ALLIED PAPER/PORTAGE CREEK/ KALAMAZOO RIVER SUPERFUND SITE

OPERABLE UNIT 1
ALLIED LANDFILL

Kalamazoo, Michigan

Record of Decision

U.S. Environmental Protection Agency Region 5

77 W Jackson Blvd
Chicago, IL 60604

[month] 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

AMSL	Above Mean Sea Level
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cm/s	Centimeters per Second
City	City of Kalamazoo
COCs	Contaminants of Concern
CSM	Conceptual Site Model
EPA	United States Environmental Protection Agency
FML	Flexible-membrane Liner
FRDLs	Former Residuals Dewatering Lagoons
FRG	Final Remediation Goal
FS	Feasibility Study
GCL	Geosynthetic Clay Liner
GDC	Geosynthetic Drainage Composite
GSI	Groundwater-Surface Water Interface
HHRA	Human Health Risk Assessment
HRDL	Historic Residuals Dewatering Lagoon
IRMs	Interim Response Measures
KRCC	Kalamazoo River Cleanup Coalition
MCL	Maximum Contaminant Level
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	Milligrams per kilogram
MHLLC	Millennium Holdings Company LLC
NCP	National Contingency Plan
NPL	National Priorities List
NREPA	Natural Resources and Environmental Protection Act
O&M	Operation and Maintenance
OU	Operable Unit
PCBs	Polychlorinated Biphenyls
ppm	Parts per Million
PRPs	Potentially Responsible Parties
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RI	Remedial Investigation
ROD	Record of Decision
State	State of Michigan
SVOCs	Semi-Volatile Organic Compounds
TCL	Target Compound List
TCRA	Time-Critical Removal Action

TSCA	Toxic Substances Control Act
UU/UE	Unlimited Use and Unrestricted Exposure
VOCs	Volatile Organic Compounds
yd^3	cubic yards

Part 1 – Declaration

1.1 Site Name and Location

Allied Paper/Portage Creek/Kalamazoo River site
CERCLA SITE ID# MID006007306
Operable Unit 1
Kalamazoo County, Michigan

1.2 Statement of Basis and Purpose

This decision document presents the Selected Remedy for Operable Unit 1 (OU1), Allied Landfill (or Allied Paper Landfill), at the Allied Paper/Portage Creek/Kalamazoo River site located in Kalamazoo, Michigan (the Site).

OU1 is located on 89 acres within the city limits of Kalamazoo, Michigan. OU1 is defined as the areas between Cork Street and Alcott Street where contamination from paper manufacturing operations is located (Figure 1). Portage Creek runs through and bisects OU1. OU1 includes areas that are zoned for residential, commercial, and manufacturing uses. Residential development exists along part of the eastern side of OU1 and a railroad corridor forms part of the western boundary.

The Selected Remedy for OU1 was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. Section 9601 *et seq.* (CERCLA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300 (NCP). This decision is based on information contained in the Administrative Record (AR) for OU1.

The State of Michigan (State) concurs with the Selected Remedy.

1.3 Assessment of Site

The response action selected in this Record of Decision (ROD) is necessary to protect human health and the environment from actual or threatened releases of hazardous substances into the environment.

1.4 Description of Selected Remedy

The primary risks associated with OU1 of the Site are to human and ecological receptors through direct contact exposure to soil and sediment which are contaminated with polychlorinated biphenyls (PCBs) and to human and ecological receptors through consumption of PCB-contaminated fish, which have become contaminated due to erosion and runoff of PCB-contaminated soil and sediment in Portage Creek and the Kalamazoo River. The U.S. Environmental Protection Agency (EPA) is selecting Alternative 2D as the remedy for OU1 to address these risks.

Alternative 2D involves excavating contaminated soils, sediments, and residuals from the Monarch area of OU1, from commercial, residential, and wetland areas of OU1, and from areas near Portage Creek, and consolidating those materials into the main body of the landfill area of OU1. Portions of the landfill area itself – those areas abutting Portage Creek – will also be excavated and consolidated, reducing the footprint of the waste from approximately 49 acres to approximately 27 acres. After consolidation, the landfill area will be covered with an impermeable cap and an active gas collection system will be installed. Excavated and backfilled areas that are not used for flood or water runoff control will be available for commercial redevelopment. The capped area will potentially be available for light recreational reuse. This redevelopment and reuse will further the long-term stewardship of OU1 after the remedy is implemented. Alternative 2D also includes long-term groundwater monitoring to verify the effectiveness of the remedy, institutional controls to protect the remedy and restrict land and groundwater use, and long-term operation and maintenance (O&M).

1.5 Statutory Determinations

The Selected Remedy set forth in this ROD achieves the statutory and regulatory mandates set forth in CERCLA Section 121 and the NCP. Specifically, the Selected Remedy addresses exposure to PCBs in a manner that is protective of human health and the environment, complies with applicable or relevant and appropriate federal and state requirements (ARARs), and is cost-effective.

The Selected Remedy does not include a treatment component, so it does not satisfy the statutory preference for treatment as a principal element. However, EPA does not consider the wastes at OU1 to be principal threat wastes because they do not appear to act as a source material and can be reliably contained in place due to their immobility. Because this remedy will result in hazardous substances, pollutants or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure (UU/UE) at certain parts of OU1, statutory reviews will be conducted every five years to ensure that the Selected Remedy is, or will be, protective of human health and the environment. Such periodic reviews are already being conducted at the Site because remedial actions have been selected and implemented at other Site OUs.

Under the Toxic Substances Control Act (TSCA), EPA finds that the PCBs remaining on site as part of the Selected Remedy will not pose an unreasonable risk of injury to human health or the environment pursuant to 40 C.F.R. Part 761.61(c).

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at OU1. Of those remedial alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance of tradeoffs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site disposal without treatment, and considering state and community acceptance.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the AR for OU1 of the Site.

Information Item	Section in Record of Decision
Chemicals of concern and their respective concentrations	2.5
Baseline risk represented by the chemicals of concern	2.7
Cleanup levels established for chemicals of concern and the basis for these levels	2.8
How source materials constituting principal threats are addressed	2.11
Current and reasonably-anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and the ROD	2.2, 2.6
Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy	2.6
Estimated capital, annual O&M, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected	2.9, 2.10
Key factor(s) that led to selecting the remedy (that is, describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision)	2.12

1.7 Authorizing Signature and Support Agency Acceptance of Remedy

EPA, as the lead agency for the Site, formally authorizes this ROD.

_____ _____

Richard C. Karl, Director
Superfund Division
U.S. Environmental Protection Agency
Region 5

Date

The State of Michigan Department of Environmental Quality (MDEQ), as the support agency for the Site, formally concurs with this ROD. MDEQ's concurrence letter is included in Appendix 1.

Part 2 – Decision Summary

2.1 Site Name, Location, and Brief Description

Name, Identification Number, Official Site Address, Location

Allied Paper/Portage Creek/Kalamazoo River site
CERCLA SITE ID# MID006007306
420 East Alcott Street, Kalamazoo, Michigan 49001

This ROD addresses OU1 of the Site. OU1 is located in Kalamazoo County of southwest Michigan. OU1 and the area surrounding OU1 are shown in Figure 1.

Site Type and Brief Description

The Site was listed on the National Priorities List (NPL) in August 1990 and consists of former disposal areas, former paper mill properties, and contaminated sediments, banks, and floodplains of the Kalamazoo River and Portage Creek.

EPA often divides complex cleanup sites into smaller, more manageable sections called operable units or OUs. The Site currently comprises six different OUs:

- OU1 – Allied Paper/Bryant Mill Pond (the subject of this ROD);
- OU2 – Willow Boulevard/A-Site Landfill;
- OU3 – King Highway Landfill;
- OU4 – 12th Street Landfill;
- OU5 – 77 miles of the Kalamazoo River and 3 miles of Portage Creek; and
- OU7 – former Plainwell Paper Mill Property.

OUs 1-4 and 7 are land-based source-area OUs. The RODs for those OUs address contaminated soils and paper-waste residuals in certain mill areas and land-based disposal areas. OU5 encompasses 77 miles of the Kalamazoo River from Morrow Dam east of Kalamazoo to the river mouth at Lake Michigan, plus a 3-mile stretch of Portage Creek in Kalamazoo. EPA designated OU6 as a placeholder for certain other source areas at the Site, but the OU6 designation currently is not used for any ongoing activities or geographic areas.

OU1 is located on 89 acres within the city limits of Kalamazoo, Michigan. OU1 is defined as the areas between Cork Street and Alcott Street (see Figure 1) where contamination from paper manufacturing operations is located. Portage Creek runs through and bisects OU1. OU1 includes areas that are zoned for residential, commercial, and manufacturing uses. Residential development exists along part of the eastern side of OU1 and a railroad corridor forms part of the western boundary. Commercial and manufacturing properties are located north and south of OU1 and along portions of the eastern and western sides of OU1.

Lead and Support Agencies and Source of Cleanup Funds

Since the start of the investigation effort in 1993, EPA and the State held interagency negotiations to determine which government agency should act as the lead agency and which as support agency in the remedial process. The roles of EPA and the State related to the Site and each OU are set forth in a series of Site-wide Memoranda of Understandings. At present, EPA is the lead agency for all response actions and enforcement activities at OU1.

EPA has issued general notice letters to multiple potentially responsible parties (PRPs) at the Site. Cleanup work done to date in OU1 was completed in large part by EPA. In 1998 and 1999, EPA conducted a time-critical removal action (TCRA) at the Bryant Mill Pond portion of OU1, partially funded by a settlement with Millennium Holdings Company LLC (MHLLC). At this time, EPA expects that funds from a bankruptcy trust and contributions from other PRPs will pay for implementation of the Selected Remedy.

2.2 Site History and Enforcement Activities

Paper mills were located on or near OU1 beginning at least as early as the 1870s. From the 1950s through the 1970s, as part of the papermaking process, those mills recycled carbonless copy paper, which contained PCBs as a carrier for the ink. Wastewater generated in that process was contaminated with PCBs, which adsorbed or adhered to suspended particles such as cellulose and clay in the wastewater.

Paper mills associated with OU1 include mills referred to as the Bryant Mill and the Monarch Mill, both of which were owned and operated by various companies at different times. The Bryant Mill was located on the northern part of OU1, both north and south of Alcott Street, while the Monarch Mill was located east and south of Portage Creek, across the creek from the rest of OU1. These mills included carbonless copy paper recycling in their operations. The portion of the former Bryant Mill located south of Alcott Street is a part of OU1. The portion of the former Bryant Mill located north of Alcott Street is a part of the Site, but not a part of OU1.

The mills either discharged contaminated wastewater directly to Portage Creek or its impounded area referred to as the Bryant Mill Pond (also referred to as the Pond), or first dewatered the wastewater in settling lagoons, which were intended to remove some of the suspended particles in the wastewater prior to discharge. Settling lagoons were located at areas of OU1 now referred to as the Bryant Historic Residuals Dewatering Lagoon (HRDL) and Former Residuals Dewatering Lagoons (FRDLs), and the Monarch HRDL (Figure 2).

The Bryant Mill Pond was formed by the damming of Portage Creek at Alcott Street in 1895, impounding the creek within the northern part of OU1. The Alcott Street Dam was built in 1895 to provide hydroelectric power and to control water for the Bryant Paper Mills. In 1976, the then owner, Allied Paper Company, drew down the water level of Bryant Mill Pond in an effort to reduce the discharge of sediment or groundwater to

Portage Creek. Surface water in Portage Creek was lowered 13 feet during the drawdown, which exposed contaminated sediments that had accumulated over many years of mill operations.

Allied Landfill Subareas

In addition to the areas described above, additional areas at OU1 became contaminated due to the papermaking operations. For purposes of managing OU1, EPA has organized the contaminated areas at OU1 into the following areas and subareas (see Figure 2):

- **Former Operational Areas**— Consists of the Bryant HRDL and FRDLs, Monarch HRDL (including the Former Raceway Channel), and areas referred to as the Former Type III Landfill and the Western Disposal Area. PCBs were introduced to the HRDL and FRDLs through the residual dewatering operations. At times, contaminated residuals from these areas were excavated and disposed of in the Western Disposal Area and the Type III Landfill. Portions of contiguous properties, including the adjacent Panelyte Marsh, Panelyte Property, Conrail Railroad Property, and the State of Michigan's Cork Street Property, are included in the Former Operational Areas due to waste materials having encroached into these areas from the Western Disposal Area.
- **Former Bryant Mill Pond Area**—Includes the area within the boundary of the Former Bryant Mill Pond, prior to dewatering, defined by a historical impoundment elevation of 790 feet above mean sea level (AMSL). A portion of the Bryant Mill property south of Alcott Street is included within this area. During mill operations, the Former Bryant Mill Pond Area was contaminated through the discharge of contaminated wastewater.
- **Residential Properties (Outlying)**—Consists of residential properties that are part of OU1, but not contiguous with the Former Operational Areas, including the following: Clay Seam Area, East Bank Area, four adjacent residential properties (Golden Age Retirement Community and three single-family residences), and property owned by the Lyondell Environmental Custodial Trust but used by owners of the three single-family residences.
- **Commercial Properties (Outlying)**—Consists of commercial properties that are part of OU1, but not contiguous with the Former Operational Areas, including the following: the Goodwill property, the Consumers Power property, the Former Filter Plant and the Alcott Street Parking Lot (both owned by the Lyondell Environmental Custodial Trust), and part of the former Bryant Mill property located south of Alcott Street.

Commented [BM1]: Which ones owned by the trust

The Residential Properties (Outlying) and Commercial Properties (Outlying) are adjacent to the Former Bryant Mill Pond area and were contaminated by the use and flooding of the Pond.

Site Investigations and Related Enforcement Activities

The Michigan Department of Natural Resources (MDNR) first became concerned about the presence of PCBs in the Kalamazoo River in 1971, after routine surface water and biota sampling at the mouth of the river indicated that PCBs were discharging from the river into Lake Michigan. During the summer of 1972, MDNR conducted an extensive survey of PCB levels in sediments of the Kalamazoo River. In 1990, the Site was listed on the NPL as a Superfund site. CERCLA site investigations began in 1993.

The baseline human health risk assessment (HHRA) for the Site was completed by MDEQ's contractor, Camp, Dresser, & McKee, in 2003. The HHRA evaluated potential current and future risks to people who may live or engage in recreational activities near the Kalamazoo River and its floodplains, including risks to subsistence and sport anglers who may consume fish caught from the Kalamazoo River. Additionally, the Michigan Department of Community Health prepared a Health Consultation for the Site in 2002.

The State of Michigan initially was the lead agency for ~~OU1~~ the Kalamazoo River Superfund Site and entered in an Administrative Order on Consent with MHLLC in 1991 for a remedial investigation (RI) and feasibility study (FS) at OU1. In 2006, the State disapproved MHLLC's draft RI Report for OU1 and then authored the final RI Report. EPA then assumed the lead agency role at the Site and approved the State's RI Report in March 2008.

At OU1, early investigative efforts recognized that if the full extent of PCBs were identified and appropriately remediated, then other associated substances at OU1 would be appropriately addressed. The RI therefore focused on PCBs for identifying the extent of contamination. In addition to PCBs, several inorganics, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) were detected in soils, sediments, and groundwater.

The RI Report describes the data collected between 1991 and 2003. The completion of the prior response actions described below, most of which were completed prior to 2004, resulted in significant changes in the lateral extent, mobility, and potential exposure pathways at OU1. Summaries of the data included in the RI Report regarding the nature and extent of PCBs at OU1 describe current conditions. The key mechanisms of PCB fate and transport are presented in the following subsection.

Pursuant to a 2007 administrative consent order with EPA, MHLLC and Georgia-Pacific, LLC agreed to perform a supplemental RI and an FS for parts of the Site. At OU1, MHLLC agreed to conduct an FS and submitted a draft FS Report in October 2009. EPA disapproved the draft and MHLLC later filed for bankruptcy. After filing for bankruptcy, MHLLC ceased performing under the 2007 consent order and never submitted a revised FS report. EPA then took over completion of the OU1 FS, which it completed in November 2013. After release of the FS Report, the City asked EPA to pause the remedy selection process so the potential for other cleanup alternatives could be explored. EPA, MDEQ and the City met extensively and explored ways that a new consolidation and

capping alternative could integrate redevelopment and long-term stewardship of the entire property into the remedy.

Response Actions and Related Enforcement Activities

Between 1990 and 2004, a series of CERCLA response actions were completed at OU1 to minimize exposure to PCBs and to stop the ongoing release of PCBs from the Former Bryant Mill Pond Area to Portage Creek and the Kalamazoo River. Those actions are summarized below.

Time-critical Removal Action at the Former Bryant Mill Pond

In 1990, EPA ordered the installation of fencing to minimize access to contaminated areas at OU1. In order to remove a large, ongoing source of PCB contamination to Portage Creek and the Kalamazoo River, EPA then completed a TCRA at the Former Bryant Mill Pond Area in 1998 and 1999. In this TCRA, EPA excavated 146,000 cubic yards (yd^3) of PCB-containing sediments, residuals, and soils from the creek banks and floodplains up to an elevation of 790 feet AMSL and placed those materials into the Bryant HRDL and FRDLs. EPA then backfilled the excavated area with clean fill and graded, seeded, and revegetated the backfilled area with native grasses and plants.

EPA's action level for the excavation was a PCB concentration of 10 milligrams per kilogram (mg/kg), with a goal of achieving post-excavation PCB concentrations less than or equal to 1 mg/kg. Only 5 of the 440 post-TCRA samples that EPA collected had PCB concentrations in excess of 1 mg/kg. The PCB concentration of those five samples ranged from 1.8 to 3.8 mg/kg. Additionally, 410 of the post-excavation samples were below the 0.33 mg/kg screening-level criterion recommended by MDEQ to be protective of people eating fish.

Interim Response Measures

After completion of the Bryant Mill Pond TCRA, one of the owners of OU1 conducted a series of small-scale Interim Response Measures (IRMs) to restrict access to OU1 and to provide erosion control and stabilization in certain areas. The IRMs further mitigated the exposure to or transport of PCBs at OU1. The IRMs are summarized below and described in detail in the RI Report:

- Installation of 2,600 feet of sealed-joint sheet pile along the Bryant HRDL and FRDLs adjacent to Portage Creek (see Figure 2) to stabilize the perimeter berms that separate the materials in the Bryant HRDL and FRDLs from the Portage Creek floodplain. This IRM was completed in 2001.
- Removal of remnant structures from the former Bryant Mill operational areas.
- Removal of several hundred yd^3 of soil containing residuals from locations between the sheet pile wall and Portage Creek and consolidation of those materials into the Bryant HRDL and FRDLs. This material was removed in 2000 and 2003 to minimize the potential for contaminated material releases to Portage Creek.

- Construction of an engineered composite cap for the Bryant HRDL and FRDLs, with its design based on Michigan Act 451, Part 115, solid waste regulations. The cap was constructed between 2000 and 2004. The cap was installed as a barrier to minimize the potential for direct contact with PCB-containing materials.
- Installation and operation of a groundwater extraction system inside the sheet pile wall and beneath the cap. The purpose of the system was to mitigate groundwater mounding behind the sheet pile wall, which might compromise the cap or inundate otherwise unsaturated residuals and increase the potential for migration of PCBs to the creek.
- Removal of approximately 1,700 yd^3 of residuals located in the floodplain on the eastern side of Portage Creek (referred to as the East Bank Area, see Figure 2) and additional PCB-containing soils between the sheet pile wall and the creek. The materials were consolidated into the Bryant FRDLs prior to construction of the cap.

After cap installation, MDEQ expressed concerns that the flexible-membrane liner (FML) used as part of the cap was left exposed for substantial periods of time. During this period, the cap was repeatedly punctured by wildlife. The then owner, MHLLC, subsequently repaired the cap, rather than replacing it as recommended, to address MDEQ concerns. MDEQ remains concerned about the current cap due to the number and quality of repairs that were made. As a result of the earlier damage, the current cap is not fully mitigating the infiltration of precipitation that might form leachate.

The IRM methods and cleanup targets were similar to those used by EPA during the Former Bryant Mill Pond TCRA. Results of all post-excavation confirmation samples were below the target PCB removal action goal of 1 mg/kg, and the excavation was backfilled with a minimum of one foot of clean fill. Upland areas of the Former Bryant Mill Pond were subsequently seeded and revegetated with native plants. However, PCB concentrations greater than 1 mg/kg continue to exist in floodplain areas not addressed by the IRMs, specifically the seep areas. Those areas will be addressed by this remedy.

2.3 Community Participation

EPA has conducted extensive public outreach for OU1. Since 2007, EPA has provided OU1 updates to the public at quarterly and semi-annual site-wide public meetings. EPA also held public meetings specifically about OU1, including two presentations in fall 2009. In January 2011, EPA presented the array of cleanup alternatives to the public. In 2013, EPA conducted OU1 tours for the mayor of Kalamazoo and citizen groups prior to publishing the FS Report in November 2013. EPA presented the FS alternatives in two open-house style meetings, one in February 2014 and another in April 2014. EPA held tours of OU1 for Representative Upton and Senators Stabenow and Levin during the summer of 2014.

Since 2007, the City had repeatedly indicated that total removal of the waste was the only cleanup plan that it would support. Members of the public expressed a similar interest. Starting in April 2014, EPA began meeting with the City with the goal of developing a

new cleanup alternative that might address some of the concerns expressed by the City and the public. The City shared the results of the meetings via a December 2014 press release and a February 2015 public meeting. The City's message was that a consolidation and capping alternative that maximizes reusable space could be beneficial to the City and the surrounding community, that total removal of the waste may not be viable, and that it could support a consolidation and capping alternative that maximizes reusable space. That alternative is Alternative 2D, EPA's Selected Remedy for OU1. EPA first shared the new alternative with the public in draft form during an April 2015 public meeting and in final form at a June 2015 public meeting. Around the time of the release of the Proposed Plan, EPA collaborated with the Kalamazoo River Cleanup Coalition (KRCC), a local stakeholder group, on raising local awareness of the remedy selection process for Allied Landfill. EPA and KRCC worked together to disseminate flyers to residents near OU1 notifying them of upcoming meetings and sharing a list of frequently asked questions. EPA also worked with KRCC in coordinating two informal availability discussion sessions, held by EPA, in addition to the formal Proposed Plan meeting and hearing.

EPA developed Alternative 2D after extensive discussions with MDEQ and the City. Since early 2014, staff from the three entities met in person more than 40 times for the purpose of exploring the potential for a different cleanup alternative than what was included in the November 2013 FS Report. From EPA's perspective, any new alternative needed to have greater long-term protectiveness than the alternatives in the November 2013 FS Report. From the City's perspective, any new alternative would need to allow for the City's intended reuse of the property as a part of their plans to revitalize the Portage Creek Corridor.

On August 21, 2015, the Kalamazoo Mayor sent a letter to the Region 5 EPA Superfund Division Director stating the City's support for Alternative 2D and intent to provide ongoing stewardship at OU1. During the 60-day public comment period on the Proposed Plan, the City provided formal comments, including the following statement: "The City is strongly committed to the ongoing joint stewardship and partnership regarding the Allied Landfill site and surrounding areas. An ongoing partnership with USEPA-Region 5 and the MDEQ will ensure that adequate redevelopment and recreation will be implemented and maintained for the site and the entire Portage Creek Corridor. The City is vitally interested and wishes to be involved with the overall long-term management and local oversight of the Allied Landfill site."

2.4 Scope and Role of Operable Unit or Response Action

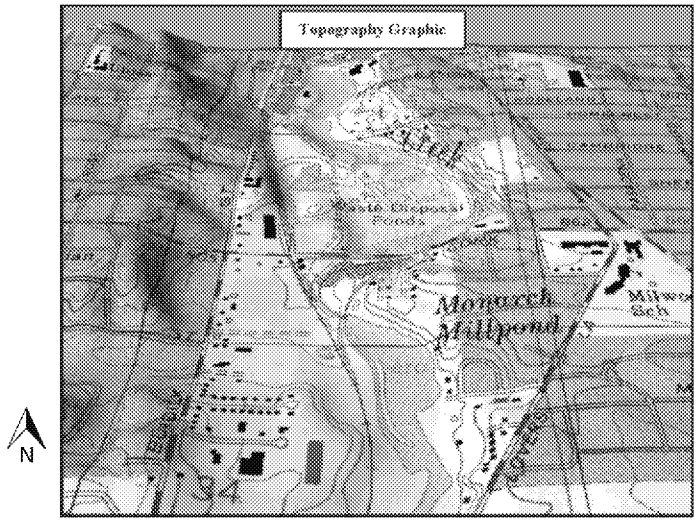
As noted earlier, a TCRA was conducted at OU1 in 1998-1999 to address the Former Bryant Mill Pond Area of OU1, and a series of IRM activities was conducted in the early 2000s to restrict site access and stabilize portions of OU1. The response action described in this ROD is intended to be the final response action for OU1. The other parts of the Site have been or will be addressed by separate response actions, as each OU of the Site is being addressed separately. The schedule for implementation of the Selected Remedy for OU1 is not dependent on response actions at any other Site OUs.

2.5 Site Characteristics

OU1 has been evaluated in the OU1 RI (completed in 2008 by MDEQ, which EPA approved), a 2009 Supplemental Groundwater Investigation (2009 Study[1]), and a 2014 groundwater investigation (2014 Investigation). Significant findings from these reports are discussed below.

Geology/Hydrogeology

OU1 is situated on the floor of a north-south trending valley drained by Portage Creek. The creek empties into the Kalamazoo River approximately 2.25 miles to the north. As shown in the graphic below, the valley is flanked by hills formed from unconsolidated material that rise about 80 feet above creek level to the east and 100 feet above creek level to the west. The graphic below and Figure 3 depict the general topography of OU1 and its environs. Total relief across OU1 is approximately 70 feet, with elevations ranging from 783 feet AMSL near the Alcott Street Dam to 853 feet AMSL at the highest point of the Monarch HRDL. The land surface of OU1 generally slopes toward Portage Creek.



Surface runoff at OU1 is generally directed to Portage Creek. Runoff from the area capped during the IRMs (e.g., the Bryant HRDL and FRDLs) is currently managed through a series of engineered drainage ditches and swales, routed to a settling basin, and discharged to Portage Creek through an engineered outlet.

Geology

[1] The 2009 Study report is included as Appendix A to the OU1 FS Report.

The geologic layers near OU1 generally consist of bedrock overlain by overburden. The bedrock underlying the region near OU1 consists of the Coldwater Shale formation. The surface of the formation, which is estimated at an elevation of 650 to 700 feet AMSL near OU1, slopes downward to the southwest. The formation is greater than 500 feet thick, with bedding dipping toward the northeast. Based on the elevation range provided above, the depth to bedrock beneath OU1 is estimated to be between 100 and 150 feet.

Classified overburden soils in the region fall primarily into the Oshtemo-Kalamazoo-Glendora complex. The geologic units range from nearly level areas of very poorly-drained Glendora soil along Portage Creek to rolling, well-drained areas of Kalamazoo soil and hilly, well-drained deposits of Oshtemo soil on the upland areas. The Glendora series consists of very poorly-drained soils on floodplains along perennial rivers and streams. The soils formed in sandy alluvium. Layers of this soil are highly variable in sequence and thickness within a horizontal distance of a few feet.

Seven units were identified in the upper sand and gravel aquifer at OU1 based on investigatory borings. The units include fill, residuals, peat, sand and gravel, silt, clay, and till. Fill and residuals are not native layers but are the result of historic OU1 activities. Based on slug test data, the hydraulic conductivity of the upper sand unit varies considerably across OU1, ranging between 1.7×10^{-2} to 4.9×10^{-5} centimeters per second (cm/s). As with most clays, the residuals have low permeability when compacted. Based on the results of 10 residuals samples collected from OU1, the measured hydraulic conductivity of the residuals was approximately 1.3×10^{-7} cm/s.

Figures 4 and 5 identify the locations of representative geologic cross sections of OU1. Figure 6 shows cross section B"-B-B'-B"' which runs north-south from the City well field through OU1, as shown in Figure 4. Figure 5 shows the location of two cross sections, B-B' and F-F', which run generally east-west through the landfill; these cross sections are shown in Figure 7 and Figure 8, respectively.

Hydrogeology

The hydrogeology at or near OU1 has been evaluated in the OU1 RI, a 2009 Supplemental Groundwater Investigation (2009 Study[2]), and a 2014 groundwater investigation (2014 Investigation). The results of these studies support the OU1 conceptual site model (CSM) and, specifically, the conclusion that there is no apparent groundwater migration pathway from OU1 to the City well fields. Figure 9 depicts the OU1 CSM and shows exposure routes and transport mechanisms for contaminants of concern (COCs) in soil and water.

The unconsolidated deposits near OU1 vary from approximately 200 to 400 feet thick. Gravelly or sandy deposits with characteristics that allow subsurface water (groundwater) to move through them are typically referred to as "aquifers." Clayey or silty deposits that do not transmit water are referred to as "aquitards" (limited water flow) or "aquicludes" (no water flow). Taken as a whole, the unconsolidated glacial materials beneath OU1

[2] The 2009 Study report is included as Appendix A to the OU1 FS Report.

consist of interbedded aquifers, aquitards, and aquicludes throughout its depth, arrayed in more or less horizontal layers. A consistent clay or silt aquitard or aquiclude beneath OU1 is not present. However, a consistent upward vertical gradient is present at OU1, inhibiting flow to the deep aquifer.

The City well fields provide geologic information for deeper elevations which is not otherwise available near OU1. The City's Millford well fields located to the south show interbedded horizontal layers similar to those at OU1 based on a limited number of data points. The geological units at the City well fields 3 and 7 to the north indicate the presence of relatively consistent materials without interbedded layers. The City well fields 3 and 7 draw from the lowest portion of the aquifer, identified as the deep aquifer at OU1.

The 2009 Study included an evaluation of existing data from OU1, the nearby Strebor property, and the City wellhead protection model. The 2009 Study also included the collection of new groundwater elevation data from OU1 and the Strebor, Panelyte, and Performance Paper properties. The 2009 Study supported the following conclusions:

- Water is not dropping down to the elevation of the City wells, as there is an upward gradient from the lower regional aquifer upward toward the surficial aquifer.
- Shallow groundwater flow in the area is generally to the east (to Portage Creek) and not northwest toward the City well fields. Shallow groundwater from adjacent properties flows to the east and west onto OU1 (see Figures 3 and 5).
- Portage Creek is the point of discharge for shallow groundwater from OU1, further directing groundwater away from the City well fields.

MDEQ generally concurred with the 2009 Study conclusions in an April 16, 2010 letter to EPA, in which MDEQ stated the following:

- Portage Creek appears to be the primary influence on the configuration of the water table surface within OU1. In the main disposal area of OU1, shallow groundwater discharges radially to Portage Creek.
- Shallow groundwater is influenced, although not completely captured, by Portage Creek.
- Due to the upward pressure exerted by the groundwater present in the regional aquifer, the downward flow of groundwater from the surficial aquifer at OU1 to the deeper regional aquifer is highly improbable.

The 2014 Investigation included the installation of monitoring wells on OU1 at depths more consistent with the City well fields. The findings of the 2014 Investigation were consistent with the CSM for OU1 and the findings of the 2009 Study. The general groundwater flow directions established for the CSM were confirmed, with water table flow towards Portage Creek, intermediate and deep zone flows toward the north-northeast, and vertical hydraulic groundwater gradients predominantly upward across OU1 and the neighboring properties. The 2014 Investigation found that a consistent lateral aquitard is not present beneath OU1.

The City raised concerns that contamination from OU1 could migrate to the City well field. As described above, all available data suggest that a flow path from OU1 toward the City well fields is unlikely. This conclusion is based on the presence of a lateral aquitard (the previously-mentioned clay layer) beneath portions of OU1 and an upward vertical hydraulic gradient between the regional aquifer (which is used by the City for potable purposes) and the shallow aquifer at OU1 (which is not classified as a drinking water aquifer).

Further empirical support for the above conceptual understanding was provided by the analytical results from water samples collected by the City from its own production wells. PCBs have never been detected in the City's samples, even at trace levels. Similarly, the 2014 Investigation identified only a single PCB detection in the wells monitored at and around OU1. The well with the detection, MW-8A, is screened immediately below waste material, and the detected concentration was below both the groundwater-surface water interface (GSI) and drinking water protection criteria. There were no PCB detections in perimeter samples located outside the extent of waste material at OU1. Together, the production well data and the 2014 Investigation support the previous findings that PCBs are not migrating off site in groundwater.

Nature and Extent of Contamination

PCBs are being used as the primary indicator to define the extent of contamination at OU1. PCBs are associated with the paper residuals and appear to be the most widespread contaminant at OU1. They are present in soils and sediments due to the residuals eroding and mixing into the soils and/or sediments in certain subareas. Other COCs, including several inorganics, VOCs, and SVOCs, were detected in soils, sediments, and groundwater at OU1 (see Table 3), but appear to be co-located with the PCBs. The RI Report concluded the following:

- Target analyte list inorganic constituents in soils and sediments that exceed criteria appear to be associated with the PCBs identified at OU1.
- Soils with inorganic constituents may be acting as a source, resulting in low-level impacts to the groundwater.
- Target compound list (TCL) VOCs in soils, sediments, and groundwater do not appear to be associated with contaminant impact identified at OU1.
- Detected TCL SVOCs in soils and sediments appear to have a similar distribution to the contaminant impact based on the data set available.
- The groundwater impact of detected SVOCs appears to be much less extensive than the SVOCs in soil at OU1. There were no SVOC exceedances of the screening criteria during the most recent groundwater sampling event.
- Concentrations of TCL pesticides did not exceed screening criteria in any media.

- TCL pesticides were not present in the groundwater at the time of sampling, which is consistent with the soil and sediment data. One pesticide was detected in a leachate sample below screening criteria.
- Soils with visual indicators of paper residuals can be expected to have PCB concentrations.
- During the most recent sampling event, PCBs were detected in several of the groundwater seep monitoring wells located along Portage Creek near the Former Operational Areas, with PCB detections above the GSI screening criteria in two locations.

Because of the co-location of PCBs and the other COCs, addressing the PCB contamination is expected to address the other COCs found at OU1. This will be confirmed with post-excavation confirmation sampling for all OU1 COCs during remedy implementation.

The red dots on Figures 10 and 11 depict the aerial extent of PCB-containing soils and residuals at the surface and subsurface, respectively, at OU1. PCBs are present in concentrations exceeding TSCA and Michigan Part 201 risk-based screening levels in the following areas: the soils and sediments in the Former Operational Areas, the area of the Former Bryant Mill Pond impacted by ongoing seeps, certain Residential Areas east of Portage Creek and certain neighboring Commercial Areas, in groundwater in the Western Disposal Area and Bryant HRDL/FRDLs, and in seeps in the Former Type III Landfill Area adjacent to the Bryant HRDL/FRDLs. The PCB detections in groundwater (3 of 56 monitoring well locations) and seeps (2 of 20 seep locations) in samples collected during the RI (Figure 12) were all co-located within or adjacent to borings that contained residuals. Based on this information, EPA does not believe there is a groundwater plume of PCBs emanating from OU1.

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Soil sample results at OU1 show isolated areas of PCBs with concentrations as high as 2,500 mg/kg. However, the reasonable maximum exposure concentration for the soils and sediments at OU1 is 60 mg/kg. This value is the highest exposure that is reasonably expected to occur at OU1 and was calculated based upon the 95 percent upper confidence limit on the mean PCB concentration in soil, sediment, and residual samples from OU1.

EPA performed a groundwater investigation in 2014 to supplement existing groundwater data collected during the RI and to confirm the CSM presented in the RI Report. PCB results from the 2014 Investigation are shown on Figure 12. Four new monitoring wells were completed to deeper elevations than previously evaluated to verify the vertical extent of contamination. PCBs were detected in 1 of 32 samples and the concentration in that sample did not exceed criteria. The percentage of inorganics detected at concentrations exceeding criteria or background was comparable to that seen during the RI. No detections of VOCs or SVOCs were attributed to the Site.

Data from the 2014 Investigation confirm the CSM presented in the RI Report. PCBs at OU1 are not mobile within the waste and do not readily leach into groundwater.

Fate and Transport

EPA evaluated the following PCB fate and transport mechanisms at OU1:

- PCB transport from surface water runoff and soil erosion;
- PCB transport in groundwater;
- PCB transport in Portage Creek; and
- PCB transport in air.

In general, PCBs are relatively immobile. They are chemically and thermally stable, fairly inert, have low solubility in water, and have a high affinity for solids. Typically, the lower the water solubility of a chemical, the more likely it is to be adsorbed onto solids. With that high adsorption tendency, PCBs have a strong affinity for soils and suspended solids, especially those high in total organic carbon such as the OU1 paper residuals, which are composed primarily of fibrous wood material and clay. The properties of PCBs as they interact with the residuals at OU1 is discussed further in the RI Report.

In addition to organic content, other soil or sediment characteristics such as soil density, particle size distribution, moisture content, and permeability affect the mobility of PCBs. Meteorological and physical conditions, such as precipitation and the presence of organic colloids (micron-sized particles), can also affect the mobility of PCBs. For example, PCBs that are dissolved or sorbed to mobile particulates (for example, colloids) may migrate with groundwater in sediments and soils.

When compacted, the OU1 residuals have a low hydraulic conductivity. The hydraulic conductivity of 10 residuals samples collected from OU1 was approximately 1.3×10^{-7} cm/s, rendering the residuals largely impermeable. As water does not easily flow through the residuals, the opportunities for PCBs to migrate via groundwater are low.

Based on the PCBs' high affinity to adhere to the OU1 residuals and the low hydraulic conductivity of those residuals, the PCBs do not migrate significantly from or through the OU1 residuals. This finding is supported by the near absence of PCB detections in groundwater samples at OU1 and by the lack of vertical and horizontal gradients in soil, sediment, and residual samples.

Surface Water Runoff and Soil Erosion

At portions of OU1 (primarily in the Former Operational Areas), PCBs and other COCs are present in surface soils and surface residuals and are, therefore, exposed to the elements. Because these materials are located at the surface, they may be transported to the floodplain or sediments in Portage Creek by erosion or surface water runoff.

Groundwater

Based upon the RI results and the 2014 Investigation, PCBs do not appear to be migrating in groundwater beyond the waste areas at OU1. PCBs were detected in 3 of 56 monitoring well locations and 2 of 20 seep locations at OU1. Those detections, above screening levels, occurred only in wells screened within or immediately adjacent to the OU1 residuals. This finding supports the conclusion that PCB transport in groundwater is limited within OU1. These data, together with the hydrological conditions described above and the lack of PCB detections in City production wells, demonstrate that a groundwater migration pathway to the City well field does not exist. Discharge of groundwater to the surface water of Portage Creek is viewed as the most significant potential groundwater migration pathway at OU1.

Other COCs found in groundwater at OU1 are primarily inorganic compounds. As described in the BERA, these COCs have a low-level impact to Portage Creek upon discharge. Exceedances of inorganic screening levels in groundwater generally occur within areas where PCBs exceed soil screening levels.

The supplemental groundwater investigation performed in 2014 confirmed that PCBs do not appear to be migrating in groundwater at OU1. The 2014 groundwater data was comparable to data collected during the RI in that exceedances of inorganic screening levels generally occur within areas where PCBs exceed soil screening levels.

Direct Discharge to Portage Creek

The most significant historical source of PCBs from OU1 was the direct or indirect discharge of PCB-containing residuals to Portage Creek and the Bryant Mill Pond. The excavation of PCB-containing sediments, residuals, and soils from the Former Bryant Mill Pond Area, subsequent replacement with clean fill, and the consolidation and capping of those materials in the main body of the landfill area has isolated most of those source materials from direct contact with surface water and removed the largest source of PCBs to Portage Creek. Under current conditions, the remaining potential sources of PCBs to Portage Creek from OU1 are primarily associated with the erosion of contaminated soils and sediments.

Air

Transport of PCBs by air can occur through wind-blown dispersion or volatilization from exposed residuals. An investigation for vapor-phase and particulate-phase PCBs was performed in 1993, when the waste materials in the HRDL and FRDLs were not covered by a cap. PCBs were not detected in any of the airborne particulate-phase samples collected at OU1. Vapor phase PCB concentrations were detected within OU1 above background concentrations, but did not exceed the secondary risk screening levels under Michigan Air Toxic regulations. The subsequent completion of the TCRA and IRMs significantly reduced the area where residuals were exposed at the ground surface. Additionally, as PCBs strongly adhere to organic materials, air transport is not anticipated to be a significant transport mechanism at OU1.

2.6 Current and Potential Future Land and Resource Uses

Land use in the area of Kalamazoo surrounding OU1 varies, with industrial, commercial, municipal, recreational, and residential areas. OU1 lies along Portage Creek. In 2008, the City prepared a redevelopment and reuse plan for the Portage Creek Corridor. That plan calls for a mix of commercial, industrial and residential redevelopment in the area. OU1 Groundwater is not currently in use. This will not change as its use will be restricted as a part of the remedy.

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During discussions described in Section 2.3 of this ROD, the City shared with EPA its intent to redevelop the Allied Landfill property for mixed use. The City has publicly stated its intent to facilitate the redevelopment of OU1 a number of times, beginning with its February 26, 2015 public meeting and most recently its public comment on the OU1 Proposed Plan. The City shared its intent that uncapped portions of the site be redeveloped for commercial or industrial use and capped portions for light recreational use. Along Portage Creek, from Cork to Alcott streets, the City intends to build a bike path that would connect with other paths outside of the OU1 property. As discussed above in Section 2.3, the City is committed to providing or ensuring long-term stewardship at all parts of OU1. There is no known active tribal land use at or near OU1.

2.7 Summary of Site Risks

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This section summarizes the risks to human health and the environment that are posed by the contamination.

Exposure to PCBs is the primary risk driver at OU1. MDEQ, as part of its RI activities, completed a *Site-wide Final (Revised) Human Health Risk Assessment* (HHRA) and *Final (Revised) Baseline Ecological Risk Assessment* (BERA) for the Site in 2003.

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Although MDEQ completed the HHRA for the entire Site, the assumptions made and the scenarios evaluated in the HHRA apply to OU1 as well as the other OUs. This evaluation identified that risks associated with PCB contamination do exist within the Kalamazoo River Study area. The table below summarizes the potential risks to Human Health.

Carcenogenic and Non-carcinogenic Human Health Risks

Receptor	Source	Medium	Chemical	Carcenogenic Range	Non-Carcinogenic Range
Angler	Fish	Fish	Total PCB	6.7E-03 to 4.9E-05	0.87 – 67 (R) 2.9 – 240 (I)
Resident	Floodplain Soils	Floodplain Soils	Total PCB	3.5E-04 to 3.4E-05	0.57-5.8 (R) 2.0-20(I)
Recreational Visitor	Floodplain Soil	Floodplain Soils	Total PCB	3.7E-05 to 3.6E-06	0.066-0.6 (R) 0.26-2.7(I)

(R) – Reproductive endpoint
(I) – Immunological endpoint
Ranges include both average and maximum concentrations.

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The HHRA quantitatively identified potential carcinogenic and non-carcinogenic risks to human health through exposure to media impacted with PCBs, including:

- consumption of fish by recreational and subsistence anglers;
- direct contact with PCB-contaminated materials by residents, recreational users, and construction/utility workers; and
- inhalation of dust and volatile emissions from PCB-contaminated materials.

~~Although MDEQ completed the HHRA for the entire Site, the assumptions made and the scenarios evaluated in the HHRA apply to OU1 as well as the other OUs.~~

The BERA quantitatively identified potential risks to various ecological receptors for different exposure pathways, including:

- direct contact with and ingestion of PCB-contaminated soils, sediments, or paper residuals by animals at OU1; and
- ingestion of PCB-contaminated animals by other animals.

In the BERA, the mink and robin were used to represent aquatic and terrestrial ecological receptors, respectively.

The exposed PCB-contaminated soils, sediments, and paper residuals at OU1 present a human health risk via the direct contact exposure pathway and ingestion of PCB contaminated fish and an ecological risk via direct contact and ingestion pathways. Exposed soils, sediments, and paper residuals currently act as a source of contaminants to Portage Creek via erosion and may result in increased aquatic risk. Additionally, active groundwater seeps at OU1 discharge low levels of PCBs to Portage Creek, likely through the transport of contaminated solids that the seeping liquids mobilize as they vent at the surface. The greatest aquatic risk is to fish, which may consume contaminated sediments, and subsistence anglers that consume contaminated fish.

As described above, The data at the site indicate that PCBs at OU1 are partitioning into, but not ~~EPA does not believe~~ that PCBs at OU1 are migrating in groundwater. In addition, the shallow aquifer is not utilized for drinking water purposes, and zoning ordinances requires all new facilities to receive drinking water from the City's water supply. Other COCs, primarily inorganic compounds, have been identified in groundwater at OU1 and are discharging to Portage Creek. The inorganics are at low levels and appear to be co-located with the PCBs in groundwater, and EPA expects that remediation to address PCB contamination will also address these other COCs.

More details about the risks to human and ecological receptors at OU1 are provided in the OU1 FS Report and the HHRA and BERA.

The key risk management goals established for OU1 are associated with exposure to PCBs in soils and sediments. During the FS, EPA developed and evaluated alternatives to mitigate the risks posed by this contamination. Those alternatives are described in later sections of this ROD. As noted earlier, other COCs have been identified at OU1 and will

be addressed with PCBs during the remedial action. These non-PCB COCs were screened against risk-based Michigan and federal cleanup numbers.

Baseline Human Health Risk Assessment

In addition to fish consumption by anglers, several other potential exposure pathways were described in the 2003 HHRA that are relevant to OU1, as follows:

- *Direct contact with river sediment (by swimmers or waders):* Direct contact exposures to river sediment during recreational activities (e.g., swimming, wading) were determined not to be an important means of exposure to PCBs, based on the Health Consultation prepared by the MDCH. As a result, such exposures were not evaluated further in the BHHRA;
- *Exposure to in-stream surface water (by swimmers or waders):* Due to the relatively low ingestion rates of surface water, the low solubility of PCBs in water, and the low dermal absorption of PCBs, the BHHRA concluded that this pathway could be assumed to be without risk,
- *Exposure to air:* Inhalation of particulates and volatile emissions from exposed floodplain soil and sediment were quantitatively evaluated in the BHHRA, but inhalation of volatile emissions from surface water was not quantitatively evaluated, and
- *Direct contact with floodplain soil and exposed sediment:* A limited number of residential properties are continuous with areas containing residuals, so a residential exposure scenario is appropriate at these residual containing areas. The BHHRA quantitatively evaluated direct contact pathways (dermal contact and incidental ingestion) that may be relevant to residents (the most highly-exposed receptor group) or recreational visitors.

Fish Advisory

MDCH has issued a fish advisory for parts of Portage Creek and the Kalamazoo River, extending from Morrow Lake Dam to Lake Michigan. For the river area from Morrow Lake Dam to the Allegan Dam (which is located in Area 6), and on Portage Creek downstream of Monarch Mill Pond (which is located just upstream of OU1), the advisory currently recommends that the general population not consume carp, catfish, suckers, smallmouth bass or largemouth bass from these areas.

MDCH's fish consumption advisory is only a recommendation, is not legally binding, and has limited effectiveness in protecting human anglers from Kalamazoo and Allegan Counties. A survey from 1994 showed that anglers ate on average two meals per month of various species taken from contaminated reaches of the river, including bass, catfish, panfish, bullheads, and carp. More than 10 percent of anglers ate more than one meal per week of these various species. This survey confirmed that the Kalamazoo River is an important recreational resource and may serve as an important source of food for certain human populations.

BHHRA Conclusions

The likelihood of any kind of cancer resulting from exposure to carcinogens at a Superfund site is generally expressed as an upper bound incremental probability, such as a "1 in 10,000 chance" (expressed as 1×10^{-4}). In other words, for every 10,000 people exposed to the site contaminants under reasonable maximum exposure conditions, one extra cancer may occur as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risk of cancer individuals face from other causes such as smoking or too much sun. The risk of cancer from other causes is estimated to be as high as one in three. The potential for non-cancer health effects is evaluated by comparing an exposure level over a specified time period (such as a lifetime) with a "reference dose" derived for a similar exposure period. A reference dose represents a level that is not expected to cause any harmful effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that the dose from an individual contaminant is less than the reference dose, so non-cancer health effects are unlikely. The hazard index (HI) is generated by adding the HQs for all COCs that affect the same target organ (such as the liver). An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, non-cancer health effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health. EPA's acceptable risk range is defined as a cancer risk range of 1×10^{-6} to 1×10^{-4} and an HI < 1. Generally, RA at a site is warranted if cancer risks exceed 1×10^{-4} and/or if non-cancer hazards exceed an HI of 1.

The BHHRA for the site (including Area 1) presented estimated cancer risks and non-cancer hazards for several populations of anglers consuming fish from the Kalamazoo River and for residential and recreational receptors exposed to floodplain soil adjacent to the former Plainwell, Otsego, and Trowbridge Impoundments.

Risk characterization for anglers was performed for three potential populations: central tendency sport anglers, high-end sport anglers, and subsistence anglers.[3] Two exposure scenarios for the three angler populations were included in the BHHRA. The first assumed a diet of 100 percent pelagic (non-bottom feeding) fish species and the second assumed a mixed species diet (76 percent pelagic species and 24 percent bottom-feeding species).

The BHHRA showed that potential excess cancer risks and non-cancer hazards exceeded acceptable levels for the fish ingestion pathway for all three angler populations. Cancer risks and non-cancer hazards were highest for the subsistence angler (2×10^{-2} and an HI of 123, respectively). Cancer risks and non-cancer hazards were lowest for the central tendency sport angler (3×10^{-4} and an HI of 17, respectively). Adverse health effects associated with PCB exposure include increased risk of liver cancers and reproductive and immunological impairment.

[3] Central tendency sport anglers were estimated to consume an average of 0.015 kg fish tissue/day (24 half-pound meals/year). High-end sport anglers were estimated to consume 0.078 kg fish tissue/day (125 half-pound meals/year). Subsistence anglers were estimated to consume 0.11 kg fish tissue/day (179 half-pound meals/year).

As noted earlier, fish advisories are currently in place to address risks to humans from consumption of fish. There are currently no restrictions in place to control human exposures to sediment, soil, or surface water.

In summary, the fish ingestion pathway poses unacceptable risks and hazards to anglers. Additionally, potential exposure to maximum floodplain soil concentrations may pose unacceptable risks and hazards to residents and recreationists. The highest risks from exposure to floodplain soils are 2- and 25-times lower than those for the central tendency sports angler and subsistence angler scenarios, respectively. The HHRA made assumptions using best professional judgment and available scientific literature on risk assessments.

Baseline Ecological Risk Assessment

As part of the original RI, CDM prepared a baseline ecological risk assessment (BERA) for OU5 that identified terrestrial and aquatic receptors and exposure pathways.

The BERA was conducted to evaluate potential adverse effects to terrestrial and aquatic ecological receptors associated with PCB exposures in surface water, sediment, surface soil, and biota. Representative ecological receptors included aquatic plants, aquatic macroinvertebrates, game fish, forage fish, rough fish, terrestrial invertebrates, small burrowing omnivorous mammals, semi-aquatic herbivorous mammals, small semi-aquatic carnivorous mammals, and top mammalian and avian predators. The BERA evaluated complete exposure pathways that included the following:

- Surface water – direct contact, uptake, ingestion, or ingestion of prey;
- In-stream sediment/interstitial water – direct contact, ingestion, or ingestion of prey; and
- Surface soil/floodplain sediment and soil – direct contact, ingestion, or ingestion of vegetation/prey.

The BERA concluded the following:

- Most aquatic biota, such as invertebrates and fish, are not expected to be adversely affected by direct contact with and ingestion of surface water because of relatively low PCB toxicity to most aquatic biota;
- PCB contamination of surface water and streambed sediment may adversely affect sensitive piscivorous predators, such as mink, through the consumption of PCB-contaminated fish; and
- Terrestrial and semi-aquatic biota are potentially at risk from floodplain sediment and surface soil, depending on life cycle characteristics (e.g., foraging behavior, diet, mobility) and predicted sensitivity to PCBs.

Basis for Action

The response action selected in this ROD is necessary to protect public health, welfare, and/or the environment from actual or threatened releases of hazardous substances into the environment from OU1.

2.8 Remedial Action Objectives

Remedial Action Objectives (RAOs) are general descriptions of the goals to be accomplished through cleanup activities. RAOs are established by considering the medium of concern, the COCs, the acceptable risk range, potential exposure routes, and potential receptors. EPA has identified the following RAOs to address the risks posed by OU1:

- RAO1: Mitigate the potential for human and ecological exposure to materials at OU1 containing COC concentrations that exceed applicable risk-based cleanup criteria.
- RAO2: Mitigate the potential for COC-containing materials to migrate, by erosion or surface water runoff, into Portage Creek or onto adjacent properties.
- RAO3: Prevent contaminated waste material at OU1 from impacting groundwater and surface water.

The Final Remediation Goals (FRGs) for OU1 are identified in Tables 1 and 2 and discussed below. In addition, as part of the Selected Remedy EPA will require that either all residuals that are visually observed in areas subject to excavation are removed or that sufficient sampling occurs to verify that the residuals do not contain PCB or other COC concentrations above the applicable FRGs.

Final Remediation Goals/Cleanup Levels

FRGs are risk-based or ARAR-based chemical-specific concentrations that help further define the RAOs. This ROD establishes the FRGs as cleanup levels. FRGs are also used to define the extent of contaminated media requiring remedial action, and are the targets for the analysis and selection of long-term remedial goals.

EPA selected FRGs for OU1 based on potential exposure pathways, risk assessments, and federal and state ARARs. The FRGs for the PCBs at OU1 are summarized in Table 1. For contaminants other than PCBs, EPA is using ~~updated~~ Michigan Act 451, Part 201, screening criteria and federal drinking water maximum contaminant levels as the FRGs. The FRGs and exposure routes for COCs other than PCBs are shown in Table 2. A summary of the frequency of FRG exceedances for COCs other than PCBs is provided in Table 3.

The BERA and the HHRA developed a series of risk-based concentrations (RBCs) for total PCBs in fish, sediment, and floodplain soil intended to be protective of anglers, recreationists, and residents, while the BERA developed RBCs for sediment and

floodplain soil intended to be protective of sensitive wildlife receptors. The RBCs are calculated, chemical-specific concentrations below which no significant health effects are anticipated for a receptor. For human receptors, the RBCs correspond to a target risk for carcinogenic effects of 1×10^{-5} and a target hazard index of 1 for non-carcinogenic effects. For ecological receptors, the RBCs correspond to a target hazard quotient of 1. RBCs for ecological receptors represent a risk range based on "no observed adverse effect level" and "lowest observed adverse effect level" risk estimates for each receptor group.

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The selection of a sediment FRG for PCBs considered the human health RBC values associated with the human receptors who consume fish. MDEQ and EPA conducted a joint review of available sediment criteria and arrived at a decision for a~~MDEQ conducted an independent evaluation and has recommended~~ a sediment FRG of 0.33 mg/kg for PCBs. MDEQ concluded that this FRG value is appropriate for sediment because it is sufficiently protective of the high-end sport angler. This FRG value also corresponds to MDEQ's historical PCB detection limit that has previously been used as a screening and target level in Michigan, and that has become a precedent value in the State for PCB site cleanup efforts under Michigan's Natural Resources and Environmental Protection Act, Part 201. Further, this FRG is close to the mean background sediment concentration of 0.31 mg/kg at the Site. An FRG of 0.33 mg/kg is protective of ~~both~~ the selected human and ecological receptors. ~~Sediment concentrations below 0.33 mg/kg are not likely to bioaccumulate in fish tissue to levels that present unacceptable risks and hazards to human populations.~~

2.9 Description of Alternatives

EPA developed different remedial alternatives in the FS to address the potential risks at OU1. EPA is required to evaluate a "No Action" alternative as a basis of comparison for the other alternatives. The remedial alternatives that were evaluated in the FS, as amended by the June 2015 FS Addendum that details Alternative 2D, are briefly described below, and the net present value cost for each alternative is provided. A more detailed description of each alternative is provided later in this section of the ROD. More information about cost, including the estimated capital, annual O&M, and periodic cost for each alternative, is provided in the "Cost" portion of Section 2.10 of this ROD.

Alternative 1—No Further Action

- No action would be taken to address the risks from OU1;
- No implementation time required; and
- Net present value cost of $110,000.

Alternative 2A—Consolidation of Outlying Areas on the Bryant HRDL/FRDLs, Former Type III Landfill, Western Disposal Area, and consolidation at Monarch HRDL. This alternative includes the following major components:

- Excavate Outlying Areas and certain Operational Subareas (see *Common Elements* discussion below for more details);

- Excavate and pull back perimeter around Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Excavate and pull back the creek-side edge of Monarch HRDL to achieve non-residential soil FRG of 10 mg/kg PCBs; where hydraulically connected to Portage Creek, set-back areas would achieve 0.33 mg/kg sediment FRG for PCBs to be protective of human consumption of fish;
- Consolidate excavated material on the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Backfill Outlying Areas to original grade after excavation and restore paved areas that require removal during the remedial action;
- Install cap on Bryant HRDL/FRDLs, Former Type III Landfill, Western Disposal Area, and Monarch HRDL;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 part per million (ppm);
- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;
- Implement restrictive covenant(s) in capped areas to prohibit interference with the cap and fences and to prohibit groundwater use;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Monitor groundwater to verify effectiveness of remedy;
- Implementation time: 2 years; and
- Net present value cost of $44,000,000.

Alternative 2B—Consolidation of Outlying Areas and Monarch HRDL on the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area. This alternative includes the following major components:

- Excavate Outlying Areas and certain Operational Subareas (See *Common Elements of Alternatives* discussion below for more details);
- Excavate Monarch HRDL to achieve non-residential soil FRG of 10 mg/kg PCBs; areas hydraulically connected to Portage Creek would achieve 0.33 mg/kg sediment FRG for PCBs to be protective of human consumption of fish;
- Excavate and pull back perimeter around Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Consolidate excavated material on the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Backfill Outlying Areas to original grade after excavation and restore paved areas that require removal during the remedial action;

- Install cap on Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 ppm;
- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;
- Implement restrictive covenant(s) in capped areas to prohibit interference with the cap and fences and to prohibit groundwater use;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Monitor groundwater to verify effectiveness of remedy;
- Implementation time: 2 years; and
- Net present value cost of $43,000,000.

Alternative 2C—Consolidation of materials from Outlying Areas and Monarch HRDL with PCB concentrations of 500 mg/kg or less on the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area, and off-site incineration of excavated soils/sediments with PCB concentrations greater than 500 mg/kg. This alternative includes the following major components:

- Excavate Outlying Areas and certain Operational Subareas (See *Common Elements of Alternatives* discussion below for more details);
- Excavate Monarch HRDL to achieve non-residential soil FRG of 10 mg/kg PCBs; areas hydraulically connected to Portage Creek would achieve 0.33 mg/kg sediment FRG for PCBs to be protective of human consumption of fish;
- Excavate and pull back perimeter around Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Transport all excavated materials with PCB concentrations greater than 500 mg/kg off site for incineration;
- Consolidate excavated materials with PCB concentrations of 500 mg/kg or less on Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Backfill Outlying Areas to original grade after excavation and restore paved areas that require removal during the remedial action;
- Install cap on Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 ppm;

- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;
- Implement restrictive covenant(s) in capped areas to prohibit interference with the cap and fences and to prohibit groundwater use;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Monitor groundwater to verify effectiveness of remedy;
- Implementation time: 2 years; and
- Net present value cost of $70,000,000.

Alternative 2D—Consolidation of Outlying Areas, Monarch HRDL and Portions of the Operations Areas into a Reduced Footprint on the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area. This alternative includes the following major components:

- Excavate the Outlying Areas, the Monarch HRDL, and portions of the Bryant HRDL/ FRDLs, Former Type III Landfill, and Western Disposal Area to achieve non-residential soil FRG of 10 mg/kg PCBs; areas hydraulically connected to Portage Creek to achieve 0.33 mg/kg sediment FRG for PCBs to be protective of human consumption of fish. (See *Common Elements of Alternatives* discussion below for more details);
- Consolidate excavated material into a reduced footprint within the on-site disposal areas (as necessary) to create a protective setback and developable area along the creek;
- Backfill Outlying Areas to original grade after excavation and restore paved areas that require removal during the remedial action. Backfill excavated areas in the Operations Areas to 1 foot above the water table and revegetate to prevent erosion of these areas;
- Install cap over the consolidated materials;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 ppm;
- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;
- Implement restrictive covenant(s) in capped areas to prohibit interference with the cap and fences and to prohibit groundwater use;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Monitor groundwater to verify effectiveness of remedy;
- Implementation time: 3 years; and
- Net present value cost of $63,000,000.

Note regarding Alternatives 2A, 2B, 2C, and 2D: Groundwater monitoring is included in all of the alternatives that leave waste in place and/or consolidated on site. Monitoring would include upgradient and downgradient wells to determine if COCs are migrating off site. Additionally, for each of the Alternative 2 options, the following two sub-alternatives were considered:

- Sub-alternative (i)—Groundwater collection and treatment, which includes a system of extraction wells or trenches installed downgradient to capture groundwater before discharge to Portage Creek; and
- Sub-alternative (ii)—Slurry wall installed downgradient of groundwater flow along with extraction wells or trenches to prevent groundwater mounding behind the slurry wall.

Alternative 3—Total Removal and Off-site Disposal. This alternative includes the following major components:

- Excavate Outlying Areas and All Operational Areas to achieve appropriate FRGs;
- Transport all materials above FRGs off site for disposal;
- Backfill excavation to above water table elevations in Operational Areas and to original grade in the Outlying Areas;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 ppm;
- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Implementation time: 5 years; and
- Net present value cost of $238,000,000.

Alternative 4—Encapsulation Containment System. This alternative includes the following major components:

- Excavate Outlying and all Operational Areas and stockpile the excavated materials;
- Line bottom of OU1 with a 3-foot compacted clay liner (or geosynthetic equivalent) beneath two 40-mil FMLs. A leachate collection and monitoring system would be constructed between the FML layers;
- Consolidate excavated materials within the lined OU1 area;
- Install cap on consolidated materials within the lined OU1 area;
- Implement restrictive covenant(s) to limit residential use in areas at which PCBs remain above 1 ppm;
- Implement restrictive covenant(s) to prevent disturbance of contaminated material under building foundations without EPA approval;

- Implement restrictive covenant(s) in capped areas to prohibit interference with the cap and fences and to prohibit groundwater use;
- Mitigate any filled wetlands and implement restrictive covenant(s) to ensure that wetland areas are not disturbed in the future;
- Monitor groundwater to verify effectiveness of remedy;
- Implementation time: 10 years; and
- Net present value cost of $159,000,000.

Common Elements of Alternatives

All alternatives except Alternative 1 (No Further Action) include pre-design investigations with sampling of soil, sediments, and residuals to further delineate the nature and extent of PCBs exceeding the relevant FRGs in certain subareas of OU1. Each alternative except Alternative 1 includes excavation of soil and sediment above respective FRGs in Outlying Areas and in certain subareas of the Operational Areas. Based on the RI, it is assumed that by addressing PCBs, other COCs would also be addressed. Confirmation sampling for PCBs and other COCs would be performed during the implementation of the remedial action to verify that respective FRGs have been achieved.

Certain Operational Subareas

Portions of the following subareas are contiguous and listed with the Operational Areas due to encroachment of waste material from the various disposal areas. However, the following subareas are discussed separately from the Bryant HRDL/FRDLs, Former Type III Landfill, and Western Disposal Area, due to the FRGs and proposed approach envisioned for Alternatives 2 through 4:

- **Former Raceway Channel**—Sediments exceeding the FRG of 0.33 mg/kg PCBs would be excavated. After confirmation samples indicate the 0.33 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the wetlands would be restored and an environmental covenant would be implemented to maintain the wetlands.
- **Panelyte Property**—Waste materials are believed to have encroached onto the southern portion of the Panelyte Property, including Panelyte Marsh, from the Western Disposal Area. Soils exceeding the FRG of 10 mg/kg PCBs would be excavated. After confirmation samples indicate the 10 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material. A restrictive covenant would be required to prohibit residential use of this area.
- **Panelyte Marsh**—Sediments exceeding the FRG of 0.33 mg/kg PCBs would be excavated. After confirmation samples indicate the 0.33 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the wetlands would be restored and an environmental covenant would be implemented to maintain the wetlands.
- **Conrail Property**—Waste materials are believed to have encroached onto the eastern portion of the Conrail Property from the Western Disposal Area. Soils exceeding the

FRG of 10 mg/kg PCBs would be excavated. After confirmation samples indicate the 10 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material. A restrictive covenant would be required to prohibit residential use of this area.

- **State of Michigan Cork Street Property**—Waste materials are believed to have encroached onto the Cork Street Property from the Monarch HRDL. Soils exceeding the FRG of 10 mg/kg PCBs would be excavated. After confirmation samples indicate the 10 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material. A restrictive covenant would be required to prohibit residential use of this area.

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- **Residential Properties (Outlying)**—Soils exceeding the FRG of 1 mg/kg PCBs would be excavated. After confirmation samples indicate the 1 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material.
- **Commercial Properties (Outlying)**—This area includes the Alcott Street Parking Lot, Former Filter Plant, Goodwill property, former Bryant Mill property, and Consumers Power property. Soils exceeding the FRG of 10 mg/kg PCBs would be excavated. After confirmation samples indicate the 10 mg/kg PCB FRG and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material. Subareas achieving PCB concentrations between 1 mg/kg and 10 mg/kg would require restrictive covenants preventing residential use. Where there are buildings that serve to mitigate direct contact but hinder the ability to remove impacted materials, restrictive covenants would be employed that would prevent disturbance of contaminated material under building foundations without EPA approval. Parking lots would be investigated and excavated to meet FRGs, as necessary.
- **Former Bryant Mill Pond Area (Outlying)** — Soils in the Former Bryant Mill Pond and sediment in the associated wetland area may have been impacted by the PCB-contaminated seeps. Soils exceeding the FRG of 10 mg/kg PCBs, floodplain soils exceeding the FRG of 6.5 to 8.1 mg/kg PCBs, and sediments exceeding the FRG of 0.33 mg/kg PCBs would be excavated. After confirmation samples indicate the respective FRGs for PCBs and the FRGs for other COCs have been achieved, the excavation would be backfilled with clean material. Wetlands were previously delineated in the Former Bryant Mill Pond Area, and at least 1 acre of wetland would be mitigated for each acre filled. An environmental covenant would be implemented to ensure that wetland areas are not disturbed in the future.

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- **Wetland Areas**—Known wetland areas were discussed above with the associated subareas. However, if additional wetland areas with suspected PCB impacts are identified within the Outlying Areas discussed above or Operational Areas during the pre-design investigation, the wetlands would be investigated for PCBs. Sediments exceeding the FRG of 0.33 mg/kg PCBs would be excavated. After confirmation samples indicate the 0.33 mg/kg PCB FRG and the FRGs for other COCs have been achieved, any filled wetlands would be mitigated as appropriate and an environmental covenant would be implemented to maintain the wetlands.

- **Floodplain Soils**—Known floodplain soils within the Outlying or Operational Areas were discussed with the associated subareas. However, if additional floodplain soils with suspected PCB impacts are identified within the Outlying or Operational Areas during the pre-design investigation, the area would be remediated for PCBs. Floodplain soils exceeding the FRG of 6.5 to 8.1 mg/kg PCBs would be excavated and then backfilled with clean material.
- **Sheet Pile Wall**—Except for Alternative 1, the partial or complete removal of the existing sheet pile wall along the western bank of Portage Creek would be evaluated as a component of each alternative.
- **Groundwater Monitoring**—Alternatives 2A, 2B, 2C, 2D, and 4 include a robust groundwater monitoring program to measure remedy performance, including monitoring wells located between the border of OU1 and the City's well field that supplies drinking water. EPA would use this groundwater monitoring to determine whether the remedy effectively prevents the contaminated waste materials from impacting any groundwater or surface water leaving OU1. If the groundwater monitoring data indicates that the remedy is not effective and a groundwater plume has developed, EPA would develop and implement a separate groundwater remedy for OU1 as appropriate. However, at this time, there is no reason to believe that a future groundwater remedy will be needed.
- **Post-removal confirmatory sampling and analysis** would be performed at the excavation areas.

Detailed Description of Alternatives

Alternative 1—No Further Action

The NCP requires EPA to evaluate a No Further Action alternative when evaluating remedial options. The No Further Action alternative serves as a baseline against which the other potential remedial alternatives are compared. Under this alternative, no further active remediation would be performed in any portion of OU1. The costs associated with this remedy are from conducting the Five Year Review, which would be required as this alternative leaves waste in place. The potential for human and ecological receptors to be exposed to COCs would not be addressed, and a potential would remain for COCs to erode into Portage Creek over time because there would be no maintenance of the existing fence, cap, soil cover, or other engineered control systems put in place as part of the interim remedial measures. Operation of the groundwater collection/treatment system would also be discontinued.

Alternative 2—Consolidation and Capping

The primary element of Alternative 2 is the excavation of contamination above FRGs from certain areas of OU1 and in-place containment of the excavated materials on other portions of OU1. The Residential Properties (Outlying), the impacted portion of the Former Bryant Mill Pond Area, the Commercial Properties (Outlying), and portions of the Former Operational Areas would be excavated. The excavated materials would be consolidated on the Bryant HRDL/FRDLs area, the Former Type III Landfill area, and

Western Disposal Areas, and if Alternative 2A were selected, the Monarch HRDL area. The areas used for consolidation would be covered with an engineered composite cap. The landfill would be constructed with appropriate erosion controls and other measures to protect against floods and other natural or human-induced incidents that might otherwise threaten the integrity of the disposal areas. As discussed below, four variations of Alternative 2 were developed to allow for variations in the material excavated and consolidation locations and methods.

Excavation along the perimeter of the Former Operations Areas would create a setback that would act as a protective buffer along Portage Creek and enhance long-term slope stability. All of the Alternative 2 options include long-term inspections and maintenance of the existing and newly-installed, engineered landfill caps and any remaining sheet pile. A long-term monitoring program would be implemented to verify the performance of the remedy, demonstrate that groundwater quality conforms to FRGs (Tables 1 and 2), and provide the appropriate management of landfill gas.

For the purpose of cost estimating, EPA assumed the cap would consist of six layers as shown in Figure 13. The layers are (from bottom to top): a non-woven geotextile, a 12-inch-thick (minimum) sand gas venting layer, a 30-millimeter polyvinyl chloride FML or equivalent (permeability less than 1×10^{-10} centimeters per second), a geosynthetic drainage composite layer, a 24-inch-thick (minimum) drainage and soil protection layer, and a 6-inch-thick (minimum) vegetated, topsoil layer. The cap design contains the landfill cap components required under Michigan's Natural Resources and Environmental Protection Act (NREPA), as amended, Part 115.

The existing sheet pile wall would be evaluated during the remedial design to determine whether it can be removed completely or is required to stabilize the base of the consolidation area on the side closest to Portage Creek. If the wall is required for stabilization, the wall would be cut off at ground surface and, if necessary, individual panels would be removed to allow groundwater flow to the creek, eliminating the need for the existing groundwater collection and treatment system, which would then be removed.

A groundwater monitoring network consisting of existing and new monitoring wells would be located outside the consolidation areas, included in the setback between Portage Creek and the consolidation area(s). The groundwater monitoring plan would also evaluate upgradient groundwater concentrations to determine local background conditions. For the purposes of cost estimating, EPA assumed that 24 monitoring wells would be installed under Alternative 2A, and 20 monitoring wells would be installed under Alternatives 2B, 2C, and 2D. The setback would also allow room for a groundwater collection and treatment system to be installed, if necessary, based on future groundwater sampling.

All of the Alternative 2 options include sub-alternatives for hydraulic control of groundwater. For sub-alternative (i), a groundwater collection and treatment system would be installed. This system would consist of groundwater extraction wells and a series of sumps and lateral drain lines. Sub-alternative (ii) would include the same groundwater

collection and treatment system as sub-alternative (i), but would also include a grout slurry wall. The grout slurry wall would be installed downgradient of the Bryant HRDL/FRDLs and Monarch HRDL (if left in place) to contain impacted groundwater located within OU1. The slurry wall would extend approximately 40 feet below ground surface based on the current sheet pile wall location. The slurry wall would not necessarily key into clay or bedrock; portions of the slurry wall at this depth would terminate in the upper sand zones.

Alternative 2 includes restrictive covenants to prevent exposure to PCBs after consolidation and to prohibit interference with the remedy. Alternative 2 also includes informational devices, access restrictions consisting of a perimeter fence for Alternatives 2A, 2B, and 2C, and warning signs to deter access to the property. More limited fencing would be present under Alternative 2D, primarily around mechanical components of the remedy such as the gas collection system.

Any areas subject to excavation would potentially be available for redevelopment after implementation of the remedy. Placement of additional fill to reach desired grade for redevelopment, or other enhancements to promote redevelopment, are not included as part of Alternative 2. Provided that additional material is placed upon the required soil protection layer, the landfill may be available for some types of recreational reuse.

Alternative 2A—Consolidation of Outlying Areas on Former Operational Areas, including the Monarch HRDL

Under Alternative 2A, the excavated material from the Outlying Areas and perimeter areas of the Operational Areas would be consolidated on the Former Operational Areas, and materials at the Monarch HRDL would be consolidated at Monarch. The areas targeted for excavation and consolidation are shown in Figure 14. After consolidation, each consolidation area would be covered with an engineered composite cap as described above.

Alternative 2B—Consolidation of Outlying Areas and the Monarch HRDL on Former Operational Areas

Under Alternative 2B, the excavated material from the Outlying Areas and certain perimeter areas of the Former Operational areas would be consolidated on the Former Operational Areas. The Monarch HRDL would also be excavated and consolidated on the Bryant HRDL/FRDLs landfill. The areas targeted for excavation and consolidation are shown in Figure 15. After consolidation, the areas used for consolidation would be covered with an engineered composite cap as described above.

Alternative 2C—Consolidation of Outlying Areas and the Monarch HRDL on Former Operational Areas, with Off-site Incineration of Excavated Materials with PCB Concentrations Greater than 500 mg/kg

The extent of excavation and the consolidation areas are the same for Alternative 2C as under Alternative 2B and are shown in Figure 15. Excavated materials with PCB concentrations greater than 500 mg/kg would be transported off site for incineration. The remaining excavated materials with PCB concentrations of 500 mg/kg or less would be consolidated on the Former Operational Areas and covered with an engineered composite cap as described above.

A pre-design investigation would be used to identify materials exceeding 500 mg/kg PCBs within the areas to be excavated. For cost-estimating purposes, EPA assumed that approximately five percent of the soils excavated from the pullback area near the Western Disposal Area and Former Type III Landfill would require off-site incineration, and that approximately two percent of soils excavated from the Outlying Areas, Monarch HRDL, and the setback between Portage Creek and Former Operational Areas would require off-site incineration. These assumptions were based on a statistical evaluation of the existing sampling data.

Alternative 2D—Consolidation of Outlying Areas, Monarch HRDL, and Portions of the Operations Areas into a Reduced Footprint on the Former Operational Areas

Alternative 2D includes the excavation of material above FRGs from the Outlying Areas, the Monarch HRDL, portions of the Bryant HRDL/ FRDLs, Former Type III Landfill, and Western Disposal Area, and consolidation into an on-site landfill encompassing 27

acres as shown in Figure 16. The resulting height of the landfill is estimated at an additional 41 feet above existing grade. The majority of the landfill would have side slopes of 4:1 (vertical:horizontal) with slopes at the top ranging from 6:1 to 10:1. After consolidation, the landfill would be covered with an engineered composite landfill cap as described above.

A pre-design investigation would be performed and would include a geotechnical investigation to evaluate the COC-containing materials that are currently in place or that would be consolidated. Features for stabilization of the landfill materials and slopes would be included in the design, as necessary, based on the investigation results. For cost estimating purposes, stormwater management and erosion control measures are assumed to consist of two bench drains, riprap, culverts, and piping before discharging to two 1-acre stormwater detention ponds. As Alternative 2D contemplates possible reuse of OU1 with resulting potential receptors nearby, an active landfill gas collection system would be included to collect landfill gasses to prevent migration and eliminate or reduce the ~~or~~ accumulation of landfill gases that could compromise the cap.

Alternative 3—Total Removal and Off-site Disposal

The primary element of Alternative 3 is the excavation and off-site disposal of all contaminated areas of OU1 as shown in Figure 17. The excavation areas would include the following:

- All Outlying Areas other than that portion of any property that may be covered by buildings; and
- Former Operational Areas, along with portions of contiguous properties to which waste materials may have encroached from the Former Operations Areas, including portions of the Panelyte Property, the Conrail Railroad Property, and the State of Michigan's Cork Street Property.

Materials would be excavated and transported directly to off-site commercial landfills. Materials with PCB concentrations of 50 mg/kg or greater would be transported to and disposed of at approved off-site landfills permitted to receive TSCA-regulated wastes. Materials with PCB concentrations less than 50 mg/kg would be transported to and disposed of at other permitted and approved landfills. Excluded from removal at this time are any PCB-containing materials that may be located under existing buildings. EPA would seek to have environmental covenants placed on such properties to prohibit disturbance of those materials without the consent of EPA. Therefore, such materials would be addressed if and when construction occurs at those locations.

Once cleanup goals have been achieved, the excavated areas would be backfilled with clean material, graded to mitigate ponding, and revegetated or otherwise restored to match the surrounding areas. The excavated and backfilled area would extend across approximately 65 acres.

Appropriate mitigation would be applied to any wetlands filled during the remedy, including, as appropriate, the Panelyte Marsh and the Former Monarch Raceway Channel. EPA would seek restrictive covenants to ensure that wetlands are not disturbed in the future.

Alternative 3 would include the removal of the sheet pile along the western bank of Portage Creek to the extent feasible. The existing groundwater treatment system would be decommissioned and removed, and the network of groundwater extraction trenches, sumps, and wells currently in place behind the sheet pile wall would be removed and disposed.

This alternative includes the removal of all material containing COCs above OU1 FRGs. However, if it is not feasible to remove some of the material, groundwater monitoring would be performed in areas where materials remain above cleanup levels to ensure that any remaining contamination does not contribute to groundwater contamination. Monitoring would be performed as described in Alternatives 2 and 4. EPA would seek restrictive covenants to prohibit disturbance of those materials without the consent of EPA for any areas where COCs are left in place above FRGs.

Alternative 4—Encapsulation Containment System

The primary element of Alternative 4 is the full encapsulation of impacted materials on site as shown in Figure 18. This alternative includes the following activities:

- Excavation of approximately 1,600,000 yd^3 of soil and/or sediment containing PCBs above the relevant FRGs;
- Sequential stockpiling of excavated materials on site during construction of a series of landfill containment cells in the locations of the current Former Operational Areas;
- Construction of a landfill bottom liner in the excavated Former Operational Areas. For cost estimating purposes, EPA assumed that the base of the liner would consist of a 3-foot compacted clay liner (or geosynthetic equivalent) beneath two 40-mil FMLs, and that a leachate collection and monitoring system would be constructed between the FML layers;
- Consolidation of the excavated materials on the newly-constructed landfill liner;
- Construction of an engineered composite landfill cap over the new landfill areas (as described in Alternative 2, except for having a 40-mil FML); and
- Depending on the capacity of the new landfill areas, some materials may need to be sent to off-site commercial landfills for disposal.

In the Outlying Areas, once excavation has been completed, the excavated areas would be backfilled with clean material, graded to mitigate ponding, and revegetated or otherwise restored to match the surrounding area. Appropriate mitigation would be applied to any wetlands filled during the remedy, including, as appropriate, the Panelyte Marsh and the Former Monarch Raceway Channel.

For purposes of illustration, the work in the Former Operational Areas could potentially be carried out in the following manner:

- Excavate soils from the Monarch HRDL and temporarily stage the soils in the Western Disposal Area. Backfill the Monarch HRDL with approximately 10 feet of clean fill to establish the base liner four feet above the water table for the disposal cell. Construct the base liner, transport approximately 75 percent of the excavated Monarch HRDL soils back to the Monarch cell; place, grade, and compact the soils; and construct the final cap. The remaining 25 percent of soils volumetrically displaced would be transported off site for disposal;
- Repeat the above process for the Bryant HRDL/FRDLs and the Former Type III Landfill;
- Repeat the above process for the western half of the Western Disposal Area, but without constructing the final cover system; and
- Complete the process for the eastern half of the Western Disposal Area, followed by construction of the final cover system over the entire Western Disposal Area.

The containment system disposal cells would be designed and built to include a double composite base liner system constructed a minimum distance of 10 feet above the groundwater table and graded to a minimum slope of 2 percent to promote drainage. For the purposes of cost estimating, it was assumed the base liner system would consist of the following components, from top down: a 40-mil primary FML, underlain by a geosynthetic clay liner (GCL), a leachate collection system consisting of a geosynthetic drainage composite (GDC) layer draining to a pumpable sump system, a leak detection system, a secondary 40-mil FML, and a secondary 3-foot compacted clay liner (or geosynthetic equivalent). The GCL would have a maximum hydraulic conductivity of 1×10^{-7} cm/s, and the GDC would have a minimum transmissivity of 3×10^{-4} square meters per second.

The disposal cells would have a cap sloped to grades of no less than four percent and consisting of the following components, from top down: a 6-inch vegetative soil layer, a 24-inch-thick (minimum) drainage and soil protection layer, a GDC, a 40-mil FML, a GCL, a non-woven needle-punched geotextile, a minimum 12-inch gas-venting layer with gas vents at appropriately spaced intervals, a basal non-woven needle-punched geotextile, and a soil grading layer. The disposal cells would be constructed with appropriate erosion controls and other measures to protect against flood events and other natural or human-induced incidents that might otherwise threaten the integrity of the disposal cells. The final cover system would cover approximately 50 acres.

Under this alternative, approximately 500,000 yd^3 of materials would have to be transported off site for disposal because not all of the material will not fit in the containment cells (the height of the cells is limited by the desired side-slope grade). Materials with PCB concentrations of 50 mg/kg or greater would be transported to and disposed of at approved off-site landfills permitted to receive TSCA-regulated wastes.

Materials with PCB concentrations less than 50 mg/kg would be transported to and disposed of at other permitted and approved landfills as appropriate. Excluded from removal are the PCB-containing materials that may be located under existing buildings. EPA would seek to have environmental covenants placed on such properties to prohibit disturbance of those materials without the consent of EPA. Excavated areas would be backfilled with clean material, graded, and revegetated or otherwise restored to match the surrounding areas. The excavated and backfilled area would extend across approximately 65 acres.

This alternative would include evaluation of the removal of the sheet pile along the western bank of Portage Creek. The need to leave portions of the sheet pile wall in place for landfill slope and bank stability would be further evaluated in the remedial design. The potential for groundwater mounding behind the wall would also be evaluated. The existing groundwater treatment system would be decommissioned and removed, and the network of groundwater extraction trenches, sumps, and wells currently in place behind the sheet pile wall would be removed and disposed.

Under Alternative 4, EPA would establish the same type of groundwater monitoring system as described for Alternative 2.

2.10 Summary of Comparative Analysis of Alternatives

Section 121(b)(1) of CERCLA presents several factors that EPA is required to consider in its assessment of alternatives. Building upon these specific statutory mandates, the NCP articulates nine evaluation criteria to be used in assessing the individual remedial alternatives. The purpose of this evaluation is to promote consistent identification of the relative advantages and disadvantages of each alternative, thereby guiding selection of remedies offering the most effective and efficient means of achieving site cleanup goals. While all nine criteria are important, they are weighed differently in the decision-making process depending on whether they evaluate protection of human health and the environment or compliance with federal and state ARARs (threshold criteria), consider technical or economic merits (primary balancing criteria), or involve the evaluation of non-EPA reviewers that may influence an EPA decision (modifying criteria).

This section of the ROD evaluates each alternative against the nine evaluation criteria and notes how each compares to the other alternatives under consideration. The nine criteria are divided into three groups: threshold, balancing, and modifying criteria. Alternatives that do not meet the threshold criteria are not considered further. In addition to the narrative discussion below, a summary of the comparative analysis of alternatives with respect to the threshold and balancing criteria is presented in Table 5. More details regarding the evaluation and comparison of the cleanup alternatives against the nine criteria can be found in the OU1 FS Report and FS Addendum.

Threshold Criteria

1. Overall Protection of Human Health and the Environment

This criterion assesses how well the alternatives achieve and maintain protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

Alternative 1 would provide no improved protection over the current conditions, would provide no risk reduction, would not be protective of human health or the environment, and would not achieve RAOs.

Alternatives 2, 3, and 4 would all be protective of human health and the environment as long as all elements of the remedy, including O&M and monitoring, are properly carried out and maintained. These alternatives would achieve the RAOs that have been established for OU1.

Alternatives 2, 3, and 4 each achieve protectiveness through excavation of contaminated soils, with consolidation on site beneath a landfill cap (Alternatives 2 and 4) or off-site disposal (Alternative 3) to prevent direct contact and contaminant transport, via erosion and runoff. Alternative 2C includes an off-site incineration component for the most-contaminated excavated soils. Alternative 3 includes complete removal and off-site disposal to eliminate the potential for exposure. When comparing Alternatives 2 and 4, Alternative 2D features the largest setback from Portage Creek and therefore has the lowest potential among these alternatives for recontamination of Portage Creek in the event of failure of the landfill.

Under current conditions, PCBs are not migrating outside the disposal areas via groundwater. Alternatives 2 and 4 each further mitigate the potential for groundwater transport through capping, which would prevent infiltration of surface water through the consolidated soils. Alternative 4 includes the installation of a bottom liner beneath the waste materials. However, gHowiven the site conditions – specifically the impermeability of the waste and upward flow of groundwater – Alternative 4 may not be significantly more protective than Alternative 2.

The few groundwater and seep samples that had elevated PCB concentrations were generally located in areas of OU1 that were not addressed by IRMs. These previously-unaddressed areas would be addressed by Alternatives 2, 3, and 4, which would reduce the risk posed by those pathways. Alternative 3 includes complete removal and off-site disposal to eliminate the potential for contaminant transport through seeps and groundwater.

As noted earlier, EPA analyzed groundwater data collected at and around OU1 and concluded that PCBs at concentrations that pose a risk are not migrating off site via groundwater. For this reason, EPA believes that groundwater sub-alternatives (i) and (ii)

are not necessary for the Alternative 2 options to be protective, because the addition of those systems would not significantly increase overall protectiveness.

2. Compliance with Applicable or Relevant and Appropriate Requirements

This criterion assesses how the alternatives comply with regulatory requirements. Federal and state regulatory requirements that are either applicable or relevant and appropriate are known as ARARs. Only state requirements that are more stringent than federal requirements are ARARs. The potential ARARs for OU1 were identified during the FS and were included in the FS Report and FS Addendum. The final ARARs for OU1 are provided in Table 6.

Alternative 1 would not comply with ARARs because it would not prevent stormwater or venting groundwater discharges to Portage Creek, in violation of Parts 31 and 201 of Michigan's NREPA.

Alternatives 2, 3, and 4 would all meet ARARs, as discussed below.

Alternatives 2 and 4 would rely on a risk-based method to address PCBs under TSCA and 40 C.F.R. § 761.61(c). The Selected Remedy, Alternative 2D, would not pose an unreasonable risk of injury to human health or the environment pursuant to 40 C.F.R. § 761.61(c) for the following reasons:

a) The residential and non-residential FRGs for PCBs listed in Table 1 are more stringent than the numbers from the HHRA or Michigan Part 201 which would otherwise be applied at OU1. Additionally, excavation of visually-observed residuals in uncapped areas will eliminate the exposure to virtually all of the PCBs in those areas. This is based upon the RI data, as PCB contamination at OU1 is closely correlated to the presence of residuals. Therefore, application during excavation of the FRGs listed in Table 1 will result in no unreasonable risk.

b) The cap, which is detailed in the Alternative 2 descriptions within Section 2.9, would be constructed over those areas in which excavated material would be consolidated. The cap would meet RAOs by eliminating direct contact exposure hazards, preventing erosion and runoff of contaminated materials and minimizing infiltration[4] of precipitation through the landfill and subsequent migration of residuals or leachate from the landfill. Given the nature of the OU1 waste – specifically that it is impermeable and that PCBs do not readily migrate from it – installation of the cap over the consolidated, contaminated materials would result in no unreasonable risk.

c) Institutional controls would be implemented at the on-site consolidated landfill areas and at any Outlying Areas where contaminated materials could not be completely excavated. The institutional controls would serve to prevent actions

[4] The landfill cap for Alternative 2 and Alternative 4 includes a polyvinyl chloride FML or equivalent with a permeability less than 1×10^{-10} cm/s.

that might result in direct contact with the contaminated materials that remain. Restrictive covenants would be implemented to protect caps, fences, and other remedy components, and to prohibit residential use in certain areas.

Alternative 3 would comply with TSCA and 40 C.F.R. § 761.61 through complete removal and off-site disposal of PCB-contaminated materials.

Alternatives 2, 3, and 4 would comply with wetlands ARARs because compensatory wetland mitigation would be provided, as necessary, in accordance with the Federal Mitigation Rule set forth at 40 C.F.R. § 230.94(c)(2-14) for any wetlands that are filled during remediation.

Under Alternatives 2 and 4 (and Alternative 3 as necessary), groundwater samples would be collected and analyzed from the shallow and lower aquifers in order to monitor the effectiveness of the remedy. Groundwater monitoring would be conducted to confirm that COCs meet Michigan Part 201 GSI criteria in groundwater venting from the shallow aquifer into Portage Creek. Groundwater monitoring would occur in both the shallow and lower aquifer to confirm that COCs are not impacting the lower aquifer.

Balancing Criteria

3. Long-term Effectiveness and Permanence

This criterion evaluates the effectiveness of the alternatives in protecting human health and the environment over the long term, once the cleanup is complete, including the adequacy and reliability of controls to address residual risk.

With the exception of Alternative 1, each of the alternatives would be expected to meet the RAOs and provide long-term effectiveness and permanence once the RAOs are met. Alternatives 2 through 4 are all combinations of proven and reliable remedial processes, and the potential for failure of these alternatives is low.

Alternatives 2 and 4, including the O&M, monitoring, and institutional controls, would achieve long-term effectiveness and permanence through on-site containment of the contaminated materials. Capping is a proven method of preventing direct contact and erosion of material containing PCBs. Alternative 2C, which includes off-site incineration of a small amount of excavated materials with PCB concentrations greater than 500 mg/kg, would not significantly increase the long-term effectiveness of the remedy because capping prevents direct contact exposure and the erosion/transport exposure route. Alternative 2D would require additional O&M for the active landfill gas collection system and for additional slope stabilization measures due to the increased height of the landfill. However, the reduced footprint of Alternative 2D would decrease the area requiring O&M.

The long-term effectiveness and permanence of Alternative 2D is enhanced by the increased width of the clean setback – significantly larger than that provided by the other

alternatives that leave waste in place – between the consolidation area and Portage Creek. The large setback would reduce the potential for erosion of COC-containing materials into Portage Creek to help achieve RAO 2. The increased setback and stabilized stream banks would also reduce the potential for Portage Creek to undermine the base of the landfill. Moreover, the long-term effectiveness and permanence of Alternative 2D is enhanced by the anticipated long-term stewardship at OU1 due to reuse of the uncapped remediated areas and capped portions of the property.

Among the capping alternatives (Alternatives 2 and 4), Alternative 2D would likely have the greatest reliability of controls (e.g., institutional controls, access controls, and maintenance of engineered barriers). Productive reuse of a site, stakeholder support of that reuse, and the resulting long-term stewardship generally increase the effectiveness of a remedy. An active presence at OU1, due to reuse of the property, would allow for better access control, thereby minimizing trespass and associated activities that could damage the physical components of the remedy. Monitoring and maintenance activities associated with the reuse of the property would assist with the required maintenance of the remedy. In addition, more active management of the property means that any problems with the remedy that do occur, such as vandalism or damage to remedy components, would likely be identified earlier than they would if active management was not performed.

Capping is an effective mechanism to prevent infiltration through materials containing PCBs. At OU1, PCBs have not been detected in groundwater outside the current disposal areas, even though some of those disposal areas are not currently capped. The installation of an engineered composite cap would further mitigate the potential for infiltration and migration of PCBs out of the waste via groundwater. Because of that cap, groundwater sub-alternatives (i) or (ii) would not significantly increase the long-term effectiveness or permanence of Alternative 2.

The Alternative 2 options include proven technologies that would provide long-term effectiveness and permanence. Alternative 4 provides an added level of protectiveness because wastes would be controlled in lined, on-site containment cells.

Alternative 3 provides the greatest degree of long-term effectiveness and permanence by removing from OU1 all contaminated materials with COC concentrations above FRGs and disposing of those materials at off-site permitted facilities.

The long-term O&M and monitoring components that would be implemented in conjunction with institutional controls under Alternatives 2 and 4 would provide the necessary mechanisms to verify the remedy is performing as anticipated over time. As a result, Alternative 4 and the various Alternative 2 options are expected to provide effective, permanent, waste-in-place remedies. No long-term O&M or monitoring would be required under Alternative 3, with the possible exception of certain limited areas where waste may be left in place due to the waste's close proximity to buildings.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

This criterion evaluates the anticipated performance of the treatment technologies that may be included as part of a remedy. EPA evaluated various treatment technologies and their applicability at OU1. EPA concluded that due to the volume and immobile nature of the waste, practical treatment to reduce the toxicity, mobility, or volume of contamination at OU1 is not available.

Alternatives 1, 2A, 2B, 2D, 3, and 4 do not include treatment as a component of the remedy and, therefore, would not reduce the toxicity, mobility, or volume of contamination at OU1. The only remedial alternative that includes treatment as a component of the remedy is Alternative 2C. However, Alternative 2C would treat only a small percentage of the waste at OU1 through off-site incineration of excavated soils that exceed 500 mg/kg, so would not significantly reduce the toxicity, mobility, or volume of most of the contamination at OU1. Additionally, it would be difficult to identify residuals with relatively high concentrations of PCBs to target for treatment because PCB contaminated materials above 500 ppm are not clustered, but are dispersed throughout the residuals at OU1.

5. Short-term Effectiveness

This criterion examines the length of time needed to implement the alternatives and the effectiveness of the alternatives in protecting human health and the environment during construction of the remedy. It considers any adverse impacts that may be posed to the community, workers, and the environment during the cleanup until RAOs are achieved.

The evaluation of short-term effectiveness is primarily related to the area and volume of COC-containing materials addressed in each alternative, the time necessary to implement the remedy, potential risks to workers, and potential impacts to the community until RAOs are achieved. A summary of these short-term effectiveness considerations for each alternative is provided in Table 4.

With the exception of Alternative 1, all of the alternatives would have some short-term impacts during construction, including increased noise from construction vehicles, the potential for airborne dust releases, increased traffic in the vicinity of OU1, increased wear on local roads, increased potential for workers to come in contact with PCB-containing materials, and other risks associated with construction work. Potential adverse impacts would be minimized through implementing a project-specific health and safety plan, keeping excavation areas properly wetted, planning truck routes to minimize disturbances to the surrounding community, and other standard best management practices, but the impacts cannot be eliminated.

Of the alternatives with active remediation, the Alternative 2 options disturb the least amount of material and require the shortest construction time. Alternatives 2A, 2B, and 2C would likely take 2 years to implement. Alternative 2D would likely take 3 years to implement and would have other short-term impacts due to the additional excavation and

consolidation volume. An estimated 39,000 truck trips would be required to implement Alternative 2A, and more than 49,000 truck trips would be required to implement Alternative 2B. Alternative 2C incurs additional short-term impacts associated with off-site transport. Compared to Alternative 2B, EPA estimates that an additional 1,000 truck trips would be required for Alternative 2C to haul materials approximately 40 miles to an intermodal facility where they would be loaded onto railcars for transport to an incineration facility. Due to the limited number and location of TSCA-permitted incineration facilities, the rail transport distance for the contaminated materials could be 1,200 miles or more. Alternative 2D would require 70,000 truck trips to implement due to the amount of soil needed to backfill excavated areas.

Alternative 2C also would have greater short-term impacts than Alternatives 2A and 2B due to the potential for dispersion or erosion of excavated materials during characterization and segregation of the excavated wastes for incineration.

The addition of sub-alternatives (i), the installation of a groundwater collection system of wells and potentially trenches, or (ii) the addition of a slurry wall to Sub- alternative (i), would increase the short-term impacts of the Alternative 2 options as they both would increase the duration of construction and increase the amount of excavation and construction relative to the alternative 2 options. Sub-alternative (ii) would have greater short-term impacts than sub-alternative (i) as the former would increase the duration of construction and amount of soil disturbance relative to the latter.

Alternatives 3 and 4 present greater short-term impacts than the Alternative 2 options due to the increased volume of materials that would be disturbed and moved as well as the increased construction duration (5 years and 10 years, respectively). Because the project duration for Alternatives 3 and 4 is longer than the Alternative 2 options, they pose greater construction-related and exposure risks to workers. The additional volume of materials to be handled in Alternatives 3 and 4 would increase truck traffic near OU1 during the project. An estimated 150,000 truck trips to and from OU1 would be necessary to implement Alternative 3. During the excavation and backfilling work under Alternative 4, more than 116,000 truck trips would be necessary to transport excavated material from the Outlying Areas to the on-site disposal cells, to bring in clean fill, and to haul displaced materials to off-site disposal locations. Any increase in truck traffic carries with it an increased risk of vehicular accidents.

In addition to the impacts discussed above, there would be other potential adverse impacts to the local community during construction, such as the potential for noise and dust. Such impacts could occur over a period of 2 years (Alternatives 2A, 2B, or 2C), 3 years (Alternative 2D), 5 years (Alternative 3), or 10 years (Alternative 4), with corresponding burdens on the local community. Although traffic impacts associated with Alternative 4 are primarily limited to 5 years, the overall construction duration (with the potential for noise and dust) is estimated at 10 years due to on-site management and emplacement of excavated materials.

There are no short-term impacts associated with Alternative 1; however, since existing measures to control access to OU1 would not be maintained, there could be an increased risk of direct exposure over the short term to individuals who trespass and come into contact with surficial contaminated materials.

6. Implementability

This criterion assesses the technical and administrative feasibility of an alternative and the availability of required goods and services. *Technical feasibility* considers the ability to construct and operate a technology, its reliability, the ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of a remedy. *Administrative feasibility* considers the ability to obtain approvals from other parties or agencies and the extent of required coordination with other parties or agencies.

There are no technical or administrative implementability issues associated with Alternative 1 because no active remediation would take place. The primary remedial components of Alternatives 2, 3, and 4 are proven, readily implementable, have been used successfully as part of other environmental cleanup projects, and are expected to be reliable over the long term. All the alternatives are administratively implementable, and although no permits would be required, the substantive applicable requirements of federal and state regulations would need to be identified and would be met.

Alternatives 2, 3, and 4 could all be constructed using readily-available conventional earth-moving equipment, and most of the necessary services and construction materials are expected to be readily available. Qualified commercial contractors with experience at other areas of the Site are available locally to perform the work.

Compared to Alternatives 2A and 2B, Alternatives 2C, 2D, 3, and 4 would be more difficult to implement due to different constraining conditions. For Alternative 2C, there is limited availability of TSCA permitted incinerators. Alternative 2D would be more difficult to implement than Alternatives 2A, 2B, or 2C due to the reduced landfill footprint and increased excavation and consolidation volumes. Additional stabilization measures may be required for the underlying soils prior to consolidation and slope stabilization measures and settlement monitoring may be required due to the increased height of the landfill. For Alternative 3, the availability of off-site solid waste and/or TSCA landfills to accept the volume of materials to be disposed could be a limiting factor in terms of construction progress and overall cost. The limited staging area available for excavated materials during construction of the containment cells would be a limiting factor for Alternative 4.

Landfill Availability: There are few solid waste landfills in southwest Michigan that are available to accept PCB-containing material. The facilities commonly have limits on disposal capacity and disposal rates. These limits may affect the timely completion of Alternatives 3 and 4, which would both send large volumes of PCB- and other COC-containing material off site for disposal. If capacity at local solid waste facilities and TSCA landfills is exhausted, use of facilities outside of southwest Michigan could

increase transport distances for off-site disposal, and consequentially increase risks and costs.

Construction of Containment Cells: Additional implementability challenges associated with construction of the containment cells in Alternative 4 include sequencing and space constraints, developing a plan for excavating nearly 1,600,000 yd^3 of COC-containing materials, constructing the full-encapsulation disposal cells, and replacing the excavated materials in the cells. As each containment cell is sequentially constructed, a successively smaller area would be available on site for staging of clean materials and temporary storage of COC-containing materials. Eventually, on-site capacity would be depleted, and a substantial volume of material would need to be sent off site for disposal. Approximately 25 percent of the soils targeted for excavation and placement in the Former Operational Areas and all of the soils excavated from the Outlying Areas would be displaced, resulting in more than 500,000 yd^3 of materials being transported off site for disposal. This has a significant impact on both the implementability and cost of this alternative. The control and management of surface water runoff from the temporarily-stored COC-containing materials would also become increasingly challenging as less area would be available for the operations under Alternative 4.

7. Cost

This criterion evaluates the capital and O&M costs of each alternative. Total present-worth costs are provided to help compare costs among alternatives with different implementation times. A discount rate of [%] was used for these calculations. The costs in the Scoping Document are based on a 30-year discount rate of 1.4%, as footnoted in the detailed cost estimate tables. The discount rate of 1.4% was selected to match the real interest rates referenced in the OMB Circular No. A-94, revised in December 2014.

Commented [FR9]: Need to include information on the discount rate used for the total present worth calculations, per the Data Certification Checklist in Section 1.6 of the ROD. That's why the checklist is there! ☺ Note that if you used anything other than 7% you'll need to provide a justification (perhaps in a footnote). Even though 7% is outdated, it's still what EPA guidance says to use.

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The costs for the range of alternatives and sub-alternatives presented in this ROD are summarized in the table below. The cost estimates are consistent with an FS-level of estimation, with an accuracy of +50 to -30 percent. While Alternative 1 has no associated capital or O&M costs since there would be no further actions taken, five-year reviews would be required and those periodic costs are reflected in the table below.

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Summary of Remedial Alternative Costs
Allied Landfill—Allied Paper, Inc. / Portage Creek / Kalamazoo River Superfund Site

Alternative	Estimated Capital Cost	Estimated O&M Cost	Estimated Periodic Cost	Total Present-worth Cost
Alternative 1	$0	$0	$110,000	$110,0000
Alternative 2A	$38 million	$6.7 million	$110,000	$44 million
Subalternative (i)	$1.7 million	$2.7 million	$0	$4.4 million
Subalternative (ii)	$11 million	$2.7 million	$0	$14 million
Alternative 2B	$38 million	$5.0 million	$110,000	$43 million
Alternative 2C	$65 million	$5.0 million	$110,000	$70 million
Alternative 2D	$57 million	$5.8 million	$110,000	$63 million

Subalternative (i)	$1.5 million	$2.7 million	$0	$4.3 million
Subalternative (ii)	$9.2 million	$2.7 million	$0	$12 million
Alternative 3	$238 million	$0 million	$110,000	$238 million
Alternative 4	$154 million	$5.0 million	$110,000	$159 million

Note: The costs for the sub-alternatives under the Alternative 2 options would be in addition to the cost of each respective option.

Modifying Criteria

8. State/Support Agency Acceptance

This criterion considers the state's preferences among or concerns about the alternatives, including comments on regulatory criteria or use of waivers.

EPA collaborated with MDEQ and the City of Kalamazoo in developing the concepts upon which Alternative 2D are based. MDEQ supports Alternative 2D.

9. Community Acceptance

This criterion considers the community's preferences or concerns about the alternatives. Among the waste-in-place alternatives, Alternative 2D has the most support from the City and other stakeholders. As stated in Section 2.3 of this ROD, the Mayor of Kalamazoo sent EPA a letter sharing his support for Alternative 2D prior to EPA's issuance of the OU1 Proposed Plan. During the public comment period, the City affirmed its support for the proposed alternative in formal comments. In its comment letter, the City also stated its intent to provide long-term stewardship at both capped and uncapped portions of OU1.

2.11 Principal Threat Wastes

The principal threat concept is applied to the characterization of "source material" at a Superfund site. Source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contaminants to groundwater, surface water or air, or acts as a source for direct exposure. EPA has defined principal threat wastes as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

EPA does not consider the waste materials at OU1 to be principal threat waste because the waste materials exhibit very low mobility and can be reliably controlled in place through consolidation and capping. Soil and groundwater data demonstrate that the PCBs at OU1 are not mobile within the waste and do not readily leach into groundwater, even though portions of OU1 are not currently capped.

2.12 Selected Remedy

The Selected Remedy for OU1 is described in this section.

EPA's remedy for addressing the contamination at OU1 is Alternative 2D. Alternative 2D involves excavating contaminated soils, sediments, and residuals from the Monarch area of OU1, from commercial, residential, and wetland areas of OU1, and from areas near Portage Creek, and consolidating those materials into the main body of the landfill area of OU1. Portions of the landfill area itself would also be excavated and consolidated, reducing the footprint of the waste from approximately 49 acres to approximately 27 acres. After consolidation, the landfill area would be covered with an impermeable cap and an active gas collection system would be installed. Excavated and backfilled areas that are not used for flood control would potentially be available for commercial redevelopment. The capped area would potentially be available for light recreational reuse. Alternative 2D also includes long-term groundwater monitoring to verify the effectiveness of the remedy, institutional controls to protect the remedy and restrict land and groundwater use, and long-term O&M. A more detailed description of Alternative 2D is provided above in Section 2.9.

Rationale for the Selected Remedy

Alternative 2D meets the threshold criteria, offers a high degree of long-term effectiveness and permanence, and represents the best balance of tradeoffs among the alternatives with respect to the balancing and modifying criteria. Alternative 2D would meet the RAOs because it would:

- prevent human and ecological exposure to contaminated materials at OU1;
- prevent the most significant route of exposure – erosion and off-site migration of contaminated materials from OU1; and
- prevent contaminated material at OU1 from impacting groundwater or surface water emanating from OU1.

EPA believes that Alternative 2D is the appropriate remedy for OU1 given the immobility of the PCB contamination as evidenced by both soil and groundwater data. The fact that PCB contamination is not migrating to groundwater at levels that pose a risk to human health or the environment, despite the fact that portions of the landfill are not currently capped, demonstrates that the waste can be reliably contained in place. Alternative 2D will achieve the RAOs within a reasonable timeframe of three years. While Alternative 2D poses more short-term adverse impacts than Alternatives 2A, 2B, and 2C, it will result in significantly greater long-term effectiveness and permanence than those alternatives due to the anticipated long-term stewardship at the OU1 property and the size of the buffer between the waste and Portage Creek. Alternative 2D requires a shorter implementation timeframe than Alternatives 3 or 4 and does not require the exposure and handling of all the waste in the landfill that would occur under those alternatives. Alternative 2D therefore results in fewer short-term adverse impacts to the local community than Alternatives 3 or 4.

While Alternative 2D is projected to cost more than Alternatives 2A and 2B, it is considered cost-effective due to its higher long-term effectiveness and permanence.

Alternatives 3 and 4 are not cost-effective because they cost orders of magnitude more than Alternative 2D without a significantly greater reduction in risk. Alternative 2C is not cost-effective because the added cost of treatment does not increase protectiveness. Alternative 2C may also be more difficult to implement, because residuals with high concentrations of PCBs are not aggregated, making them difficult to locate and transport to one of the few available incinerators. Alternatives 2A, 2B, and 2C lack the features, such as the larger setback of the waste and the anticipated stewardship, that lead to the higher long-term effectiveness and permanence of Alternative 2D.

Among the Alternative 2 options, Alternative 2D has the greatest amount of public support.

Expected Outcomes of the Selected Remedy

The Selected Remedy, Alternative 2D, will reduce the risks to human health and the environment posed by PCBs and other COCs at OU1. Implementation of the remedy will entail consolidation of contaminated material (some of which is currently exposed) under an engineered barrier. Doing so will address the risks posed by contaminated material at OU1: direct contact exposure, erosion and runoff into Portage Creek and the potential to impact surface water or groundwater. Capped Portions of OU1 will be covered with clean material and recreational use would be possible above additional material placed upon the cap.

Excavated areas of OU1 will be remediated to appropriate FRGs so as to be protective for the variable land use and exposure scenarios at OU1. Those use and exposure scenarios include:

- Residential use at areas adjacent to residential properties east of Portage Creek,
- Commercial or industrial use at most uncapped parts of OU1.
- Recreational use at the capped area of OU1
- Protective use for anglers at areas that impact fish subject to consumption
- Protective use by ecological receptors at wetland areas

The corresponding FRGs are detailed in Tables 1 & 2.

Cost of the Selected Remedy

The estimated cost of implementing the Selected Remedy is $63,000,000. A detailed cost estimate for the Selected Remedy is provided in Table 7. The information in the cost estimate is based on the best available information regarding the anticipated scope of the Selected Remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design and remedy implementation phases. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

ARARs for the Selected Remedy

The ARARs for the Selected Remedy are discussed above in Section 2.10 and can be found in Table 6.

2.13 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The discussion below describes how the Selected Remedy meets these statutory requirements and explains the five-year review requirements associated with the Selected Remedy.

Protection of Human Health and the Environment

The Selected Remedy, Alternative 2D, provides overall protection of human health and the environment from the contamination at OU1 and will meet the RAOs that have been established. RAO 1 will be achieved by mitigating the potential for human and ecological exposure to materials containing COCs above the relevant FRGs. RAO 2 will be achieved since materials with COC concentrations above relevant FRGs would be covered with an engineered cap. The cap will mitigate the potential for migration to Portage Creek or onto adjacent properties by erosion. RAO 3 will be achieved by preventing surface water infiltration through the waste. In order to confirm that RAO 3 has been achieved, a long-term groundwater monitoring program will be implemented. Institutional controls, monitoring, and maintenance of various areas of OU1 are critical components for maintaining protectiveness over time.

The Selected Remedy also includes a long-term inspection and maintenance program. Landfill gas and groundwater monitoring, as well as long-term inspection and maintenance activities, will be conducted to assess whether the remedy is functioning as intended.

Compliance with Applicable or Relevant and Appropriate Requirements

The Selected Remedy is expected to comply with the federal and state ARARs that are specific to this Remedial Action. The ARAs for this action are discussed above in Section 2.10 and can be found in Table 6.

Cost-Effectiveness

In EPA's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition

was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP Section 300.430(f)(I)(ii)(D)). It is important to note that more than one cleanup alternative can be cost-effective, and the NCP does not mandate the selection of the most cost-effective alternative. Cost-effectiveness deals with the reasonableness of the relationship between the effectiveness afforded by each alternative and its costs compared to other available options.

Alternatives 2A, 2B, and 2D are all considered cost-effective alternatives. Although the Selected Remedy, Alternative 2D, is projected to cost more than Alternatives 2A and 2B, it is cost-effective due to its higher long-term effectiveness and permanence. Alternatives 3 and 4 are not cost-effective as they cost orders of magnitude more than the Selected Remedy without a significantly greater reduction in risk. Alternative 2C is not cost-effective as the added cost of treatment featured in that alternative does not increase protectiveness.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable/Preference for Treatment as a Principal Element

The Selected Remedy, Alternative 2D, represents the maximum extent to which permanent solutions and treatment are practicable at OU1 and provides the best balance of tradeoffs with respect to the balancing and modifying criteria as compared to the other options. These tradeoffs are summarized below.

Alternative 2D provides long-term and effective protection against exposure to contaminated materials by consolidating and capping those materials under an engineered barrier. Compared to the other cost-effective alternatives (Alternatives 2A and 2B), Alternative 2D features the largest setback from Portage Creek and therefore has the lowest potential for recontamination of Portage Creek.

Alternative 2D does not include a treatment component because the contamination at OU1 does not lend itself to any cost-effective treatment. EPA does not consider the waste materials at OU1 to be principal threat wastes because they do not appear to act as source materials and can be reliably contained in place due to their immobility. Soil and groundwater data demonstrate that the PCBs at OU1 are not mobile within the waste and do not readily leach into groundwater.

Alternative 2D will achieve the RAOs within a reasonable timeframe of three years. While Alternative 2D poses more short-term adverse impacts than Alternatives 2A, 2B, and 2C, it will result in significantly greater long-term effectiveness and permanence compared to those alternatives due to the anticipated long-term stewardship at the property and the size of the buffer between the waste and Portage Creek. Compared to Alternatives 3 and 4, Alternative 2D requires a shorter implementation timeframe and does not require exposing and handling all of the waste. Alternative 2D will therefore result in less short-term adverse impacts to the local community than Alternatives 3 or 4.

Although Alternative 2D is projected to cost more than Alternatives 2A and 2B, it is cost-effective due to its higher long-term effectiveness and permanence. Alternatives 3 and 4 are not cost-effective as they cost orders of magnitude greater than Alternative 2D without a significantly greater reduction in risk. Alternative 2C is not cost-effective as the added cost of treatment featured in the remedy does not increase protectiveness. Alternative 2C may also be more difficult to implement, because residuals with high concentrations of PCBs are not aggregated, making them difficult to locate and transport to one of the few available incinerators. Alternatives 2A, 2B, and 2C lack the features, such as the larger setback of the waste and the anticipated stewardship, that lead to the higher long-term effectiveness and permanence of Alternative 2D.

The State of Michigan and the City of Kalamazoo support Alternative 2D. EPA developed Alternative 2D after collaborating with MDEQ and the City for the purpose of exploring ways that a cleanup alternative could have greater long-term protectiveness than those in the November 2014 FS, while allowing for the City's intended reuse of the property as a part of their plans to revitalize the Portage Creek Corridor. Alternative 2D is the favored alternative of the State. The City stated its support for Alternative 2D during the public comment period, as did a number of citizen groups.

Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for UU/UE, statutory review of the remedy protectiveness will be conducted every five years. Two five-year reviews have already been conducted at the Site, and OU1 will be included in future five-year reviews.

2.14 Documentation of Significant Changes

The Proposed Plan for OU1 was issued for public comment on September 23, 2015. The Proposed Plan identified Alternative 2D as the Preferred Alternative. The Proposed Plan public comment period ran from September 23, 2015 through December 1, 2015. CERCLA Section 117(b) and NCP Section 300.430(f)(5)(iii) require an explanation of any significant changes from the remedy presented in the Proposed Plan that was published for public comment. Based upon its review of the written and oral comments submitted during the public comment period, EPA has determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary or appropriate.

Part 3 - Responsiveness Summary

In accordance with CERCLA Section 117, 42 U.S.C. Section 9617, EPA released the Proposed Plan on September 23, 2015, and the public comment period ran through December 1, 2015, to allow interested parties to comment on the Proposed Plan. EPA held a public meeting regarding the Proposed Plan on November 19, 2015, at the Washington Writer's Academy, Kalamazoo, Michigan. Approximately 40 people attended the meeting. Representatives from EPA, MDEQ, and MDNR were present at the public meeting. A written transcript from the public meeting is available in the AR.

The AR index is attached as Appendix 2 to this ROD. EPA, in consultation with MDEQ, carefully considered all information found in the AR prior to selecting the remedy documented in this ROD. Complete copies of the Proposed Plan, AR, and other pertinent documents are available at:

The Kalamazoo Public Library	EPA Region 5 Superfund Division Records Center
315 South Rose	77 West Jackson Boulevard
Kalamazoo, MI 49007	Chicago, IL 60604

EPA is not required to reprint the comments of the commenter verbatim and may paraphrase where appropriate. In this responsiveness summary, EPA has included large segments of the original comment. However, persons wishing to see the full text of the comment should refer to the commenter's submittal to EPA, which is included in the AR.

3.1 Comments from the Community

1.

Table 1 - Summary of Final Remediation Goals Established by EPA for PCBs

OU1 Feasibility Study Report—Allied Paper, Inc./ Portage Creek/Kalamazoo River Superfund Site

Medium	Pathway	Exposure Scenario	PCB FPRG	Basis
Soils	Human Health	Residential	1.0 mg/kg[a]	40 CFR §761.61(a)(4)
		Non-Residential	10 mg/kg[b]	40 CFR §761.61(a)(4)
		Recreational	23 mg/kg[c]	HHRA
	Ecological	Aquatic	0.5–0.6 mg/kg	BERA
		Terrestrial	6.5–8.1 mg/kg	BERA
Subsurface Soils	Human Health	Residential	1.0 mg/kg[a]	40 CFR §761.61(a)(4)
		Non-Residential	10 mg/kg[b]	40 CFR §761.61(a)(4)
Surface and Subsurface Sediments	Human Health	Recreational	23 mg/kg[c]	HHRA
		Terrestrial	6.5–8.1 mg/kg	BERA
		Fish Consumption	0.33 mg/kg[c,d]	HHRA
	Ecological	Aquatic	0.5–0.6 mg/kg	BERA
Groundwater (including seeps)	Human Health	Direct Contact	3.3 µg/L[e]	MI Part 201 direct contact criteria
		Groundwater-Surface Water Interface (GSI)	0.2 µg/L[f]	MI Part 201 GSI criteria
Residuals	N/A	Qualitative: Where an excavation is proposed, all visible residuals are to be removed unless analytical data are available to confirm PCBs (if present) are below applicable criteria.		

Commented [YJ13]: Confused by how these are being applied – by current/anticipated land use but does that work for all media & exposure scenario? What about soils, eco: aquatic vs terrestrial?

Notes:

[a] Based on high-occupancy cleanup level (without conditions) set forth in 40 CFR § 761.61(a)(4).
[b] Based on 40 CFR §761.61(a)(4) with restrictive covenant prohibiting residential use.
[c] Based on recreational exposure as developed in HHRA.
[d] Default sediment criteria of 0.33 mg/kg will be applied to shallow soil in areas of periodic inundation due to the potential runoff of shallow soils into surface water. Evaluation of contaminated soil runoff to surface water required under R299.5728(f).
[e] Groundwater for use as drinking water is not considered a complete pathway so the Part 201 Drinking Water criteria of 0.5 microgram per liter (µg/L) was not used. The Part 201 direct contact criteria were used for protection of human health due to the presence of seeps.
[f] The groundwater criteria protective of surface water is a FPRG where the GSI is present (MCL 324.20120e and Part 31).
BERA = baseline ecological risk assessment; HHRA = human health risk assessment; mg/kg = milligrams per kilogram;

N/A = not applicable

Source: CH2M HILL 2009

Table 2 - Summary of Final Remediation Goals for COCs other than PCBs
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

	Soils/Sediments (µg/kg)					Groundwater and Seeps [a] (µg/L)	
Analyte	Statewide Default Background Level	Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria and RBSLs	Residential Direct Contact Criteria & RBSLs	Non-Residential Direct Contact Criteria & RBSLs	Residential Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSL
SVOCs							
4-methylphenol	N/A	7,400	1,000	11,000,000	36,000,000	370	30
PCDD/PCDF [b]							
Total TCDD Equivalent(O)	N/A	NLL	NLL	0.09	0.99	N/A	
Inorganics							
Aluminum (B)	6,900,000	1,000	N/A	50,000,000	370,000,000	50	N/A
Antimony	N/A	4,300	94,000	180,000	670,000	6	130
Arsenic	5,800	4,600	4,600	7,600	37,000	10	10
Barium (B)	75,000 [c]	1,300,000	660,000 (G)	37,000,000	130,000,000	2,000	1,000 (G)
Cadmium (B)	1,200 [c]	6,000	3,000 (G)	550,000	2,100,000	5	2.5 (G)
Chromium	N/A	30,000	3,300	2,500,000	9,200,000	100	11
Cobalt	6,800	800	2,000	2,600,000	9,000,000	40	100
Copper	32,000 [c]	5,800,000	100,000 (G)	20,000,000	73,000,000	1,000	18 (G)
Cyanide	390	4,000	100	12,000	250,000	200	5.2
Iron (B)	12,000,000	6,000	N/A	160,000,000	580,000,000	300 (E)	N/A
Lead (B)	21,000 [c]	700,000	2,500,000 (G)	400,000	900,000	4	14 (G)
Magnesium (B)	N/A	8,000,000	N/A	1,000,000,000	1,000,000,000	400,000	N/A
Manganese (B)	440,000	1,000	26,000 (G)	25,000,000	90,000,000	50	1,300 (G)
Mercury	130	1,700	50	160,000	580,000	2	0.0013
Nickel	20,000 [c]	100,000	100,000 (G)	40,000,000	150,000,000	100	100 (G)
Selenium	410	4,000	400	2,600,000	9,600,000	50	5
Zinc	47,000 [c]	2,400,000	230,000 (G)	170,000,000	630,000,000	2,400	235 (G)

[a] Only the data from the 2002–2003 groundwater and seep samples are summarized to reflect conditions after removal.
[b] Dioxin and furans only were sampled in 1998.
[c] Background value used in RI as screening criteria; lowest risk-based level highlighted used for COC comparison.

N/A = Not Applicable, NLL= Not likely to leach, RBSL = risk-based screening level, µg/kg = micrograms per kilogram
(B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion.
(E) Criterion is the aesthetic drinking water value, as required by § 20120a(5) of NREPA 1994 PA 451, as amended by NREPA of 1994.

(G) Calculated value dependent on ph, hardness.
(O) The concentration of all polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, shall be added together and compared to the criteria for 2,3,7,8- tetrachlorodibenzo-p-dioxin.
Highlighted cells = lowest applicable criteria.
Source: Non-Residential Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 Risk-Based Screening Levels, document release date March 25, 2011.

TABLE 3

Summary of VOCs, SVOCs, Pesticides, PCDD/PCDF, and Inorganic Exceedances

OU1 Feasibility Study Report—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Analyte	Surface Soils	Subsurface Soils	Surface Sediments	Subsurface Sediments	Groundwater[a]	Seeps[a]
VOCs						
Carbon Tetrachloride		1/54				
Acetone			1/2			
SVOCs						
Acenaphthene			1/2			
Carbazole			1/2			
Dibenzofuran			1/2			
Phenanthrene		1/54				
4-methylphenol		12/54				
Naphthalene		1/54	1/2			
Pentachlorophenol		1/54	1/2			
Pesticides						
None						
PCDD/PCDF[b]						
Total TCDD Equivalent	1/8					
Inorganics						
Aluminum	1/2	26/55			5/72	1/37
Antimony		7/55				
Arsenic	1/2	9/54	1/2		23/72	10/37
Barium		23/55	1/2	1/1	4/72	4/37
Cadmium		5/55				
Chromium	2/2	53/55	2/2	1/1	1/72	
Cobalt		6/55				
Copper		23/55		1/1		
Cyanide		21/54			4/72	3/37
Iron	1/2	8/55	1/2	1/1	64/72	31/37
Lead	1/2	20/55	1/2	1/1	1/72	
Magnesium		13/55				
Manganese		4/55			66/72	36/37
Mercury		20/55		1/1		
Nickel		1/55		1/1	4/72	1/37
Selenium		10/55	1/2	1/1		
Silver				1/1	2/72	
Sodium					4/72	
Vanadium					1/72	1/37
Zinc		28/45	1/2	1/1	7/72	

Note:
x/y = number of samples (x) exceeding screening level criteria out of number of samples (y)
[a] Only the data from the 2002/2003 groundwater and seep samples are summarized to reflect conditions after removal
[b] Dioxin and furans only sampled in surface soils in 1998
PCDD = polychlorinated dibenzodioxins; PCDF = polychlorinated dibenzofurans

TABLE 4
Summary of Short-term Effectiveness Considerations
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

▪ Alternative	▪ Total Area Addressed	▪ Total Volume of COC-Containing Materials Excavated	▪ Duration	▪ Worker Risks	▪ Community Impacts
Alternative 1	No areas addressed	No volume of impacted PCB-containing materials addressed	No time period to implement	No worker risks from implementation as no action is taken.	Potential off-site migration of COC-containing materials.
Alternative 2A	65 acres, 48 acre cap	350,000 yd3	Approximately 2 years	Least of the active alternatives; managed by health and safety plan.	Associated with dust, noise, and truck traffic.
Alternative 2B	65 acres, 42 acre cap	479,000 yd3	Approximately 2 years	Slightly increased due to moving Monarch HRDL; managed by health and safety plan.	Slightly increased due to dust, noise, and truck traffic.
Alternative 2C	65 acres, 42 acre cap	479,000 yd3	Approximately 2 years	Greater than 2A and 2B due to potential exposure during characterization and transportation.	Greater than 2A and 2B due to additional management for characterization and off-site transport.
Alternative 2D	65 acres, 27 acre cap	920,000 yd3	Approximately 3 years	Greater than 2A, 2B, or 2C due to increased excavation and consolidation volume.	Greater than 2A, 2B, and 2C due to longer construction duration and transport of backfill materials.
Subalternative (i)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Risks are easily managed by health and safety plan. Continued risks present with operation and maintenance of treatment system.	Slightly increased over Alternative 2 options during construction due to well installation and treatment system construction.
Subalternative (ii)	N/A	N/A	Concurrent with Alternative 2 Options, but indefinite O&M	Greater risks than subalternative (i) due to construction of slurry wall. Similar O&M risks.	Slightly increased over Alternative 2 options during construction due to well installation and treatment system construction. Greater than subalternative (i) due to slurry wall construction.
Alternative 3	65 acres	1,600,000 yd3	5 years	Greater than Alternative 2 given the area/volume of targeted material; increased travel for disposal and increased project duration.	Greater than Alternative 2 due to noise, dust, and increased truck traffic, which would average 115 trips daily in and out of OU1 for the

TABLE 4
Summary of Short-term Effectiveness Considerations
Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

▪ Alternative	▪ Total Area Addressed	▪ Total Volume of COC-Containing Materials Excavated	▪ Duration	▪ Worker Risks	▪ Community Impacts
					duration of the project. Greatest number of miles driven due to volume transported to disposal facilities with limited locations.
Alternative 4	65 acres, 48 acre landfill	1,600,000 yd3	10 years	Greater than Alternatives 2 and 3 given the area/volume of targeted material and significantly increased project duration.	Greater than Alternatives 2 and 3 due to noise and dust over the longest project duration. Slightly fewer truck trips than Alternative 3, but 1/3 of the miles outside OU1 due to decreased volume transported to disposal facilities.

Table 5

- **Comparative Analysis of Alternatives**

Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Alternative	Description	Overall Protection	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Cost
Alternative 1	**No action**	Not protective. No action would be taken.	Would not meet ARARs	Not effective. Site conditions would remain the same.	No reduction of toxicity, mobility, or volume.	No worker risks. No action to be taken.	Implementable as no action would be taken.	$110,000
Alternative 2	**Consolidation and capping**							
2A	Construct caps on both Monarch and Operations areas	Protective. Remaining exposed contamination would be covered and contained. Infiltration of surface water would be minimized.	Meets ARARS	Effective. Larger landfill footprint requiring O&M than Alternatives 2B, 2C, and 2D.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, most effective of active alternatives. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology has been implemented at similar OUs.	$44,000,000
2B	Consolidate Monarch within Operations areas	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required.	Meets ARARS	Effective	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 2-year period, slightly longer than 2A. Worker risk associated with dermal contact, inhalation, and ingestion. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology has been implemented at similar OUs. Combining Monarch on the Operations Area would reduce the footprint of contamination.	$43,000,000
2C	Consolidate Monarch within operations areas and transport excavated soils with PCBs >500 mg/kg off site for incineration	Protective. Remaining exposed contamination would be covered and contained. Consolidation of the Monarch HRDL within the operations area would reduce the amount of monitoring required. Off-site incineration of some of the highest PCB concentrations would be slightly more protective.	Meets ARARs	Effective	Reduction of toxicity and volume would be achieved through treatment of a portion of the material.	Implementation over 2-year period, slightly longer than 2A and 2B. Worker risk associated with dermal contact, inhalation, and ingestion due to increased management with characterization and segregation. Risks are controllable. Community impacts: associated dust, noise, traffic, and off-site transportation of contaminated materials.	Proven technology has been implemented at similar OUs. Combining Monarch on the operations area would reduce the footprint of contamination. TSCA-permitted incinerators are in limited quantity. Identifying, segregating and shipping make 2C more difficult to implement.	$70,000,000
2D	Consolidate Monarch and portions of Operations Areas under an approximate 27 acre cap.	Protective. Remaining exposed contamination would be covered and contained.	Meets ARARs	Effective. Increased O&M requirements over Alternatives 2A, 2B, and 2C. Community stewardship may help facilitate the monitoring and maintenance of the cap and effectiveness of controls. Provides larger clean buffer along Portage Creek.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 3-year period is longer than 2A, 2B, or 2C resulting in increases to worker risk associated with inhalation and ingestion. Community impacts: associated dust and noise during construction and increased traffic associated with trucking backfill materials.	Proven technology has been implemented at similar OUs. Implementability challenges are increased due to the consolidation on a smaller footprint resulting in a taller landfill. Additional stabilization measures may be required.	$63,000,000

Table 5

- **Comparative Analysis of Alternatives**

Allied Landfill—Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Alternative	Description	Overall Protection	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Cost
Subalternative (i)	Groundwater collection and treatment system	Protective. Achieves RAO 3 with collection and treatment of potentially impacted groundwater.	Meets ARARs	Effective	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Manageable risk associated with the installation of wells and construction of treatment system.	Proven technology.	$4,400,000 for Alternative 2A $4,300,000 for Alternative 2B, 2C or 2D
Subalternative (ii)	Groundwater collection and treatment system with slurry wall	Achieves RAO 3 with collection and treatment of potentially impacted groundwater, but may create mounding or otherwise alter groundwater flow.	Meets ARARs	Effective	Provides some reduction of volume through treatment of PCBs in groundwater. However, minimal contaminant mass is present in the groundwater.	Increased short-term risks to construction worker and environment over subalternative (i) during installation of the slurry wall. Community impacts; associated dust, noise, and traffic associated with slurry wall construction.	Proven technology. Implementation may result in groundwater mounding or short-circuiting around the barrier if operation of the groundwater treatment system ceased.	$14,000,000 for Alternative 2A $12,000,000 for Alternative 2B, 2C or 2D
Alternative 3	**Total Removal and Off-site Disposal**	Protective. Contamination would be disposed of at an approved landfill facility both hazardous and non-hazardous.	Meets ARARS	More effective than Alternative 2 due to removal from OU1. No cover maintenance or source for potential groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved. Volume may be increased if soils require dewatering by addition of cement.	Implementation over 5-year period. Worker risk associated with dermal contact, inhalation and ingestion would occur over a longer period of time. Risks are controllable. Community impacts: associated dust, noise, and traffic.	Proven technology, landfill space in the area could be limited requiring the hauling of waste a significant distance from OU1.	$238,000,000
Alternative 4	**Encapsulation Containment System**	Protective. Little advantage achieved by construction of the liner. Compacted waste can already achieve 1×10^{-7} centimeters per second hydraulic conductivity, limiting groundwater flow through the material.	Meets ARARS	More effective than Alternative 2. The source material is fully encapsulated further minimizing potential for groundwater impacts.	No reduction of toxicity, mobility, or volume would be achieved.	Implementation over 10-year period. Worker risk associated with dermal contact, inhalation, and ingestion would occur over a longer period of time. Risks are controllable. Community impacts: associated dust and noise is the least short-term effective alternative.	Proven technology.	$159,000,000