics for total LA water concentrations for each candidate water source based on the results from the Phase II study. **Table 4-4** (Panel B) rank orders each candidate water source in order of mean reported total LA water concentration (from lowest to highest). Rank orders are also shown based on detection frequency and maximum reported total LA water concentration. No final ranking is provided, instead this table is only provided to assist the decision makers in their selection of an alternate water source. The selection of which water sources may be used during future removals is beyond the scope of this report; the EPA will make that determination in consultation with the removal contractor.

Because the detection of LA was unexpected in water bodies that were not directly linked to the Rainy Creek watershed, the nature of the LA structures detected in these samples were reviewed. The EDS spectra for the observed LA structures showed that 22 of the 50 LA structures observed during the TEM analyses of Phase II water samples showed that the LA structures were WRTA and contained NaK. The other 28 LA structures observed were ranked as being characteristic of AC or TR and no sodium or potassium was noted in the EDS spectra for these structures (XX - without sodium and potassium). XX tremolite and XX LA are

indicative of country rock origin rather than vermiculite mountain ore body origin. According to Meeker *et al.* (2003), asbestos structures originating from the Libby vermiculite ore body contain detectable levels of both sodium and potassium, whereas other potential sources of LA may not. This would indicate that about half of the LA structures observed in these water samples do not originate from the Libby vermiculite ore body.

Although there is a mild correlation for some of the more remote locations (e.g., Locations #5 and #15 shown on **Figure 4-1**) to be XX, compared to the location closest to the mine (Location #8), which contains NaK, the data are too limited (i.e., too few structures per location) to draw any robust conclusions. In general, the locations for LA structures ranked as NaK versus XX do not appear to be either spatially or temporally significant.

5 DATA QUALITY ASSESSMENT

Data quality assessment (DQA) is the process of reviewing existing data to establish the quality of the data and to determine how any data quality limitations may influence data interpretation (EPA 2006).

5.1 Surveillances and Audits

5.1.1 Field Surveillances

Field surveillances consist of periodic observations made to evaluate adherence to investigation-specific governing documents. The schedule for performing field surveillances is dependent on the duration of the investigation, frequency of execution, and magnitude of process changes. Because Phase I and Phase II sampling programs are similar, a field surveillance was conducted during the Phase I sampling and no field surveillance was performed for the Phase II sampling program. The Phase I field surveillance was conducted on November 9, 2011, by Karen Repine (CDM Smith). In brief, sampling preparation, surface water sampling, equipment decontamination, preparation of field documentation, and GPS point collection were observed. In addition, copies of field documentation for the Phase 1 water sampling event, including logbook entries and field sample data sheets (FSDSs) were reviewed. The only deficiency noted was that visitors were not documented in the logbook. This deficiency was brought to the attention of the field staff following review of the field documentation and corrected. No significant deficiencies were observed the day of the surveillance (CDM Smith 2013).

Field audits are broader in scope than field surveillances and are evaluations conducted by qualified technical or quality assurance (QA) staff that are independent of the activities audited. Based on the determination that the field contractor (CDM Smith) was well-versed in the collection of surface water samples for the Libby project, only the field surveillance was necessary. No field audit was performed during either the Phase I or Phase II sampling programs.

5.1.2 Laboratory Audits

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

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

5.2 Field and Laboratory Modifications

Field deviations from and modifications to the investigation SAP/QAPPs were recorded on a field Libby ROM Form. The ROM forms are used to document all permanent and temporary changes to procedures contained in guidance documents governing investigation that have the potential to impact data quality or usability. Any minor deviations (i.e., those that will not impact data quality or usability) have been documented in the field logbooks.

Appendix D contains copies of all ROM forms associated with this investigation. Review of these forms revealed the following modifications during the Phase I sampling:

- The preparation and analysis procedures (Section B4.1 of the SAP) were modified to standardize the analytical procedures for the sampling program. The Analytical Requirements Summary (WATER-1111) was also updated to reflect these changes.
- The City of Libby pump house (BD-004343, Location #1) located at 1260 Cabinet Heights Road was determined to not be a viable source for collecting water samples due to a dismantled pump system. Therefore, no samples were collected at this location.
- Sampling at J. Neils Park (SP-1 45710, Location #13) was delayed for two days due to the winterization of the park's water system. Therefore, J. Neils Park samples were collected from the frost-free spigot south of baseball field on six consecutive days beginning November 9, 2011.
- Location descriptions for Parmenter Creek (SP-145705, Location #11), Granite Creek (SP-145701, Location #9) and Cherry Creek (SP-145703, Location #7) were adjusted from the Phase I SAP text to more accurately describe the physical sampling locations. The corrected sampling descriptions are provided in Section 1.2.1 of this report.

The following modifications were made during the Phase II sampling:

- An additional sample location called 875 US Highway 2 (OU5) (SP-146636, Location #16) was added and three samples collected at this location on May 22, 24, and 25, 2012. Addition of this location provided another potential water source location along the Kootenai River for consideration.

No negative implications are expected as a result of these modifications to the Phase I SAP and the Phase II SAP/QAPP.

5.3 Data Verification and Validation

5.3.1 Data Verification

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

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

A total of 16 TEM analyses (8 samples for Phase I and 8 samples for Phase II) were reviewed in accordance with SOP EPA-LIBBY-09 as part of the data verification effort. Hard copy FSDS forms were reviewed in accordance with SOP EPA-LIBBY-11 for each of these samples. In brief, one critical error[4] was discovered during the FSDS and TEM verification process in which the volume applied to the filter was incorrectly transferred from the water preparation record to the benchsheet and the EDD. As a result, the reported analytical sensitivity and concentration values in the original EDD were incorrect. No critical errors were discovered during the FSDS verification. All critical and non-critical issues identified during the data verification effort were submitted to the field teams and/or analytical laboratories for resolution and rectification.

All tables, figures, and appendices (including all hard copy documentation and the database [as provided in **Appendix A** and **Appendix C**, respectively]) generated for this report reflect corrected data.

5.3.2 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.

[4] A critical error is defined as an issue that could influence the reported sample concentration or location information.

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

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

A copy of the program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) is currently pending. When this report is finalized, it will be located on the Libby Lab eRoom. Interpretation of the data quality is subject to change upon completion of this report.

5.4 Quality Control Evaluation

Field-based QC samples are those samples which are prepared in the field and submitted to the laboratory in a blind fashion. That is, the laboratory is not aware the sample is a QC sample, and treats the sample in the same way as a field sample.

5.4.1 Field Quality Control

Two types of field QC samples were collected for surface water as part of this sampling investigation – field blanks and field duplicates.

<u>Field Blanks</u>

A field blank is a sample of the same medium as field samples, but which does not contain any contaminant. Field blanks were prepared by placing 400 mL of clean water (e.g., store bought drinking water) into the same type of sample collection container as the field samples. Field blanks were collected at a frequency of one field team per day. During Phase I, in accordance with the SAP, one field blank per week was collected and analyzed. Although the SAP/QAPP for Phase II also stated that one field blank per week should be analyzed, one field blank per day (or more) was collected and analyzed (i.e., more than was required). The field blanks were analyzed for asbestos by the same method as was used for field sample analysis. The results of the surface water field blanks are presented in **Table 5-1.** As shown in the table, all samples

were non-detect for LA. These results indicate that LA was not introduced into the samples as a consequence of sample collection and handling or analysis.

Field Duplicates

Field duplicates for surface water are a second water sample collected sequentially from the same station as the parent sample. The field duplicates were collected using the same collection technique as the parent field samples. For these investigations, water field duplicate samples were to be collected at a rate of one field duplicate per twenty field samples (5%). Field duplicates were sent for analysis by the same method as field samples.

A total of four field duplicates for water were collected during Phase I (a collection frequency of 5.6%) and three field duplicates for water were collected during Phase II (a collection frequency of 4.8%). Field duplicate results were compared to the original parent field sample using the Poisson ratio test with a 90% confidence interval (Nelson 1982). As seen in **Table 5-2**, the results of the field duplicates were not statistically different from the parent field samples. These data show that surface water results are reproducible and that the influence of inherent sampling and analytical variability is minimal.

5.4.2 Laboratory QC Evaluation

Laboratory QC analyses are evaluated by the EPA QATS contractor on a program-wide basis rather than on an investigation-specific basis. The rationale for this is that the number of laboratory QC samples directly related to this investigation is too limited to draw meaningful conclusions regarding overall data quality. Refer to the pending program-wide QA/QC summary report covering samples collected and analyzed in 2010-2012 (CB&I 2013) for information regarding program-wide data quality of the analytical laboratories. As noted previously, interpretation of the data quality is subject to change upon completion of this report.

5.5 Data Adequacy Evaluation

A comparison of the data collected with the DQOs specified in the governing SAP/QAPPs (USACE and CDM 2011; USACE and CDM Smith 2012) is presented below.

5.5.1 Spatial and Temporal Representativeness

The spatial goals of this study included collecting representative data from each of the water source candidate locations. The temporal goals of the study included collecting surface water during both high and low flow conditions. Surface water samples were collected in May of 2012 (high flow conditions) and November of 2011 (low flow conditions). Thus, the collected data met both the spatial and temporal objectives specified in the in the governing SAP/QAPPs (USACE and CDM 2011; USACE and CDM Smith 2012).

5.5.2 Sample Completeness

The completeness of the dataset is described as a ratio of the amount of data expected from the field program versus the amount of valid data received from the laboratory. Valid data are considered to be those that have not been rejected during the validation process and have been verified at the specified frequency in the SAP/QAPPs (USACE and CDM 2011; USACE and CDM Smith 2012). Completeness can be expressed by the following equation:

$$\text{Completeness} = \frac{\text{(total number of valid results)}}{\text{(total number of requested results)}} \times 100$$

Based on the data verification and data validation presented in Section 5.3.1 and Section 5.3.2, respectively, the completeness of the sample set for Phase I is 92.3%, with 72 valid results received out of 78 results requested. One planned sampling location was deleted during the low flow sampling effort due to a non-functional pump. The completeness of the sample set for Phase II is 105%, with 63 valid results received of the 60 results requested. One opportunistic sample was collected and analyzed as part of the high flow sampling effort.

5.5.3 Confirmation of Analysis Stopping Rules

Surface water samples analyzed by TEM had specific analytical requirements specified in the SAP/QAPPs (USACE and CDM 2011; USACE and CDM Smith2012). The analysis stopping rules for these samples were summarized in Section 3.1.4. In brief, analysis continued until either the target analytical sensitivity of 10,000 L^{-1} was achieved, 100 LA structures were observed, or a total filter area of 1.0 mm^2 was examined. All samples had less than 100 asbestos structures, so none of the analyses ended as a consequence of this stopping rule.

In Phase I, 67 out of 72 samples (93%) achieved the target analytical sensitivity of 10,000 L^{-1} (or lower). Of the remaining 5 samples (which were all collected from J. Neils Park, location #13), depending upon the sample, the analysis continued until between 1.3 to 3.7 mm^2 of filter was examined (i.e., even beyond what was expected based on the stopping rule). From a data usability point of view, this means that the data are more than adequate for use. However, from a cost standpoint, this means that the analyses could have been terminated at an early point and still have achieved one of the stopping rules.

In Phase II, only 7 out of 63 samples (11%) achieved the target analytical sensitivity of 10,000 L^{-1}. The laboratory was not able to achieve the target sensitivity for most samples because the amount of dilution required to yield suitable particulate loading levels on the prepared filter (usually only 30 mL or less was able to be filtered in Phase II, whereas 50 mL was filtered in Phase I). This increased dilution for Phase II samples, may have been a consequence of higher turbidity due to higher flow conditions. For those samples that did not achieve the target analytical sensitivity, the analysis continued until about 1.0 mm^2 of filter had been examined

(i.e., the maximum filter area examined achieved the stopping rule). The achieved sensitivities for these samples ranged from about 12,000 to 360,000 L^{-1}. Thus, any interpretation of non-detect results needs to consider the achieved analytical sensitivity.

5.5.4 Filter Loading

The TEM analysis of filters generated from surface water samples examines only a portion of the total filter. For the purposes of computing concentration in the water sample, it is assumed that the filter is evenly loaded. The assessment of filter loading evenness is evaluated using a Chi-square (CHISQ) test, as described in ISO 10312 Annex F2. If a filter fails the CHISQ test for evenness, the reported result may not be representative of the true concentration in the sample, and the results should be given low confidence. An evaluation of filter loading for the surface water samples from this study (see **Table 5-3**) shows that all filters passed the CHISQ test (i.e., p value ≥ 0.001). Thus, it is concluded that uneven filter loading is not of significant concern for the surface water sample analyzed in this study.

5.6 Historical Flow Comparison

To determine whether Phase I samples (collected during the period of November 7 through 18, 2011) and Phase II samples (collected during the period of May 14 through 25, 2012) were collected during typical flow conditions based on flow measurements from 2007 through 2012, flow data for the nearby Kootenai River and the Fisher River were reviewed (see **Figure 5-1**). As shown in this figure, flows during the period of November 7 through 18, 2011 appear to be on the high side, i.e., representing the higher end of surface water flows during this period. The time period for Phase I was selected to represent low flows. If concentrations correlate with flow information, then since the flow during this period is higher than what is typical, the concentrations observed during Phase I are more likely to be representative of typical or worst case scenario concentrations.

The time period for Phase II was selected to represent high flows. As shown in **Figure 5-1**, flows during the period of May 14 through 25, 2012 appear to be fairly typical, i.e., historically representing neither the highest nor the lowest flows of the surface water during this period. Thus, if concentrations correlate with flow information, then since the flow during this period is typical, the concentrations observed during Phase II are more likely to be representative of typical concentrations.

5.7 Conclusions

Based on a review of each of these data quality metrics, it is concluded that the surface water results from this investigation are of adequate quality to support their intended use.

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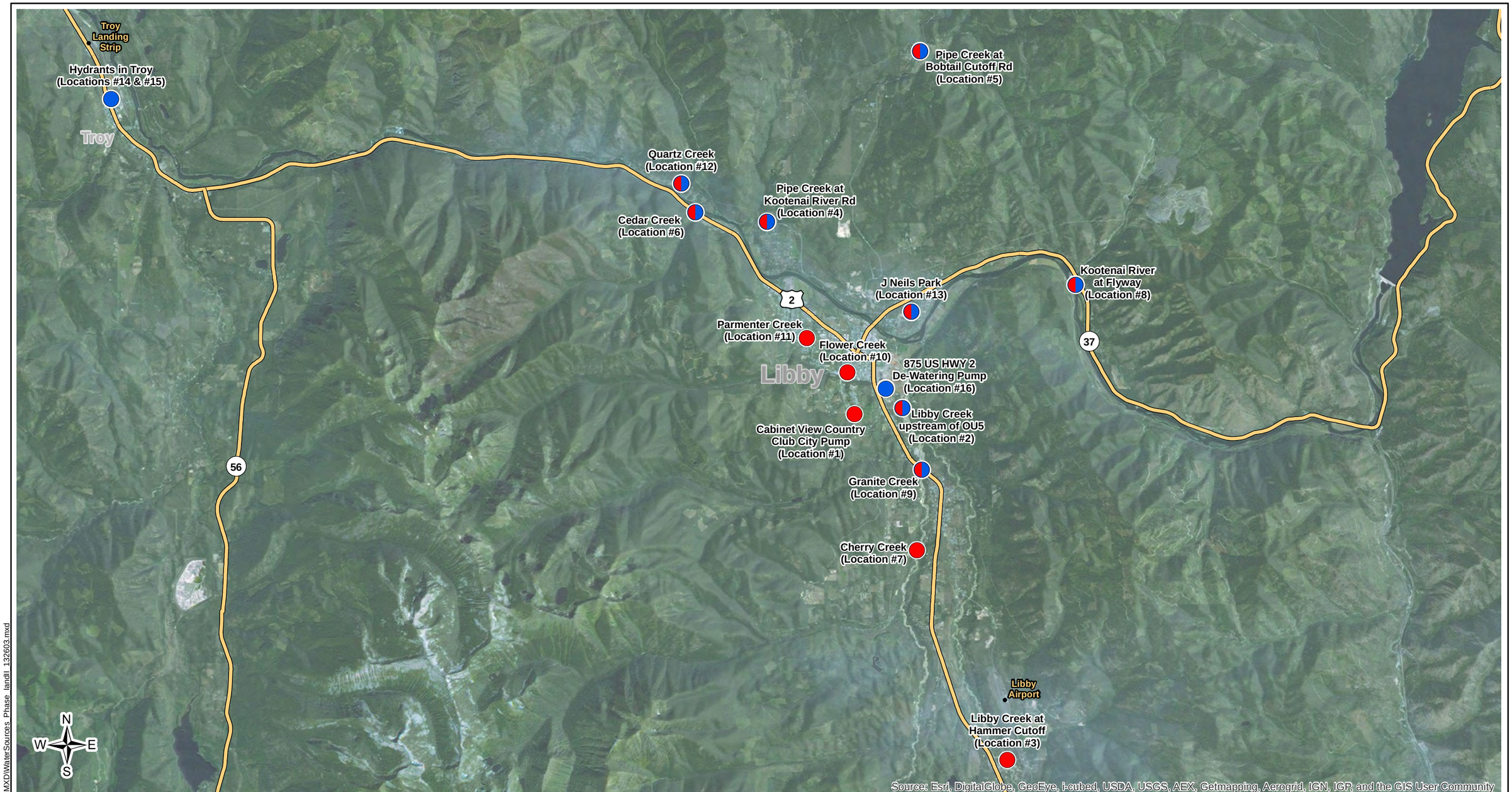
FIGURES



Legend

- Phase I Water Source Sampling Location
- Phase II Water Source Sampling Location
- Phases I & II Water Source Sampling Location

3 1.5 0 3 6

Miles

1 inch = 3 miles

Map Date: 3/26/2013

Figure 1 - 1
Water Source Sampling Locations Evaluated in Phases I and II

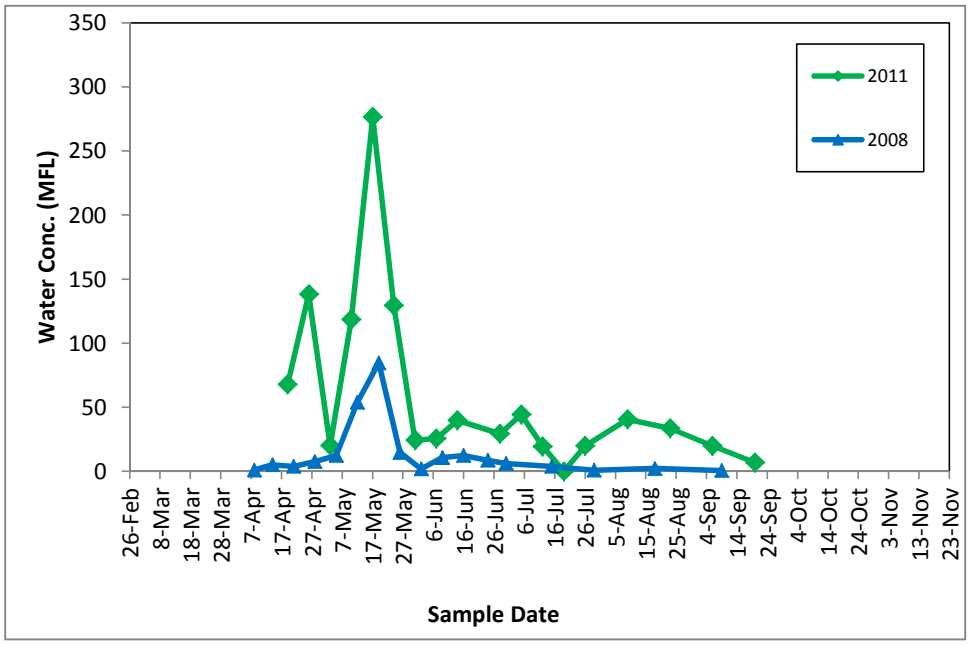
Libby Asbestos Project
Libby, Montana

CDM Smith

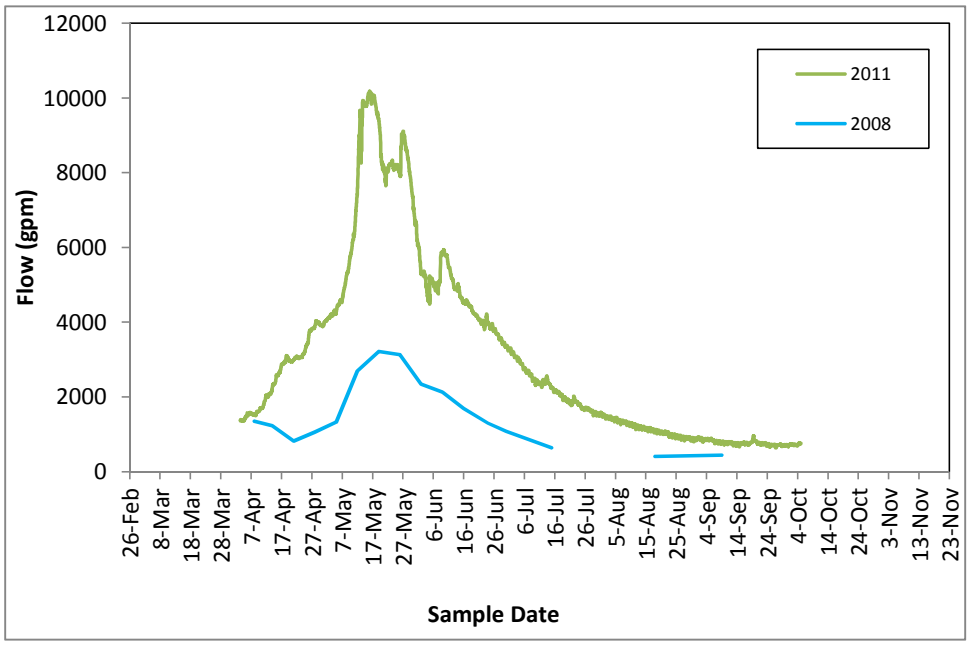
CDM Map File: R:\2603-VolpeLibby\GIS\MXD\WaterSources_Phase_landII_132603.mxd

FIGURE 1-2
MEASURED LA AND FLOW IN LOWER RAINY CREEK (LRC-6)

Panel A: Total LA Water Concentration

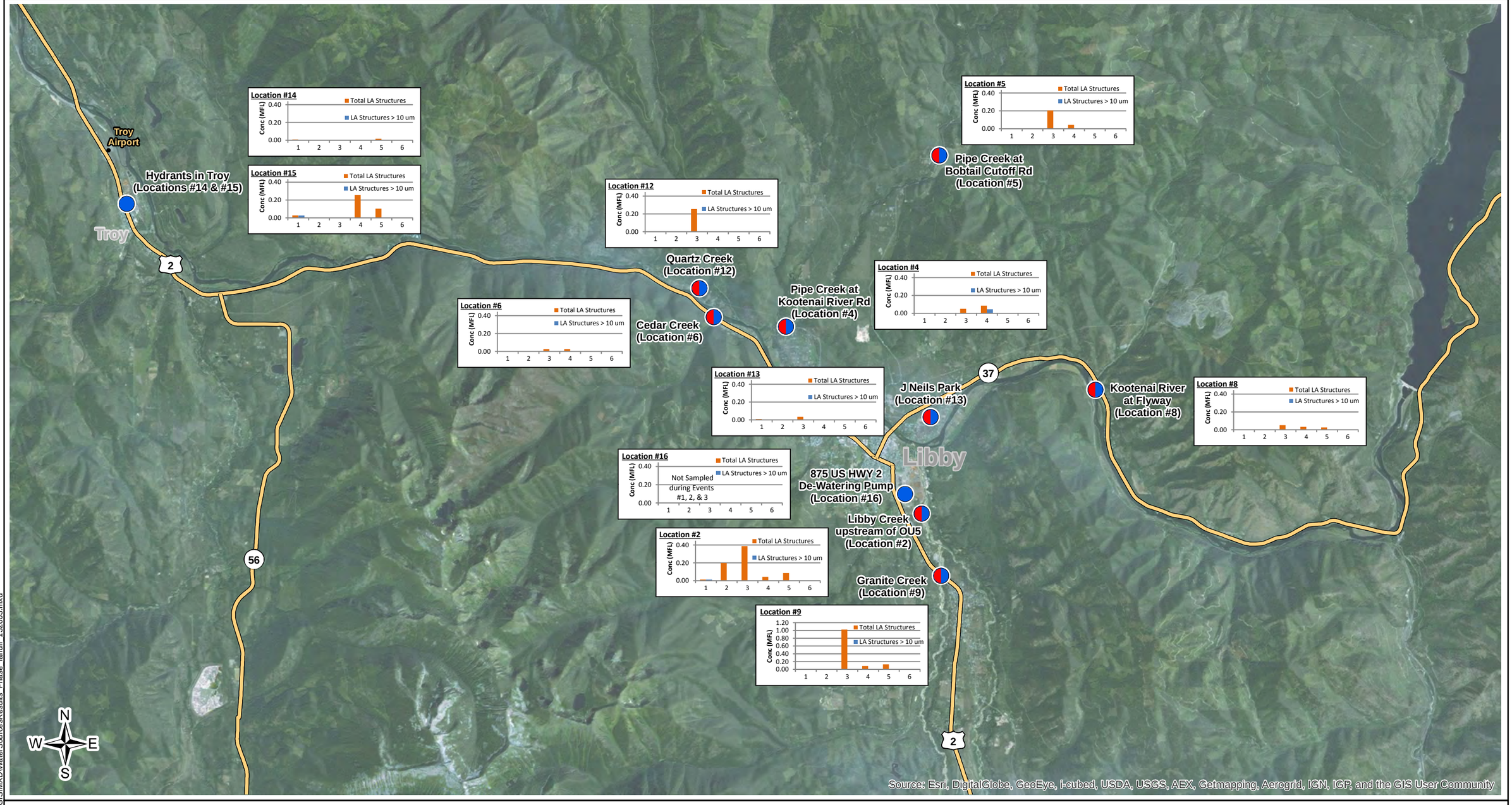


Panel B: Flow



MFL - million fibers per liter
gpm - gallons per minute

Source: Total LA water concentrations as reported from the OU3 Phase II-A study (2008) and Phase IV-B study (2011). Flow data provided from OU3 field measurements (2008) and flume autosampler (2011).



CDM Map File: R:\2603-Volpe\Libby\GIS\MXD\WaterSourcesResults_Phase_IandII_132603.mxd

Legend

- Phase II Water Source Sampling Location
- Phases I & II Water Source Sampling Location

3 1.5 0 3 6

Miles

1 inch = 3 miles

Map Date: 3/28/2013

Figure 4 - 1
Water Source Sampling Results for Phase II Results (May 2012 - High Flow)

Libby Asbestos Project
Libby, Montana

CDM Smith

FIGURE 4-2
PHASE II FLOW MEASUREMENTS

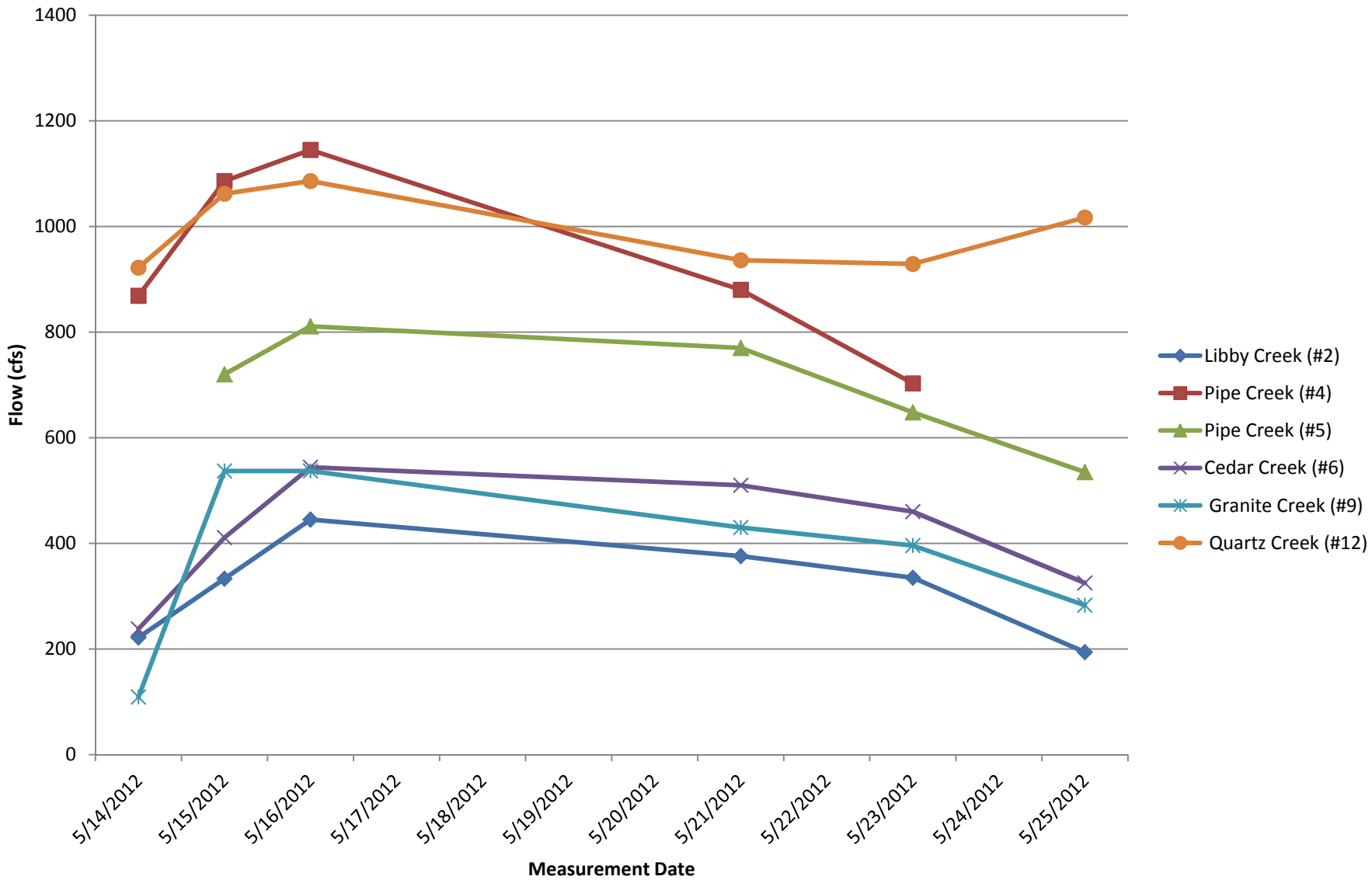
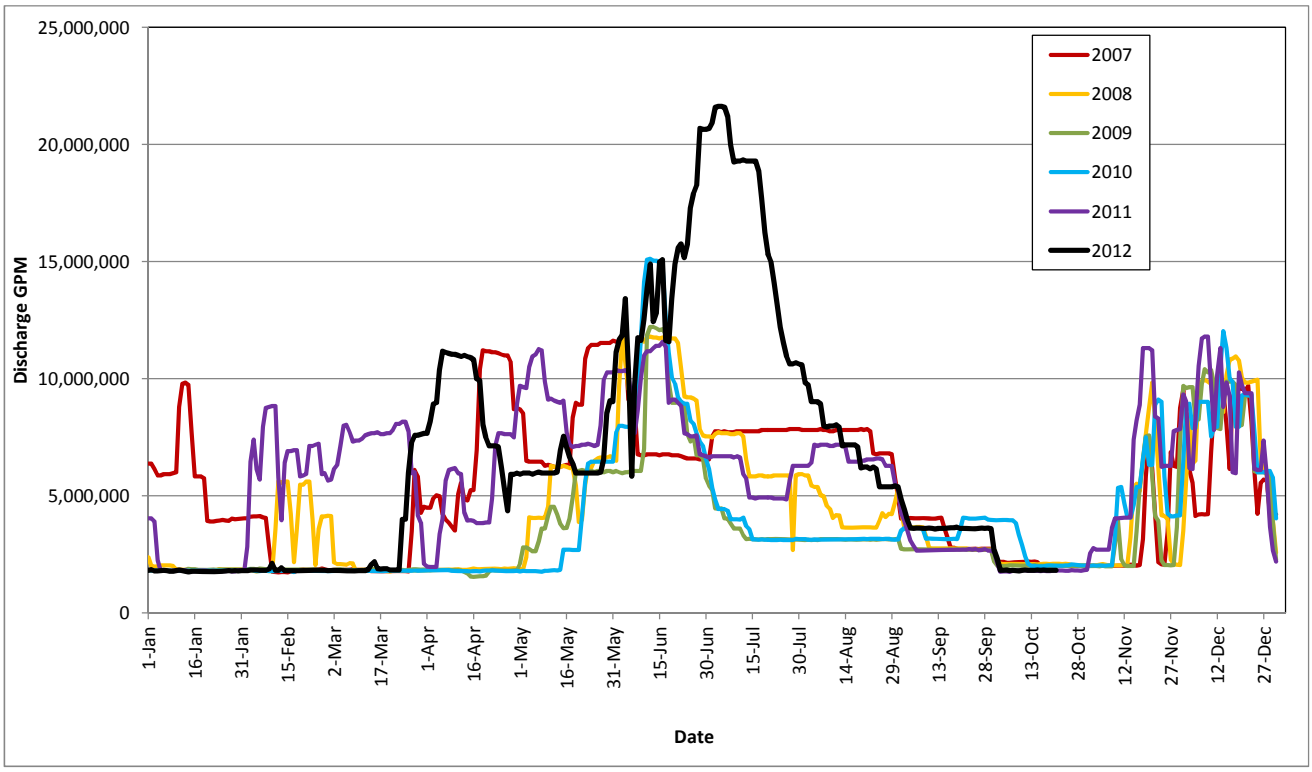
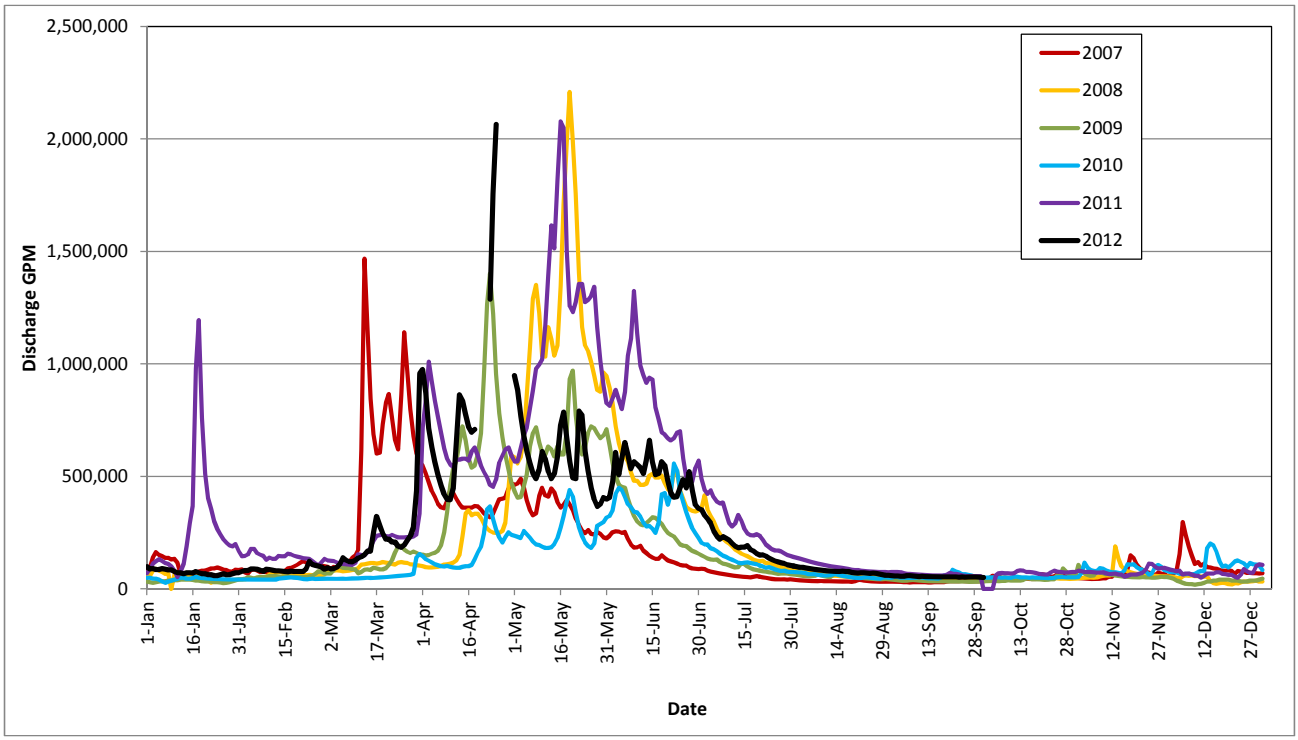


FIGURE 5-1. HISTORICAL SURFACE WATER FLOW (2007 TO 2012)

PANEL A: KOOTENAI RIVER SURFACE WATER FLOW (2007 TO 2012)



PANEL B: FISHER RIVER SURFACE WATER FLOW (2007 TO 2012)



Flow information gathered from USGS gauging station. National Water Information System: Web Interface. Available online at: http://waterdata.usgs.gov/nwis/nwisman/

Station 12301933 -- Kootenai River below Libby Dam near Libby MT

Station 12302055 -- Fisher River near Libby MT

TABLES

TABLE 1-1
SAMPLE LOCATION INFORMATION

Location #	Location Description	Location ID	Phase I Samples			Phase II Samples		
			Sample ID	Sample Date	Sample Time	Sample ID	Sample Date	Sample Time
#1	City pump near Cabinet View Country Club	SP-131927	*no samples collected [1]*			*no samples collected [1]*		
#2	Upstream of OU5 fire pond flume	SP-145700	1W-00001	11/7/2011	11:19	2W-00001	5/14/2012	11:15
			1W-00024	11/8/2011	10:56	2W-00013	5/15/2012	08:40
			1W-00028	11/9/2011	13:44	2W-00025	5/16/2012	12:26
			1W-00049	11/14/2011	09:56	2W-00036	5/21/2012	10:25
			1W-00062	11/16/2011	14:07	2W-00049	5/23/2012	12:31
			1W-00077	11/18/2011	13:45	2W-00068	5/25/2012	09:34
#3	NE of Hammer Cutoff bridge	SP-145702	1W-00014	11/7/2011	12:17	*no samples collected [2]*		
			1W-00023	11/8/2011	10:37			
			1W-00029	11/9/2011	13:19			
			1W-00050	11/14/2011	10:52			
			1W-00063	11/16/2011	13:04			
			1W-00078	11/18/2011	12:25			
#4	Upstream of Kootenai River Rd bridge, near stand pipe	SP-145707	1W-00004	11/7/2011	14:20	2W-00006	5/14/2012	12:56
			1W-00016	11/8/2011	08:44	2W-00015	5/15/2012	09:25
			1W-00030	11/9/2011	14:25	2W-00027	5/16/2012	13:33
			1W-00042	11/14/2011	11:47	2W-00040	5/21/2012	11:45
			1W-00057	11/16/2011	16:25	2W-00053	5/23/2012	13:30
			1W-00068	11/18/2011	13:27	2W-00066	5/25/2012	10:13
#5	Upstream of Bobtail cut off Rd bridge	SP-145709	1W-00005	11/7/2011	14:49	2W-00007	5/14/2012	13:30
			1W-00018	11/8/2011	09:17	2W-00017	5/15/2012	10:02
			1W-00031	11/9/2011	14:51	2W-00028	5/16/2012	14:04
			1W-00041	11/14/2011	12:05	2W-00041	5/21/2012	12:25
			1W-00058	11/16/2011	16:02	2W-00054	5/23/2012	14:03
			1W-00069	11/18/2011	12:58	2W-00067	5/25/2012	08:49
#6	Upstream of US Highway 2 bridge, near standpipe	SP-145706	1W-00006	11/7/2011	13:33	2W-00005	5/14/2012	12:28
			1W-00019	11/8/2011	09:41	2W-00021	5/15/2012	10:55
			1W-00032	11/9/2011	14:09	2W-00033	5/16/2012	14:48
			1W-00046	11/14/2011	09:38	2W-00045	5/21/2012	12:48
			1W-00066	11/16/2011	13:33	2W-00057	5/23/2012	14:45
			1W-00071	11/18/2011	10:50	2W-00071	5/25/2012	10:52
#7	NE of Granite Creek Rd bridge	SP-145703	1W-00007	11/7/2011	12:30	*no samples collected [2]*		
			1W-00022	11/8/2011	10:25			
			1W-00033	11/9/2011	13:26			
			1W-00052	11/14/2011	11:05			
			1W-00060	11/16/2011	13:12			
			1W-00076	11/18/2011	12:10			
#8	Kootenai River adjacent to KDC flyaway pumphouse	SP-145711	1W-00008	11/7/2011	15:10	2W-00009	5/14/2012	14:04
			1W-00015	11/8/2011	08:03	2W-00020	5/15/2012	10:35
			1W-00034	11/9/2011	15:10	2W-00031	5/16/2012	14:26
			1W-00040	11/14/2011	12:25	2W-00044	5/21/2012	11:24
			1W-00056	11/16/2011	15:38	2W-00056	5/23/2012	14:23
			1W-00067	11/18/2011	11:37	2W-00061	5/25/2012	08:31
#9	W side of US Highway 2, S side of creek	SP-145701	1W-00009	11/7/2011	11:46	2W-00002	5/14/2012	11:36
			1W-00025	11/8/2011	10:47	2W-00014	5/15/2012	08:57
			1W-00026	11/8/2011	10:48	2W-00026	5/16/2012	12:38
			1W-00035	11/9/2011	13:35	2W-00038	5/21/2012	10:45
			1W-00051	11/14/2011	10:41	2W-00050	5/23/2012	12:48
			1W-00061	11/16/2011	14:00	2W-00070	5/25/2012	09:52

TABLE 1-1
SAMPLE LOCATION INFORMATION

Location #	Location Description	Location ID	Phase I Samples			Phase II Samples		
			Sample ID	Sample Date	Sample Time	Sample ID	Sample Date	Sample Time
#10	Upstream of Balsam St bridge	SP-145704	1W-00010	11/7/2011	13:09	*no samples collected [2]*		
			1W-00021	11/8/2011	10:02			
			1W-00036	11/9/2011	13:54			
			1W-00048	11/14/2011	09:50			
			1W-00064	11/16/2011	12:45			
			1W-00073	11/18/2011	11:09			
#11	NW corner of bridge on Dome Mountain Ave	SP-145705	1W-00011	11/7/2011	13:21	*no samples collected [2]*		
			1W-00020	11/8/2011	09:54			
			1W-00037	11/9/2011	14:00			
			1W-00047	11/14/2011	09:44			
			1W-00065	11/16/2011	13:45			
			1W-00072	11/18/2011	11:02			
#12	Upstream of Kootenai River Rd bridge	SP-145708	1W-00012	11/7/2011	14:05	2W-00008	5/14/2012	13:07
			1W-00017	11/8/2011	09:06	2W-00018	5/15/2012	09:38
			1W-00038	11/9/2011	14:34	2W-00029	5/16/2012	13:45
			1W-00044	11/14/2011	11:37	2W-00043	5/21/2012	11:59
			1W-00059	11/16/2011	16:18	2W-00055	5/23/2012	13:43
			1W-00070	11/18/2011	13:07	2W-00065	5/25/2012	10:25
#13	J Neils Park	SP-145710	1W-00013	11/9/2011	16:30	2W-00010	5/14/2012	13:45
			1W-00027	11/10/2011	11:04	2W-00019	5/15/2012	09:15
			1W-00039	11/11/2011	12:17	2W-00030	5/16/2012	13:17
			1W-00053	11/12/2011	13:26	2W-00039	5/21/2012	10:11
			1W-00054	11/13/2011	15:28	2W-00052	5/23/2012	13:15
			1W-00055	11/14/2011	09:22	2W-00064	5/25/2012	09:02
#14	1210 E Missoula Ave (potable shop hydrant) Troy, MT	SP-146408	*no samples collected [3]*			2W-00011	5/14/2012	14:46
						2W-00023	5/15/2012	11:25
						2W-00034	5/16/2012	15:11
						2W-00046	5/21/2012	13:12
						2W-00058	5/23/2012	15:08
						2W-00072	5/25/2012	11:12
#15	215 Riverside Ave (non-potable hydrant) Troy, MT	SP-146409	*no samples collected [3]*			2W-00012	5/14/2012	14:57
						2W-00024	5/15/2012	11:38
						2W-00035	5/16/2012	15:21
						2W-00047	5/21/2012	13:21
						2W-00059	5/23/2012	15:19
						2W-00073	5/25/2012	11:23
#16	875 US Highway 2 (OU5)	SP-146636	*no samples collected [4]*			2W-00048	5/22/2012	12:20
						2W-00060	5/24/2012	13:30
						2W-00069	5/25/2012	09:22

[1] Existing pump in the pump house was found to be non-functional. Sample excluded.

[2] Locations are too far from cleanup activities and thus, excluded from Phase II sampling.

[3] New sample locations only analyzed during Phase II.

[4] Opportunistic sample only collected during Phase II.

TABLE 4-1
PHASE I (LOW FLOW) WATER SOURCE STUDY RESULTS

Location Description	Location ID	Sample Date	Sample ID	Sensitivity (1/L)	Total LA Structures** N Structures	Conc. (MFL)
Libby Creek, upstream of	SP-145700	07-Nov-11	1W-00001	9.9E+03	0	0.00
OU5 fire pond flume	**Location #2**	08-Nov-11	1W-00024	5.5E+03	0	0.00
		09-Nov-11	1W-00028	9.2E+03	0	0.00
		14-Nov-11	1W-00049	5.5E+03	0	0.00
		16-Nov-11	1W-00062	5.5E+03	0	0.00
		18-Nov-11	1W-00077	5.5E+03	0	0.00
Libby Creek, NE of	SP-145702	07-Nov-11	1W-00014	9.9E+03	0	0.00
Hammer Cutoff bridge	**Location #3**	08-Nov-11	1W-00023	5.5E+03	0	0.00
		09-Nov-11	1W-00029	9.2E+03	0	0.00
		14-Nov-11	1W-00050	5.5E+03	0	0.00
		16-Nov-11	1W-00063	5.5E+03	0	0.00
		18-Nov-11	1W-00078	5.5E+03	0	0.00
Pipe Creek, Upstream of	SP-145707	07-Nov-11	1W-00004	9.9E+03	0	0.00
Kootenai River Rd	**Location #4**	08-Nov-11	1W-00016	5.5E+03	0	0.00
bridge, near stand pipe		09-Nov-11	1W-00030	9.2E+03	0	0.00
		14-Nov-11	1W-00042	5.5E+03	0	0.00
		16-Nov-11	1W-00057	5.5E+03	0	0.00
		18-Nov-11	1W-00068	5.5E+03	0	0.00
Pipe Creek, Upstream of	SP-145709	07-Nov-11	1W-00005	9.9E+03	0	0.00
Bobtail Cutoff Rd bridge	**Location #5**	08-Nov-11	1W-00018	5.5E+03	0	0.00
		09-Nov-11	1W-00031	9.2E+03	0	0.00
		14-Nov-11	1W-00041	5.5E+03	0	0.00
		16-Nov-11	1W-00058	5.5E+03	0	0.00
		18-Nov-11	1W-00069	5.5E+03	0	0.00
Cedar Creek, Upstream	SP-145706	07-Nov-11	1W-00006	9.9E+03	0	0.00
of US Highway 2 bridge,	**Location #6**	08-Nov-11	1W-00019	5.5E+03	0	0.00
near standpipe		09-Nov-11	1W-00032	9.2E+03	0	0.00
		14-Nov-11	1W-00046	5.5E+03	0	0.00
		16-Nov-11	1W-00066	5.5E+03	0	0.00
		18-Nov-11	1W-00071	5.5E+03	0	0.00
Cherry Creek, NE of	SP-145703	07-Nov-11	1W-00007	9.9E+03	0	0.00
Granite Creek Rd bridge	**Location #7**	08-Nov-11	1W-00022	5.5E+03	0	0.00
		09-Nov-11	1W-00033	5.5E+03	0	0.00
		14-Nov-11	1W-00052	5.5E+03	0	0.00
		16-Nov-11	1W-00060	5.5E+03	0	0.00
		18-Nov-11	1W-00076	5.5E+03	0	0.00
Kootenai River adjacent	SP-145711	07-Nov-11	1W-00008	9.9E+03	0 +	0.00
to KDC flyway	**Location #8**	08-Nov-11	1W-00015	9.9E+03	0	0.00
pumphouse		09-Nov-11	1W-00034	9.2E+03	0	0.00
		14-Nov-11	1W-00040	9.2E+03	0	0.00
		16-Nov-11	1W-00056	9.2E+03	0	0.00
		18-Nov-11	1W-00067	9.2E+03	0	0.00

TABLE 4-1
PHASE I (LOW FLOW) WATER SOURCE STUDY RESULTS

Location Description	Location ID	Sample Date	Sample ID	Sensitivity (1/L)	Total LA Structures** N Structures	Total LA Structures** Conc. (MFL)
Granite Creek, W side of US Highway 2, S side of creek	SP-145701 **Location #9**	07-Nov-11	1W-00009	9.9E+03	0	0.00
		08-Nov-11	1W-00025	5.5E+03	0	0.00
		09-Nov-11	1W-00035	5.5E+03	0	0.00
		14-Nov-11	1W-00051	5.5E+03	0	0.00
		16-Nov-11	1W-00061	5.5E+03	0	0.00
		18-Nov-11	1W-00075	5.5E+03	0	0.00
Flower Creek, Upstream of Balsam St bridge	SP-145704 **Location #10**	07-Nov-11	1W-00010	9.9E+03	0	0.00
		08-Nov-11	1W-00021	5.5E+03	0	0.00
		09-Nov-11	1W-00036	5.5E+03	0	0.00
		14-Nov-11	1W-00048	5.5E+03	0	0.00
		16-Nov-11	1W-00064	5.5E+03	0	0.00
		18-Nov-11	1W-00073	5.5E+03	0	0.00
Parmenter Creek, NW corner of bridge on Dome Mountain Ave	SP-145705 **Location #11**	07-Nov-11	1W-00011	9.9E+03	0	0.00
		08-Nov-11	1W-00020	5.5E+03	0	0.00
		09-Nov-11	1W-00037	5.5E+03	0	0.00
		14-Nov-11	1W-00047	5.5E+03	0	0.00
		16-Nov-11	1W-00065	5.5E+03	0	0.00
		18-Nov-11	1W-00072	5.5E+03	0	0.00
Quartz Creek, Upstream of Kootenai River Rd bridge	SP-145708 **Location #12**	07-Nov-11	1W-00012	9.9E+03	0	0.00
		08-Nov-11	1W-00017	5.5E+03	0	0.00
		09-Nov-11	1W-00038	5.5E+03	0	0.00
		14-Nov-11	1W-00044	5.5E+03	0	0.00
		16-Nov-11	1W-00059	5.5E+03	0	0.00
		18-Nov-11	1W-00070	5.5E+03	0	0.00
J Neils Park	SP-145710 **Location #13**	09-Nov-11	1W-00013	3.6E+04	0	0.00
		10-Nov-11	1W-00027	2.8E+04	0	0.00
		11-Nov-11	1W-00039	2.8E+04	0	0.00
		12-Nov-11	1W-00053	1.1E+04	0	0.00
		13-Nov-11	1W-00054	9.2E+03	0	0.00
		14-Nov-11	1W-00055	1.1E+04	0	0.00

**No structures longer than 10 um were observed in any sample.
+ 1 chrysotile structure detected (0.01 MFL)

1/L = per liters
Conc. = concentration
ID = identifier
LA = Libby amphibole
MFL = million fibers per liter
N = number
um = micrometers

Results based on subscription to the Scribe project databases as of 6/5/13.
Data verification of this dataset is complete.

TABLE 4-2
PHASE II (HIGH FLOW) WATER SOURCE STUDY RESULTS

Location Description	Location ID	Sample Date	Sample ID	Sensitivity (1/L)	Total LA Structures N Structures	Total LA Structures Conc. (MFL)	LA Structures > 10 um N Structures	LA Structures > 10 um Conc. (MFL)
Libby Creek, Upstream of OU5 fire pond flume	SP-145700	5/14/2012	2W-00001	1.3E+04	1	0.01	1	0.01
	Location #2	5/15/2012	2W-00013	6.6E+04	3	0.20	0	0.00
		5/16/2012	2W-00025	1.3E+05	3	0.39	0	0.00
		5/21/2012	2W-00036	4.3E+04	1	0.04	0	0.00
		5/23/2012	2W-00049	8.6E+04	1 +	0.09	0	0.00
		5/25/2012	2W-00068	3.5E+04	0	0.00	0	0.00
Pipe Creek, Upstream of Kootenai River Rd bridge, near stand pipe	SP-145707	5/14/2012	2W-00006	3.6E+04	0	0.00	0	0.00
	Location #4	5/15/2012	2W-00015	7.2E+04	0	0.00	0	0.00
		5/16/2012	2W-00027	5.1E+04	1	0.05	0	0.00
		5/21/2012	2W-00040	4.3E+04	2	0.09	1	0.04
		5/23/2012	2W-00053	2.6E+04	0	0.00	0	0.00
		5/25/2012	2W-00066	2.6E+04	0	0.00	0	0.00
Pipe Creek, Upstream of Bobtail Cutoff Rd bridge	SP-145709	5/14/2012	2W-00007	3.5E+04	0	0.00	0	0.00
	Location #5	5/15/2012	2W-00017	1.8E+04	0	0.00	0	0.00
		5/16/2012	2W-00028	5.1E+04	4	0.20	0	0.00
		5/21/2012	2W-00041	4.3E+04	1	0.04	0	0.00
		5/23/2012	2W-00054	2.6E+04	0	0.00	0	0.00
		5/25/2012	2W-00067	3.5E+04	0	0.00	0	0.00
Cedar Creek, Upstream of US Highway 2 bridge, near standpipe	SP-145706	5/14/2012	2W-00005	1.4E+04	0	0.00	0	0.00
	Location #6	5/15/2012	2W-00021	1.4E+04	0	0.00	0	0.00
		5/16/2012	2W-00033	2.6E+04	1	0.03	0	0.00
		5/21/2012	2W-00045	2.6E+04	1	0.03	0	0.00
		5/23/2012	2W-00057	2.6E+04	0	0.00	0	0.00
		5/25/2012	2W-00071	2.6E+04	0	0.00	0	0.00
Kootenai River adjacent to KDC flyway pumphouse	SP-145711	5/14/2012	2W-00009	1.4E+04	0	0.00	0	0.00
	Location #8	5/15/2012	2W-00020	7.2E+03	0	0.00	0	0.00
		5/16/2012	2W-00031	5.1E+04	1	0.05	0	0.00
		5/21/2012	2W-00044	3.2E+04	1	0.03	0	0.00
		5/23/2012	2W-00056	2.6E+04	1	0.03	0	0.00
		5/25/2012	2W-00061	2.6E+04	0	0.00	0	0.00
Granite Creek, W side of US Highway 2, S side of creek	SP-145701	5/14/2012	2W-00002	1.8E+04	0	0.00	0	0.00
	Location #9	5/15/2012	2W-00014	2.4E+04	0	0.00	0	0.00
		5/16/2012	2W-00026	2.6E+05	4	1.02	0	0.00
		5/21/2012	2W-00038	4.3E+04	2	0.09	0	0.00
		5/23/2012	2W-00050	4.3E+04	3	0.13	0	0.00
		5/25/2012	2W-00070	3.5E+04	0	0.00	0	0.00
Quartz Creek, Upstream of Kootenai River Rd bridge	SP-145708	5/14/2012	2W-00008	1.2E+04	0	0.00	0	0.00
	Location #12	5/15/2012	2W-00018	1.2E+04	0	0.00	0	0.00
		5/16/2012	2W-00029	1.3E+05	2	0.26	0	0.00
		5/21/2012	2W-00043	2.6E+04	0	0.00	0	0.00
		5/23/2012	2W-00055	1.7E+04	0	0.00	0	0.00
		5/25/2012	2W-00065	3.5E+04	0	0.00	0	0.00
J. Neils Park	SP-145710	5/14/2012	2W-00010	9.9E+03	1	0.01	0	0.00
	Location #13	5/15/2012	2W-00019	9.9E+03	0	0.00	0	0.00
		5/16/2012	2W-00030	1.7E+04	2	0.03	0	0.00
		5/21/2012	2W-00039	2.2E+04	0	0.00	0	0.00
		5/23/2012	2W-00052	1.7E+04	0	0.00	0	0.00
		5/25/2012	2W-00064	9.2E+03	0	0.00	0	0.00

TABLE 4-2
PHASE II (HIGH FLOW) WATER SOURCE STUDY RESULTS

Location Description	Location ID	Sample Date	Sample ID	Sensitivity (1/L)	Total LA Structures N Structures	Total LA Structures Conc. (MFL)	LA Structures > 10 um N Structures	LA Structures > 10 um Conc. (MFL)
1210 E Missoula Ave (potable shop hydrant), Troy, MT	SP-146408 **Location #14**	5/14/2012	2W-00011	9.2E+03	1	0.01	0	0.00
		5/15/2012	2W-00023	9.9E+03	0	0.00	0	0.00
		5/16/2012	2W-00034	1.7E+04	0	0.00	0	0.00
		5/21/2012	2W-00046	2.2E+04	0	0.00	0	0.00
		5/23/2012	2W-00058	1.7E+04	1	0.02	0	0.00
		5/25/2012	2W-00072	2.6E+04	0	0.00	0	0.00
215 Riverside Ave (non-potable hydrant), Troy, MT	SP-146409 **Location #15**	5/14/2012	2W-00012	1.4E+04	2	0.03	2	0.03
		5/15/2012	2W-00024	7.1E+04	0	0.00	0	0.00
		5/16/2012	2W-00035	2.6E+05	0	0.00	0	0.00
		5/21/2012	2W-00047	4.3E+04	6	0.26	0	0.00
		5/23/2012	2W-00059	2.6E+04	4	0.10	0	0.00
		5/25/2012	2W-00073	3.5E+04	0	0.00	0	0.00
875 US Highway 2 (OU5)	SP-146636	5/22/2012	2W-00048	3.6E+05	0	0.00	0	0.00
		5/24/2012	2W-00060	1.8E+05	0	0.00	0	0.00
		5/25/2012	2W-00069	9.2E+03	0	0.00	0	0.00

+ 1 anthophyllite structure detected (0.09 MFL)

1/L = per liters
Conc. = concentration
ID = identifier
LA = Libby amphibole
MFL = million fibers per liter
N = number
um = micrometers

Results based on subscription to the Scribe project databases as of 6/5/13.
Data verification of this dataset is complete.

TABLE 4-3
PHASE II FLOW MEASUREMENTS

Location #	Location Description	Location ID	Sample Date	Flow (ft^3/sec)
#1	City pump near Cabinet View Country Club	SP-131927	no samples collected [1]	
#2	Upstream of OU5 fire pond flume	SP-145700	5/14/2012	221.82
	Libby Creek		5/15/2012	333
			5/16/2012	445
			5/21/2012	376 [3]
			5/23/2012	335 [3]
			5/25/2012	194 [3]
#3	NE of Hammer Cutoff bridge	SP-145702	no samples collected [2]	
#4	Upstream of Kootenai River Rd bridge,	SP-145707	5/14/2012	868.8
	near stand pipe		5/15/2012	1086
	Pipe Creek		5/16/2012	1145 [3]
			5/21/2012	880 [3]
			5/23/2012	703 [3]
			5/25/2012	NM [4]
#5	Upstream of Bobtail cut off Rd bridge	SP-145709	5/14/2012	NM [4]
			5/15/2012	720
			5/16/2012	811 [3]
			5/21/2012	770 [3]
			5/23/2012	648 [3]
			5/25/2012	535 [3]
#6	Upstream of US Highway 2 bridge,	SP-145706	5/14/2012	238.13
	near standpipe		5/15/2012	411
	Cedar Creek		5/16/2012	544 [3]
			5/21/2012	510 [3]
			5/23/2012	460 [3]
			5/25/2012	325 [3]
#7	NE of Granite Creek Rd bridge	SP-145703	no samples collected [2]	
#8	Kootenai River adjacent to KDC flyaway	SP-145711	5/14/2012	NMF [5]
	pumphouse		5/15/2012	NMF [5]
	Kootenai River		5/16/2012	NMF [5]
			5/21/2012	NMF [5]
			5/23/2012	NMF [5]
			5/25/2012	NMF [5]
#9	W side of US Highway 2, S side of creek	SP-145701	5/14/2012	109
	Granite Creek		5/15/2012	537
			5/16/2012	537 [3]
			5/21/2012	430 [3]
			5/23/2012	396 [3]
			5/25/2012	283 [3]
#10	Upstream of Balsam St bridge	SP-145704	no samples collected [2]	
#11	NW corner of bridge on Dome Mountain Ave	SP-145705	no samples collected [2]	

TABLE 4-3
PHASE II FLOW MEASUREMENTS

Location #	Location Description	Location ID	Sample Date	Flow (ft^3/sec)
#12	Upstream of Kootenai River Rd bridge Quartz Creek	SP-145708	5/14/2012	922
			5/15/2012	1062
			5/16/2012	1086 [3]
			5/21/2012	936 [3]
			5/23/2012	929 [3]
			5/25/2012	1017 [3]
#13	J Neils Park	SP-145710	5/14/2012	NA [6]
			5/15/2012	NA [6]
			5/16/2012	NA [6]
			5/21/2012	NA [6]
			5/23/2012	NA [6]
			5/25/2012	NA [6]
#14	1210 E Missoula Ave (potable shop hydrant) Troy, MT	SP-146408	5/14/2012	NA [6]
			5/15/2012	NA [6]
			5/16/2012	NA [6]
			5/21/2012	NA [6]
			5/23/2012	NA [6]
			5/25/2012	NA [6]
#15	215 Riverside Ave (non-potable hydrant) Troy, MT	SP-146409	5/14/2012	NA [6]
			5/15/2012	NA [6]
			5/16/2012	NA [6]
			5/21/2012	NA [6]
			5/23/2012	NA [6]
			5/25/2012	NA [6]
#16	875 US Highway 2 (OU5)	SP-146636	5/22/2012	NA [6]
			5/24/2012	NA [6]
			5/25/2012	NA [6]

[1] Existing pump in the pump house was found to be non-functional. Sample excluded.

[2] Locations are too far from cleanup activities and thus, excluded from Phase II sampling.

[3] Width estimated due to health and safety concerns

[4] NM = not measured

[5] NMF = not measured because flow gauge available for river

[6] NA = not applicable because sample was collected from hydrant, faucet, or pump

TABLE 4-4
WATER SOURCE RANKING

Panel A: Summary Statistics

Location #	Location Description	Location ID	Total LA		
			# of Detections/ 6 sampling events (Detection Frequency=DF)	Mean Conc. (MFL)	Maximum Conc. of Detections (MFL)
#1	City pump near Cabinet View Country Club	SP-131927	excluded from further evaluation because the existing pump in the pump house was found to be		
#2	Libby Creek, Upstream of OU5 fire pond flume	SP-145700	5	0.1212	0.3875
#3	Libby Creek, NE of Hammer Cutoff bridge	SP-145702	excluded from further evaluation because too far from cleanup activities planned for 2012		
#4	Pipe Creek, Upstream of Kootenai River Rd bridge, near stand pipe	SP-145707	2	0.0229	0.0861
#5	Pipe Creek, Upstream of Bobtail Cutoff Rd bridge	SP-145709	2	0.0413	0.2046
#6	Cedar Creek, Upstream of US Highway 2 bridge, near standpipe	SP-145706	2	0.0086	0.0258
#7	Cherry Creek, NE of Granite Creek Rd bridge	SP-145703	excluded from further evaluation because too far from cleanup activities planned for 2012		
#8	Kootenai River adjacent to KDC flyway pumphouse	SP-145711	3	0.0182	0.0512
#9	Granite Creek, W side of US Highway 2, S side of creek	SP-145701	3	0.2064	1.0232
#10	Flower Creek, Upstream of Balsam St bridge	SP-145704	excluded from further evaluation because too far from cleanup activities planned for 2012		
#11	Parmenter Creek, NW corner of bridge on Dome Mountain Ave	SP-145705	excluded from further evaluation because too far from cleanup activities planned for 2012		
#12	Quartz Creek, Upstream of Kootenai River Rd bridge	SP-145708	1	0.0426	0.2558
#13	J. Neils Park	SP-145710	2	0.0073	0.0341
#14	1210 E Missoula Ave (potable shop hydrant), Troy, MT	SP-146408	2	0.0044	0.0172
#15	215 Riverside Ave (non-potable hydrant), Troy, MT	SP-146409	3	0.0644	0.2558
#16	875 US Highway 2 (OU5)	SP-146636	0*	NA	NA

* LA not detected in any of the samples collected, however only 3 samples instead of 6 were collected at this location.
NA = not applicable

Panel B: Water Source Ranking (based on low to high detections/concentration)

Location #	Location Description	Location ID	Rank based on Mean Conc.	Rank based on Detection Frequency**	Rank based on Maximum Conc. of Detections**
#16	875 US Highway 2 (OU5)	SP-146636	1	1	1
#14	1210 E Missoula Ave (potable shop hydrant), Troy, MT	SP-146408	2	3	2
#13	J. Neils Park	SP-145710	3	3	4
#6	Cedar Creek, Upstream of US Highway 2 bridge, near standpipe	SP-145706	4	3	3
#8	Kootenai River adjacent to KDC flyway pumphouse	SP-145711	5	8	5
#4	Pipe Creek, Upstream of Kootenai River Rd bridge, near stand pipe	SP-145707	6	3	6
#5	Pipe Creek, Upstream of Bobtail Cutoff Rd bridge	SP-145709	7	3	7
#12	Quartz Creek, Upstream of Kootenai River Rd bridge	SP-145708	8	2	8
#15	215 Riverside Ave (non-potable hydrant), Troy, MT	SP-146409	9	8	8
#2	Libby Creek, Upstream of OU5 fire pond flume	SP-145700	10	11	10
#9	Granite Creek, W side of US Highway 2, S side of creek	SP-145701	11	8	11

** Locations with the same number of detections or maximum concentrations have equal rankings.

TABLE 5-1
EVALUATION OF FIELD BLANKS

Panel A: Phase I Field Blanks

Date	Sample ID	N Total LA
11/7/2011	1W-00003	0
11/14/2011	1W-00043	0

Samples analyzed by TEM-ISO (high magnification)

Panel B: Phase II Field Blanks

Date	Sample ID	N Total LA
5/14/2012	2W-00004	0
5/15/2012	2W-00016	0
5/15/2012	2W-00022	0
5/16/2012	2W-00032	#N/A
5/21/2012	2W-00037	0
5/23/2012	2W-00051	0
5/25/2012	2W-00063	0

Samples analyzed by TEM-ISO (high magnification)
#N/A = not submitted for analysis

TABLE 5-2
EVALUATION OF FIELD DUPLICATES

Panel A: Phase I Field Duplicates

Location Description	Location	Sample Date	Sample ID	Sample Type	Replicate #1			Poisson Ratio Comparison (90% CI)
					Sensitivity (cm^{-2})	N Total LA Structures	Total LA Surface Loading (s/cm^2)	
Libby Creek, upstream of OU5 fire pond flume	SP-145700 **Location #2**	11/7/2011	1W-00001	Field Sample	9.9E+03	0	0.0E+00	Both counts are 0; the rates are not different
			1W-00002	Field Duplicate	9.9E+03	0	0.0E+00	
Granite Creek, W side of US Highway 2, S side of creek	SP-145701 **Location #9**	11/8/2011	1W-00025	Field Sample	5.5E+03	0	0.0E+00	Both counts are 0; the rates are not different
			1W-00026	Field Duplicate	5.5E+03	0	0.0E+00	
Flower Creek, Upstream of Balsam St bridge	SP-145704 **Location #10**	11/18/2011	1W-00073	Field Sample	5.5E+03	0	0.0E+00	Both counts are 0; the rates are not different
			1W-00074	Field Duplicate	5.5E+03	0	0.0E+00	
Quartz Creek, Upstream of Kootenai River Rd bridge	SP-145708 **Location #12**	11/14/2011	1W-00044	Field Sample	5.5E+03	0	0.0E+00	Both counts are 0; the rates are not different
			1W-00045	Field Duplicate	5.5E+03	0	0.0E+00	

Samples analyzed by TEM-ISO (high magnification, target sensitivity 100,000 cm^{-2})

Panel B: Phase II Field Duplicates

Location Description	Location	Sample Date	Sample ID	Sample Type	Replicate #1			Poisson Ratio Comparison (90% CI)
					Sensitivity (cm^{-2})	N Total LA Structures	Total LA Surface Loading (s/cm^2)	
Granite Creek, W side of US Highway 2, S side of creek	SP-145701 **Location #9**	5/14/2012	2W-00002	Field Sample	1.8E+04	0	0.0E+00	Both counts are 0; the rates are not different
			2W-00003	Field Duplicate	1.4E+04	0	0.0E+00	
Pipe Creek, Upstream of Bobtail Cutoff Rd bridge	SP-145709 **Location #5**	5/21/2012	2W-00041	Field Sample	4.3E+04	1	4.3E+04	[0-19] The rates are not different
			2W-00042	Field Duplicate	4.3E+04	0	0.0E+00	
Kootenai River adjacent to KDC flyway pumphouse	SP-145711 **Location #8**	5/25/2012	2W-00061	Field Sample	2.6E+04	0	0.0E+00	Both counts are 0; the rates are not different
			2W-00062	Field Duplicate	3.5E+04	0	0.0E+00	

Samples analyzed by TEM-ISO (high magnification, target sensitivity 100,000 cm^{-2})

TABLE 5-3
CHI-SQUARE EVALUATION FOR TEM ANALYSES

Location #	Location Description	Location ID	Phase I Samples			Phase II Samples		
			Sample ID	Sample Date	Chi Square P	Sample ID	Sample Date	Chi Square P
#1	City pump near Cabinet View Country Club	SP-131927	*no samples collected [1]*			*no samples collected [1]*		
#2	Upstream of OU5 fire pond flume	SP-145700	1W-00001	11/7/2011	1.00	2W-00001	5/14/2012	0.48
			1W-00024	11/8/2011	1.00	2W-00013	5/15/2012	0.54
			1W-00028	11/9/2011	1.00	2W-00025	5/16/2012	0.54
			1W-00049	11/14/2011	1.00	2W-00036	5/21/2012	0.48
			1W-00062	11/16/2011	1.00	2W-00049	5/23/2012	0.48
			1W-00077	11/18/2011	1.00	2W-00068	5/25/2012	1.00
#3	NE of Hammer Cutoff bridge	SP-145702	1W-00014	11/7/2011	1.00	*no samples collected [2]*		
			1W-00023	11/8/2011	1.00			
			1W-00029	11/9/2011	1.00			
			1W-00050	11/14/2011	1.00			
			1W-00063	11/16/2011	1.00			
			1W-00078	11/18/2011	1.00			
#4	Upstream of Kootenai River Rd bridge, near stand pipe	SP-145707	1W-00004	11/7/2011	1.00	2W-00006	5/14/2012	1.00
			1W-00016	11/8/2011	1.00	2W-00015	5/15/2012	1.00
			1W-00030	11/9/2011	1.00	2W-00027	5/16/2012	0.48
			1W-00042	11/14/2011	1.00	2W-00040	5/21/2012	0.51
			1W-00057	11/16/2011	1.00	2W-00053	5/23/2012	1.00
			1W-00068	11/18/2011	1.00	2W-00066	5/25/2012	1.00
#5	Upstream of Bobtail cut off Rd bridge	SP-145709	1W-00005	11/7/2011	1.00	2W-00007	5/14/2012	1.00
			1W-00018	11/8/2011	1.00	2W-00017	5/15/2012	1.00
			1W-00031	11/9/2011	1.00	2W-00028	5/16/2012	0.57
			1W-00041	11/14/2011	1.00	2W-00041	5/21/2012	0.48
			1W-00058	11/16/2011	1.00	2W-00054	5/23/2012	1.00
			1W-00069	11/18/2011	1.00	2W-00067	5/25/2012	1.00
#6	Upstream of US Highway 2 bridge, near standpipe	SP-145706	1W-00006	11/7/2011	1.00	2W-00005	5/14/2012	1.00
			1W-00019	11/8/2011	1.00	2W-00021	5/15/2012	1.00
			1W-00032	11/9/2011	1.00	2W-00033	5/16/2012	0.48
			1W-00046	11/14/2011	1.00	2W-00045	5/21/2012	0.48
			1W-00066	11/16/2011	1.00	2W-00057	5/23/2012	1.00
			1W-00071	11/18/2011	1.00	2W-00071	5/25/2012	1.00
#7	NE of Granite Creek Rd bridge	SP-145703	1W-00007	11/7/2011	1.00	*no samples collected [2]*		
			1W-00022	11/8/2011	1.00			
			1W-00033	11/9/2011	1.00			
			1W-00052	11/14/2011	1.00			
			1W-00060	11/16/2011	1.00			
			1W-00076	11/18/2011	1.00			
#8	Kootenai River adjacent to KDC flyaway pumphouse	SP-145711	1W-00008	11/7/2011	1.00	2W-00009	5/14/2012	1.00
			1W-00015	11/8/2011	1.00	2W-00020	5/15/2012	1.00
			1W-00034	11/9/2011	1.00	2W-00031	5/16/2012	0.48
			1W-00040	11/14/2011	1.00	2W-00044	5/21/2012	0.48
			1W-00056	11/16/2011	1.00	2W-00056	5/23/2012	0.48
			1W-00067	11/18/2011	1.00	2W-00061	5/25/2012	1.00
#9	W side of US Highway 2, S side of creek	SP-145701	1W-00009	11/7/2011	1.00	2W-00002	5/14/2012	1.00
			1W-00025	11/8/2011	1.00	2W-00014	5/15/2012	1.00
			1W-00026	11/8/2011	1.00	2W-00026	5/16/2012	0.57
			1W-00035	11/9/2011	1.00	2W-00038	5/21/2012	0.51
			1W-00051	11/14/2011	1.00	2W-00050	5/23/2012	0.54
			1W-00061	11/16/2011	1.00	2W-00070	5/25/2012	1.00

TABLE 5-3
CHI-SQUARE EVALUATION FOR TEM ANALYSES

Location #	Location Description	Location ID	Phase I Samples			Phase II Samples		
			Sample ID	Sample Date	Chi Square P	Sample ID	Sample Date	Chi Square P
#10	Upstream of Balsam St bridge	SP-145704	1W-00010	11/7/2011	1.00	*no samples collected [2]*		
			1W-00021	11/8/2011	1.00			
			1W-00036	11/9/2011	1.00			
			1W-00048	11/14/2011	1.00			
			1W-00064	11/16/2011	1.00			
			1W-00073	11/18/2011	1.00			
#11	NW corner of bridge on Dome Mountain Ave	SP-145705	1W-00011	11/7/2011	1.00	*no samples collected [2]*		
			1W-00020	11/8/2011	1.00			
			1W-00037	11/9/2011	1.00			
			1W-00047	11/14/2011	1.00			
			1W-00065	11/16/2011	1.00			
			1W-00072	11/18/2011	1.00			
#12	Upstream of Kootenai River Rd bridge	SP-145708	1W-00012	11/7/2011	1.00	2W-00008	5/14/2012	1.00
			1W-00017	11/8/2011	1.00	2W-00018	5/15/2012	1.00
			1W-00038	11/9/2011	1.00	2W-00029	5/16/2012	0.51
			1W-00044	11/14/2011	1.00	2W-00043	5/21/2012	1.00
			1W-00059	11/16/2011	1.00	2W-00055	5/23/2012	1.00
			1W-00070	11/18/2011	1.00	2W-00065	5/25/2012	1.00
#13	J Neils Park	SP-145710	1W-00013	11/9/2011	1.00	2W-00010	5/14/2012	0.47
			1W-00027	11/10/2011	1.00	2W-00019	5/15/2012	1.00
			1W-00039	11/11/2011	1.00	2W-00030	5/16/2012	0.53
			1W-00053	11/12/2011	1.00	2W-00039	5/21/2012	1.00
			1W-00054	11/13/2011	1.00	2W-00052	5/23/2012	1.00
			1W-00055	11/14/2011	1.00	2W-00064	5/25/2012	1.00
#14	1210 E Missoula Ave (potable shop hydrant) Troy, MT	SP-146408	*no samples collected [3]*			2W-00011	5/14/2012	0.48
						2W-00023	5/15/2012	1.00
						2W-00034	5/16/2012	1.00
						2W-00046	5/21/2012	1.00
						2W-00058	5/23/2012	0.48
						2W-00072	5/25/2012	1.00
#15	215 Riverside Ave (non-potable hydrant) Troy, MT	SP-146409	*no samples collected [3]*			2W-00012	5/14/2012	0.00
						2W-00024	5/15/2012	1.00
						2W-00035	5/16/2012	1.00
						2W-00047	5/21/2012	0.62
						2W-00059	5/23/2012	0.57
						2W-00073	5/25/2012	1.00
#16	875 US Highway 2 (OU5)	SP-146636	*no samples collected [4]*			2W-00048	5/22/2012	1.00
						2W-00060	5/24/2012	1.00
						2W-00069	5/25/2012	1.00

[1] Existing pump in the pump house was found to be non-functional. Sample excluded.
[2] Locations are too far from cleanup activities and thus, excluded from Phase II sampling.
[3] New sample locations only analyzed during Phase II.
[4] Opportunistic sample only collected during Phase II.

APPENDICES

(Provided electronically on the enclosed disk)

Appendix A
Field Documentation

(Field Sample Data Sheet Forms and Lognotes)

Appendix A-1
Phase I Field Documentation

(Field Sample Data Sheet Forms and Lognotes)

Appendix A-2
Phase II Field Documentation

(Field Sample Data Sheet Forms and Lognotes)

Appendix B
Analytical Laboratory Reports

Appendix B-1
Phase I Analytical Laboratory Reports

Appendix B-2
Phase II Analytical Laboratory Reports

Appendix C
Libby Project Database

(As of 06/05/2013)

Appendix D
Record of Modification Forms

(Phase I only, no ROMs for Phase II)

Appendix E

Water Source Study **Verification Summary Report**