Libby Asbestos Superfund Site
Libby and Troy Residential and Commercial Properties, Parks, and Schools

Operable Units 4 and 7
Lincoln County, Montana

Final Operations and Maintenance Plan, Revision 0

April 2020

Contract No. W912DQ-18-D-3008
Task Order No. F0008

Prepared for:
U.S. Environmental Protection Agency
Region VIII
1595 Wynkoop Street
Denver, Colorado 80202

Prepared by:
CDM Federal Programs Corporation
555 17th Street, Suite 500
Denver, Colorado 80202

Under Contract to:
U.S. Army Corps of Engineers
Omaha District
1616 Capitol Avenue
Omaha, Nebraska 68102

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Approved by: _____ Date: 04/21/20
Thomas E. Cook
CDM Smith Project Manager

Approved by: MEACHAM.MARK.R.1229663182 Digitally signed by MEACHAM.MARK.R.1229663182 Date: 2020.04.21 11:00:17 -05'00' Date: 4/21/20
Mark Meacham
USACE Program Manager

Approved by: _____ Date: 4/22/2020
Jason Rappe
DEQ Project Officer

Approved by: _____ Date: 4-21-2020
Mike Cirian
EPA Region VIII Remedial Project Manager

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List of Abbreviations and Acronyms

ARAR	applicable or relevant and appropriate requirement
ARP	Lincoln County Asbestos Resource Program
BMP	best management practice
BOH	City-County Board of Health for Lincoln County
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DEQ	Montana Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
Grace	W.R. Grace & Co.
HASP	health and safety plan
HI	hazard index
IC	institutional control
ICIAP	institutional control implementation and assurance plan
IDLH	immediately dangerous to life or health
LA	Libby amphibole asbestos
landfill	Class IV Asbestos Cell at the Libby Class II landfill
LASOC	Libby Asbestos Superfund Oversight Committee
O&F	operational and functional
O&M	operations and maintenance
OSHA	Occupational Safety and Health Administration
OU	operable unit
PEN	Lincoln County Property Evaluation Notification Regulation
POTS	Property Operations Tracking System
RACR	remedial action completion report
RAL	remedial action level
ROD	record of decision
Site	Libby Asbestos Superfund Site
SOW	statement of work
USACE	U.S. Army Corps of Engineers
VCI	vermiculite-containing insulation
Zonolite	Universal Zonolite Insulation Company

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Section 1
Introduction

This operations and maintenance (O&M) plan presents the administrative, financial, and technical aspects and requirements for inspecting, operating, and maintaining the remedial action for Operable Unit (OU) 4 and OU7 of the Libby Asbestos Superfund Site (Site) (Superfund Enterprise Management System #MT0009083840) (Figure 1-1). In 2014, with the finalization of the *Libby Asbestos Site Residential/Commercial Action Level and Clearance Criteria Technical Memorandum Amendment B* (Amendment B) (EPA 2014), the National Priorities List (NPL) boundary and Site OU boundaries were formalized (Figure 1-2). Based on current information, OU4 and OU7 are comprised of 8,112 properties—6,635 within OU4 and 1,477 within OU7. In order to address public comments following the public comment period of this O&M plan, a responsiveness summary has been prepared and is provided as Appendix A.

The remedial action selected in the *Record of Decision for Libby Asbestos Superfund Site, Libby and Troy Residential and Commercial Properties, Parks and Schools, Transportation Corridors, Industrial Park, Operable Units 4–8* (ROD) (EPA 2016) was necessary to protect human health and the environment from actual or threatened releases of Libby amphibole asbestos (LA) at the Site. An O&M plan is required at OU4 and OU7 because controls have been employed to address contamination remaining at various levels within the Site.

O&M shall be performed in accordance with the U.S. Environmental Protection Agency's (EPA's) *Guidance for Management of Superfund Remedies in Post Construction* (EPA 2017). The Montana Department of Environmental Quality (DEQ) is the agency responsible for O&M at OU4 and OU7; however, this responsibility is shared among several designated agencies and stakeholders and discussed further in Section 1.3 of this O&M plan.

OU4 and OU7, the subject of this O&M plan, include areas impacted by contamination from activities associated with mining, processing, and shipping of vermiculite by W.R. Grace & Co. (Grace). The selected remedy for the land use categories within OU4 and OU7 include Alternative SO6: Partial Excavation of Contaminated Soil, Disposal of Excavated Soil at the Former Libby Vermiculite Mine, Administrative Controls, and Monitoring; and Alternative BM5: Partial Removal of Accessible Contaminated Building Materials, Disposal of Removed Materials at an Existing Permitted Facility, Encapsulation of Remaining Contaminated Building Materials, Interior Cleaning, Administrative Controls, and Monitoring. These alternatives are further detailed in the ROD (EPA 2016).

In general, the remedy for the Site has consisted of a combination of excavating contaminated soil and replacement with clean backfill, capping contamination remaining in place following partial excavation with clean backfill, removing accessible contaminated building materials, and blocking/sealing remaining inaccessible contaminated building materials in place. This O&M plan was prepared to monitor and maintain the physical remedies, engineered controls, and nonengineered or institutional controls (ICs) associated with remaining LA and LA source materials present in surface soil and subsurface soil, and within currently inaccessible areas of

buildings within OU4 and OU7. All other forms of asbestos not related to LA and LA source materials should be managed in accordance with regulations expressed by the DEQ Asbestos Control Program, and are outside the scope of this O&M plan.

1.1 Site Location and Background

The Site encompasses the Cities of Libby and Troy, Montana. Libby is the county seat of Lincoln County and lies in the northwest corner of Montana, about 35 miles east of Idaho and 65 miles south of Canada. Troy is approximately 20 miles west of downtown Libby along U.S. Highway 2.

OU4 includes residential, commercial, and public properties such as schools and parks in and around Libby. OU7 includes residential, commercial, and public properties such as schools and parks in and around Troy.

In 1881, gold miners discovered vermiculite 7 miles northeast of Libby. In the early 1920s, Edward Alley initiated mining operations on the vermiculite ore body. Full-scale operations began later that decade under the name Universal Zonolite Insulation Company (Zonolite). This ore body contained a mixture of amphibole mineral fibers of varying elemental composition (e.g., winchite, richterite, tremolite; collectively referred to as LA) that were identified in the Rainy Creek complex near Libby, as defined by Meeker et al. (Meeker et al. 2003). Unlike the commercially exploited chrysotile asbestos, commercial use of the LA material never occurred on a wide scale because during the lifespan of the mine, it seemed a byproduct of little or no value. A variety of products used the commercially exploited vermiculite. These products included insulation and construction materials, a carrier for fertilizer and other agricultural chemicals, and a soil conditioner.

The mining of vermiculite ore used standard strip mining techniques and conventional mining equipment. An on-site dry mill processed the ore to remove waste rock and overburden material. Once processed, vehicles transported the ore from the mine to the former screening plant, which sorted the ore into five size ranges. After the sorting process, various locations across the United States received the material for either direct inclusion in products or for "expansion" prior to use in products. Expansion, also known as "exfoliation" or "popping," involved heating the ore, usually in a dry kiln, to approximately 2,000 degrees Fahrenheit. This process explosively vaporizes the water contained within the mica structure, causing the vermiculite to expand. The result was the vermiculite material most commonly seen in stores, sold as a soil conditioner for gardens and greenhouses. This material was processed and handled at four main locations:

- OU1: the export plant located in Libby on the south side of the Kootenai River, just north of the downtown area
- OU2: the screening plant located across MT Highway 37 from the entrance to Rainy Creek Road, and the railroad loading station located directly across the Kootenai River from the screening plant
- OU3: the mine and the mill located on Rainy Creek Road on top of Zonolite Mountain
- OU5: the expansion plant located at the end of Lincoln Road, near 5th Street

In 1963, Grace purchased Zonolite and continued the vermiculite mining operations. A wet milling process, added in 1975, operated in tandem with the dry mill to reduce dust generated by the milling process. The dry mill went offline in 1985. Expansion operations at the export plant ceased in Libby sometime prior to 1981, although this area was still used to bag and export milled ore until mining operations terminated in 1990. Prior to its closure in 1990, the mine produced about 80 percent of the world's supply of vermiculite (EPA 2016).

Since 1999, EPA has conducted response activities (e.g., investigation, sampling, removal, remediation, abatement, disposal) to address areas in the Libby Valley contaminated with LA. EPA's involvement was initiated in response to media articles, which detailed extensive asbestos-related health problems in the Libby population. While at first the situation was thought to be limited to those with direct or indirect occupational exposures, it soon became clear there were multiple exposure pathways and many persons with no link to mining-related activities were affected.

Largely, the LA contamination found in the Libby Valley came from one or some combination of source materials (e.g., vermiculite insulation, processed vermiculite ore, mine wastes). LA from these source materials has been found in interior building dust samples and local soils, which in turn act as secondary sources.

Workers at the mine lived in both Libby and Troy and commuted to the mine to work each day. The workers were exposed to LA-contaminated materials at the mine and processing facilities, and they transported LA-contaminated dust to their homes on their heavily contaminated clothing and equipment, unknowingly exposing their families and contaminating their properties.

Vermiculite was transported from the mine for decades, and residents of both Libby and Troy had access to these materials. Waste vermiculite was used for amending soils in gardens, flowerbeds, and lawns; filling in low-lying areas at properties and beneath sidewalks and driveways; backfilling utilities and septic systems; and insulating buildings and houses. Vermiculite-containing insulation (VCI) was used in attics, and to a lesser extent in walls, for insulation. In some cases, VCI was added to existing insulation to increase the insulating capability (R-value) of the existing insulation.

Exposure to contamination has largely been mitigated by removing surface soils at the Site. In addition, response actions involving removing accessible VCI and LA-containing building materials and debris, detail cleaning contaminated attic and interior spaces, and blocking and sealing inaccessible VCI and LA-containing building materials in place have occurred at the Site.

Details of response activities within OU4 and OU7 are detailed in the *Final Remedial Investigation Report, Residential and Commercial Properties, Operable Unit 4 – Libby Asbestos National Priorities List Site* (CDM Federal Programs Corporation [CDM Smith] 2014), the *Final Remedial Investigation Report, Operable Unit 7* (Tetra Tech 2014), and the *Final Remedial Action Completion Report, Operable Units 4 and 7* (RACR) (CDM Smith 2020a).

1.2 Current Site Information

1.2.1 Land Use Categories

The land use categories discussed in this section are described in the ROD. Land use categories are not for purposes of development/zoning; rather, they were developed to assess the varying risks of LA exposure and establish corresponding remedial action levels (RALs) and clearance criteria. Current land use categories and individual property status information is available through the DEQ Response Manager database.

Residential/Commercial

This land use category includes private residential, commercial, and public properties within the Cities of Libby (OU4) and Troy (OU7) that are currently used, or will be used in the future, for residential, commercial, or governmental (service-related) purposes not involving large-scale manufacturing of products for sale and export outside of the Site. Streets and alleyways within OU4 and OU7, as well as churches not providing primary and secondary education (i.e., kindergarten through 12th grade) and/or higher education in a school setting, are also included in the residential/commercial land use category.

This land use category also includes future public and private school properties within Libby and Troy that do not currently exist but are planned to provide primary, secondary, or higher education. This simplifies the O&M assessment process and allows the remedy to remain protective since the RALs for the residential/commercial land use category are the most restrictive of all the land use categories.

Parks/Schools

This land use category includes park properties within OU4 and OU7 with current or future use for public or commercial recreational purposes. It also includes roadways within public or commercial parks, and public and private school properties within OU4 and OU7 that are currently used to provide primary, secondary, or higher education (e.g., Kootenai Valley Head Start, Libby High School, Libby Middle School).

Churches that do not provide primary, secondary, or higher education, and schools established in the future, will be part of the residential/commercial properties land use category previously described.

Industrial

No industrial properties currently exist within OU4 and OU7. Should future industrial development occur, it is anticipated that it would fall into the commercial category previously described.

1.2.2 Remedial Action Criteria

As described in the ROD, RALs for contaminated media are site-specific criteria used to determine whether a remedial action at a particular property or location using physical remedy components or approaches would be required because of LA contamination in soil and building materials. The remedial clearance criteria are site-specific criteria used to determine when the physical remedy

component or the approach used in a cleanup action at a particular property or location would be considered complete. In contrast to RALs, which define conditions when remedial action should begin, remedial clearance criteria define conditions when the physical remedy component or approach can end. Appendix B provides a summary of the remedial action criteria from the ROD for each of the OU4 and OU7 land use categories.

1.2.3 Boundary Conditions

Boundary conditions exist at OU4 and OU7 and are defined as features or conditions that limit the ability to further remediate LA contamination because of physical or technical constraints, and the related lack of accessibility the boundary conditions present. Boundary conditions include the following:

- Presence of building foundations that could be compromised by the response action
- Presence of pavement that is relatively permanent (e.g., roadways and sidewalks)
- Presence of large tree root systems
- Presence of bedrock
- Presence of groundwater that is not seasonal or perched and thus cannot be readily avoided
- A preset maximum vertical extent of 3 feet below ground surface, due to limited future accessibility of subsurface soils under typical residential, commercial, park and school activities
- A maximum horizontal extent to the adjacent property boundary where cleanup occurred or where other boundary conditions (e.g., pavement, bedrock) existed

1.2.4 Parcel Ownership

OU4 and OU7 are comprised of 8,112 properties—6,635 are within OU4 and 1,477 are within OU7. Following remedial action completion, all parcel ownership information from EPA's Response Manager database was provided to DEQ and the Lincoln County Asbestos Resource Program (ARP) for management. All information from EPA's Response Manager and Property Operations Tracking System (POTS) database was migrated into a POTS 2 database for management of property information by DEQ. However, DEQ determined it was more efficient to retain a DEQ version of Response Manager with select POTS 2 data migrated into it for use during O&M. Therefore, property ownership and response action status (including completed response action information) is available through the DEQ Response Manager database and within other data files provided to DEQ and ARP by EPA during the operational and functional (O&F) period for properties within OU4 and OU7. DEQ maintains a geospatial database of OU4 and OU7 boundaries based on the geospatial database provided by EPA.

1.3 O&M Responsibilities

As described in the introduction, DEQ is the primary agency responsible for O&M activities at OU4 and OU7, with support and oversight provided by other agencies and stakeholders. A summary of each entity's responsibilities is described below.

EPA O&M Responsibilities

EPA is the oversight agency responsible for determining whether the remedy at the Site is protective of human health and environment. In making this determination, EPA is responsible for conducting five-year reviews. Section 6 summarizes the five-year review process and associated requirements. Additionally, EPA is responsible for administering funds from the O&M settlement account to DEQ during O&M. Further details regarding funding are provided in Section 1.4.

DEQ O&M Responsibilities

For OU4 and OU7, DEQ is responsible for O&M of the implemented remedial action. DEQ will be responsible for developing and implementing cooperative agreements with local agencies and stakeholders, managing the reimbursement program for O&M-related activities, and administering contracts (e.g., laboratory services), as necessary, to implement ICs and protect the physical remedy. DEQ will also be responsible for managing past and future information regarding property response activities, and presence of known remaining LA and LA source materials. Information acquired during property-specific response activities is located within each hard copy property file in EPA's records center and electronically on external hard drives transferred to DEQ and ARP. Relevant historical property information is contained in the DEQ Response Manager database. Additionally, DEQ maintains a Web-based mapping tool using previously developed shape files provided by EPA. Analytical data stored in EPA's Scribe and Libby 2 databases have been reported to DEQ and ARP in final Excel reports (by sample media) as of the end of remedial action, and all future analytical data will be managed by DEQ.

In addition, DEQ will be responsible for conducting inspections of the Site on at least an annual basis. Activities to be performed during these inspections may include visual assessment of properties within OU4 and OU7, review of Montana811 calls, review of past remedy maintenance and repair, review of sampling and analysis data and reports, evaluation of IC effectiveness, and reporting. These activities are discussed in further detail within subsequent sections of this plan.

Lincoln County and ARP O&M Responsibilities (as outlined in DEQ/County cooperative agreements)

ARP works under the direction of the City-County Board of Health for Lincoln County (BOH). Through DEQ and county-developed cooperative agreements, ARP will be the local presence responsible for implementing protective measures and ICs during O&M. ARP is a program staffed in Lincoln County, Montana that was initially funded by EPA through completion of remedial action and O&F at the Site. ARP was developed as a program to educate the public regarding the remaining risks of LA exposure, provide resources to manage risks associated with LA exposure, and implement initiatives to reduce or prevent the risk of LA exposure. It is expected that ARP will continue to provide information, as needed, to assist property owners and their contractors

in understanding the appropriate best management practices (BMPs) and ICs that apply to their properties (EPA 2016).

Additionally, ARP will implement the Lincoln County Property Evaluation Notification Regulation (PEN). Lincoln County established this regulation as an IC to ensure protection of the remedy.

The Lincoln County Solid Waste Department will operate and maintain the Class IV Asbestos Cell at the Libby Class II landfill (landfill). This cell will be made available for disposal of LA-contaminated material. The landfill was developed during removal and remedial action work and has been transferred to Lincoln County.

Stakeholders

The primary stakeholders for the Site are property owners, residents, and workers. As stated in the ROD, the selected physical remedy called for leaving contamination in soil and within inaccessible areas where it did not present a risk of exposure. Stakeholders may be exposed to LA during O&M if O&M activities and associated ICs and BMPs are not maintained, monitored, and followed.

O&M activities, specifically the ICs developed for O&M, will provide property owners and residents with information on their property status, the potential for LA contamination left in place, and provide resources and regulations to follow to aid in public awareness and protectiveness. The ICs provide tools (e.g., PEN) to property owners to make formal notification of activities on their property that may disturb the physical protective remedy components. The ICs will also provide guidance and information to property owners that have not had a remedy. If disturbance of the remedy does occur, is expected to occur, or there is potential to encounter LA or LA source materials at their property, property owners should contact ARP to determine appropriate O&M activities to implement.

Property owners in OU4 and OU7 that had cleanups performed have been informed of the contamination that remains in place at their property, if any, as well as the necessity to maintain physical barriers intended to cap and/or encapsulate remaining LA contaminated materials. The property owner is expected to ensure activities on their property do not disturb the physical protective remedy in place. If disturbance of the remedy does occur or is expected to occur, property owners should contact ARP to determine appropriate O&M activities to implement. Assistance will be available to homeowners to address potential exposures to LA and LA source materials. Property owners or contractors who have followed reasonable assurances to protect the remedy may be eligible for reimbursement of LA-related costs associated with activities. Responsible practices by property owners is essential to the success of the O&M program. Processes for reimbursement of response activities and decision criteria are discussed in Section 1.5.

1.4 Identification of Available Funding for O&M

EPA set up a settlement fund for the Site. From the settlement fund, $11 million was placed into a separate interest-bearing account dedicated to helping to pay for future sitewide (all OUs except OU3 and OU6) O&M. Currently, the funds in that account are nearly $12 million. The cost of the sitewide O&M program will be evaluated through a cost-risk analysis to help minimize

uncertainty associated with those costs. O&M settlement funds are administered by EPA to DEQ through a cooperative agreement grant and are subject to EPA eligibility requirements. EPA will administer O&M settlement funds for costs associated with LA and LA-source materials where property owners have provided and will continue to provide access for associated response activities; where property owners have not actively participated in a for-profit enterprise of distributing, treating, storing, or disposing of vermiculite; and where property owners take appropriate precautions in handling any LA/LA source materials in and around their home, avoiding possible activities that may spread LA/LA source materials to other locations without first consulting with DEQ and/or ARP. Further guidance regarding funding for remedy maintenance activities during the O&M period are discussed in the *Guidance for Management of Superfund Remedies in Post Construction* (EPA 2017).

In addition to this settlement fund, under Montana Code Annotated 75-10-743(10)(c) and 75-10-704(4)(j)(I), starting July 1, 2018, DEQ receives an appropriation of $600,000 annually from an orphan share transfer. The subsequent Montana Code Annotated 75-10-1601 provided a framework on how this money could be used, and established a permanent trust fund to pay exclusively for costs to the state of cleanup and long-term O&M for Libby. From this account, $480,000 is allocated annually for oversight and support of the advisory team (i.e., Libby Asbestos Superfund Oversight Committee [LASOC]). As of September 2019, the trust fund balance was $852,536. DEQ also received approximately $5 million as part of the bankruptcy settlement with Grace. As determined by DEQ, after consideration of LASOC recommendations and state Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) policy and precedent, these funds could also be used to support O&M activities in Libby and Troy, particularly in those situations where EPA-administered funds are precluded from being used.

If other currently available and planned funding resources are depleted, remaining EPA-held "remedial action settlement funds" may be made available to the state to be used for O&M activities related to encounters with LA within OU4 and OU7, subject to federal funding restrictions.

EPA's position regarding eligibility of Site O&M settlement funding toward long-term O&M is provided in the responsiveness summary (Appendix A).

1.5 Property Reimbursement Program

An O&M reimbursement program has been established for property owners and/or contractors to recover eligible O&M response costs related to LA contamination that are implemented to protect the remedy. It is expected that costs not associated with the sampling and/or removal of LA/LA source materials will be the responsibility of the property owner.

Several tools have been developed to evaluate reimbursement eligibility. The Property Reimbursement Eligibility flowcharts included in DEQ's O&M manual (DEQ 2020; manual in development) provide guidance on potential state and/or federal funding sources that are available. Once work has been deemed eligible for reimbursement, element-specific eligibility costs can be determined and outlined in an ARP-developed statement of work (SOW) and approved by DEQ. DEQ has the ability to utilize alternative funding sources to support O&M

activities within OU4/OU7, particularly in situations where EPA-administered funds are precluded from being used.

To be eligible for reimbursement, the property must be located within the NPL boundary and have existing LA contamination that exceeds or could lead to an exceedance of RALs defined in the ROD. Additionally, the property owner must be willing to provide consent for DEQ or its designee to access the property. Considerations for the type of property disturbance and/or change in use must be evaluated. Considerations of past remedial actions, maintenance of controls, and potential developer windfall situations also need to be assessed.

If a property owner has private insurance that covers all or a portion of the work, O&M response costs may be eligible for reimbursement only if the property owner is willing to provide insurance contact information. O&M response costs will not be eligible for reimbursement if the insurance contact information is not provided or if the insurance company covers all costs for the response.

Federal properties are not eligible for O&M reimbursement. Rather, other sources of federal funds are available for response activities during O&M. Disturbances that occur at federal properties remain subject to the reporting and documentation requirements described in this plan. SOWs, analytical results, and as-builts are expected to be provided to ensure most recent property records.

Upon completion of the work, ARP will inspect the property to ensure adherence to the SOW. Eligible items will be verified to confirm proper documentation, quantities, and accurate costs. A claim form will then be submitted by the property owner and will identify whether payment will be made directly to the property owner, or to the contractor who performed eligible activities outlined in the SOW. If payment is not directly to the party that performed the work (i.e., incurred the cost), the property owner will be responsible for making payments to associated parties. Claims to cover up-front costs prior to activities commencing may be requested through DEQ, and will be determined on a case-by-case basis.

1.6 Statement of Basis and Purpose

The purpose of this O&M plan is to present the activities necessary for inspecting, operating, and maintaining the effectiveness of the OU4 and OU7 remedial action, including administrative, financial, and technical details and requirements. This O&M plan and the *Institutional Control Implementation and Assurance Plan, Operable Units 4 and 7* (ICIAP) (CDM Smith 2020b) are to be in place before O&M begins. The plans will be reviewed and revised as appropriate on a routine basis to ensure activities continue to operate effectively.

1.6.1 O&M Objectives

The implementation and maintenance of the remedial measures, in accordance with the O&M plan, are designed to meet the following remedial action objectives, as discussed in the ROD (EPA 2016):

- Minimize the inhalation of LA during disturbances of soil contaminated with LA such that the resulting exposures result in cumulative cancer risks that are within or below EPA's

acceptable risk range of 10^{-6} to 10^{-4} and cumulative noncancer hazard index (HI) that is at or below 1.0

- Minimize the inhalation of LA during disturbances of building materials contaminated with LA such that the resulting exposures result in cumulative cancer risks that are within or below EPA's acceptable risk range of 10^{-6} to 10^{-4} and cumulative noncancer HI that are at or below 1.0

Long-term O&M objectives for OU4 and OU7 are:

- Observe and maintain the integrity of the remedies and controls
- Monitor, evaluate, and update ICs to ensure protectiveness – ICs for this O&M plan are detailed in the ICIAP (CDM Smith 2020b), including the following soil and building materials objectives:
    - Soil – prevent LA fibers that may remain in soil at properties after meeting remedial criteria for the land use category, or at undeveloped properties, from becoming a future source of unacceptable exposure
    - Building Materials – prevent LA fibers that may remain in inaccessible building materials from becoming a future source of unacceptable exposure

1.6.2 Summary of Long-Term O&M Activities

Long-term O&M (i.e., O&M efforts to be conducted for an indefinite period into the future) will be performed to maintain the integrity of the remedy components (protective covers, backfilled areas, containment of VCI/contaminated building materials), and ICs will be implemented. As noted in the ROD, ICs and O&M will continue to ensure protectiveness of the remedy despite delisting or deletion of an OU from the Site, or the Site from the NPL (EPA 2016).

Prior to any on-site O&M work, a property-specific SOW will be developed that details the work to be performed at the property. All O&M work should be performed in compliance with the appropriate safety standards. Planning should include provisions for responding to and reporting accidents involving site personnel, operating emergencies, and other unusual events such as fires, floods, or weather damage.

The following activities will be considered routine O&M activities:

- **OU4 and OU7 Site Inspections.** Nonintrusive visual site inspections will be conducted to ensure integrity of the physical remedy and engineered controls remain intact. OU4 and OU7 site inspections are assumed to be performed at least annually, and concurrently with EPA's five-year site reviews. OU4 and OU7 site inspections are discussed in Section 2.
- **Sampling, Monitoring, and Analysis.** Sampling, monitoring, and analysis may be conducted to determine whether areas meet remedial action levels and clearance criteria following activities described in Section 3, in order to maintain the integrity of the Site. Also, if there is an agreed-upon land use category change between DEQ or designee and the property owner, sampling may be conducted as appropriate. Reimbursement eligibility,

specific sampling decision criteria, and sampling details are captured in the OU4/OU7 O&M manual (DEQ 2020; manual in development) and corresponding sampling guidance.

- **Physical Remedy and Engineered Control Maintenance.** Planned renovations, new construction, demolition, and changes in use are expected and anticipated during O&M. Physical remedy maintenance is discussed in Section 3, including issues that may arise with the physical remedy or engineered control during long-term O&M, and contingency plans for damage to the physical remedy or engineered control. Damage to a physical remedy or engineered control observed during annual OU4 and OU7 site inspections are expected to be identified as described in Section 2 to mitigate exposure to underlying/inlying contamination.

- **ICs Evaluation and Updates.** As part of the OU4 and OU7 site inspection, ICs will be evaluated on at least an annual basis and updated, if necessary, to ensure protectiveness. Evaluation and updates for different types of ICs are discussed in Section 4 and detailed in the ICIAP (CDM Smith 2020b).

- **Reporting.** Reports summarizing O&M activities will be prepared on an annual basis. Annual reporting also involves regular review and updates, as necessary, to SOWs (see Section 1.5.2) and as-built drawings prepared during the reporting period. Development of health and safety plans (HASPs) for O&M are recommended for the protection of workers at the Site and are the responsibility of the entity performing work under each respective HASP. Reporting requirements are discussed in detail in Section 5.

1.7 Overview of Transition from Remedial Action to Operations and Maintenance

A remedy becomes O&F either 1 year after construction is complete, or when the remedy is determined concurrently by EPA and the state to be functioning properly and performing as designed, whichever is earlier (EPA 2017). EPA considers remedial action at OU4 and OU7 to be complete, as responses that occurred both before and after the signing of the ROD meet the remedy requirements. Table 1-1 below summarizes the response activities completed prior to and during the remedial action. The property counts and statuses shown in Table 1-1 were obtained from POTS 2 on October 16, 2019.

Table 1-1. Property Status Table

Status	OU4	OU7	Property Count
Response Not Required (RALs not exceeded)	3,758	1,208	4,966
Response Completed Indoor	291	62	353
Response Completed Indoor/Outdoor	767	42	809
Response Completed Outdoor	1,368	98	1,466
Investigation Not Required[1]	291	3	294
Investigation Required – Access Refused	155	62	217
Response Required – Access Granted[2]	1	0	1
Response Required – Access Refused	4	2	6
Total	**6,635**	**1,477**	**8,112**

[1] These properties include undeveloped government-owned lands, timber industry lands, borrow sources/fill pits, and roadways not associated with OU8; assigned an Investigation Not Required status.

[2] The response action is on hold due to property owner medical issues. The property owner's representative will contact DEQ when they are prepared for the response action.

1.7.1 Schedule for Transition from Remedial Action to Operations and Maintenance

Table 1-2 presents a summary of the major events for transition from remedial action to O&M at OU4 and OU7, and associated dates of these events. The RACR (CDM Smith 2020a) provides a summary of all response activities that occurred prior to and following publication of the ROD. For OU4 and OU7, a joint site inspection occurred in fall 2018 and winter 2019, and the beginning of the 1-year O&F period began April 2019. As shown in Table 1-2, the first annual O&M site inspection is anticipated in 2021.

Table 1-2. Summary of the Major Events for Transition from Remedial Action to O&M

Date	Event
December 1999	Begin Phase 1 investigation
Summer 2000	Begin Phase 2 investigation
Spring 2002	Begin Contaminant Screening Study
Summer 2002	Begin removal action at OU4 and OU7 properties
December 2003	Draft Final Residential/Commercial Cleanup Action Level and Clearance Criteria, Technical Memorandum, Libby Asbestos Site
April 2009	Troy OU7 Residential/Commercial Cleanup Criteria Specific Use Area Visible Vermiculite Action Level Technical Memorandum
April 2011	Amendment A to Draft Final Residential/Commercial Cleanup Action Level and Clearance Criteria, Technical Memorandum, Libby Asbestos Site
February 2014	Amendment B to Draft Final Residential/Commercial Cleanup Action Level and Clearance Criteria, Technical Memorandum, Libby Asbestos Site
June 2014	OU4 and OU7 remedial investigation complete
May 2015	OUs 4–8 feasibility study complete
November 2015	Sitewide human health risk assessment complete
February 2016	OUs 4–8 ROD signed
Fall 2018/Winter 2019	Final joint site inspection
January 2019	Remedial action complete

Date	Event
April 2019	Start of O&F[1]
April 2020	Final RACR
March 2020	ICIAP approval
April 2020	O&M plan approval
TBD (estimated Spring/Summer 2020)	Tentative end of O&F; start of O&M
TBD (estimated Spring 2021)	First annual O&M site inspection
TBD (estimated Summer 2021)	First annual O&M report
TBD (estimated Spring 2020)	Five-year review (Five-year reviews will be done concurrently with sitewide five-year reviews. The first sitewide review was completed June 22, 2015.)

TBD – to be determined

[1] Based on an EPA letter dated March 12, 2019, joint inspection activities continued after the listed O&F date.

Annual O&M site inspections, annual O&M reporting, and EPA five-year reviews will be conducted indefinitely as long as contaminants remain on-site at levels that call for restricted uses and limited exposure.

DEQ is statutorily responsible for O&M at OU4 and OU7. Staffing for O&M at OU4 and OU7 primarily consists of ARP and DEQ staff. As specified in cooperative agreements, ARP is expected to implement the PEN[1], perform assessments, develop SOWs, review work conducted under these SOWs, provide data input and management, provide resource support services including education and information IC programs, and assist DEQ personnel in performing annual site inspections. EPA personnel and/or their contractors will perform five-year reviews.

[1] The OU4/OU7 ICIAP includes a full discussion of ARP's role in delivery of ICs, including details of the PEN.

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Section 2
Site Inspections

Site inspections are conducted to provide information about a site's status and to document the conditions of the remedy and the site (EPA 2017). DEQ or its designee will conduct site inspections (e.g., site assessments, annual site inspection) for OU4 and OU7. Inspections will be documented in accordance with applicable requirements and/or guidance. DEQ or its designee will obtain the necessary access agreements for any on-site inspections. The recommended O&M Annual Site Inspection Checklist is provided as Appendix C.

2.1 Site Inspection Objectives

Consistent with the O&M objectives presented in Section 1.5.1, the objectives of OU4 and OU7 site inspections will include, but are not limited to, the following:

- Observe and maintain the integrity of the engineered controls and physical remedies (e.g., protective covers or backfilled areas, encapsulated/sealed building materials) to maintain the protection of human health and the environment
- Evaluate the implementation of ICs to ensure protectiveness, as described in Section 4

2.2 Observe Site Conditions

Monitoring protocol includes nonintrusive visual site inspections with limited sample collection[2] to ensure integrity of the physical remedies and engineered controls. Site inspections will be performed annually at a minimum, and concurrently with EPA's five-year review, according to the proposed O&M schedule presented in Section 1.6.

2.2.1 Inspect the Integrity of Physical Remedies and Engineered Controls

Annual site inspections may include review of PEN documentation (e.g., metrics, participation data), Montana811 call records, building records, ARP contact records, landfill records, property files (e.g., SOWs, as-builts), title records, aerial photographs, and results from sampling events, as well as property owner interviews and evaluation of specific IC instruments. In addition, visits to select properties may occur to observe whether the backfills and vegetation, and encapsulation of contaminated building materials, as applicable, are intact and prevent exposure to LA.

[2] Collection of samples are not anticipated during annual site inspections or as a part of five-year reviews, however, can be implemented as deemed appropriate by DEQ and/or EPA during those review cycles. General O&M sampling efforts can be found within the OU4/OU7 O&M manual (DEQ 2020; manual in development) and corresponding sampling guidance.

Results of the inspection will be evaluated to determine if:

- ICs related to land use changes, changes in use frequency, and encountered LA soils and materials are effective and sufficient at protecting the remedy, including that:
  - PEN documents correlate to observed construction activities, landfill receipts/disposal records, building permits, aerial photography, etc.
  - Contracting and training resources are sufficient during O&M to evaluate if remedial criteria continue to be met for properties with completed response action
  - Property owner interviews reflect public education outreach efforts to ensure knowledge of risks and responsibilities under O&M
  - Title reviews match DEQ database records for potential environmental conditions and known environmental conditions
  - Coordination with local government services for development and potential land use and/or use frequency changes are sufficient (e.g., subdivisions, building permit, and septic installation coordination)
  - ARP records adequately document assessment results, SOWs, contractor oversight, and completion records
  - The DEQ Response Manager database is sufficient to effectively track and monitor implementation of O&M activities

2.2.2 Other Site Features

Some buildings, soil areas, parking surfaces, and roads have not required response actions to remove, block, or encapsulate contaminated material; therefore, O&M of these areas will consist primarily of IC implementation and BMPs. The ICs discussed in Section 4 and the ICIAP (CDM Smith 2020b) will be used to address these areas and potential LA exposures.

Section 3
Physical Remedy O&M Activities

Damage to physical remedies and engineered controls could result from erosion, vandalism, motor vehicle traffic, digging, building renovation/demolition, normal wear and tear, deterioration of encapsulated building materials, lack of maintenance, land development and/or changes in use area or use frequency. Damage to physical remedies and engineered controls at OU4 and OU7 has the potential to result in exposure to LA that would result in unacceptable risk to human health and the environment. Such damage may be the result of either excavation activities and/or changes or additions to structures and building components, or it may be the result of natural causes such as floods, snow, ice, fires, wind, etc.

Prior to conducting physical remedy O&M activities, it is recommended that health and safety procedures be addressed specific to the work being performed. Occupational Safety and Health Administration (OSHA), applicable entities engaged in field operations under this O&M plan, shall follow OSHA regulations, as specified in 29 Code of Federal Regulations, Hazardous Waste Operations and Emergency Response, 1920.120 may apply[3]. In general, training requirements pursuant to OSHA regulations should be outlined in a recommended HASP for all applicable entities conducting field O&M activities under this plan. If disturbance to the protective physical remedy or engineered control occurs or is anticipated to occur, notice should be provided to ARP in accordance with the PEN. Likewise, if LA or LA source materials are encountered or suspected, ARP and/or DEQ should be contacted. Based on the degree of exposure anticipated, ARP may elect to provide the property owner with BMP advice and/or conduct a site assessment to determine if additional response activities are necessary at the property. If corrective work is deemed necessary, the following activities would typically be performed, under the direction of DEQ:

- ARP would assess the site and educate the property owner on BMPs, including the necessary measures to secure and/or isolate the disturbed areas and to limit contaminant migration so that the protection of human health and the environment is maintained
- ARP would develop an SOW that outlines the necessary corrective action required to address LA-contamination at the site
- ARP would provide the homeowner with licensed contractor contact information, resources available for owners self-performing work, SOW requirements, BMPs along with the appropriate disposal protocol, and reimbursement eligibility information
- ARP would provide oversight of the corrective action work, as necessary, and perform a final inspection to ensure SOW elements have been met

[3] Property owners performing activities on their own, are not considered "applicable entities" and do not fall under OSHA regulations. However, property owners are encouraged to follow best management practices when conducting O&M activities at their property.

- Once ARP has verified that SOW elements have been achieved, eligible expenses would be reimbursed (see Section 1.5 for details regarding the reimbursement eligibility process)

3.1 Corrective Action to a Disturbance of the Physical Remedy

DEQ, with assistance from ARP, is responsible for making the determination of remedy response. General wear and tear or erosion may result in the need for a corrective action to the physical remedy or engineered control. General wear and tear may include rutting and cracking on ground surfaces from heavy equipment such as snowplows, damage to the grass due to foot traffic, or deteriorating building materials encapsulation/sealing/blocking.

A corrective action to the physical remedy or engineered control is generally warranted if there is significant likelihood of exposure from LA-contaminated soil or building materials. Additional excavation of LA-contaminated soil or construction of building/area containment may be necessary to secure the disturbed areas so that the protection of human health and environment is maintained and contaminant migration does not occur. If a corrective action occurs or is anticipated to occur, notice should be provided to ARP. Likewise, if LA or LA source materials are encountered or suspected, ARP and/or DEQ should be contacted. Based on the degree of exposure anticipated, ARP may elect to provide the property owner with corrective action advice (e.g., BMPs), work with property owner/contractor to develop an SOW, and/or specifically address the corrective action at the property in real-time (e.g., remove/dispose of LA source materials, apply or provide poly sheeting to isolate the exposure area).

LA-contaminated soil or building materials uncovered prior to or during a corrective action will be excavated/remediated and disposed of at an approved facility (e.g., the landfill). For soil corrective actions, sampling and analysis may be conducted to confirm that contamination did not migrate beyond the corrective action area. For building corrective actions, sampling and analysis may be performed to confirm the area is within acceptable criteria for access/use and/or to confirm LA contamination did not migrate outside of the corrective action area. Corrective actions will be evaluated in accordance with ROD RALs; previous remedial action sampling analytical results will also be considered.

Corrective action for soil disturbance of a physical remedy, and the application of engineered controls, will follow these general steps:

1. Complete the initial site inspection and document the disturbance; address corrective action, if applicable (e.g., remove/dispose of LA/LA source materials, apply or provide poly sheeting to isolate the exposure area).
2. Develop an SOW that outlines work specific to removal of LA/LA source materials.
3. Ensure that clean fill material is obtained from an approved off-site (outside the Libby valley) borrow source and is analyzed in accordance with the *Fill Material Quality Assurance Project Plan* (CDM Smith 2018) to ensure it is within specifications for the respective fill type and not contaminated with LA.

Corrective action for disturbance of a building materials physical remedy will follow these general steps:

1. Complete the initial site inspection to document the disturbance; address corrective action, if applicable (e.g., remove/dispose of LA source materials, apply or provide poly sheeting to isolate exposure area).
2. Develop an SOW that outlines work specific to removal of LA/LA source materials.
3. Utilize appropriate resources for blocking, sealing, or encapsulating LA-contaminated building materials, as guided by the *Response Action Work Plan* (Environmental Restoration 2018).

Modifications and/or renovations unrelated to LA, LA source material, or LA-containing building materials or debris are the responsibility of the property owner. Materials and disposal activities related to LA, LA source material, or LA-containing building materials or debris will be addressed under O&M. DEQ or its designee is responsible for ensuring that the corrective action is completed in accordance with the ROD, BMPs, and other methods, as applicable.

3.3 Future Encounters with Contaminated Material

If disturbance of the protective physical remedy or engineered control causes exposure, advice on how to address encounters with contaminated materials will be obtained from DEQ or ARP. Future encounters with contaminated materials could potentially occur if there is a disturbance to a physical remedy, during property changes where LA is present, or in soils that were not previously identified as containing LA.

The selected physical remedy for the Site left contamination within inaccessible building materials where it does not present a risk of exposure as long as the physical remedy components are not compromised. Contamination also remains beneath backfilled areas and encapsulation locations, within infrequently used areas, and because of boundary conditions at properties, as discussed in the ROD. Additionally, for property owners that chose not to participate in the selected remedy (refused access), there is known and potential additional LA contamination at their properties.

Infrequently used areas refers to those areas of residential and commercial properties that are likely to be used on a less regular basis, such as pastures and fields, wooded lots, and areas beneath structures (e.g., soils beneath low clearance decks and raised sheds). Because of this, the RAL for soil in infrequently used areas at residential and commercial properties is less stringent than for soil in frequently used areas, as described in the ROD. This is also true for areas of a property that are currently not used or maintained (e.g., wooded areas, unmaintained fields). If the future use of an area changes and/or it is used on a more frequent basis (e.g., the yard at a property is extended into what was once a pasture), ARP/DEQ should be notified. DEQ, with assistance from ARP, will make the determination on the need for additional response activities regarding use area changes.

ICs such as informational devices, as described in Section 4, will be used to inform property owners, tenants, and land users of proper actions to avoid and how to handle future encounters

with contaminated soil and building materials at the Site. Additional information regarding BMPs is available as an appendix to the ICIAP (CDM Smith 2020b).

If the material encountered was not anticipated prior to the start of O&M, EPA and DEQ will evaluate whether the material represents an unforeseen site condition and determine how the corrective action will be funded (EPA 2016). An unforeseen site condition is defined as a significant deposit of LA that was not previously characterized and was not in an area that was anticipated to have LA.

In certain site-specific circumstances, EPA may determine that it is appropriate to pay or partially pay for certain responses or modifications to remedies even though DEQ has assumed responsibility for O&M. When evaluating whether it is appropriate for EPA to pay some or all the costs to respond to a circumstance after DEQ has assumed responsibility for O&M, EPA should consider whether:

- A latent design or construction defect in a remedy that affects protectiveness is discovered after the construction has been completed and O&M has begun
- A new, previously not identified contaminant of concern is discovered, which necessitates a fundamental change to the ROD
- An applicable or relevant and appropriate requirement (ARAR) change requires a more stringent cleanup level than the one established in the ROD

If the remedy is damaged by some form of natural disaster, then DEQ should be prepared to make the necessary corrective actions (EPA 2017). Federal disaster funds may be made available if the area has been declared a disaster under the Stafford Act.

Section 4
Monitor Institutional Controls

ICs are nonengineering measures designed to prevent or limit exposure to LA encountered and/or left in place at OU4 and OU7. According to the ROD, the Site remedies are as follows:

> "Based on consideration of the CERCLA requirements, the detailed analysis of remedial alternatives, state comments, and all public comments…, EPA has determined that the preferred remedial alternatives for contaminated soil and contaminated building materials presented in the Proposed Plan for the Site-wide cleanup is the appropriate remedy for OUs 4, 5, 6, 7, and 8 of the Site. The selected remedy consists of Alternative SO6: Partial Excavation/Disposal, Backfill, Institutional Controls, and Monitoring and Alternative BM5: Partial Removal/Disposal, Encapsulation, Interior Cleaning, Institutional Controls, and Monitoring, as described in this section (EPA 2016)."

ICs are required to be maintained pursuant to the ROD, and "LA contamination remaining in soils and building materials does not allow for UU/UE [unlimited use/unrestricted exposure] of these media (EPA 2016)." Based on ICs being an integral part of the remedy selected for the Site, EPA has developed an ICIAP for OU4 and OU7 to ensure ICs applicable to O&M and remedy protection are properly documented, implemented, and operating effectively during O&M, as indicated in remedy selection in the ROD. This section of the O&M plan presents a general overview of ICs and maintenance procedures necessary to meet the objective of monitoring the ICs to ensure that they are effective in limiting exposure to LA during O&M.

In accordance with EPA guidance *Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites* (EPA 2012), the OU4 and OU7 ICIAP (CDM Smith 2020b) identifies the elements of each applicable IC, the entities' roles and responsibilities for implementing each IC during O&M, and the objectives for the ICs that are planned to be in place during O&M. Additionally, ICs are more effective if they are "layered" to enhance the protectiveness of the remedy (EPA 2012).

Specific details regarding the types of ICs and the IC instruments applicable to OU4 and OU7 are detailed in the ICIAP (CDM Smith 2020b). Listed below are the general categories of ICs, with examples of potential ICs mechanisms within each category for OU4 and OU7:

- **Proprietary Controls.** Proprietary controls are created pursuant to state law to prohibit activities that may compromise the effectiveness of the remedy or potentially pose adverse exposure to LA. Proprietary controls restrict activities or future resource use that may result in unacceptable risk to human health or the environment (EPA 2012). No environmental covenants or proprietary controls currently exist for OU4 and OU7.
- **Government Controls.** Governmental controls are used to impose limitations on land use or resource use without notification or evaluation (EPA 2012). Local governments have a variety of land use government controls to limit land or resource use including zoning

restrictions, regulations, ordinances, statutes, or building permits (EPA 2012). Since this category of ICs is put in place under local jurisdiction, they may be changed or terminated without DEQ or EPA approval. EPA generally has less authority to enforce such controls but can coordinate and work with DEQ and local entities to help facilitate, maintain, and track the effectiveness of these ICs (EPA 2012). Governmental controls for the Site include:

- PEN (developed by BOH/ARP and implemented by ARP)

- **Informational Devices.** Informational devices provide information or notification to local communities when contamination remains on-site to aid in reducing potential exposure (EPA 2012). Informational devices for the Site include:

  - Montana Department of Transportation encroachment permit application and addendum
  - Notices of environmental conditions and notices of potential environmental conditions for properties that refused EPA inspection and/or remedy
  - Montana811 (per Montana Code Annotated 69-4-503)
  - ARP educational and resource pillars, which include the following educational programs and others developed by BOH/ARP:
    - BMP awareness for public
    - LA contractor awareness
    - Educational outreach at schools and businesses
    - Property transaction awareness
    - Health fairs and public outreach campaign
    - Financial awareness – information on reimbursement assistance for LA issues
    - City of Libby procedure coordination
      - *City utility maintenance and repair*
      - *City building property maintenance and repair*
    - City of Troy procedure coordination
      - *City utility maintenance and repair*
      - *City building property maintenance and repair*
    - Current Lincoln County departmental procedures – ARP/BOH provides review and LA information
      - *Subdivision review planning/coordination*

  - *Septic/on-site wastewater system review planning and coordination*
  - *Landfill services and material acceptance criteria coordination*
  - *Business license request coordination (e.g., review potential land use changes)*
  - *Planning department land use coordination*

- Data and administrative record sources, including:
  - DEQ Response Manager and geospatial data
  - Property information hard drives
  - Libby Asbestos Superfund Site administrative record

    The full administrative record is housed at the EPA Superfund Records Center in Denver, Colorado. Contact information is as follows:

    EPA Superfund Records Center
    1595 Wynkoop Street
    Denver, CO 80202-1129
    Hours: Monday through Friday from 8:00 a.m. to 5:00 p.m.

    To request copies of administrative record documents, call:
    (303) 312-7273 or (800) 227-8917 ext. 312-7273 (toll free Region 8 only)

    Local information repositories include the Lincoln County Public Library branches. Contact information is as follows:

    Lincoln County Public Library – Main Branch, Libby
    220 W 6th Street
    Libby, MT 59923
    (406) 293-2778
    Hours: Monday through Friday from 9:00 a.m. to 5:00 p.m.; Saturday from 10:00 a.m. to 2:00 p.m.

    Lincoln County Public Library – Troy
    207 3rd Street
    Troy, MT 59935
    (406) 295-4040

  - EPA Libby Asbestos Superfund website
  - ARP website
- Libby Asbestos Superfund Site – OU4 and OU7 BMP manual (Appendix C in ICIAP)

ICs will be evaluated during annual O&M inspections by DEQ or its designated representative, and during EPA's 5-year review, but may be evaluated more frequently, if necessary. The routine evaluation of the ICs will, at a minimum, assess whether:

1. The selected IC instruments remain in place and are effective.
2. The ICs are implemented such that they meet the stated objectives, are measurable, and provide protection required by the remedy.

Modification of ICs (e.g., legal or administrative steps) may be required based on effectiveness during O&M. If an event occurs that could lead to a modification, the OU4 and OU7 ICIAP (CDM Smith 2020b), in conjunction with this O&M plan, will be reviewed and revised accordingly to ensure ICs at the Site continue to provide adequate protection of the remedy and effectively reduce exposure to LA. If ICs need to be revised, DEQ will notify EPA to facilitate a revision to the ICIAP. Although it is not anticipated for this site, termination of ICs may occur if all remaining contamination at the Site is removed to a level below that which poses a risk to human health and the environment.

Section 5
Reporting Requirements

Further described in Section 6, five-year review reports will be completed by EPA on a five-year cycle, with the initial schedule presented in Table 1-2 and in accordance with the *Comprehensive Five-Year Review Guidance* (EPA 2001).

Annual reports summarizing O&M activities will be prepared by DEQ and submitted to the EPA Remedial Project Manager on an annual basis or as required following unforeseen events.

Annual reports may include sections on results from routine inspections; listing of response actions; updates of relevant SOWs or as-built drawings; updates of the O&M plan; community complaints and responses; and verifications of the integrity of ICs. Additionally, any ARAR change that may require a more stringent cleanup level than the one established by the ROD will be identified.

In the event any instrument of ICs for OU4 and OU7 is found to be inadequate or needs to be modified, or if additional ICs are necessary to ensure protectiveness of the remedy, that information will be included within the Site annual inspection report prepared by DEQ. Modification of ICs may be required for further development of ICs or existing ICs to improve effectiveness. If an event occurs that could lead to a modification, the ICIAP will be reviewed and revised accordingly to ensure the ICs at OU4 and OU7 continue to provide adequate protection and meet IC objectives. EPA, in coordination with DEQ, is responsible for modification of the ICIAP, which can be done at any time deemed appropriate.

These reports will assist DEQ and EPA in evaluating the adequacy of O&M and the frequency of responses, and how these factors relate to determining and ensuring protectiveness of the remedy.

5.1 Special Reports

DEQ will prepare special reports due to unforeseen events or conditions based on the magnitude of the event as determined by DEQ. One example of a special report is an incident report. Incident reports are used to document the details of accidents involving site personnel and other unusual events such as fires, floods, or weather damage. These special reports should be made available to EPA, the appropriate OU4 or OU7 property owner, and other interested parties in a timely manner.

Special reports could also be used to identify developments and changing ARARs. While community asbestos-related health concerns, trends, and research developments are outside the purview of O&M, it should be recognized that these issues can be evaluated by the Agency for Toxic Substances and Disease Registry.

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Section 6
Summary of Five-Year Review Activities

LA will remain on-site above levels that allow for unrestricted use of OU4 and OU7. The levels of LA remaining on-site are not considered in excess of RALs, and remedies are in place that are considered protective. However, LA does exist beyond protective remedies, which could pose a risk to human health and the environment in the event those remedies are compromised. Five-year reviews will be required to evaluate the implementation and performance of the remedy at OU4 and OU7, and to determine whether the remedy remains protective of human health and the environment. Five-year reviews of OU4 and OU7 will be done concurrently with sitewide five-year reviews, and are anticipated to start in June 2020, since the first sitewide review was completed June 22, 2015. EPA is responsible for performing and funding the five-year reviews as long as the reviews are required. The remedy will be re-evaluated in accordance with the review requirements of CERCLA Section 121(c). The five-year review process consists of six components: (1) community involvement and notification, (2) document review, (3) data review and analysis, (4) site inspection, (5) interviews, and (6) protectiveness determination (EPA 2003).

- Community involvement activities will include notifying the community that the five-year review will be conducted, notifying the community that the five-year review has been completed, and providing the results of the review.
- Document review involves a review of all relevant documents and data to obtain information to assess the performance of the response action. Documents for review include the ROD (EPA 2016), ARARs, annual O&M reports, any special reports prepared, and annual IC evaluations conducted as part of the annual site inspection.
- Data review and analysis will involve a review of sampling and monitoring plans and results from monitoring activities.
- Site inspections will be conducted to gather information about the site's (property's) status and to visually confirm and document the conditions of the remedy, the site, and the surrounding area.
- Interviews may be conducted as necessary with the site manager, site personnel, and people who live or work near the site to gather additional information about the site's status or identify remedy issues.
- A determination is made on whether the remedy remains protective of human health and the environment.

Reports summarizing the five-year review will be prepared by EPA in accordance with the *Comprehensive Five-Year Review Guidance* (EPA 2001).

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Section 7
Cost Estimate

As part of the O&M plan, a cost estimate is developed to address all the O&M activities discussed. The O&M cost estimate, provided in Appendix D, was primarily developed to provide EPA and DEQ with a preliminary cost basis for routine and nonroutine remedy maintenance, annual site inspections, and cost for five-year reviews.

7.1 Purpose and Intended Uses

The O&M cost estimate reflects the capital and annual costs for implementing long-term O&M within OU4 and OU7.

The intended use of the O&M cost estimate is to support EPA and DEQ in developing and preparing the annual O&M budget for OU4 and OU7. The O&M cost estimate is also used to help EPA and DEQ management understand the costs associated with implementing long-term O&M at OU4 and OU7 and helps in developing the cooperative agreement work plan between EPA and DEQ. This cost estimate only considers EPA O&M settlement funds as discussed in Section 1.4 and does not take into account other potential funding sources previously identified.

7.2 Methodology and Organization

The O&M cost estimate is based on the selected remedy (Alternatives SO6 and BM5) cost estimate prepared in 2015 for the ROD (EPA 2016). Because the ROD took a holistic approach and included a selected remedy cost estimate of combined OUs (OU4, OU5, OU6, OU7, and OU8), an O&M cost estimate specific to OU4 and OU7 was prepared for this O&M plan. The selected remedy cost estimate was developed according to *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (EPA 2000).

The O&M cost estimate consists of cost worksheets, a cost summary, and a present-value analysis. The cost worksheets provide the costs for individual O&M components. The cost summary includes annual O&M costs and other periodic costs for the long-term O&M. It also includes contingencies and professional and technical services costs (excluding remedial design costs). Present-value analysis of the estimated O&M cost was also developed. For this, a period of 30 years was assumed, although O&M will be conducted indefinitely throughout the life of the Site.

Present-value analysis is a method to evaluate expenditures, either capital or O&M, which occur over different time periods. The single-cost figure, referred to as the present value, is the amount needed to be set aside at the initial point in time (base year) to assure that funds will be available in the future as they are needed, assuming certain economic conditions. Inflation was first applied to annual costs prior to the present-value analysis. Inflation was based on the U.S. Army Corps of Engineers (USACE) Civil Works Construction Cost Index System yearly composite cost index (weighted average). The discount rate for present-value analysis was based on the 10-year average of nominal 30-year treasury interest rates (Appendix C of the Office of Management and Budget [OMB] Circular A-94 [OMB 2018]).

7.3 Cost Estimates Accuracy and Cost Uncertainty

The O&M cost estimate is developed to be as accurate as the current information allows and is based on the scope presented. The cost estimate is expected to have an accuracy of -30 percent to +50 percent of the actual costs. This cost accuracy range is consistent with EPA's *Remedial Design/Remedial Action Handbook* (EPA 1995) for preliminary development of O&M activities and responsibilities. Currently, this cost estimate is an opinion of probable cost only, and further refinement of the cost estimate will be performed after additional inputs are gained from the stakeholders.

The O&M cost estimate does not include costs associated with facilitating specific EPA contracting vehicles (e.g., interagency agreements or design and engineering services contracts), and as such, these will not be covered under O&M funds. Typical costs include program management costs, general and administrative costs, and subcontracting costs and fees. In addition, costs incurred for EPA to conduct five-year reviews will not be paid out through the separate interest-bearing account used for future sitewide or OU4 and OU7 O&M. Because EPA five-year review costs are not allocated through the O&M fund, they have been presented in a separate table (Table 7-2).

7.4 O&M Cost Estimate

As stated above, this is a probable cost of O&M. The actual cost may be lower or higher depending on whether DEQ can find cost efficiencies in implementing O&M at OU4 and OU7.

The O&M cost estimate (cost worksheets, cost summary, and present-value analysis) is presented in Appendix D. The following tables present the summary of the O&M cost estimates:

Table 7-1. Summary of Probable O&M Cost

Probable O&M Cost Type	Description	Cost
Routine Annual Cost	Includes routine site inspection, evaluating and updating ICs, administering ICs (property database, education, miscellaneous ARP activities), project management and technical support, and physical remedy/engineered control maintenance.	**$663,500**

Notes:
1. Detailed costs and backup are presented in Appendix D.
2. Costs are rounded to the nearest $1,000.
3. Costs based on 2016 prices.
4. Costs presented are expected to have accuracy between -30 percent to +50 percent of actual cost, based on the scope presented.

Table 7-2. Summary of Probable EPA Five-Year Review Cost

Probable O&M Cost Type	Description	Cost
EPA Five-Year Review[1]	Includes community involvement and notification, document review, data review and analysis, site inspection, interviews, and protectiveness determination.	$63,000

[1] Costs incurred for EPA to conduct five-year reviews is not covered under O&M funds.

Section 8
References

CDM Smith. 2020a. *Final Remedial Action Completion Report, Operable Unit 4 and 7*, Libby Asbestos Superfund Site, Lincoln County, Montana. Report prepared for EPA.

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Figures

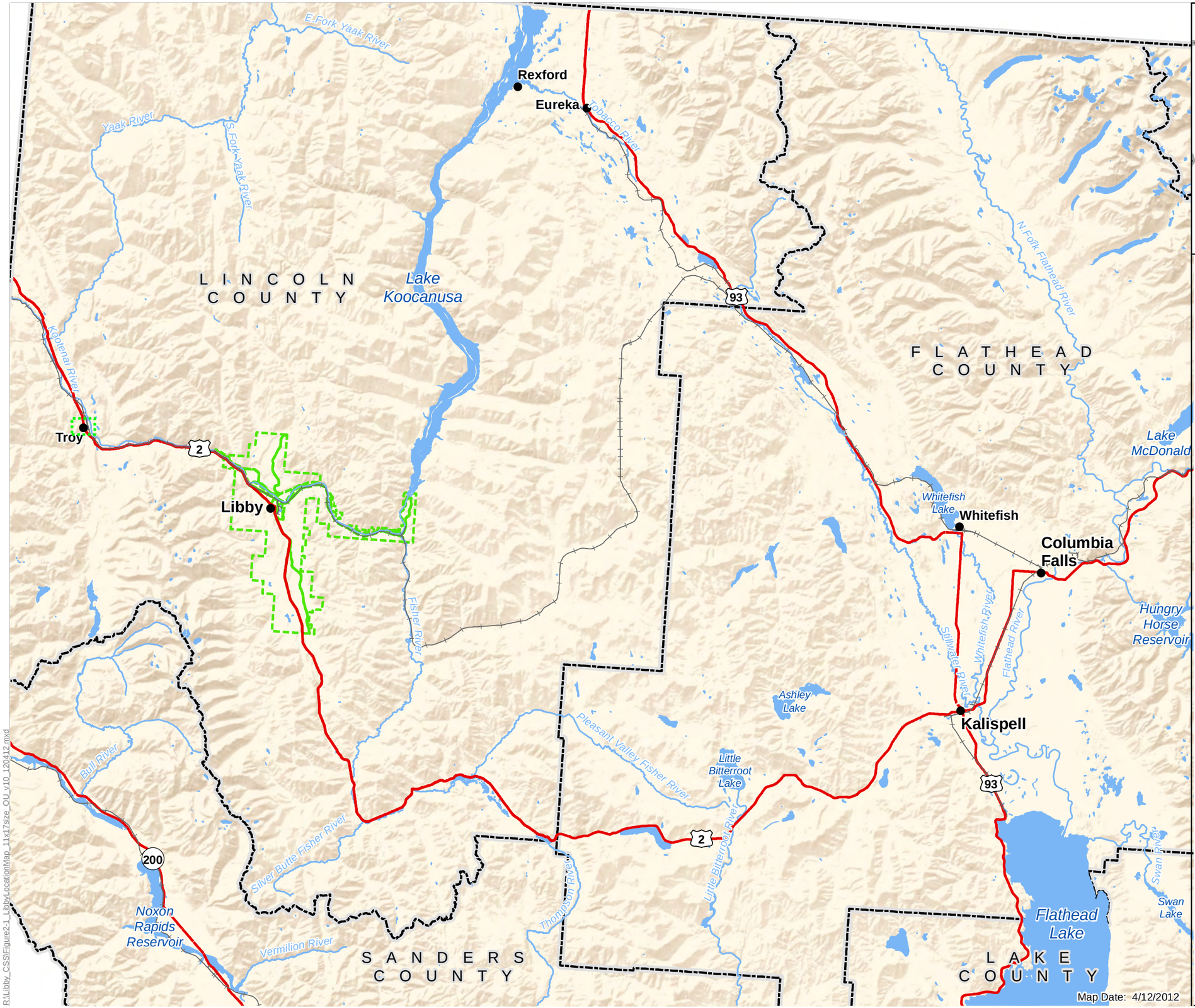

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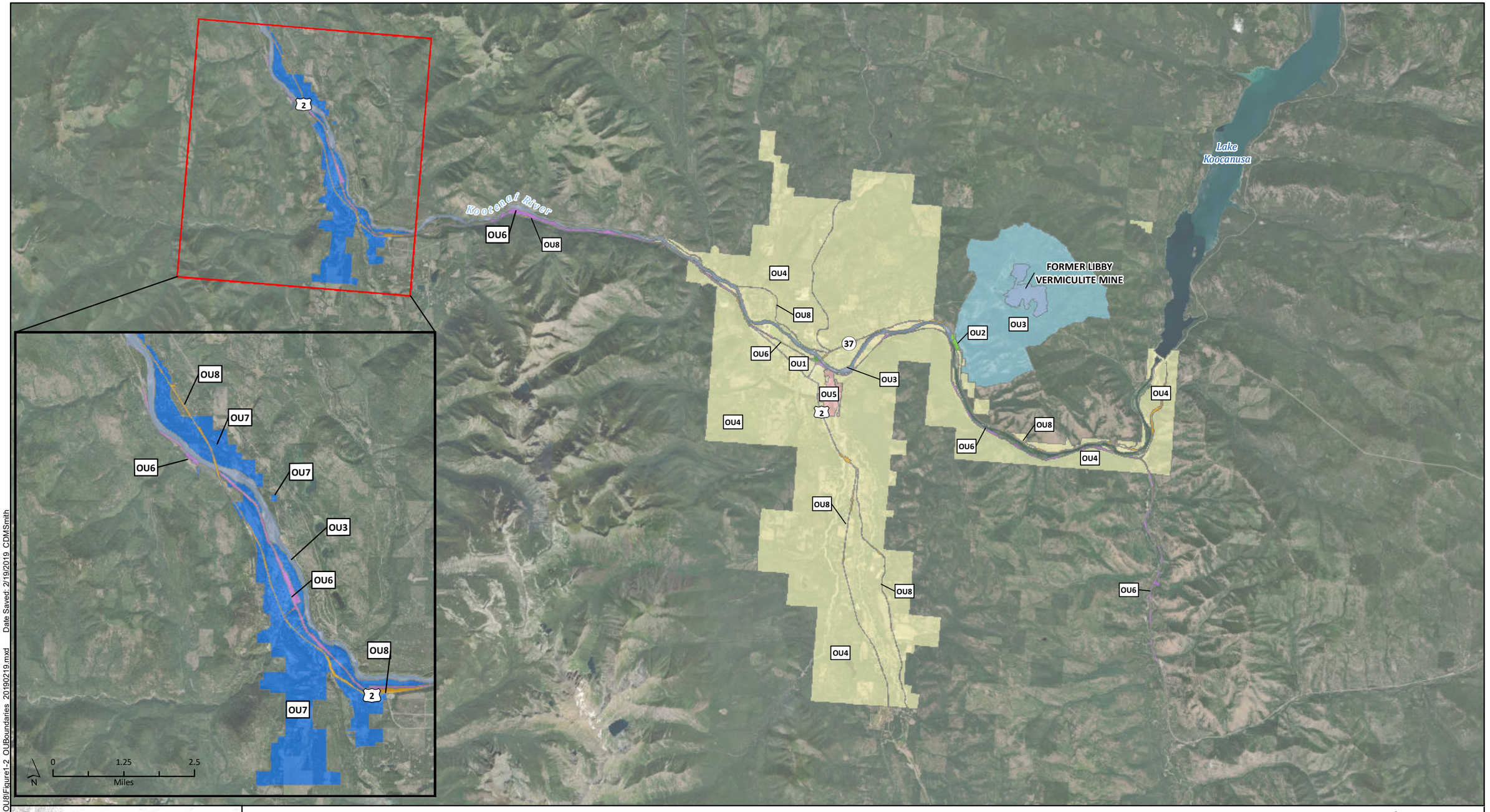
Figure 1-1

Site Location Map
Libby Asbestos Site
Lincoln County, Montana

CDM Smith



- OU1 - Former Export Plant
- OU2 - Former Screening Plant
- OU 3 Phase 1 (Forest)
- OU 3 Phase 2 (Former Mine Site/Kootenai River)
- OU4 - Residential/Commercial Areas within Libby
- OU5 - Former Stimson Lumber Mill
- OU6 - Burlington Northern and Santa Fe Railroad
- OU7 - Residential/Commercial Areas within Troy
- OU8 - Highways

Note(s):
1. EPA established the preliminary study area boundary for the purposes of planning and developing the scope of the Remedial Investigation/Feasibility Study (RI/FS) for OU3. This study area boundary may be revised as data are obtained during the RI for OU3 on the nature and extent of environmental contamination associated with releases that may have occurred from the mine site. The final boundary of OU3 will be defined by the final EPA-approved RI/FS.

Aerial Sources: Esri, USGS, NOAA
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Road and Railroad Source: US Census Tiger/Line
Waterways and Waterbodies Source: National Hydrography Dataset - USGS

Figure 1-2
Operable Unit Boundaries
Libby Asbestos Superfund Site | Lincoln County, MT

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Appendix A

OU4/OU7 O&M Plan Responsiveness Summary

1.0 PUBLIC AND STAKEHOLDER COMMENTS ON THE DRAFT FINAL OU4/OU7 OPERATION AND MAINTENANCE PLAN

A total of 64 comments were received from 6 stakeholders specific to the Final Draft Operable Unit 4/7 (OU4/OU7) Operation and Maintenance (O&M) Plan for the Libby Asbestos Superfund Site (Site). The number that each party submitted is summarized below.

- 1 citizen – 1 comment
- Lincoln County Commissioners, City-County Board of Health for Lincoln County, Institutional Control Steering Committee, Lincoln County Asbestos Resource Program (Submitted collaboratively) – 62 comments
- Montana Department of Environmental Quality (DEQ) – 1 comment

Out of 64 comments received on the Draft Final OU4/OU7 O&M Plan, a majority of the comments were from the Lincoln County Commissioners, City-County Board of Health for Lincoln County, Institutional Control Steering Committee, Lincoln County Asbestos Resource Program (ARP) who jointly provided comments and were editorial in nature regarding specific text within the document. Those editorial suggestions were considered and revised as appropriate to text within the final O&M plan. The remainder of the comments received primarily fall within the following categories: Length/Format of public comment period, legal and financial liability to property owners, remaining risk from Libby amphibole asbestos (LA) exposure /wildfire/structure fire impacts/additional sampling, funding /availability of leftover remediation settlement funds. A list of the most common comments are presented within this section. A summary of the response to these comments is provided in Section 2.

Frequent Comments

1. Length/Format of public comment period
2. Legal and Financial Liability to Property Owners
3. Risk from Libby amphibole asbestos (LA) Exposure/Wildfire/Structure Fire Impacts/additional sampling
4. Funding/Availability of Leftover remediation Settlement Funds

2.0 RESPONSE TO COMMENTS NARRATIVE

2.1 Length/Format of Public Comment Period/

The formal public comment period is designed to collect all comments, and then provide a comprehensive response after the end of that period. The *Record of Decision for Libby Asbestos Superfund Site, Libby and Troy Residential and Commercial Properties, Parks and Schools, Transportation Corridors, Industrial Park, Operable Units 4-8, Lincoln County, Montana* (ROD) clarified that a public comment period would be made available once ICs for the Site had been identified and incorporated into an ICIAP document. In addition to the ICIAP public comment period, EPA offered a public comment period on the OU4/OU7 O&M plan as well. Since the ICIAP and the operations and maintenance (O&M) plan are closely related, any comments received during both comment periods were considered in finalizing these plans. The public comment period of 30

days was announced in three local newspapers. The U.S. Environmental Protection Agency (EPA) published a fact sheet summarizing information in the both the ICIAP and O&M plan and provided contact information on how to formally submit comments in the local newspapers, the fact sheet, and on the EPA website. Additionally, EPA agreed to assist in hosting a public meeting following completion of the ICIAP and O&M plan, to discuss additional questions and concerns from the community.

2.2 Legal and Financial Liability to Property Owners

ICs and the O&M program have been developed to minimize the financial burden of addressing LA as long as the proper steps are taken with ARP and DEQ (e.g., Property Evaluation Notification [PEN] process). Any LA identified during the PEN process would be included as appropriate for financial reimbursement, upon evaluation by ARP and authorization by DEQ. Additional text was added to the O&M plan to address this concern. Public information sheets will be available during O&M to describe the reimbursement program and to guide homeowners through this process, as well.

EPA will administer O&M settlement funds to DEQ for costs associated with LA and LA-source materials where property owners have provided and will continue to provide access for associated investigations and/or response actions; the property owner has not actively participated in a for-profit enterprise of distributing, treating, storing, or disposing of vermiculite; and property owners will take appropriate precautions in handling any LA source materials in and around their home, avoiding where possible activities which may spread LA source materials to other locations without first consulting with DEQ and/or ARP.

2.3 Remaining Risk from Libby amphibole asbestos (LA) Exposure/Wildfire/Structure Fire Impacts/additional sampling

The human health risk assessment (HHRA) was comprehensive and is the basis for determining what level of contamination posed an unacceptable risk at the Site. EPA developed a remedy, remedial action levels, and clearance criteria in the ROD that are intended to be protective of human health and the environment. ICs are a large component of the remedy listed within the ROD, and were established in part to address residual risks to human health presented in the HHRA. EPA reviewed the work completed within OU4 and OU7 and found the remedy to be complete. Over 8,000 properties were evaluated and more than 2,600 had a response action completed. The ICs and O&M program were developed with the goal of requiring minimal restrictions, provide assistance and information to educate the public and institute a process to protect the remedy to guard against areas becoming re-contaminated.

The remedial action objectives (RAOs) were established as part of the ROD for Operable Units 4 through 8 and, thus, cannot be modified. If the remedial action levels and clearance criteria specified in the ROD are met, it is expected residual risks would meet the acceptable risk ranges and hazard threshold set forth in the RAOs.

Detailed information on the risk calculation methods is presented in the HHRA for the Site. In brief, risks are evaluated separately for cancer endpoints (i.e., mesothelioma) and non-cancer endpoints

(e.g., pleural thickening). The exposure air concentration is one of the inputs in the calculation of both cancer risks and non-cancer hazards. Cancer risks are calculated using a cancer-specific toxicity value, which is the slope factor, and non-cancer hazards are calculated based on a non-cancer-specific toxicity value, which is the reference concentration (RfC). The HHRA used the EPA-developed LA RfC of 9x10-5 f/cc in the calculation of the non-cancer hazard index (HI). However, the RfC is based on a continuous lifetime exposure assumption, thus, it is not appropriate to apply this threshold to evaluate less-than-lifetime exposures. The risk and hazard equations incorporate a time-weighting fact to account for exposures that are not continuous. Please refer to the HHRA for additional information on the risk calculation methods and result interpretations.

As part of O&M, periodic monitoring includes annual inspections, which involves interviews, record reviews, and site inspections. Asbestos health surveillance is outside the scope of EPA and DEQ on this Site, and thus is outside the scope of the O&M program. Ambient air monitoring at the Site was conducted from 2006 to 2013 by EPA and DEQ (from 2009 to 2013). As presented in the HHRA, exposures to LA in ambient air do not result in an unacceptable risk and are not likely to contribute significantly to cumulative risk. Additionally, all ambient air data was collected during a time when removal of LA contamination was taking place on the Site; thus, the available data represent a worst case scenario under current conditions. Future ambient air monitoring is not anticipated, but could be re-evaluated if annual inspections or 5-year reviews conclude that it is warranted.

The primary criterion for ARP assistance is that a property owner is conducting an activity that would impact the LA remedy on a property, and the property owner is coordinating this activity with ARP. Random sampling and updates are not anticipated unless conditions warrant a re-evaluation or a property condition changes and is coordinated through ARP.

Structure fires within OU4 and OU7 are considered an unscheduled event and will be managed under O&M on a case by case basis if LA contamination could present a potential for exposure from the property or within a structure. Training regarding the awareness of LA has been provided by the EPA and future opportunities will be available upon request by ARP to local volunteer fire departments during O&M. As presented in the HHRA, as evidenced through both simulated and authentic wildfire events in a worst-case scenario (i.e., a wildfire within OU3), outdoor air exposures would not present an unacceptable risk to residents within OU4 and OU7.

2.4 Funding/Availability of Leftover Remediation Settlement Funds

Funding for O&M is described within revised text of the final O&M plan and discusses availability of both O&M funding and remaining EPA-held “remedial action settlement funds.” Funding for ARP during O&M will be directed through DEQ and not EPA. Grant funding in the past is beyond the scope of the O&M plan. The O&M Plan discusses educational components that will be in place during O&M and ARP under the direction of DEQ will be the primary facilitator in providing education and information to the public during O&M. ARP is a program set up for O&M at the Site, was funded through a cooperative agreement grant with EPA during remedial action and will be funded similarly during O&M by DEQ though a State-county Memorandum of Agreement utilizing available O&M settlement funds.

Table 1 represents the EPA's position in regard to eligibility of Site O&M settlement funding towards long term O&M.

Table 1. EPA Matrix for eligibility of Site O&M settlement funding towards long term O&M

Situation	Sampling eligibility provided through EPA transferred settlement funds	Cleanup eligibility provided through EPA transferred settlement funds
If a developer is proposing the work - *eligibility is based on reasonable expectations relative to timing and minimum cleanup requirements (not developers desired end product).	No	Yes*
If the property and/or engineered controls have not been maintained as agreed by EPA and DEQ (e.g. requestor did not follow the PEN process, negligence on part of requestor to not follow BMPs/guidance)	No	No
If the property parcel is listed as a "refusal" (e.g., property owner did not grant access for investigation or previous required response action)	No	No
If insurance will pay for part or all of repairs and owner provides insurance contacts - **Eligible for EPA transferred settlement funds for the applicable portion not paid by insurance	Yes	Yes**
If property owner will not provide insurance contacts	No	No
If property undergoes a land use change - ***if necessary to maintain compliance with RALs and decision documents required under the ROD and as agreed by EPA and DEQ	Yes***	Yes***
If property is outside the Superfund boundary - ***** Eligible for EPA transferred settlement funds if EPA determines contamination tied back to the Former W.R. Grace vermiculite mine.	No****	No****
If there is a 'miss' or 'unforeseen condition' – private property owner	Yes	Yes
If there is a 'miss' or 'unforeseen condition' – developer	Yes	Yes

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Appendix B

Remedial Action Criteria Summary from the Record of Decision

Libby Asbestos Superfund Site Land Use Categories	Soil Remedial Action Level for Frequently Used Areas and Infrequently Used Areas	Remedial Clearance Criteria for Surface Soil	Remedial Clearance Criteria for Sub- Surface Soil	Remedial Action Level for Contaminated Building Materials
Residential/Commercial – private residential and commercial properties as well as public properties within the City of Libby (OU4) and the City of Troy (OU7) that are currently used, or will be used in the future for residential and commercial or governmental (service-related) purposes that are not involved in large-scale manufacturing of products for sale and export outside of the site.	*Frequently Used Areas:* LA soil concentrations of Bin B2 (0.2% to <1%) or Bin C (≥1%) by PLM-VE *Or* LA soil concentrations of Bin B1 by PLM-VE if the spatial extent of the Bin B1 area is more than 25 percent of the total soil exposure area at a property *Infrequently Used Areas*: LA soil concentrations of Bin B2 (0.2% to <1%) or Bin C (≥1%) by PLM-VE	*For Frequently used areas:* No LA soil concentrations of Bin B2 (0.2% to <1%) or Bin C (≥1%) by PLM-VE can be present *and* No more than 25% of the total soil exposure area can be Bin B1 by PLM-VE and the remainder of the total soil exposure area is Bin A *Infrequently Used Areas:* No LA soil of Bin B2 (0.2% to <1%) or Bin C (>1%) by PLM-VE can be present.	Confirmation soil samples collected at the depth of excavation are Bin A or Bin B1 by PLM-VE (i.e., LA is not present or is present at levels less than 0.2 percent) unless boundary conditions (e.g., depth of excavation reaches 36-inch depth) are reached.	Presence of accessible LA-containing vermiculite insulation in any quantity in living spaces, non-living spaces, and/or secondary structures *Or* Presence of accessible friable and/or deteriorated building materials containing greater than or equal to 0.25 percent LA by polarized light microscopy using point counting (400 points examined) (PLM-PC400) (e.g., chinking, plaster, mortar, and other materials on boilers, pipes, or other appurtenances).
Industrial – industrial properties that are currently used, or will be used in the future, for large-scale manufacturing of products for sale and export outside of the Site. Currently, only a portion of the properties at the existing industrial park within OU5 are identified within this land use category.	LA soil concentrations of Bin C (≥1%) by PLM-VE	No LA soil concentrations of Bin C (≥1%) by PLM-VE can be present.	Confirmation soil samples collected at the depth of excavation are Bin A, Bin B1 or Bin B2 by PLM-VE (i.e., LA is not present or is present at levels less than 1 percent) unless boundary conditions (e.g., depth of excavation reaches 36-inch depth) are reached.	Presence of accessible LA-containing vermiculite insulation in any quantity in living spaces, non-living spaces, and/or secondary structures *Or* Presence of accessible friable and/or deteriorated building materials containing greater than or equal to 0.25 percent LA by polarized light microscopy using point counting (400 points examined) (PLM-PC400) (e.g., chinking, plaster, mortar, and other materials on boilers, pipes, or other appurtenances).
Parks/Schools – park properties within OU4 and OU7 that are currently used, or will be used in the future, for public or commercial recreational purposes. It also includes roadways within public or commercial parks. Also includes, the public and private school properties within OU4 and OU7 that are currently used to provide primary, secondary, or higher education. Churches that do not provide primary, secondary, or higher education and schools established in the future are part of the residential/commercial properties land use category.	LA soil of Bin B2 (0.2% to <1%) or Bin C (≥1%) by PLM-VE	No LA soil of Bin B2 (0.2% to <1%) or Bin C (≥1%) by PLM-VE can be present.	Confirmation soil samples collected at the depth of excavation are Bin A or Bin B1 by PLM-VE (i.e., LA is not present or is present at levels less than 0.2 percent) unless boundary conditions (e.g., depth of excavation reaches 36-inch depth) are reached.	Presence of accessible LA-containing vermiculite insulation in any quantity in living spaces, non-living spaces, and/or secondary structures *Or* Presence of accessible friable and/or deteriorated building materials containing greater than or equal to 0.25 percent LA by polarized light microscopy using point counting (400 points examined) (PLM-PC400) (e.g., chinking, plaster, mortar, and other materials on boilers, pipes, or other appurtenances).

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Appendix C

Recommended Annual O&M Checklist

RECOMMENDED ANNUAL O&M /REMEDY EVALUATION CHECKLIST

Introduction and Purpose

Effective operation and maintenance (O&M) at Superfund sites generally is critical to ensure that remedies remain protective of human health and the environment.

The recommended Annual O&M Remedy Evaluation Checklist has been designed to help the Remedial Project Manager (RPM) capture data routinely collected during O&M in a way that can better evaluate the efficiency and effectiveness of the remedial action. This recommended checklist may also be used to evaluate an operating remedy prior to transferring the site to the State for O&M. In addition, remedy performance summarized using this recommended checklist can be used to communicate remedy progress to the local community, highlight potential issues before they become problems and help the RPM complete five-year reviews more efficiently.

The information that you collect using this recommended form should help you answer the following questions:

- Is the remedy achieving the remedial action objectives (RAOs), maintaining cleanup goals and/or achieving technology-specific performance goals?
- If the remedy is not achieving the established objectives and goals, what must I do to correct this and how can I document this?
- If the remedy is achieving the performance goals, objectives and performance standards, are there any opportunities to optimize the remedy to make it work more efficiently?

This recommended checklist is intended to be completed annually. It is recommended that any data that you use to complete this evaluation be attached to the checklist, as this will make completing the next year's evaluation easier.

This recommended checklist does not recommend the level of review carried out in the U.S. Environmental Protection Agency (EPA) five-year review process. However the recommended checklist contains review elements that are consistent with a five-year review process.

Instructions:

The recommended checklist is in Microsoft Word and was designed to be completed electronically. Most questions involve a short answer, yes/no response or simply checking the box. Questions that involve a short answer will have an expandable text box. For responses that ask to you to "select one," please double click on "select one" and choose the correct answer. If the information is not available for a particular question, please indicate this with a N/A. A site visit is strongly encouraged, but not required prior to completing the recommended checklist.

1. This evaluation is intended to be completed yearly once O&M activities have begun at a site and can be stored and maintained in an electronic format.
2. For large complex sites, consider completing a separate checklist for each Operable Unit (OU).
3. This evaluation should be based on information and documentation (e.g., O&M reports and monitoring data) that is readily available to the RPM.
4. Section VIII, "Technical Data and Remedy Performance," provides specific instructions regarding what data and information are important for this section. Data entered in Section VIII are used to evaluate the specific technology used in that remedial action (RA). Please note: *Section VIII, Appendix E, Other Remedy Types/Components* was designed to be used by the RPM for the annual review of O&M remedies and remedy components that are not addressed in Appendices A through D or by the separate *Recommended Annual O&M Remedy Evaluation Checklist for Contaminated Sediment Remedies*, OSWER #9355.0-118.
5. When you have completed the recommended checklist, please sign and date page 1 and place the completed document in the site file. Additionally, we recommend that you save the completed checklist electronically for use in completing the next year's evaluation.

Generally, including the Recommended Annual O&M/Remedy Evaluation Checklist in the site repository can provide the community with information about O&M status and remedy performance and can demonstrate that the Region is tracking performance to ensure that the remedy remains protective.

Acronym List			
AS	Air Sparging	PCOR	Preliminary Close Out Report
CSM	Conceptual Site Model	PRGs	Preliminary Remediation Goals
GAC	Granular Activated Carbon	PRP	Potentially Responsible Party
ICs	Institutional Controls	RAO	Remedial Action Objective
LEL	Lower Explosive Limit	ROD	Record of Decision
LTRA	Long-Term Response Action	RPM	Remedial Project Manager
MNA	Monitored Natural Attenuation	RSE	Remediation System Evaluation
NPL	National Priorities List	SVE	Soil Vapor Extraction
O&F	Operational and Functional	TI Waivers	Technical Impracticability Waivers
O&M	Operation and Maintenance	USACE	U.S. Army Corps of Engineers
OSHA	Occupational Safety and Health Administration	VEB	Vertical Engineered Barrier
OU	Operable Unit	VOCs	Volatile Organic Compounds

RECOMMENDED ANNUAL O&M /REMEDY EVALUATION CHECKLIST

Please save electronically and send this completed checklist and any attachments to the site file and site repository.

I. SIGNATURES AND APPROVALS					
RPM			**RPM (If appropriate)**		
Name:			Name:		
Telephone:			Telephone:		
Signature:		Date:	Signature:		Date:
State Contact (if appropriate)					
Name:					
Telephone:					
Signature:					Date:

II. GENERAL SITE INFORMATION			
Site Name:			
State:			
Period Covered:	to		EPA Site ID:
Site Lead:	(Select one)	Other, specify:	
Organization responsible for O&M operations:		(Select one)	
Other, specify:			
Site Remedy Components (ref. Section VIII):			
Preliminary Close Out Report (PCOR) date:			
Operational & Functional (O&F) date:			
Last five-year review date:			
NPL deletion date:			
Did you make a site visit during this review?	☐ Yes ☐ No		Date:
If no, why:			
Date of next planned checklist evaluation:			
Location of Administrative Record/Site Files:			
During the site visit, was monitoring equipment operational?			☐ Yes ☐ No ☐ N/A
Please elaborate:			
Has an Optimization Study been conducted at the site?	☐ N/A ☐ Yes ☐ No		Date:
If not, is one planned?			

List all site events since the last evaluation that impact or may impact remedy performance.
Chronology of events since last report (e.g., site visits, receipt of reports, equipment failures, shutdowns, vandalism, storm events):
Elaborate on significant site events or visits to site:

III. DOCUMENTS AND RECORDS Because these documents may be required for the five-year review, verify what documents are currently available on-site, or note off-site location:				
Document	**Required**	**Not required**	**On-site**	**Off-site (indicate where)**
O&M Manual	☐	☐	☐	☐
O&M Maintenance Logs	☐	☐	☐	☐
O&M Annual Reports	☐	☐	☐	☐
RA as-built drawings modified during O&M	☐	☐	☐	☐
Site-Specific Health and Safety Plan	☐	☐	☐	☐
Contingency/Emergency Response Plan	☐	☐	☐	☐
O&M/Occupational Safety and Health Administration (OSHA) Training Records	☐	☐	☐	☐
Settlement Monument Records	☐	☐	☐	☐
Gas Generation Records	☐	☐	☐	☐
Ground Water Monitoring Records	☐	☐	☐	☐
Surface Water/Sediment/Fish Monitoring Records**	☐	☐	☐	☐
Cap/Cover System Inspection Records	☐	☐	☐	☐
Leachate Extraction Records	☐	☐	☐	☐
Discharge Compliance Records	☐	☐	☐	☐
Institutional Controls (ICs) Review	☐	☐	☐	☐
Other(s) (Please name each)	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐

** Note: A separate O&M checklist has been developed for surface water/sediment remedies. For completeness, answer this question regarding documentation requirements and availability, and enter more detailed information in the surface water/sediment checklist.

IV. ADMINISTRATIVE ISSUES Check all that apply:	Date Initiated:
☐ Explanation of Significant Differences in progress	
☐ Record of Decision (ROD) Amendment in progress	
☐ Site in O&F period	
☐ Long-Term Response Action (LTRA) in progress	
☐ LTRA Transition to O&M in progress	
☐ Notice of Intent to Delete site in progress	
☐ Partial Site Deletion in progress	
☐ Technical Impracticability (TI) Waivers in progress	
☐ Reuse Assessment or Reuse Plan in progress	
☐ Revised Risk Assessment in progress ☐ Ecological OR ☐ Human Health	
☐ Other administrative issues:	

VI. O&M COSTS The purpose of this section is to document what is known about O&M costs for this site. It is realized that not all cost information will be readily available, but to the extent possible, please provide the following information, as this will help identify cost increases and flag potential budget issues before they arise.	
What was the total annual O&M cost for the previous year?	
What is the expected total annual O&M cost for the upcoming year?	
Please provide an approximate breakout of the previous year's O&M costs below.	**Use either $ or %**
Analytical (e.g., lab costs):	
Materials (e.g., treatment chemicals, cap materials):	
Oversight (e.g., project management):	
Monitoring (e.g., ground water sampling):	
Utilities (e.g., electric, gas, phone, water):	
ICs (implementation and enforcement):	
Other (e.g., capital improvements, equipment repairs):	
Describe any unanticipated/unusually high or low O&M costs and potential future O&M funding issues.	

VII. INSTITUTIONAL CONTROLS (ICs)**

The purpose of the IC evaluation at the O&M phase is to determine if the ICs are implemented, effective and durable. The following references may be useful for completing this evaluation:

- *Institutional Controls Bibliography: Institutional Control, Remedy Selection, and Post Construction Completion Guidance and Policy* (OSWER 9355.0110, December 2005);
- *Supplement to the Comprehensive Five-Year Review Guidance; Evaluation of Institutional Controls* (OSWER 9355.7-12, working draft 3/17/05);
- *National IC Strategy to Ensure Institutional Controls Implementation at Superfund Sites* (OSWER 9355.0-106, September 2004); and
- *Institutional Controls: A Site Manager's Guide to Identifying, Evaluating and Selecting Institutional Controls at Superfund and RCRA Corrective Action Cleanup* (OSWER 9355.0-7-4FS-P, September 2000).

** Note: A separate O&M checklist has been developed for surface water/sediment remedies. For completeness, answer this question regarding ICs, and enter more detailed information in the surface water/sediment checklist.

Identify each IC (media, objective, and instrument) implemented/to be implemented at the site. Attach an extra sheet if necessary.	
Are the ICs adequate to minimize the potential for human exposure and protect the integrity of the remedy? If no, please explain.	☐ Yes ☐ No
Please identify the party responsible for compliance and enforcement of the IC.	
Please describe what the ICs are intended to accomplish, who they are designed to inform, the source document for the IC, and where the IC information is located.	
Please identify the date when the ICs were implemented. If the ICs have yet to be implemented, please identify the party responsible for implementing the ICs and the scheduled implementation date.	
If the ICs have been implemented, are they still in place? If the ICs remain in place, please identify whether there is a planned termination date and, if so, what it is.	
Are there reasons to clarify or modify the appropriate decision document(s) to improve the effectiveness and/or durability of the ICs? If yes, please explain and describe any plans to clarify/modify the document(s).	☐ Yes ☐ No

VIII. TECHNICAL DATA AND REMEDY PERFORMANCE

The purpose of this section is to help prompt questions about remedy performance over the past year, the adequacy of monitoring activities to assess remedy performance, and changes in field conditions or understanding that could affect the remedy. Specific sections also prompt questions about remedy optimization. Addressing these questions on an annual basis can help to flag opportunities and potential issues to watch in the coming year and help inform future improvements in remedy O&M. The collection of annual checklists can also serve as documentation of when a potential issue was first identified, what was done to address it, and when it was addressed. Thus, an annual checklist can be a useful, succinct source of information to help RPMs recount O&M history.

Questions for specific remedy types (e.g., ground water pump-and-treat) are contained in Appendices A through D at the end of the form. Appendix E contains general questions that can be used to document technical data and remedy performance for remedies and remedy components that do not fit within the specific categories identified in the remainder of this checklist. Identify the remedy types in Section VIII.A, below, and complete a copy of each appendix that is applicable to the site. If the site includes multiple remedies or remedy components of the same type, please complete a copy of the applicable appendix for each remedy/component (e.g., if the remedy includes two separately managed containment areas, complete two copies of Appendix C, one for each area). A separate O&M checklist has been developed for surface water/sediment remedies and remedy components. If the site includes a surface water/sediment remedy, note this below and complete the surface water/sediment checklist.

A. Please identify the type(s) of remedy(ies) this Annual O&M Remedy Evaluation Checklist addresses:

- ☐ Ground Water Pump-and-Treat (please complete Appendix A)
- ☐ Ground Water Monitored Natural Attenuation (MNA) (please complete Appendix B)
- ☐ Ground Water or Soil Containment (please complete Appendix C)
- ☐ Soil Vapor Extraction/Air Sparging (please complete Appendix D)
- ☐ Other Remedy Types (please complete Appendix E)

IX. RECOMMENDATIONS

New Recommendations, from this annual review:

Recommendation	Party Responsible	Milestone Date

APPENDICES

TECHNICAL DATA AND REMEDY PERFORMANCE ANNUAL O&M /REMEDY EVALUATION CHECKLIST

RECOMMENDED APPENDIX A. GROUND WATER PUMP-AND-TREAT REMEDIES

The following checklist is an abbreviated set of questions that could be used by an EPA RPM for annually reviewing the O&M of a ground water pump-and-treat remedy, including pump-and-treat remedies designed for hydraulic containment. This checklist was developed using concepts presented in EPA guidance, *Elements for Effective Management of Operating Pump and Treat Systems* (EPA 542-R-02-009, December 2002). This guidance is part of a series of fact sheets that EPA OSRTI has prepared as guidance to the ground water remediation community on effectively and efficiently designing and operating long-term ground water remedies. For more information, including the guidance *O&M Report Template for Ground Water Remedies (with Emphasis on Pump and Treat Systems)* (EPA 542-R-05-010, April 2005) and report *Pilot Project to Optimize Superfund-Financed Pump and Treat Systems: Summary Report and Lessons Learned* (EPA 542-R-02-008a), visit EPA's CLU-IN Website (www.cluin.org/).

A. Remedy Goals and Conceptual Site Model (CSM)

1. Review of the current remedy goals and measurements: Remedy goals may be expressed in terms of a broad, long-term purpose or intent specified in a decision document (e.g., cleanup to a specified concentration), a performance-based metric or milestone intermediate in duration (e.g., a 20% decrease in monthly influent concentrations within 24 months of operation); or a specific and short-term objective (e.g., demonstration of plume containment).

List the short-term objectives and intermediate system goals:	
List the final system goals:	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last O&M review, is there a reason to re-evaluate the system goals? Note: this might be due to factors such as regulatory framework has been revised; better technology/strategy alternatives available; existing goals appear unrealistic; costs greater than originally anticipated; extent of plume has changed; new sources of contamination removed and/or discovered; or land use or ground water production near site has changed. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

2. Review of changes to the CSM: The CSM is a combination of text and figures that describe the hydrogeologic system, the cause of the ground water impacts, and the fate and transport of the ground water contaminants. If monitoring data during active remediation do not agree with expectations, this could point to a gap in the conceptual model that should be addressed with a focused investigation. This does not imply a return to the "remedial investigation" phase. The CSM should evolve over time, including during active remediation, as more information about the site becomes available. The following questions may be used to evaluate the need for updating the CSM:

Since the last time you completed the O&M checklist for this system, have new contaminant sources been identified or have previously suspected contaminant sources been eliminated from further consideration? If yes, use this space to comment.	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, have new contaminants been identified in the ground water that could affect remedy effectiveness? If yes, use this space to comment.	☐ Yes ☐ No
Based on your answers to the above questions, would it be useful to update the CSM at this time?	☐ Yes ☐ No

If yes, please describe any plans to update the CSM.	

B. Remedy Performance Assessment

1. Evaluate remedy effectiveness: The following questions are intended to review whether the ground water pump-and-treat remedy is performing as intended and whether there are opportunities for optimizing the remedy.

Plume Capture

When addressing these questions, it may be useful to refer to *A Systematic Approach for Evaluation of Capture Zones at Pump and Treat Systems* (EPA 600/R-08/003, January 2008).

Has a three-dimensional target capture zone been clearly defined? If no, use this space to explain why not.	☐ Yes ☐ No
If not clearly defined, describe plans to better define the target capture zone.	
What lines of evidence have been used to evaluate actual capture achieved (e.g., flow budget and/or capture zone width calculations, potentiometric surface maps, water elevation pairs, concentration trends at wells beyond the target capture zone, particle tracking in conjunction with ground water modeling, tracer tests)	

System Equipment/Structures (e.g., extraction wells, collection systems)

Since the last time you completed an O&M checklist for this system, has the downtime associated with non-routine operations and maintenance exceeded expectations? If yes, what systems have been responsible for unplanned downtime (e.g., extraction pumps, wastewater facilities)? If yes, what corrections have been or are being made to minimize downtime?	☐ Yes ☐ No
Since the last time you completed the O&M checklist for this remedy/remedy component, have any major repairs to the pump-and-treat system(s) been required? If yes, describe the repairs, their impact on progress toward remediation milestones, and actions taken to minimize similar repairs in the future.	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, have the extraction/injection well rates changed significantly? If yes, describe the known/suspected source of the change, if identified. If yes, is the change reflective of a long-term condition and, if so, how will this be addressed in the O&M of the system?	☐ Yes ☐ No
Since the last time an O&M checklist was completed for this system, have air emissions from the system met permit requirements, if any? If not, what is being done to meet the permit requirements?	☐ Yes ☐ No ☐ N/A
Since the last time an O&M checklist was completed for this system, has effluent discharge met permit requirements? If not, what was (is) the problem and what was (or will be) done to correct it?	☐ Yes ☐ No

Optimization

Has an optimization study been conducted for this system?	☐ Yes ☐ No
If an optimization study has been conducted, have any of the optimization recommendations been implemented since the last time an O&M checklist was completed for this system?	☐ Yes ☐ No ☐ N/A
If optimization recommendations have been implemented (during this or prior review periods), describe any new results observed or conclusions drawn since the last time an O&M checklist was completed for this system.	
If optimization recommendations have not been implemented, why not?	

2. Evaluate collection and analysis of performance monitoring data	
Do the approaches used to interpret ground water monitoring data (e.g., concentration trend analyses, plume contour and/or bubble maps, plume cross-sections, potentiometric surface maps) provide adequate information to assess the performance of the pump-and-treat remedy? If no, describe plans, if any, to implement new approaches.	☐ Yes ☐ No
Based on information collected since the last O&M review, is there a need to re-evaluate the parameters, sampling methods, sampling frequency, and monitoring locations used to evaluate remedy performance?	☐ Yes ☐ No
Are ground water data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No
Are performance-monitoring reports of sufficient quality and frequency to evaluate the efficacy of the remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
C. Cost Effectiveness	
Are actual parameters consistent with design parameters (based on process monitoring)? If not, how do they differ? (check all that apply) ☐ Influent rate to treatment plant ☐ Influent concentrations ☐ Mass loading to the system ☐ Removal efficiency for each treatment component ☐ Air to water ratio (air strippers) ☐ Materials usage (e.g., granular activated carbon (GAC), chemicals) ☐ Other (please explain)	☐ Yes ☐ No
Based on the above comparisons, have any above ground systems or process monitoring procedures been evaluated/implemented to reduce costs? If yes, please identify which of the following have been done to reduce costs. (check all that apply) ☐ Ensuring proper maintenance and efficiency of equipment ☐ Replacing treatment components with alternate technologies (e.g., replace UV/Oxidation with air stripping) or more appropriately sized components ☐ Eliminating unnecessary or redundant treatment components that are no longer needed (e.g., metals removal or GAC polishing system) ☐ Changing discharge ☐ Automating system to reduce labor ☐ Optimizing ground water extraction rates and/or locations ☐ Other (please explain)	☐ Yes ☐ No
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No Change to the System ☐ Modify/Optimize System ☐ Modify/Optimize Monitoring Program ☐ IC Modifications ☐ Implementation of Contingency/Alternative Remedy	
Basis for decision:	

RECOMMENDED APPENDIX B. GROUND WATER MONITORED NATURAL ATTENUATION (MNA) REMEDIES

The following checklist is an abbreviated set of questions that could be used by an EPA RPM for annually reviewing the O&M of a MNA remedy for ground water. This MNA guidance checklist was developed using concepts presented in EPA guidance, *Performance Monitoring of MNA Remedies for* [volatile organic compounds] *(VOCs) in Ground Water* (EPA/600/R-04/027; April 2004). For some approaches, a more detailed remedy optimization study or remediation system evaluation (RSE) may be beneficial. For guidance on remedy optimization studies or RSEs, visit EPA's CLU-IN Website (www.cluin.org/) or the U.S. Army Corps of Engineers (USACE) Hazardous, Toxic and Radioactive Waste Center of Expertise RSE Website (www.environmental.usace.army.mil/)

A. Remedy Goals and Conceptual Site Model (CSM)	
1. Review of the current remedy goals and measurements: The remedy goals may be expressed in the ROD as remedial action objectives (RAOs) and preliminary remediation goals (PRGs). RAOs provide a general description of what the cleanup will accomplish (e.g., restoration of ground water). PRGs are the more specific statements of the desired endpoint concentrations or risk levels, for each exposure route, that are believed to provide adequate protection of human health and the environment.	
List the intermediate system goals (RAOs and PRGs).	
List the final system goals (RAOs and PRGs).	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last review, is there a need to re-evaluate the remedy goals? Note: this might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear realistic, and if there have been changes to land use or ground water production near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No
2. Review of changes to the CSM: The CSM for natural attenuation is the site-specific qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biologic, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and monitoring plan, it can be reevaluated as new data are developed throughout the lifetime of the remedy. The following questions may be used to evaluate the need for updating the CSM:	
Have new contaminant sources been identified or have previously suspected contaminant sources been eliminated from further consideration since the last time you completed the O&M checklist for this remedy? If yes, use this space to comment.	☐ Yes ☐ No
Has there been an increase or decrease in size of the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., what is the nature and magnitude of the change).	☐ Increase ☐ Decrease ☐ No change
Has there been an increase or decrease in vertical extents of the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., what is the nature and magnitude of the change).	☐ Increase ☐ Decrease ☐ No change
Has there been an increase or decrease in the maximum contaminant concentrations in the plume since the last time you completed an O&M checklist for this remedy? Comments (e.g., have maximum concentrations changed for all or a subset of contaminants, which ones, and by how much).	☐ Increase ☐ Decrease ☐ No change
What types of reaction zone(s) are present in the plume (aerobic, anaerobic, or both)?	

Based on information collected since the last O&M review, is there a need to re-evaluate the number and/or location of monitoring points in the reaction zone(s)? If yes, use this space to comment.	☐ Yes ☐ No
Based on information collected since the last O&M review, is there a need to re-evaluate the number and/or location of monitoring points in the target zones? If yes, use this space to comment.	☐ Yes ☐ No
Has there been a change in ground water flow rate or direction that may suggest monitoring frequency or locations may need to be reevaluated? If yes, use this space to comment.	☐ Yes ☐ No
Is there evidence of periodic pulses of residual contamination from the vadose zone that suggest new monitoring points should be added in the vadose zone? If yes, use this space to comment.	☐ Yes ☐ No
If there is reason to re-evaluate the number and location of monitoring points and/or monitoring frequency (as indicated in above responses), identify any plans for re-evaluating the monitoring program.	
Based on your responses to the above questions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM.	☐ Yes ☐ No

B. Remedy Performance Assessment

1. Review performance monitoring objectives. The OSWER Directive 9200.4-17P (U.S. EPA, 1999a) provides eight specific objectives for the performance-monitoring program of an MNA remedy.

For each of the following eight performance monitoring objectives, identify which are currently being met, which are currently being met but could benefit from further review, and which are currently not being met.

Objective	Status		
	Being met	*Benefit from review*	*Not being met*
1) Demonstrate that natural attenuation is occurring according to expectations	☐	☐	☐
2) Detect changes in environmental conditions that may reduce the efficacy of any of the natural attenuation processes	☐	☐	☐
3) Identify any potentially toxic and/or mobile transformation products	☐	☐	☐
4) Verify that the plume(s) is not expanding downgradient, laterally or vertically	☐	☐	☐
5) Verify no unacceptable impact to downgradient receptors	☐	☐	☐
6) Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy	☐	☐	☐
7) Demonstrate the efficacy of ICs that were put in place to protect potential receptors	☐	☐	☐
8) Verify attainment of remediation objectives	☐	☐	☐

If any of these objectives are not being met or would benefit from review, please describe (e.g., in what way is the objective not being met, why might the objective benefit from further review).

Describe any plans to review and/or change the location, frequency or types of samples and measurements to meet this (these) objective(s).

2. Evaluate remedy effectiveness: The following questions are intended to review whether the MNA remedy is performing as intended, or whether there may be a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated.	
Since the last O&M review, have contaminant concentrations in soil or ground water at specified locations exhibited an increasing trend not originally predicted during remedy selection?	☐ Yes ☐ No
Since the last O&M review, have near-source wells exhibited large concentration increases indicative of a new or renewed release?	☐ Yes ☐ No
Since the last O&M review, have contaminants been detected in monitoring wells located outside of the original plume boundary or other compliance-monitoring boundary?	☐ Yes ☐ No
Since the last O&M review, have analyses concluded that the rate of decrease of contaminant concentrations may be inadequate to meet the remediation objectives?	☐ Yes ☐ No
Since the last O&M review, have changes in land and/or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the MNA remedy?	☐ Yes ☐ No
Since the last review, have contaminants been identified in locations that pose or have the potential to pose unacceptable risk to receptors?	☐ Yes ☐ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment.	☐ Immediate action ☐ Monitored for future ☐ N/A
Based on your answers to the above questions, is there reason to evaluate the need for a contingent remedy at this time? If yes, use this space to comment.	☐ Yes ☐ No
3. Evaluate collection and analysis of performance monitoring data	
What evidence has been used to evaluate actual plume dissipation (e.g., temporal trends in individual wells, estimation of mass reduction, comparisons of observed contaminant distributions with predictions and required milestones, comparison of field-scale attenuation rates)?	
Since the last O&M review, has it been necessary to modify the site-specific plans (e.g., Sampling and Analysis Plan, Quality Assurance Project Plan, Data Management Plan) to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to evaluate whether field parameters that are critical to an MNA evaluation (e.g., dissolved oxygen, redox potential) are being collected at appropriate monitoring points? If yes, use this space to comment.	☐ Yes ☐ No
Do the approaches used to interpret ground water monitoring data (e.g., concentration trend analyses, plume contour and/or bubble maps, plume cross-sections, potentiometric surface maps) provide adequate information to assess the performance of the natural attenuation remedy? If no, describe plans, if any, to implement new approaches.	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to re-evaluate the ground water and soil-monitoring program to more accurately delineate and monitor the plume boundary? If yes, use this space to comment.	☐ Yes ☐ No
Since the last O&M review, has it been necessary to modify the data quality assessment, including statistical tests (if appropriate), regression analysis, scatter plots, etc. to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Are ground water data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No

If statistical tests are used, do the data meet the assumptions of the statistical test?	☐ Yes ☐ No
If no, does this suggest the need to change the monitoring program or re-evaluate the statistical approach? Use this space to comment.	☐ Evaluate monitoring program ☐ Evaluate statistical approach ☐ Neither
Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of sampling? Use this space to comment.	☐ Yes ☐ No
Are performance-monitoring reports of sufficient quality and frequency to evaluate the efficacy of MNA as a remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
Are techniques or models being used to evaluate adequacy/redundancy of individual wells in the monitoring network, and adequacy/redundancy of sampling frequency? Note that techniques may range from statistical trend analysis to application of ~~a~~ decision support tool.	☐ Yes ☐ No
If no, are there plans to evaluate the adequacy/redundancy of individual monitoring wells and/or sampling frequency? Use this space to comment.	☐ Yes ☐ No
C. Cost Effectiveness: Key considerations in looking at cost-effectiveness of an MNA remedy are the list of parameters for monitoring, as well as the frequency and location of monitoring. Decreases in monitoring parameters, frequency or locations may be appropriate and allow for reductions in project monitoring costs. For example, decreases in monitoring frequency for certain parameters may be warranted if the remedy is proceeding according to expectations and trends are stable after evaluation of data from a sufficient number of monitoring periods (e.g., many years). To support such a decision, the available data generally cover a time period sufficient to allow for an evaluation of seasonal trends and other long-term cycles and trends.	
Does information collected since the last O&M review suggest opportunities to eliminate monitoring points (e.g., because of redundancy, unreliability, or changes in program objectives)? If yes, use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest opportunities to replace current analytical and sampling methods with less expensive methods and still meet the data quality objectives? If yes, use this space to comment.	☐ Yes ☐ No
Can the analyte list be shortened to focus on the known contaminants of concern?	☐ Yes ☐ No
D. Remedial Decisions: Following data evaluation, decisions are routinely made regarding the effectiveness of the MNA remedy, monitoring program, and ICs, and the need for contingency or alternative remedies. The following remedial decisions are discussed in Section 4 of the EPA guidance document *Performance Monitoring of MNA Remedies for VOCs in Ground Water* (EPA/600/R-04/027; April 2004). Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No Change to the Monitoring Program ☐ Modify/Optimize Monitoring Program ☐ IC Modifications ☐ Implementation of Contingency/Alternative Remedy ☐ Terminate Performance Monitoring and Initiate Verification Monitoring	
Basis for decision:	

RECOMMENDED APPENDIX C. CONTAINMENT REMEDIES

The following checklist is an abbreviated set of questions that could be used by a EPA RPMs for an annual review of the O&M of a containment remedy and associated off-gas treatment system. This checklist focuses on engineered containment remedies, including landfill caps, covers, and vertical engineered barriers (VEB). Containment by other means such as hydraulic control and in-situ sediment containment remedies are not addressed by this appendix. See separate surface water/sediment remedy checklist for sediment remedies. Although the checklist includes items for off-gas systems, it focuses on off-gas collection. The checklist does not address off-gas management using combustion systems because such systems are uncommon at Superfund sites.

A. Remedy Description, Goals and Conceptual Site Model (CSM)

1. Review of the current remedy

Identify the containment systems in place:

- ☐ Cap/cover
- ☐ VEB
- ☐ Liner
- ☐ Landfill gas collection
- ☐ Landfill gas management
- ☐ Leachate detection
- ☐ Leachate collection
- ☐ Leachate management
- ☐ Other (Describe:)

Identify the O&M components:

- ☐ Inspection
- ☐ Monitoring
- ☐ Testing
- ☐ Ground water monitoring
- ☐ Surface water monitoring
- ☐ Landfill gas monitoring
- ☐ Vapor intrusion monitoring
- ☐ Leachate monitoring
- ☐ Other (Describe:)

2. Review of the current remedy goals

Identify the remedy goals (RAOs):

- ☐ Prevent direct contact with a contaminant source
- ☐ Prevent migration of a contaminant source to:
  - ☐ A drinking water aquifer
  - ☐ Surface water
  - ☐ Soil or other solid media
  - ☐ Air (via wind-borne material)
  - ☐ Air (via volatilization)
  - ☐ Other (Describe:)
- ☐ Prevent migration of contaminated ground water
- ☐ Prevent vapor intrusion or indoor air exposure
- ☐ Control off-gas
- ☐ Other remedy goals (Describe:)

What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?

What schedule has been established for measuring and reporting each metric?

Based on new information or events since the last O&M review, is there a need to re-evaluate the remedy goals? This might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear to be realistic, and whether there have been changes in land use or ground water production near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

3. Review of changes to the CSM: The CSM for a containment remedy is the site-specific, qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biological, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and the post-closure maintenance plan or O&M plan, the model should be re-evaluated as new data are collected throughout the lifetime of the remedy.	
Does new information gathered or conclusions reached since the last time the O&M checklist was completed indicate a change in understanding about the sources, types, migration, and fate of contaminants? *Note that indicators could include (1) the remedy not functioning as designed, (2) unexpected contaminants or contaminant concentrations above the required levels at the point of compliance, (3) unexpected trends in contaminant concentrations, (4) unexpected changes in the flow rate or direction of ground water, (5) unexpected changes in off-gas characteristics, or (6) unexpected evidence of vapor intrusion in nearby structures.*	☐ Yes ☐ No
Based on new information and/or conclusions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM.	☐ Yes ☐ No
B. Remedy Performance Assessment This section contains a series of questions that can be used to help assess a containment remedy's effectiveness and evaluate the collection and analysis of performance monitoring data. For each potential problem identified, an analysis should be performed to determine what, if anything should be done.	
1. Evaluate remedy effectiveness: The following questions are intended to review whether the containment remedy is performing as intended or whether there is a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated. A contingency remedy may be considered if there is a "yes" answer to one or more of the following three questions. *Note that additional measures and methods for evaluating the effectiveness of containment remedies can be found in "EPA/USACE Draft Technical Guidance for RCRA/CERCLA Final Covers" (EPA 540-R-04-007) and "EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Review Site Inspection Checklist" (OSWER Directive 9355.7-03B-P).*	
Since the last O&M review, has inspection or testing of the cap, cover, liner, or VEB indicated that the system is failing or could eventually fail?	☐ Yes ☐ No
Since the last O&M review, have changes in land, surface water, or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the containment remedy?	☐ Yes ☐ No
Since the last O&M review, have contaminants been identified in new locations or at higher concentrations where they pose or have the potential to pose unacceptable risks to receptors?	☐ Yes ☐ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment. What actions, if any, have been taken and/or are planned in response to the new information?	☐ Immediate action ☐ Monitored for future ☐ N/A
For VEB Only: Note that additional measures and methods for evaluating VEB effectiveness can be found in "EPA Evaluation of Subsurface Engineered Barriers at Waste Sites".	
Have bulk integrity tests been performed since the last O&M review?	☐ Yes ☐ No

If bulk integrity tests have been performed since the last review, do test results indicate that need to evaluate possible breaches or excessive leakage in the VEB over the short and long terms? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Based on information collected since the last O&M review, do contaminant concentrations upgradient of the VEB indicate the need to evaluate actions to prevent possible contaminant migration? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Does information collected since the last O&M review suggest the need to evaluate hydraulic controls as an additional measure to control possible contaminant migration around the VEB (answer N/A if hydraulic controls are already part of the remedy)? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
For Off-Gas Collection Management Only: Note that additional measures and methods for evaluating off-gas collection and management effectiveness can be found in "USACE Landfill Off-Gas Treatment, Thermal Oxidation Checklist".	
Since the last O&M review for this system, have off-gas volume and composition been consistently within equipment design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review for this system, have off-gas system operational characteristics, such as required temperatures and pressures, been maintained within system design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last time an O&M checklist was completed for this system, have off-gas emissions met all federal, state, and local regulatory requirements? If no, what is being done to meet these requirements?	☐ Yes ☐ No
Based on information collected since the last O&M review, is there any evidence of unacceptable vapor intrusion in nearby structures? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Based on information collected since the last O&M review, have concentrations of off-gases inside buildings or at the site fence line suggested the need to assess safety and human health threats? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
2. Evaluate collection and analysis of performance monitoring data Note that more detailed information about performance parameters can be found in the following documents: ▪ "EPA/USACE Draft Technical Guidance for RCRA/CERCLA Final Covers" (EPA 540-R-04-007) ▪ "EPA Comprehensive 5-Year Review Guidance, Appendix D, Five-Year Review Site Inspection Checklist" (OSWER Directive 9355.7-03B-P) ▪ "USACE Landfill Off-Gas Treatment, Thermal Oxidation Checklist" ▪ "EPA Evaluation of Subsurface Engineered Barriers at Waste Sites" (EPA 542-R-98-005; August 1998).	
Since the last O&M review, has it been necessary to modify planned inspections, sampling events, and sample analyses, as reflected in the site post-closure maintenance plan or O&M plans, to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Has information collected since the last O&M review suggested the need to re-evaluate whether performance parameters that are critical to evaluation of the containment remedy are being collected at appropriate monitoring points? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No

Are ground water and off-gas system monitoring data managed electronically? If no, use this space to explain why not.	☐ Yes ☐ No
Since the last O&M review, have monitoring data been analyzed to identify trends and their significance? If no, use this space to explain why not.	☐ Yes ☐ No
Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of data collection? Use this space to comment.	☐ Yes ☐ No
Are inspection and performance monitoring reports of sufficient quality and frequency to evaluate the efficacy of containment as a remedy and recognize protectiveness problems in time for effective action? If no, what actions, if any, have been taken or are planned to address this situation?	☐ Yes ☐ No
C. Cost-Effectiveness	
If off-gas is currently being treated, can it be vented to the atmosphere without treatment in compliance with all applicable federal, state, and local regulations?	☐ Yes ☐ No ☐ N/A
If yes, has the possibility of discontinuing off-gas treatment been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
If leachate is currently being collected and treated, is operation of the leachate system necessary for proper functioning of the containment system?	☐ Yes ☐ No ☐ N/A
If no, has the possibility of discontinuing leachate collection and treatment been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
If hydraulic controls are being used in conjunction with a VEB, would the VEB provide passive containment without these controls?	☐ Yes ☐ No ☐ N/A
If yes, has the possibility of discontinuing the hydraulic controls been explored? Use this space to comment.	☐ Yes ☐ No ☐ N/A
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No change to the remedy ☐ Modify or optimize remedy ☐ Modify or optimize O&M ☐ Modify ICs ☐ Implement contingency or alternative remedy ☐ Terminate inspections or monitoring	
Basis for decision:	

RECOMMENDED APPENDIX D. SOIL VAPOR EXTRACTION/AIR SPARGING REMEDIES

- The following checklist is an abbreviated set of questions that EPA RPMs could use when conducting an annual review of the O&M of a soil vapor extraction (SVE), air sparging (AS), or combined SVE/AS remedy. This checklist does not represent the level of review used in EPA's five-year review process to determine whether the remedy is or will be protective of human health and the environment. However, the checklist does contain review elements regarding the performance of SVE and/or AS remedies that are consistent with the comprehensive five-year review process.

A. Remedy Description, Goals and Conceptual Site Model (CSM)

1. Review of the current remedy

Identify the current remedy:

- ☐ SVE
- ☐ AS

How many extraction wells or trenches are used for SVE (if applicable)?

How many injection wells are used for AS (if applicable)?

2. Review of the current remedy goals

List the remedy goals (RAOs):

- ☐ Prevent migration of a contaminant source to:
  - ☐ A drinking water aquifer
  - ☐ Surface water
  - ☐ Soil or other solid media
- ☐ Prevent migration of contaminated ground water
- ☐ Restore ground water
- ☐ Other (Describe:)

List the short-term objectives and intermediate system goals.

List the long-term soil and ground water cleanup goals.

What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?

What schedule has been established for measuring and reporting each metric?

Based on new information or events since the last O&M review, is there a reason to re-evaluate the remedy goals? Note that this might be due to factors such as whether the regulatory framework has been revised, whether existing goals appear to be realistic, and whether there have been changes in land or ground water use near the site. If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

3. Review of changes to the CSM: The CSM for a SVE/AS remedy is the site-specific, qualitative and quantitative description of the migration and fate of contaminants with respect to possible receptors and the geologic, hydrologic, biological, geochemical and anthropogenic factors that control contaminant distribution. Because the CSM provides the basis for the remedy and the O&M plan, the model should be re-evaluated as new data are collected throughout the lifetime of the remedy.	
Does new information gathered or conclusions reached since the last time the O&M checklist was completed indicate a change in understanding about the sources, types, migration, and fate of contaminants? *Note that indicators could include: (1) the remedy not functioning as designed, (2) unexpected contaminants or contaminant concentrations above the required levels at the point of compliance, (3) unexpected trends in contaminant concentrations, (4) unexpected changes in the flow rate or direction of ground water, (5) unexpected changes in off-gas characteristics, (6) unexpected evidence of vapor intrusion in nearby structures; or (7) identification of new sources.*	☐ Yes ☐ No
Based on new information and/or conclusions, would it be useful to update the CSM at this time? If yes, please describe any plans to update the CSM.	☐ Yes ☐ No
B. Remedy Performance Assessment This section contains a series of questions that can be used to help assess a SVE/AS remedy's effectiveness and evaluate the collection and analysis of performance monitoring data.	
1. Evaluate remedy effectiveness: The following questions are intended to review whether the SVE/AS remedy is performing as intended, or whether there is a need to implement a contingency remedy. A contingency remedy is a cleanup technology or approach that functions as a backup remedy in the event that the selected remedy fails to perform as anticipated. A contingency remedy may be considered if there is a "yes" answer to either of the following five questions.	
Based on information collected since the last O&M review, do monitoring data indicate that the system is failing or could eventually fail to meet remedy goals?	☐ Yes ☐ No
Since the last O&M review, has the areal extent of contamination (or plume) increased in a manner not originally predicted during remedy selection?	☐ Yes ☐ No
Since the last O&M review, have monitoring data exhibited trends indicative of a new or renewed release?	☐ Yes ☐ No
Since the last O&M review, have changes in land and/or ground water use been suggested and or implemented that have the potential to reduce the protectiveness of the SVE/AS remedy?	☐ Yes ☐ No
Since the last O&M review, have contaminants been identified in new locations or at higher concentrations where they pose or have the potential to pose unacceptable risks to receptors?	☐ Yes ☐ No
If you answered yes to any of the above questions, did the information suggest the need for immediate action or is the condition being monitored to evaluate the need for future action? Use this space to comment. What actions, if any, have been taken and/or are planned in response to the new information?	☐ Immediate action ☐ Monitored for future ☐ N/A
Based on your answers to the above questions, is there reason to evaluate the need for a contingent remedy at this time? If yes, use this space to comment.	☐ Yes ☐ No

Blowers and Piping	
Since the last O&M review for this system, has evidence of excessive corrosion of system components been observed? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review, if blowers are operated intermittently, do VOC concentrations increase after they are shut off? How has this information been interpreted and what actions, if any, have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, have blower operational characteristics, such as flow rate, pressure, and discharge temperatures, been consistently within equipment design parameters? If no, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Since the last O&M review, if water is manually removed from the extraction blower water separator, has water accumulation been observed that could adversely impact blower operation? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, have all blowers, water separators, valves, and piping components been consistently operational?	☐ Yes ☐ No
Has the downtime associated with non-routine operations and maintenance of the blowers since the last time you completed an O&M checklist for this system exceeded expectations? If yes, what have been identified as the causes? If yes, what corrections have been or are being made to minimize downtime?	☐ Yes ☐ No
Does the operational history suggest that the preventative maintenance plan for the blowers needs to be re-evaluated? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No
Soil Vapor Extraction System	
Identify the SVE system characteristics, if any, that have deviated consistently/frequently from operational expectations since the last time an O&M checklist was completed for this system: ☐ Vapor flow rates at one or more extraction wells ☐ Vapor compositions (VOCs, CO_2, O_2) at one or more extraction wells ☐ Pressures at one or more extraction wells ☐ Flow at blower (prior to entry of any dilution air if used) ☐ Accumulation of water in the water separator	
Does this (do these) deviation(s) indicate a new condition since the last O&M review or an ongoing trend?	☐ New condition ☐ Ongoing trend ☐ N/A
What has been identified as the cause for this (these) deviation(s)?	
What actions, if any, have been or are being taken in response to this (these) deviation(s)?	
Based on information collected since the last O&M review, is there any evidence of unacceptable vapor intrusion in nearby structures? If yes, what actions have been taken and/or are planned in response?	☐ Yes ☐ No

Since the last O&M review, have gas concentrations in the blower discharge been running close enough to the lower explosive limit (LEL) or shown an increasing trend that suggests the need for action? *Note that specific compound LEL data are available in many chemistry texts as well as National Fire Protection Agency guidelines.* What actions, if any, have been taken and/or are planned in response to the new information?	☐ Yes ☐ No
Air Sparging System	
Since the last O&M review of the AS system, have flow rates at each injection well been consistently maintained within system design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
Based on information collected since the last O&M review, have dissolved oxygen concentrations been maintained at a level sufficient to promote biological activity? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
Since the last O&M review, are measured dissolved oxygen concentrations consistently indicative of good air/water contact rates (i.e., are concentrations near saturation)? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No
VOC Control System	
If the SVE system contains a VOC control device, has the device consistently met performance and compliance monitoring requirements (e.g., total VOC emission limits, specific compound limits, monitoring, air permit) since the last O&M review for this system? If no, what actions have been taken and/or planned in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, has the VOC control system consistently meet required destruction and removal efficiencies? If no, what actions have been taken and/or planned in response?	☐ Yes ☐ No
Since the last O&M review, have any violations of air permits been reported? If yes, what has been or is being done to meet permit requirements?	☐ Yes ☐ No
Since the last time you completed an O&M checklist for this system, has the VOC control system been responsible for downtime associated with non-routine operations and maintenance? If yes, ▪ What was (were) the cause(s) for unplanned shutdown(s)? ▪ What has been done or is being done to minimize future downtime?	☐ Yes ☐ No
Thermal Oxidizers	
Since the last O&M review for this system, have the operational characteristics (e.g., LEL history of feed gas, operating temperature, inlet flow, oxygen level in flue gas, fuel use) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
Since the last O&M review, has there been any indication of improper operation of flashback protection equipment (e.g., detonation arrestor, sealed drum)? If yes, what actions have been taken and/or planned in response?	☐ Yes ☐ No
Since the last O&M review, has there been any indication of improper operation of safety interlocks (e.g., high LEL, high oxidizer temperature, loss of flame, low fuel pressures)? If yes, what actions have been taken and/or planned in response?	☐ Yes ☐ No

If acid gases are present, have scrubber operations (e.g., scrubber liquid flow and pH, caustic use, scrubber blowdown and its treatment) been consistent with operational expectations since the last O&M review? If no, what actions have been taken and/or planned in response?	☐ Yes ☐ No
Carbon Adsorbers	
Does the unit have humidity controls?	☐ Yes ☐ No
Since the last O&M review for this system, have the operational characteristics (e.g., relative humidity data at adsorber inlet, adsorber operating temperature, carbon breakthrough, carbon change out history, operating velocity through adsorbers, adsorber discharge VOC data) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
Other Control Devices	
Since the last O&M review for this system, have the operational characteristics (e.g., biofiltration media surface loading rate, temperature controls, nutrient addition rate) been consistently within equipment design parameters? If no, what actions, if any, have been or are being taken in response?	☐ Yes ☐ No ☐ N/A
2. Evaluate collection and analysis of performance monitoring data	
Since the last O&M review, has it been necessary to modify sampling frequency relative to the original O&M plan to account for new information and/or unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
Does soil and/or ground water data collected since the previous O&M review (e.g., VOCs concentrations, ground water elevations) suggest the need to re-evaluate other aspects of the monitoring program (e.g., monitoring locations, test parameters) to account for new information/unforeseen circumstances? If yes, use this space to comment.	☐ Yes ☐ No
C. Cost Effectiveness: Key considerations in looking at cost-effectiveness are the O&M costs incurred relative to design and reduction in VOC removal rates. Opportunities to reduce costs can be potentially found in the following areas:	
Does information collected since the last O&M review suggest that flows could be redistributed to speed overall remediation (i.e., reduce or eliminate flow to/from wells where removals have reached near asymptotic conditions or where cleanup goals have been achieved)? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review show evidence of diffusion-limited VOC movement?	☐ Yes ☐ No
If yes, has the idea of modifying operation to pulsing (intermittent) been considered to speed overall remediation? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review show reduced VOC removal rates that might warrant a reduction in monitoring frequencies? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest that VOC recovery rates have been reduced to the extent that the VOC control device can be eliminated? Use this space to comment.	☐ Yes ☐ No ☐ N/A

Does information collected since the last O&M review suggest that an alternative, lower cost VOC control device could be used? Use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest that operation of the VOC control device could be modified to reduce costs, e.g., operate thermal oxidizer at lower temperatures or lower dilution air flows (e.g., when LEL basis no longer requires design flow) or use larger carbon beds to reduce carbon supplier charges for change outs? Use this space to comment.	☐ Yes ☐ No
Has maintenance history since the last O&M review identified high-maintenance equipment that could be replaced? Use this space to comment.	☐ Yes ☐ No

E. Remedial Decisions: Indicate which of the following remedial decisions are appropriate at the present time and provide a basis for each decision:

- ☐ Continue current remedy
- ☐ Goals have been achieved -- system can be shutdown in favor of MNA
- ☐ Modify/optimize remedial system(s) – use intermittent operation; optimize flows to/from wells to promote increased removals; increase use of sparging to promote biodegradation; add new wells if contaminant movement is indicated to areas currently not being influenced; implement cost reduction measures; conduct more detailed evaluation of the contaminated zone using a tool such as Pneulog.
- ☐ Modify/optimize O&M – increase monitoring to provide additional data for more definitive assessment at the next review
- ☐ Modify ICs
- ☐ Implement contingent or alternative remedy

Basis for decision:

RECOMMENDED APPENDIX E. OTHER REMEDY TYPES/COMPONENTS

The following checklist is a set of questions that may be used by EPA RPMs for an annual review of the O&M of remedies and remedy components that are not addressed in Appendices A through D or the separate surface water/sediment remedy O&M checklist. This could include remedies/components that involve a technology that is not covered in these other materials or remedies/components where the O&M can be more efficiently reviewed using the more streamlined questions below. If the site includes multiple remedy components that are not covered elsewhere, multiple copies of this appendix, each applying to a different component or related set of components, could be completed.

A. Remedy Description and Goals

1. Review of current remedy goals, and measurements

The following questions can be used to document basic information about the remedy and remedy goals to provide context for the remainder of the information in this appendix.

Identify the remedy component(s) and associated systems and technologies being covered on this form:	
What are the intermediate and final system goals?	
What metrics (performance criteria) are being implemented to measure project progress towards meeting each goal?	
What schedule has been established for measuring and reporting each metric?	
Based on new information or events since the last O&M review of this system/technology, is there a need to re-evaluate the remedy goals? If yes, identify the remedy goals that should be re-evaluated, the rationale, and any plans for re-evaluating the goals.	☐ Yes ☐ No

2. Review of changes to the CSM

The following questions ask about changes in contamination and other field conditions that could affect the monitoring program, system operations, and other aspects of O&M. They provide context for questions in subsequent sections that ask whether action should be taken to modify the O&M program.

Do monitoring data indicate trends/patterns that are inconsistent with the CSM (or similar conceptual understanding of site conditions) that was used as the basis for design of the remedy/remedial component(s)? If yes, use this space to comment.	☐ Yes ☐ No
Have there been changes in field conditions (e.g., change in land/water use) that differ significantly from the conditions incorporated in the CSM (or similar conceptual understanding of site conditions) that was used as the basis for design of the remedy/remedial component(s)? If yes, use this space to comment.	☐ Yes ☐ No
Have new contaminant sources been identified? If yes, please describe the new sources and how they are they being addressed:	☐ Yes ☐ No

B. Remedy Performance Assessment

This section contains a series of questions that can be used to help assess whether the monitoring program and remediation systems O&M should be adjusted.

1. Monitoring Program

Describe changes to the monitoring program that have been made since the last time you completed the O&M checklist for this remedy component.	
Are the baseline data and post-remedy data adequate to perform statistical comparisons and evaluate remedy performance? If no, what actions have been or are being taken in response?	☐ Yes ☐ No

Is high variability in the data interfering with or preventing a meaningful interpretation of the data?	☐ Yes ☐ No
If yes, could this situation be mitigated by increasing the density or frequency of data collection? Use this space to comment.	☐ Yes ☐ No
Based on changes in contamination or field conditions (see A.2 of this appendix), is there reason to modify the monitoring program? If yes, describe changes to the monitoring program that are most necessary.	☐ Yes ☐ No
Has the adequacy/redundancy and cost-effectiveness of the monitoring program been evaluated, including evaluation of sampling locations, frequency, sampling and analytical methods, monitoring parameters, and test methods? Use this space to comment.	☐ Yes ☐ No
Is there reason to modify the monitoring program to address inadequacies, remove redundancies, and/or improve its cost-effectiveness? If yes, describe changes to the monitoring program that would likely have the greatest impact.	☐ Yes ☐ No
Do you have adequate documentation (e.g., good quality O&M reports) and tools (e.g., software) to effectively manage and interpret monitoring data? If no, please explain how documentation and/or tools could be improved.	☐ Yes ☐ No
2. System Operations	
Describe changes to system operations that have been made since the last time you completed the O&M checklist for this remedy component.	
Is (are) the remedial system(s) covered under this appendix performing as expected relative to the remediation milestones and goal(s)? If no, what actions have been or are being taken in response?	☐ Yes ☐ No
Do monitoring data indicate trends/patterns that are consistent with remedial design expectations? If no, what actions have been or are being taken in response?	☐ Yes ☐ No
Based on observations regarding contamination or field conditions (see A.2 of this appendix and previous questions in this section), is there reason to modify systems operations to improve remedy performance? If yes, describe changes to system operations that are most necessary.	☐ Yes ☐ No
Has an optimization study been conducted for the remedy/remedy component(s)? Use this space to comment.	☐ Yes ☐ No
Has the downtime associated with non-routine operations and maintenance exceeded expectations? If yes, what actions have been or are being taken to minimize downtime?	☐ Yes ☐ No
Based on optimization and downtime considerations, is there reason to modify systems operations to improve remedy performance? If yes, describe changes to system operations that are most necessary.	☐ Yes ☐ No
3. Maintenance	
Are routine maintenance activities adequate to ensure the reliable operation of the remedial system(s)? If no, what changes to the maintenance program are most necessary?	☐ Yes ☐ No

Have any major repairs to the remedial system(s) been required since the last time you completed the O&M checklist for this remedy/remedy component? If yes, describe the repairs, their impact on progress toward remediation milestones, and actions taken to minimize similar repairs in the future.	☐ Yes ☐ No
C. Cost Effectiveness	
Does information collected since the last O&M review suggest opportunities to reduce costs associated with equipment operations and maintenance? If yes, use this space to comment.	☐ Yes ☐ No
Does information collected since the last O&M review suggest opportunities to reduce costs associated with the monitoring program? If yes, use this space to comment.	☐ Yes ☐ No
D. Remedial Decisions: Indicate which of the following remedial decisions is appropriate at the present time and provide the basis for the decision.	
☐ No Change ☐ Modify/Optimize System ☐ Modify/Optimize Monitoring Program ☐ Modify ICs ☐ Implement Contingency/Alternative Remedy	
Basis for decision:	

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Appendix D

O&M Cost Estimate

TABLE PV-OU4 and OU7 O&M

PRESENT VALUE ANALYSIS

Opinion of Probable Cost
O&M Cost Estimate

Site: OU4 & OU7
Location: Lincoln County
Phase: O&M
Base Year: 2019

Year[1]	Annual Site Maintenance and Monitoring Costs	Total Annual Expenditure[2]	Discount Factor (7.0%)	Present Value[3]
2019	$0	$0	1.0000	$0
2020	$663,500	$663,500	0.9346	$620,107
2021	$663,500	$663,500	0.8734	$579,501
2022	$663,500	$663,500	0.8163	$541,615
2023	$663,500	$663,500	0.7629	$506,184
2024	$663,500	$663,500	0.7130	$473,076
2025	$663,500	$663,500	0.6663	$442,090
2026	$663,500	$663,500	0.6227	$413,161
2027	$663,500	$663,500	0.5820	$386,157
2028	$663,500	$663,500	0.5439	$360,878
2029	$663,500	$663,500	0.5083	$337,257
2030	$663,500	$663,500	0.4751	$315,229
2031	$663,500	$663,500	0.4440	$294,594
2032	$663,500	$663,500	0.4150	$275,353
2033	$663,500	$663,500	0.3878	$257,305
2034	$663,500	$663,500	0.3624	$240,452
2035	$663,500	$663,500	0.3387	$224,727
2036	$663,500	$663,500	0.3166	$210,064
2037	$663,500	$663,500	0.2959	$196,330
2038	$663,500	$663,500	0.2765	$183,458
2039	$663,500	$663,500	0.2584	$171,448
2040	$663,500	$663,500	0.2415	$160,235
2041	$663,500	$663,500	0.2257	$149,752
2042	$663,500	$663,500	0.2109	$139,932
2043	$663,500	$663,500	0.1971	$130,776
2044	$663,500	$663,500	0.1842	$122,217
2045	$663,500	$663,500	0.1722	$114,255
2046	$663,500	$663,500	0.1609	$106,757
2047	$663,500	$663,500	0.1504	$99,790
2048	$663,500	$663,500	0.1406	$93,288
2048	$663,500	$663,500	0.1314	$87,184
TOTALS:	$19,905,000	$19,905,000		$8,233,172
TOTAL PRESENT VALUE OF OU4 and OU7 O&M COSTS				**$8,230,000**

Notes:

For cost estimating purposes, O&M costs are presented for a 30-year period after determination of O&F.

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented and methodology used for estimating.

This cost accuracy range is consistent with EPA's Remedial Design/Remedial Action Handbook (EPA 1995) for preliminary development of O&M activities and responsibilities.

[1] Duration is assumed to be 30 years for present value analysis.

[2] Total annual expenditure is the total cost per year with no discounting.

[3] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for detail

[4] Total present value is rounded to the nearest $10,000. Inflation and depreciation are excluded from the present value

TABLE CS-OU4 and OU7 O&M

Opinion of Probable Cost

O&M Cost Estimate

COST ESTIMATE SUMMARY

Site: OU4 & OU7
Location: Lincoln County
Phase: O&M
Base Year: 2018
Date: July 26, 2019

The following activities are considered routine O&M activities: Annual Site Inspections and Reporting, Physical Remedy Maintenance, ARP,and IC Evaluation and Updates.

ANNUAL COST - SITE MAINTENANCE AND MONITORING (Years 1 through 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Annual Site Condition and Reporting					
Annual Site Inspection [1]	1	YR	$1,759.60	$1,760	
Annual Site Reporting [2]	1	YR	$6,771.98	$6,772	
Asbestos Resource Program (ARP) [3]	1	YR	$277,450	$277,450	
Physical Remedy Maintenance Activities [4]					
Major Response to the Physical Remedy (Soil)	1	YR	$30,471.93	$30,472	yearly costs to cover 5 exterior responses
Major Response to the Physical Remedy (BM)	1	YR	$181,261.16	$181,262	yearly costs to cover 15 interior responses
SUBTOTAL				$497,716	
Contingency (Scope and Bid)	10%			$49,772	5% Scope, 5% Bid
SUBTOTAL				$547,488	
Project Management [6]	10%			$54,749	Middle value of the recommended range in EPA 540-R-00-002 was used.
Technical Support [7]	10%			$54,749	Upper value of the recommended range in EPA 540-R-00-002 was used.
SUBTOTAL				$656,986	
Monitor Institutional Controls [5]	1	YR	$6,490	$6,490	Unit costs, quantities, and calculations in Cost Worksheets Report
SUBTOTAL				$6,490	
TOTAL ANNUAL O&M COST				**$663,500**	Total capital cost is rounded to the nearest $1,000.

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.
Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented and methodology used for estimating.

[1] Non-intrusive visual site inspections will be conducted to ensure integrity of the physical remedy or engineered control remains intact and assumed to be performed at least annually.

[2] Annual reports summarizing O&M activities will be prepared by DEQ and submitted to the EPA remedial project manager on an annual basis.

[3] General wear and tear or erosion may result in the need for a minor response to the physical remedy or engineered control. Assumed that annual ARP cost includes costs of minor responses to physical remedy as well as future encounters with contaminated materials

[4] A major response occurs when significant exposure to contaminated soil beneath the backfill or contaminated building material may result and additional excavation, removal or encapsulation of contaminated materials would be required. Contaminated soil or building materials will be excavated/remediated and disposed of at an approved facility. Sampling and analysis would be conducted to confirm that contamination did not migrate outside of the breached area.

[5] ICs evaluation will be conducted to assess whether the selected IC instrument remains in place and whether the ICs are enforced such that they meet the stated objectives and performance goals and provide protection required by the response.

[6] Project management includes, but is not limited to, planning and reporting , community relations support, contract administration, permitting (if needed), and legal services outside of ICs.

[7] Technical support includes, but is not limited to, oversight of O&M activities and progress reporting.

EA Each
LS Lump Sum
QTY Quantity
YR Year

TABLE PV-ADRFT

PRESENT VALUE ANALYSIS

Annual Discount Rate Factors Table

Site: OU4 & OU7
Location: Lincoln County
Phase: O&M
Base Year: 2019

Discount Rate (Percent): 7.0

Year	Discount Factor[1,2]	Year	Discount Factor[1,2]
0	1.0000	26	0.1722
1	0.9346	27	0.1609
2	0.8734	28	0.1504
3	0.8163	29	0.1406
4	0.7629	30	0.1314
5	0.7130		
6	0.6663		
7	0.6227		
8	0.5820		
9	0.5439		
10	0.5083		
11	0.4751		
12	0.4440		
13	0.4150		
14	0.3878		
15	0.3624		
16	0.3387		
17	0.3166		
18	0.2959		
19	0.2765		
20	0.2584		
21	0.2415		
22	0.2257		
23	0.2109		
24	0.1971		
25	0.1842		

Notes:

[1] Annual discount factors were calculated using the formulas and guidance presented in Section 4.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

[2] The real discount rate of 7.0% was obtained from "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000, Page 4-5.

TABLE PV-OU4 and OU7 5-YEAR REVIEW

PRESENT VALUE ANALYSIS

Opinion of Probable Cost
O&M Cost Estimate

Site:	**OU4 & OU7**
Location:	**Lincoln County**
Phase:	**O&M**
Base Year:	**2019**

Year[1]	Annual Site Maintenance and Monitoring Costs	Periodic Costs (Major Breach Repair)	Periodic Costs (Five-Year Site Reviews)	Total Annual Expenditure[2]	Discount Factor (7.0%)	Present Value[3]
2018	$0	$0	$0	$0	1.0000	$0
2019	$0	$0	$0	$0	0.9346	$0
2020	$0	$0	$0	$0	0.8734	$0
2021	$0	$0	$0	$0	0.8163	$0
2022	$0	$0	$0	$0	0.7629	$0
2023	$0	$0	$63,000	$63,000	0.7130	$44,919
2024	$0	$0	$0	$0	0.6663	$0
2025	$0	$0	$0	$0	0.6227	$0
2026	$0	$0	$0	$0	0.5820	$0
2027	$0	$0	$0	$0	0.5439	$0
2028	$0	$0	$63,000	$63,000	0.5083	$32,023
2029	$0	$0	$0	$0	0.4751	$0
2030	$0	$0	$0	$0	0.4440	$0
2031	$0	$0	$0	$0	0.4150	$0
2032	$0	$0	$0	$0	0.3878	$0
2033	$0	$0	$63,000	$63,000	0.3624	$22,831
2034	$0	$0	$0	$0	0.3387	$0
2035	$0	$0	$0	$0	0.3166	$0
2036	$0	$0	$0	$0	0.2959	$0
2037	$0	$0	$0	$0	0.2765	$0
2038	$0	$0	$63,000	$63,000	0.2584	$16,279
2039	$0	$0	$0	$0	0.2415	$0
2040	$0	$0	$0	$0	0.2257	$0
2041	$0	$0	$0	$0	0.2109	$0
2042	$0	$0	$0	$0	0.1971	$0
2043	$0	$0	$63,000	$63,000	0.1842	$11,605
2044	$0	$0	$0	$0	0.1722	$0
2045	$0	$0	$0	$0	0.1609	$0
2046	$0	$0	$0	$0	0.1504	$0
2047	$0	$0	$0	$0	0.1406	$0
2048	$0	$0	$63,000	$63,000	0.1314	$8,278
TOTALS:	$0	$0	$378,000	$378,000		$135,935
TOTAL PRESENT VALUE OF OU1 5-YEAR REVIEW COSTS						**$140,000**

Notes:

For cost estimating purposes, O&M costs are presented for a 30-year period after determination of O&F. The first 5-year review is assumed to occur in 2022.

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented and methodology used for estimating.

This cost accuracy range is consistent with EPA's Remedial Design/Remedial Action Handbook (EPA 1995) for preliminary development of O&M activities and responsibilities.

[1] Duration is assumed to be 30 years for present value analysis.

[2] Total annual expenditure is the total cost per year with no discounting.

[3] Present value is the total cost per year including a 7.0% discount factor for that year. See Table PV-ADRFT for details.

[4] Total present value is rounded to the nearest $10,000. Inflation and depreciation are excluded from the present value cost.

TABLE CS-OU4 & OU7 FIVE-YEAR REVIEW

Opinion of Probable Cost

O&M Cost Estimate

COST ESTIMATE SUMMARY

Site: OU4 & OU7
Location: Lincoln County
Phase: O&M
Base Year: 2018
Date: July 26, 2019

Five-year reviews of OU4 and 7 will be required to evaluate the implementation and performance of the remedy and to determine whether the remedy remains protective of human health and the environment. The EPA is responsible for performing and funding the five-year reviews as long as they are required.

FIVE-YEAR SITE REVIEW PERIODIC COSTS (Years 5, 10, 15, 20, 25, and 30)

DESCRIPTION	QTY	UNIT(S)	UNIT COST	TOTAL	NOTES
Visual Site Inspection	1	LS	$8,537	$8,537	Unit costs, quantities, and calculations in Cost Worksheets Repor
Five-Year Site Review Report	1	LS	$31,676	$31,676	Unit costs, quantities, and calculations in Cost Worksheets Report
SUBTOTAL				$40,213	
Contingency (Scope and Bid)	20%			$8,043	10% Scope, 10% Bid (Low end of the recommended range in EPA 540-R-00-002).
SUBTOTAL				$48,256	
Project Management	10%			$4,826	Middle value of the recommended range in EPA 540-R-00-002 was used.
Technical Support	20%			$9,651	Upper value of the recommended range in EPA 540-R-00-002 was used.
TOTAL				$62,733	
TOTAL PERIODIC COST				**$63,000**	Total capital cost is rounded to the nearest $1,000

Notes:

Percentages used for contingency and professional/technical services costs are based on guidance from Section 5.0 of "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study", EPA 2000.

Costs presented are expected to have an accuracy between -30% to +50% of actual costs, based on the scope presented and methodology used for estimating.

Abbreviations:

LS Lump Sum
QTY Quantity

OU4 and OU7 Operation and Maintenance Cost Estimate

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