Preassessment Screen:
Smurfit-Stone/Frenchtown Mill Site
Frenchtown, Montana

Prepared for:
Montana Natural Resource Damage Program
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Executive Summary

The Smurfit-Stone/Frenchtown Mill Site (the Site), on the Clark Fork River in western Montana, was a paper mill from 1957 to 2010. Industrial activities at the mill resulted in the release of hazardous substances into the floodplain and exposure of natural resources to these hazardous substances. When hazardous substances harm (or "injure") natural resources that are held in trust for the public, Federal and State laws provide mechanisms for natural resource Trustees to seek compensation from potentially responsible parties for those injuries on behalf of the public. Regulations outlining a process for conducting a natural resource damage assessment (NRDA) have been promulgated by the U.S. Department of the Interior (DOI) at 43 CFR Part 11.

The Trustees of natural resources for the Site include State, Federal, and Tribal Trustees. The Montana Natural Resource Damage Program (NRDP) represents the Governor of the State of Montana, the Trustee for natural resources for the State of Montana. The Federal Trustees for the Site are the U.S. Fish and Wildlife Service and the U.S. Department of Agriculture Forest Service, and the Tribal Trustees are the Confederated Salish and Kootenai Tribes and the Kalispel Tribe.

The Trustees are evaluating whether to proceed with an NRDA for the Site. A Preassessment Screen (PAS) is the first step in the NRDA process based on DOI regulations. The Montana NRDP retained Abt Associates to prepare this PAS and determine whether readily available information suggests that the Trustees can make a successful claim and should proceed with an NRDA for the Site and downstream habitat. This PAS focuses on the Site, including the Clark Fork River.

The purpose of a PAS is to provide a "rapid review of readily available information" to ensure that there is "a reasonable probability of making a successful claim before monies and efforts are expended in carrying out an assessment" [43 CFR § 11.23(b)]. There are five criteria used to determine whether to proceed with an assessment [43 CFR § 11.23(e)], which the Trustees evaluated in this PAS:

1. **A discharge of oil or a release of a hazardous substance has occurred**

   The Trustees have reviewed available data, reports, and literature available for the Site, and they have confirmed evidence of releases of hazardous substances from historical activities at the mill.

2. **Natural resources for which the Federal or State agency or Indian Tribe may assert trusteeship under the Comprehensive Environmental Response, Compensation, and Liability Act have been or are likely to have been adversely affected by the discharge or release**

   Based on a review of readily available data and information, the Trustees have concluded that natural resources for which the Trustees may assert trusteeship have been adversely affected by the release of hazardous substances from the mill property. Groundwater resources, surface water resources (including sediments), and biological resources have been exposed to, and adversely affected by, elevated concentrations of metals, dioxins/furans, and other hazardous substances. Aquatic resources that utilize surface water and sediment as habitat, including fish within the Clark Fork River, have been exposed to and potentially adversely affected by the releases. Floodplain habitats along the Clark Fork River are also adversely affected by the releases. Hazardous substances have potentially impacted a number of natural resource services, including ecological services (e.g., habitat for biota); human use services such as water use, consumptive recreation (e.g., angling), and non-consumptive recreation (e.g., bird watching); and passive (nonuse) services (e.g., existence and bequest values).

3. **The quantity and concentration of the released hazardous substance is sufficient to potentially cause injury, as that term is used in this part, to those natural resources**

The Trustees have reviewed readily available data, comparing concentrations of hazardous substances in groundwater, floodplain and upland soils, surface water resources, and fish tissues to background concentrations and known adverse effects levels. The data confirmed that these hazardous substances are elevated above both background levels and adverse effects levels, thus confirming potential injury. For example, concentrations of arsenic, manganese, and dioxins/furans in groundwater exceed promulgated Federal and/or State groundwater quality criteria. In addition, concentrations of dioxins/furans in fish tissues of fish collected immediately downstream of the mill property in 2013 were sufficient for the State to issue advisories banning or limiting fish consumption.

4. **Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost**

The Trustees have reviewed available sources of data and determined that an assessment can be conducted and additional data can be obtained at a reasonable cost. The Site is currently undergoing a remedial investigation; the Trustees are working with response agencies to help ensure that ongoing data collection will provide data sufficient for both the evaluation of remedial actions and the evaluation of potential natural resource injuries. To the extent that this remedial investigation does not address data gaps that the Trustees have identified, the Trustees are prepared to obtain the data required in a cost-efficient manner.

5. **Response actions, if any, carried out or planned, do not or will not sufficiently remedy the injury to natural resources without further action**

Although the final remedy has not been selected, the U.S. Environmental Protection Agency and the Montana Department of Environmental Quality are currently contemplating response actions that are not sufficient to remedy the injury to natural resources without further action. In addition, hazardous substance releases and potential natural resource injuries at the Site date back decades, and the Trustees, acting on behalf of the public, are entitled to compensation for these interim injuries and service losses.

In summary, based on the five criteria set forth in the DOI regulations [43 CFR § 11.23(e)], the Trustees have determined that an assessment of natural resource damages is warranted.

1. Introduction

The Smurfit-Stone/Frenchtown Mill Site (the Site) is in Frenchtown, Montana, approximately 11 miles northwest of Missoula (Figure 1).[1] The mill property lies adjacent to the Clark Fork River and is partially within its floodplain. It was an operating pulp and paper mill from 1957 to 2010, mainly producing kraft linerboard that was in turn used to manufacture corrugated cardboard (NewFields, 2015; U.S. EPA, 2017d).

The U.S. Environmental Protection Agency (EPA) proposed adding the Site to the National Priorities List (NPL) on December 12, 2013 (U.S. EPA, 2013); it has not yet been listed (U.S. EPA, 2017c). In 2015, EPA entered into an Administrative Order on Consent (AOC) with potential responsible parties (PRPs; see Section 1.3) to conduct a remedial investigation (U.S. EPA, 2015). EPA, the Montana Department of Environmental Quality (MDEQ), and the PRPs are currently conducting remedial investigation and site characterization activities.

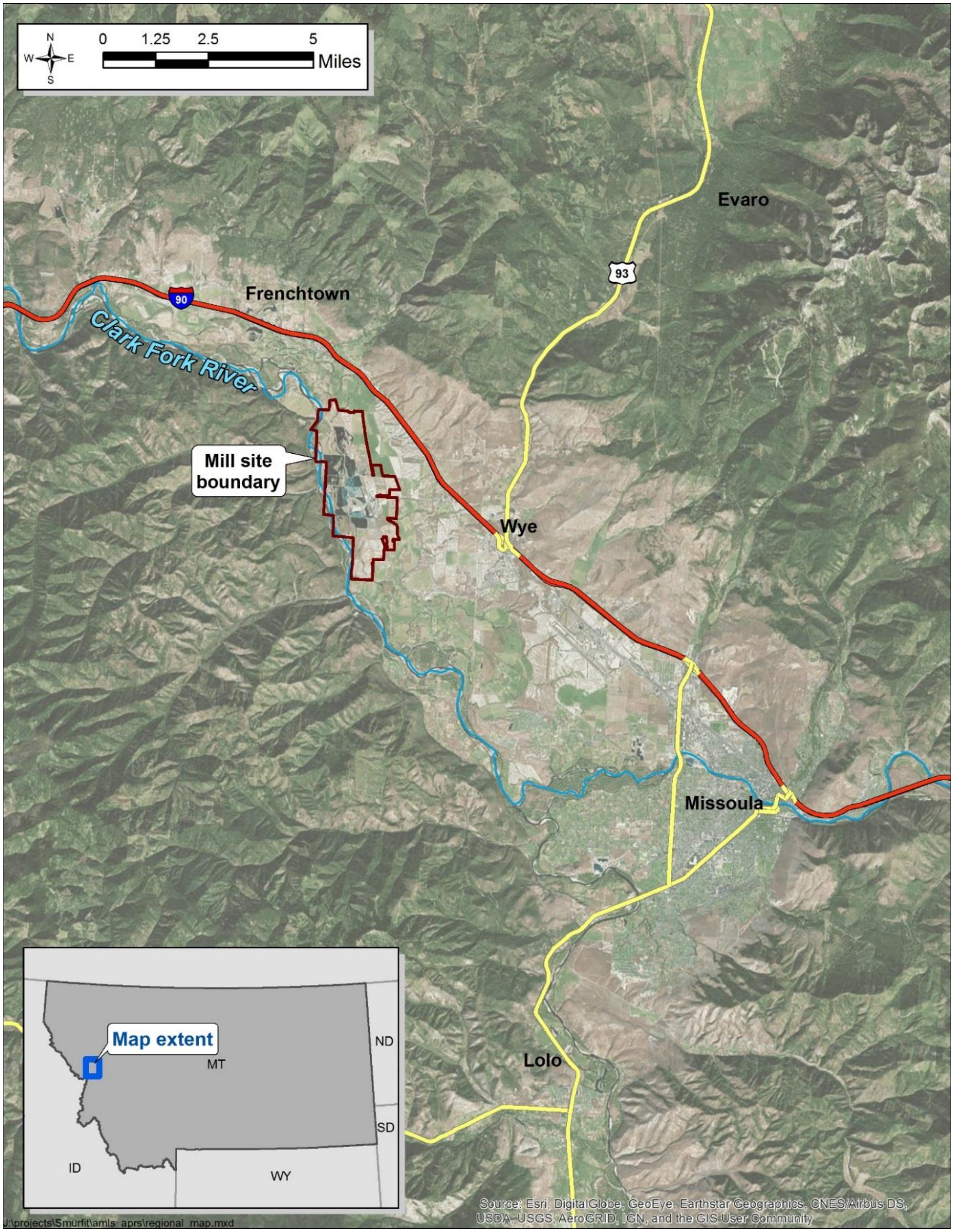
The initial site characterization activities have shown that hazardous substances were released from the mill property. When hazardous substances harm (or "injure") natural resources that are held in trust for the public, Federal and State laws provide mechanisms that authorize natural resource Trustees to seek compensation from PRPs for those injuries. Regulations outlining a process for conducting natural resource damage assessments (NRDAs) for the release of hazardous substances have been promulgated by the U.S. Department of the Interior (DOI) at 43 CFR Part 11 (hereafter, the DOI regulations). These regulations are not mandatory; however, assessments performed in compliance with these regulations have the force of a rebuttable presumption under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 USC § 9607(f)(2)(C)].

The Trustees of natural resources for the Site include State, Federal, and Tribal Trustees. The Montana Natural Resource Damage Program (NRDP) represents the Governor of the State of Montana, the Trustee of natural resources for the State of Montana. The Federal Trustees for the Site are the U.S. Fish and Wildlife Service (USFWS) and the U.S. Department of Agriculture Forest Service, and the Tribal Trustees are the Confederated Salish and Kootenai Tribes and the Kalispel Tribe.

The Trustees are evaluating whether to proceed with an NRDA for the Site. A Preassessment Screen (PAS) is the first step in the NRDA process based on the DOI regulations. The Montana NRDP retained Abt Associates to prepare this PAS and determine whether readily available information suggests that the Trustees can make a successful claim and should proceed with an NRDA for the Site and downstream habitat. This PAS focuses on the Site, including the Clark Fork River.

1. The Site includes the mill property in Frenchtown, as well as contaminated groundwater under that property, and anywhere that released hazardous substances have come to be located, including the Clark Fork River.

Figure 1. Smurfit-Stone/Frenchtown Mill Site. The full extent of the Site includes areas in the Clark Fork River where released hazardous substances have come to be located, which is not yet known.



1.1 Intent of the Preassessment Screen

Subpart B of the DOI regulations provide guidelines for conducting a PAS. The purpose of a PAS is to provide "a rapid review of readily available information," focusing on resources for which a Federal, State, or Tribal agency can assert trusteeship, to ensure that there is "a reasonable probability of making a successful claim before monies and efforts are expended in carrying out an assessment" [43 CFR § 11.23(b)]. A PAS is not intended to serve as a complete assessment of natural resources injuries or damages. This PAS was prepared using existing data to evaluate whether the Trustees have a reasonable probability of making a successful claim.

1.2 Criteria to be Addressed by the Preassessment Screen

The content and requirements of a PAS include five criteria that are used to evaluate whether to proceed with an assessment [43 CFR § 11.23(e)]:

1. A discharge of oil or a release of a hazardous substance has occurred
2. Natural resources for which the Federal or State agency or Indian Tribe may assert trusteeship under CERCLA have been or are likely to have been adversely affected by the discharge or release
3. The quantity and concentration of the discharged oil or released hazardous substance is sufficient to potentially cause injury to those natural resources
4. Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost
5. Response actions, if any, carried out or planned, do not or will not sufficiently remedy the injury to natural resources without further action.

The remainder of this document provides the information to satisfy these criteria, following Subpart B of the DOI regulations. Section 2 provides information about the Site and the release of hazardous substances [43 CFR § 11.24]. Section 3 is a preliminary identification of resources potentially at risk [43 CFR § 11.25]. Section 4 documents the determination that all of the PAS criteria have been met, and Section 5 presents the Trustees' determination to proceed with an NRDA for the Site. This is followed by references cited in the text.

1.3 Potentially Responsible Parties

PRPs at the Site include past owners and operators of the mill, the current property owners, and railroad companies that transported materials to and from the mill. Waldorf Paper Products (Waldorf) originally built the mill in 1957. Waldorf merged with Hoerner Boxes, Inc. in 1966 to create the Hoerner Waldorf Corporation (Hoerner Waldorf). Hoerner Waldorf merged with Champion International Corp. (Champion) in 1977, and Champion operated the mill until Stone Container purchased the property in 1986. The International Paper Company (International Paper) purchased Champion in 2000 and is a PRP at the Site (U.S. EPA, 2015; Briggeman, 2017).

Stone Container operated the mill after the 1986 purchase. Stone Container merged with the Smurfit Corporation in 1998 to form Smurfit-Stone Container, which operated the mill until it shut down in 2010. RockTenn acquired Smurfit-Stone Container in 2011. WestRock CP, LLC (WestRock) is the successor to RockTenn and is a PRP at the Site (U.S. EPA, 2015).

In 2011, M2Green Redevelopment, LLC (M2Green), an affiliate of Green Investment Group, Inc., purchased the mill with the aim of future redevelopment (Green Investment Group, 2011). Most of the industrial structures were removed by 2013. The company has rebranded the mill property as the Frenchtown Technology and Industrial Center (Briggeman, 2017). M2Green is also a PRP at the Site.

The Site includes a railroad spur that was used for transporting raw materials to the mill and finished products from the mill. Northern Pacific Railway, which originally constructed the spur in 1957, is now the BNSF Railway Company (BNSF). In 1987, BNSF entered into an agreement with Montana Rail Link (MRL) that gave MRL rights to use the spur. MRL used the spur to transport materials to and from the mill. BNSF and MRL are also PRPs for the Site (U.S. EPA, 2015).

2. Site History and Hazardous Substance Releases

This section includes Site information and documentation of releases of hazardous substances pursuant to the DOI regulations [43 CFR § 11.24]:

- Section 2.1 provides the location and description of the Site [43 CFR § 11.24(a)(4)]
- Section 2.2 describes the operational history and waste disposal at the Site [43 CFR § 11.24(a)(4)]
- Section 2.3 summarizes sources of hazardous substances [43 CFR § 11.24(a)(3)]
- Section 2.4 describes released hazardous substances [43 CFR § 11.24(a)(2); 43 CFR § 11.24(a)(5)]
- Section 2.5 describes time, quantity, duration, and frequency of the hazardous substance releases [43 CFR § 11.24(a)(1)]
- Section 2.6 discusses whether damages being considered are barred by specific defenses or exclusions from liability under CERCLA or the Clean Water Act (CWA) [43 CFR § 11.24(b)].

The PRPs were listed previously in Section 1.3 [43 CFR § 11.24(a)(6)].

2.1 Location and Description

The mill property is located in the Clark Fork Drainage, directly adjacent to the Clark Fork River (see Figure 1), and partially falls within the river's 100-year floodplain. Topography at the mill property is relatively flat, ranging in elevation from approximately 3,070 feet near the core industrial area, to approximately 3,040 feet at the Clark Fork River (URS, 2012). Regionally, the Clark Fork River drainage is approximately 3,000–3,200 feet above sea level and is encircled by mountain ranges with elevations of 5,000–8,000 feet above sea level (URS, 2012; NewFields, 2015).

The mill property covers 3,150 acres, with approximately 3.6 miles of river frontage (URS, 2012). A 15-foot-wide levee separates wastewater holding ponds from the Clark Fork River (Figure 2). The levee is 3.7 miles long and ranges from 2 to 25 feet in height above the ground surface. This levee provides flood protection under "seasonally normal flows" (NewFields, 2015, p. 7).

There is also a higher internal levee at the mill property, with a distance from the river that varies from approximately 0.5 to 2 miles (Figure 2). This upper levee was not breached on May 18, 1997, when the Clark Fork River discharge was 55,100 cubic feet per second (cfs), the largest flood event to occur since 1930 (NewFields, 2015; USGS, 2018).

Alluvial groundwater is close to the ground surface at the mill property, particularly adjacent to the river. Some of the abandoned waste treatment ponds in the floodplain are seasonal wetlands, partially inundated with groundwater (URS, 2012). The groundwater is hydrologically connected to the Clark Fork River.

The land that immediately surrounds the mill property is primarily agricultural, used for cultivating feed for livestock, growing alfalfa and grain crops, and cattle grazing, interspersed with some residential areas (URS, 2012).

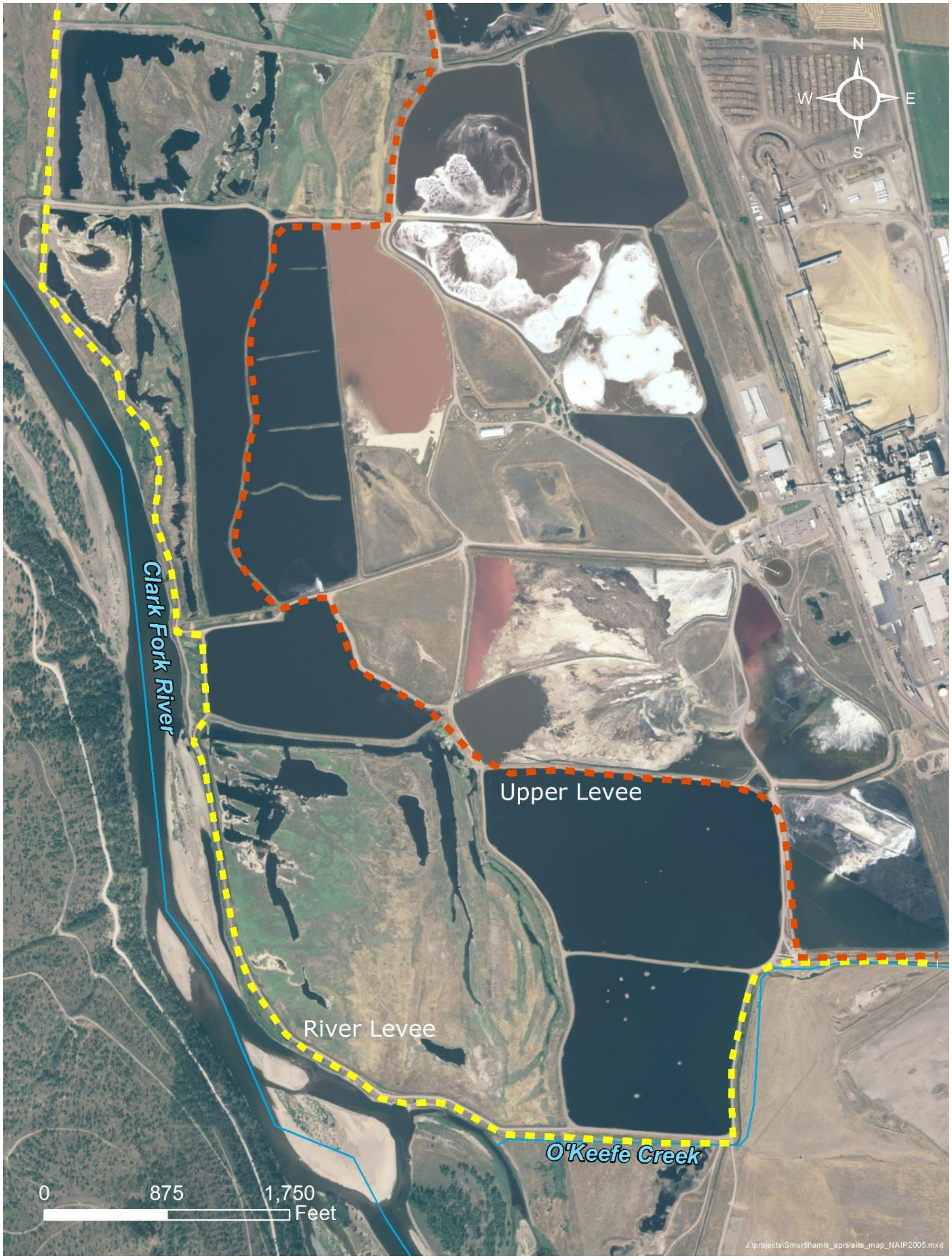
2.1.1 Rivers and Creeks

The Clark Fork River, which flows northwest along the western boundary of the mill property (see Figures 1 and 2), is the largest river by volume in Montana. It sustains agricultural operations, provides community drinking water, and supports recreational activities including angling and boating (Clark Ford Coalition, 2018). The Clark Fork River begins at the junction of Warm Springs Creek and Silver Bow Creek near Anaconda and ends at Lake Pend Oreille in Idaho. The portion of the river within west-central Montana drains an area of 22,150 square miles. Major tributaries upstream of the Site include the Bitterroot River (~ 10 miles upstream) and the Blackfoot River (~ 20 miles upstream).

The Clark Fork River has a mean daily flow of 156 cfs at its headwaters, increasing to 2,590 cfs near the mill property. Peak flows in this reach have exceeded 50,000 cfs four times since 1930. The river reaches a mean daily flow of 22,389 cfs by the time it reaches Lake Pend Oreille, about 190 river miles downstream of the mill property (NewFields, 2015; USGS, 2018).

O'Keefe and Lavalle creeks flow through the southern end of the mill property and drain into the Clark Fork River. Because of the presence of westslope cutthroat trout and bald eagle nesting habitat, the Northwest Power and Conservation Council (NWPC) has named O'Keefe Creek a "protected area," where the council believes hydroelectric development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat (NWPC, 2017).

Figure 2. Levees at the south end of the mill property (2005 photograph).



2.1.2 Groundwater

The mill property sits predominately on alluvial sediments of the Clark Fork River drainage, within the northwestern portion of the Missoula Valley. During the Pleistocene Epoch, the Missoula Valley experienced successive glaciation and interglaciation events, which flooded and drained the valley. Approximately 12,000 years ago, the Missoula Valley was covered by Lake Missoula, a glacial lake nearly 2,000-feet deep. When this lake receded, it left behind clay and silt deposits. These glacial lake deposits are now overlain by the more recently deposited unconsolidated alluvial sediments associated with the Clark Fork River, and underlain by a deeper geologic unit of unconsolidated cobbles (URS, 2012; NewFields, 2015).

Groundwater is found within two geologic units at the mill property. This includes the shallow groundwater, comprising mainly Clark Fork River deposits of unconsolidated sands, gravels, and cobbles. Below the shallow groundwater is the unconsolidated cobble unit that is the deeper groundwater. These two units are separated by finer-grained (silty-clay) Lake Missoula deposits (URS, 2012; NewFields, 2015).

Depth to the shallow groundwater varies across the mill property, ranging from less than 5 feet to more than 25 feet below the ground surface (URS, 2012; NewFields, 2015). The shallowest depths occur close to the Clark Fork River. These groundwater elevations fluctuate seasonally, responding to spring runoff and return flows from agriculture, varying by at least one foot or more. The deeper aquifer is approximately 100–150 feet below the ground surface. Groundwater beneath the mill property is unconfined and generally flows from east to west, discharging to the Clark Fork River (NewFields, 2015).

The shallow groundwater has lower yields than the deeper groundwater. Private wells near the mill property and the water supply wells for the mill are completed in the deeper groundwater. There are 14 deep water supply wells at the south end of the mill property that were used during mill operations to supply water to the plant. The deeper aquifer produced 15 million gallons per day of process water during the operational history of the mill. With the exception of monitoring wells, there are no wells completed in the shallower groundwater on the mill property (NewFields, 2015).

2.1.3 Habitats

The mill property provides different types of habitat that are utilized by local flora and fauna. During mill operations, the wastewater treatment ponds on the mill property were flooded at different times, depending on wastewater discharge and storage needs. Today, the upper ponds outside of the 100-year floodplain remain mostly dry, providing meadow habitat. This habitat is utilized by birds, small mammals, and terrestrial invertebrates (U.S. EPA, 2017a). The lower ponds within the 100-year floodplain support wetland habitat for at least part of the year, providing potential habitat for aquatic macroinvertebrates, waterfowl, and other biota (U.S. EPA, 2017a).

When the water table is elevated, groundwater sustains the surface water in these lower ponds. The floodplain areas on the mill property overlap with wetland habitat areas designated in the National Wetlands Inventory (U.S. EPA, 2017a). Further, U.S. EPA (2017a) describes the core industrial area at the mill property as an “attractive nuisance” area, with attributes that attract wildlife, including low-lying areas that fill with water after rain events, and grasses growing in open areas that provide roosting and nesting areas.

A portion of the mill property is comprised of agricultural lands, which also provides some measure of habitat for birds, mammals, and invertebrates, including, for example, resting and foraging habitat for passerine birds. The Clark Fork River, and O'Keefe and Lavalle creeks provide both riparian and aquatic habitats. Portions of OU3 include forested and shrubby riparian areas adjacent to the creeks and the river. The forested areas along the Clark Fork River include sparsely distributed ponderosa pines, with an open understory, low-lying shrubs, and snags (U.S. EPA, 2018a).

2.1.4 Biota

Many different species of vertebrate and invertebrate biota are present in or near the Site. U.S. EPA (2017a) identified 36 invertebrate species, as well as 20 fish species, 243 bird species, 3 amphibian species, 3 reptile species, and 30 mammal species in Missoula County.

Site-specific species information includes information from fish and bird surveys, and onsite observations. Schmetterling and Selch (2013) collected northern pike and rainbow trout in the backwaters, sloughs, and margins of the Clark Fork River immediately downstream of the mill property. U.S. EPA (2017a) reports additional fish species found in the river adjacent to the mill property, according to the online database for the Montana Fisheries Information System (MFISH). Common species in the Clark Fork River reaches associated with the Site include largescale and longnose suckers, longnose dace, mountain whitefish, and rainbow trout. Fish species that MFISH classifies as "rare" include brook trout, brown trout, pumpkinseed, westslope cutthroat trout, bull trout, largemouth bass, yellow perch, peamouth, Rocky Mountain sculpin, and northern pike [although as noted previously, Schmetterling and Selch (2013) found northern pike immediately downstream of the mill property].

Onsite observations of wildlife include many species of small birds, water birds (mallards, herons, grebes), and raptors (hawks, owls, golden eagles, bald eagles). Onsite mammal observations include rabbits, whitetail deer, elk, coyote, fox, river otters, badgers, beavers, and other rodents. In the industrial area, owls nesting in buildings, small birds drinking and washing in puddled water, raptors hunting small mammals, and bats roosting in the buildings have also been observed (U.S. EPA, 2017a). Along the Clark Fork River, large snags provide perches for eagles and osprey. Great blue herons, kingfisher, and a variety of passerine birds and waterfowl have been observed along the shoreline of the river (U.S. EPA, 2018a).

Several sensitive species may also occur at the Site. In Missoula County, USFWS (2017) has identified six threatened, one proposed, and one candidate species that may occur (Table 1). Of this list, EPA reports that the wolverine and threatened bull trout are known or expected to occur at the Site. The USFWS has designated critical habitat for bull trout in the Clark Fork River [74 FR 2269], including the reach adjacent to the mill property and downstream reaches likely within the Site (U.S. EPA, 2017a).

The Site lies within the Montana Audubon Clark Fork River – Grass Valley Important Bird Area (IBA). Audubon has documented 16 bird species of conservation priority within the IBA, including 6 pairs of bald eagles, Lewis's woodpeckers, red-naped sapsuckers, and willow flycatchers (URS, 2012; U.S. EPA, 2017d). The Montana Natural Heritage Program has also identified 27 bird species of concern in Missoula County (MTNHP, 2016).

Table 1. Listed threatened, proposed, or candidate species in Missoula County

Common name	Scientific name	Status
Grizzly bear	*Ursus arctos horribilis*	Listed threatened
Water howellia	*Howellia aquatilis*	Listed threatened
Canada lynx	*Lynx canadensis*	Listed threatened
Bull trout[a]	*Salvelinus confluentus*	Listed threatened
Yellow-billed cuckoo	*Coccyzus americanus*	Listed threatened
Red knot	*Calidris canutus rufa*	Listed threatened
Wolverine[a]	*Gulo gulo luscus*	Proposed
Whitebark pine	*Pinus albicaulis*	Candidate

a. Species that have been observed at or near the Site.

Source: USFWS, 2017.

2.2 Operational History

2.2.1 Mill Operations

The mill operated as a pulp and paper mill from 1957 to 2010. It primarily used virgin pulp to produce rolls of kraft linerboard, which was then used to manufacture corrugated containers. The milling operation created pulp from wood chips that were hauled to the mill or wood that was chipped at the mill. Onsite chipping often created waste bark and wood (i.e., hog fuel), which was eventually burned in a multi-fuel boiler. Beginning in 1990, up to 30% of the raw pulp was created from the recycling of old corrugated containers at an onsite recycled fiber plant (NewFields, 2015; U.S. EPA, 2017a, 2017d).

To create the pulp, wood chips were washed and sent to digesters, where they were "cooked" in white liquor (sodium hydroxide and sodium sulfate). Spent digester liquor and pulp washing fluids were collected from digesters and concentrated to solids, which were then burned in recovery boilers. This process recovered some process chemicals (e.g., sodium carbonate, sodium sulfate), which were used to regenerate white liquor (NewFields, 2015).

Power boilers and lime kilns at the mill produced stack emissions. While the mill was in operation, MDEQ required the monitoring of regulated emissions and a renewal of the mill's operating permit every five years (NewFields, 2015).

When the mill opened in 1957, production capacity was 250 tons per day (tpd) of kraft pulp. The capacity expanded multiple times over the years, to 600 tpd in 1960, 1,150 tpd in 1966, and 1,850 tpd in 1977. Production apparently peaked at 1,900 tpd in 1993, declining to 1,600 tpd in the early 2000s before operations ceased in 2010 (URS, 2012). The majority of the pulp was used to produced unbleached linerboard; however, from 1960 to 1999, the operation included production of bleached pulp and white linerboard. In the preliminary assessment of the Site, URS (2011) reported that the mill produced 150 tpd of bleached pulp starting in 1960, and maintained that level of bleached pulp production after the expansion in 1966.

NewFields (2015) stated that bleached pulp was 6% of the total production over the lifetime of the mill, suggesting that the mill may have produced less than 150 tpd of bleached pulp in some years between 1960 and 1999. If the plant operated 350 days per year at the production levels listed above, and bleached pulp was 6% of the total production, the quantity of bleached pulp produced from 1960 to 1999 would have been about 1.6 million tons.

2.2.2 Wastewater and Sludge

The mill utilized about 15 million gallons per day of water for operations, from two well fields located in the southern portion of the mill property. This groundwater was used in various process and recovery systems throughout the mill, and resulted in a similar amount of wastewater generated daily (NewFields, 2015).

The wastewater system at the mill evolved over time. At the beginning of operations in 1957, wastewater mixed with paper fiber solids (sludge) was discharged into the Clark Fork River without treatment. After complaints of foam, discoloration, and fish kills in the river, the first wastewater ponds (known as settling or sludge ponds) were constructed in 1958 (URS, 2012). Wastewater and sludge from pulp production (including bleached pulp sludge starting in 1960) was discharged into these unlined ponds until a primary clarifier was installed in 1969 (URS, 2012) or 1970 (NewFields, 2015). The clarifier removed sludge from the wastewater. The solids from the clarifier were deposited in Settling Ponds P3, P4, and P5, while the liquid waste stream was directed to other holding ponds (Figures 3 and 4).

In 1974 and 1975, Hoerner Waldorf installed secondary treatment aeration basins, tertiary polishing ponds, and a series of additional holding ponds. After sludge was removed from the clarifier, the wastewater was transferred to aeration basins. The aeration basins operated in a series: aeration basins AB1 and AB2 were constructed in 1974–1975, and aeration basin AB3 was constructed in 1990 (Figure 4). Supplemental nutrients (i.e., nitrates and phosphates) were added to these basins to assist with the water treatment process (URS, 2011; NewFields, 2015).

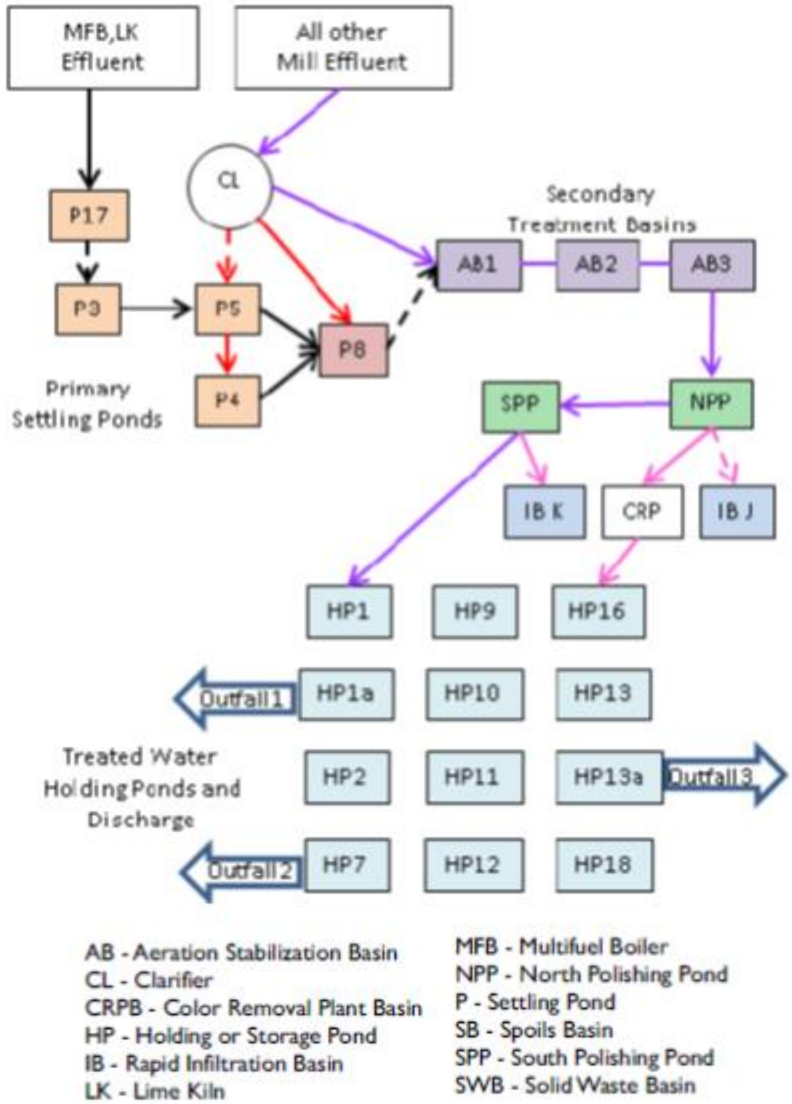
After aeration, the wastewater was transferred to polishing ponds that allowed for further settling of solids. After polishing, the treated wastewater was diverted to one of 12 holding ponds and discharged through Montana Pollutant Discharge Elimination System (MPDES) permitted outfalls. The MPDES permit allowed for direct discharge of wastewater to the Clark Fork River during spring high flows (MDHES, 1986), or when flows exceed 1,900 cfs (URS, 2011).

A Color Removal Plant (Figures 3 and 4) was added in 1988 (NewFields, 2015). If needed, wastewater from the north polishing pond could be diverted to the Color Removal Plant to reduce color prior to discharge to the holding ponds. This mainly occurred prior to 1999 when the bleach plant was operating, as the bleaching process contributed a large amount of color to the wastewater (URS, 2011).

Solids from the Color Removal Plant were collected in holding tanks, blended with spent (black) liquor, and burned in the recovery boilers. Occasionally, the holding tanks in the Color Removal Plant were flushed out into the Color Removal Plant Basin (NewFields, 2015). When the treated effluent in the holding ponds met temperature and color standards, mainly during high-flow events, it was discharged to the Clark Fork River.

Three rapid infiltration basins were used from 1974 to 1983. When the holding ponds were at capacity, the treated wastewater was moved to the rapid infiltration basins. In 1977, 63% of the mill wastewater was routed through rapid infiltration ponds (URS, 2011). While none of the ponds or basins were lined, these infiltration basins were specifically designed to allow for rapid infiltration into groundwater (URS, 2012).

Figure 3. Schematic diagram of the mill wastewater treatment system, after the construction of the dewatering plant.



Source: NewFields, 2015, Figure 4.

In 1997, Stone Container installed a sludge dewatering plant, and dewatered solids became fuel for the multi-fuel boiler, reducing the need to dispose of sludge in the ponds. An emergency spill pond was also constructed at the mill property, for use if a spill or other disruption occurred in the industrial process. In these cases, flows could be diverted to the pond before they reached the wastewater treatment system (Smurfit-Stone Container, 2004, as cited in URS, 2011). The dates of use of this pond are unknown (URS, 2011).

Figure 4. Mill property wastewater treatment ponds, basins, and landfills in July 2007. See Figure 3 for acronym and abbreviation definitions (LF = landfill).

Background image: 7/10/2007, © DigitalGlobe.

2.2.3 Solid Wastes

For most of the mill's operational history, general refuse, construction waste, hog fuel ash, lime kiln waste, and some asbestos-containing materials were placed into one of six solid waste basins (i.e., landfills; see Figure 4). Most of the solid waste basins were closed in 1993; one basin remained open and received inert materials (e.g., wood, gravel, log yard wastes, bricks) after 1993 (NewFields, 2015). Dredge spoils from the secondary treatment (aeration) basins were placed into one of two spoils basins. Spoils from the primary settling ponds may also have been placed into the spoils basins (NewFields, 2015).

2.2.4 Remedial Activities

As noted previously, EPA and the three of the PRPs (International Paper, WestRock, and M2Green) entered into an AOC to conduct formal remedial investigation activities in 2015 (U.S. EPA, 2015). The AOC defines three operable units (OUs) at the Site (Figure 5):

1. OU1 is defined in the AOC as "several non-contiguous parcels of agricultural land totaling approximately 1,570 acres located along the perimeters of the site to the north, south, and east." OU1 generally includes areas within the mill property boundary that were not used for industrial purposes. Most of OU1 is grasslands for cattle grazing, and irrigated grain and alfalfa fields.

2. OU2 is the former industrial area, including the former mill building and process areas. OU2 covers approximately 255 acres of the Site.

3. OU3 comprises the areas where liquid and solid wastes were stored and treated, including the wastewater treatment system (i.e., settling ponds, secondary aeration basins, polishing ponds, holding ponds, and infiltration basins) and the solid waste repositories (i.e., solid waste landfills, spoils basins). OU3 covers approximately 1,700 acres of the mill property, including areas along the Clark Fork River within the river's 100-year floodplain (Figure 5). Although not depicted in Figure 5 and subsequent figures, OU3 also includes groundwater impacted by hazardous substances from mill activities, and locations in the Clark Fork River (many yet to be investigated) where hazardous substances from mill activities have come to be located.

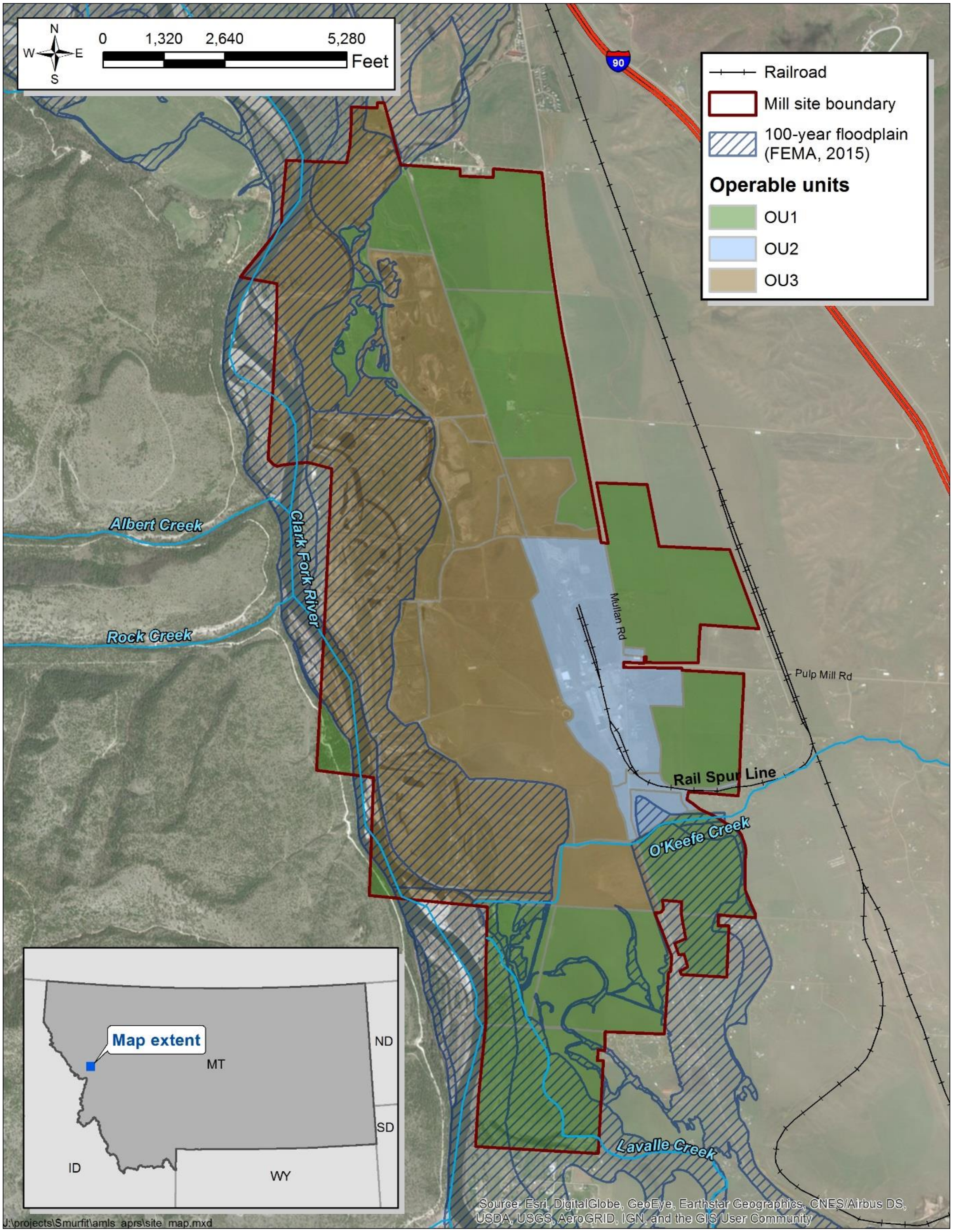
EPA conducted an initial Site investigation in 2011, as part of the assessment to determine a hazard-ranking score for possible listing on the NPL. This effort included the collection and analysis of soil, sediment, surface water, and groundwater samples near the waste ponds and adjacent to the Clark Fork River (URS, 2012). The PRPs challenged the validity of the URS (2012) data (RockTenn, 2014), and EPA subsequently excluded those data from their database of Site samples.

In 2014, the PRPs' contractor (NewFields) collected soil, waste material, and groundwater samples, focusing on areas that were not included in the 2011 investigation, primarily in OU1 and OU2 (NewFields, 2015). In November and December 2015, NewFields conducted follow-up sampling of soil and groundwater in the three OUs, following an EPA-approved Remedial Investigation Work Plan (RIWP). NewFields (2016c) summarized this collection effort in a 2016 data summary report.

In June 2016, NewFields conducted a groundwater sampling event following the RIWP (NewFields, 2015) and Addendum 1 to the RIWP (NewFields, 2016a). They collected samples during a period of seasonally high groundwater elevations and presented the results of this work in a data summary report (NewFields, 2017b).

Also in 2016, NewFields conducted a soil investigation of polychlorinated biphenyls (PCBs) in OU2. The samples were collected in accordance with RIWP Addendum 2 (NewFields, 2016b), and the results were summarized in a 2017 PCB soils investigation report (NewFields, 2017c).

Figure 5. OUs at the Site. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.



EPA recently completed an ecological risk assessment (ERA) and a human health risk assessment on OU1 (U.S. EPA, 2017a, 2017b). They identified contaminants of potential ecological concern (COPECs) in soils, surface waters, and sediments (U.S. EPA, 2017a). In the ERA, they determined which COPECs were site-related, and characterized the potential risk of these COPECs to several ecological receptors. EPA also conducted a Screening Level Ecological Risk Assessment (SLERA) for OU2 and OU3 in which they identified COPECs in OU2 and OU3 soils, and in surface water and sediments of the Clark Fork River (U.S. EPA, 2017d). The baseline ecological risk assessment for OU2 and OU3 will be conducted in 2018.

2.3 Sources of Hazardous Substances

Areas with hazardous substances at the mill property include sludge ponds, an emergency spill pond, aeration basins, polishing ponds, wastewater storage ponds, landfills, the industrial area, a land farm, and storage tanks (above and below ground). In this section, we summarize information from existing Site documents. However, as the Missoula Health Department has emphasized to EPA and MDEQ (e.g., Nielson, 2016, 2017), the full extent of the materials buried in waste areas at the mill property is not known.

2.3.1 Sludge Ponds

From 1958 until the primary clarifier was installed in 1969–1970, sludge ponds received untreated waste, including waste from bleached pulp production starting in 1960. Waldorf generated approximately 20,000 tons of sludge a year, which was pumped into four sludge ponds (Ponds 3, 4, 5, and 17). From 1960 to 1966, about 25% of the total pulp production (150 of 600 tpd) was bleached (see Section 2.2.1); if the mill produced 20,000 tons of sludge per year, roughly 5,000 tons per year of bleached pulp sludge was pumped into these unlined ponds. The four ponds vary in depth (7–14 feet) and cover approximately 91 acres. These ponds were not lined and were not designed as modern permitted waste repositories (Nielson, 2016); wastewater has infiltrated through the bottom of the ponds into the shallow aquifer (URS, 2011).

The sludge consisted of fiber solids, inorganic solids, and fly ash. The sludge dewatering facility, constructed in 1997, removed excess liquid from the sludge, providing a fuel source for the multi-fuel boiler and reducing the need for sludge disposal (Smurfit-Stone Container, 2004, as cited in URS, 2011).

Kidston (2018) recently published historical photographs taken when the mill was operating, including a photograph that appears to be a sludge pond with an unidentified and decomposed drum present (Figure 6). To date, the remedial investigation of the Site has not included a detailed analysis of the waste in the sludge ponds or other solid waste ponds (Nielson, 2016, 2017).

2.3.2 Emergency Spill Pond

The emergency spill pond on the mill property was built to contain a spill or other disruption in the industrial process (Smurfit-Stone Container, 2004, as cited in URS, 2011). The pond comprises a wet cell and a dry cell. In June 2011, during a reconnaissance study, EPA noted a breach in the northwest corner of the wet cell, as well as no engineered liner or runoff controls (URS, 2011). Thus, the spill pond may be a source of hazardous substances. The dates and use of this pond are unknown (URS, 2011).

Figure 6. Historical photograph of a sludge pond. The contents of the drum and the date of the photograph are unknown.

Source: Kidston, 2018.

2.3.3 Infiltration Basins, Aeration Basins, Polishing Ponds, and Holding Ponds

The infiltration basins received large quantities of wastewater that became a source of hazardous substances to the underlying groundwater. They were designed to dispose of wastewater via rapid infiltration through the bottom of the ponds into the shallow aquifer (Smurfit-Stone Container, 2004, as cited in URS, 2011).

Section 2.2.2 described the wastewater treatment system at the mill property, including the aeration basins, polishing ponds, and holding ponds. None of these basins and ponds were lined. Any hazardous substances released to these basins and ponds may have been transported to underlying soils or alluvial groundwater. Some of the ponds were constructed to a depth below the water table (URS, 2012), and those parts of the ponds are seasonally inundated. In addition, many of the holding ponds lie within the FEMA (2015) 100-year floodplain (Figure 5).[2]

2. The Trustees are evaluating the Federal Emergency Management Agency 100-year floodplain delineation.

2.3.4 Solid Waste Landfills

As described in Section 2.2.3, solid wastes generated at the mill were placed into four onsite landfills until 1993. Disposal mainly occurred in three areas (Stone Container, 1992, as cited in URS, 2011; see Figure 4):

- Landfill A received general refuse, including paper, plastic, scrap metal, wood, glass, and food
- Landfills 6 and C received hog fuel ash and lime (Landfill C also received ragger wire, which is baling wire and twine that comes with recycled cardboard)
- Landfill F received asbestos-contaminated waste.

These areas were formally closed in 1995 after being capped with 18 inches of clay and 6 inches of topsoil (MDEQ, 1995, as cited in URS, 2011). After October 1993, all Class II waste (e.g., general refuse, ragger wire, boiler ash) was taken offsite, while Class III waste (e.g., saw dust, wood chips, kiln bricks) was placed into a new landfill (Landfill G).

2.3.5 Industrial Area

The former industrial area (OU2) housed the pulp and paper production facilities. The production of pulp and paper at the mill used and produced many hazardous chemicals, including bleaching chemicals, liquid sulfur dioxide, liquid ammonia, sodium hydroxide, sodium salts, dimethyl disulfide, methyl sulfide, liquors of high pH, turpentine, acids, and non-condensable gases. Additionally, bulk petroleum products were stored onsite. Large hydraulic equipment was used at the facility, some of which may have contained PCBs as additives (URS, 2011).

The pulping process at the mill relied heavily on the recovery and reuse of chemicals; however, any leaks, spills, and overflows from the transfer, handling, and storage systems were directly transferred to the primary clarifier (Smurfit-Stone Container, 2004, as cited in URS, 2011). Large spills of petroleum or chemicals could be manually rerouted to the emergency pond before reaching the primary clarifier (U.S. EPA, 1993, as cited in URS, 2011).

2.3.6 Land Farm

The south end of OU2 includes a 23-acre parcel adjacent to O’Keefe Creek that was used as a land farm for the onsite treatment of petroleum-contaminated materials (NewFields, 2015).

2.3.7 Storage Tanks

The mill property included four above ground and four below ground storage tanks. Three of these tanks contained bunker oil, while the contents of the remaining five tanks are unlisted. MDEQ reported evidence of leaks at three of the tanks (MDEQ, 2011a, as cited in URS, 2011).

2.4 Hazardous Substances Released

NewFields (2015, 2017b) and the U.S. EPA (2017b, 2017c, 2017d) have identified numerous hazardous substances of potential concern at the Site that have been released from the above-described sources, including metals, PCBs (a.k.a. Aroclors), and dioxins/furans (Table 2). Additional data on hazardous substance releases and the potential exposure of natural resources are discussed in subsequent sections.

Table 2. Hazardous substances identified at the Site

Soil	Surface water	Sediment	Groundwater
Dioxins/furans[a, c]	Dioxins/furans[a, c]	Dioxins/furans[a, c]	Dioxins/furans[d, e]
Aluminum[a, c]		Arsenic[a, c]	Arsenic[d, e]
Antimony[c]		Cadmium[c]	Manganese[b, d, e]
Aroclor 1254[c]		Chromium[c]	
Aroclor 1260[c]		Copper[a, c]	
Arsenic[c]		Manganese[c]	
Barium[a, c]		Mercury[c]	
Cadmium[c]		Silver[c]	
Chromium[a, c]		Zinc[a, c]	
Copper[a, c]			
Lead[a, c]			
Manganese[a, c]			
Mercury[c]			
Nickel[c]			
Selenium[a, c]			
Vanadium[a, c]			
Zinc[a, c]			

a. U.S. EPA, 2017b.
b. U.S. EPA, 2017c.
c. U.S. EPA, 2017d.
d. NewFields, 2015.
e. NewFields, 2017b.

Hazardous substances released at the Site include chlorinated dioxins and furans, including 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzofuran (TCDF). These compounds are persistent organic pollutants (POPs) that do not readily degrade in the environment and are highly toxic. In the late 1980s, EPA and the paper industry conducted a study incorporating sampling data from all 104 bleaching kraft paper mills in the United States (U.S. EPA, 1990). This study found that 97% of sludge samples contained detectable TCDD, and 100% of sludge samples contained detectable TCDF. Similarly, 85% of wastewater effluent samples contained detectable TCDD and 94% of wastewater samples contained detectable TCDF (U.S. EPA, 1990). As discussed previously, this mill produced about 1.6 million tons of bleached pulp between 1960 and 1999. Sludges from the bleaching process were placed in unlined ponds, which could be ongoing sources of TCDD and TCDF.

2.5 Time, Quantity, Duration, and Frequency of Releases

The mill operated between 1957 and 2010. Releases of hazardous substances may have occurred at any time over the five decades that the mill was operating. During the first year of operations, releases from the mill property resulted in complaints of fish kills, foam, and discoloration of the Clark Fork River, leading to construction of the first sludge ponds in 1958 (URS, 2012). Settling sludges before discharging to the river would have reduced but not eliminated direct releases of hazardous substances to the river. The mill produced up to 6 billion gallons of wastewater per year during operations (URS, 2011).

The construction of the primary clarifier in 1969–1970 and additional wastewater treatment ponds in the 1970s further reduced the likelihood of direct discharge of hazardous substances from sludge ponds to the Clark Fork River. However, none of the waste treatment ponds and sludge landfills are lined. Hazardous substances may have been released into waste repositories, transported to groundwater resources, and subsequently transported to surface water resources at any time since 1958.

The mill produced about 20,000 tons of sludge from the settling ponds, primarily from 1958 until the dewatering plant was constructed in 1997. The sludges were placed into (and remain in) unlined landfills (URS, 2011). Hazardous substances in the sludges can be transported to underlying groundwater and subsequently to the Clark Fork River.

The total quantity of hazardous substances released through sludges, wastewater, and other sources is unknown.

2.6 Damages Excluded from Liability

The Trustees evaluated whether the damages being considered are barred by specific defenses or exclusions from liability under CERCLA or the CWA [43 CFR §§ 11.24(b) and (c)]. The possible exclusions of liability include whether damages:

- Resulting from the releases were specifically identified as an irreversible and irretrievable commitment of natural resources in an environmental impact statement or other comparable environmental analysis, that the decision to grant the permit or license authorizes such commitment of natural resources, and that the facility or project was otherwise operating within the terms of its permit or license, so long as, in the case of damages to an Indian tribe occurring pursuant to a Federal permit or license, the issuance of the permit or license was not inconsistent with the fiduciary duty of the United States with respect to such Indian Tribe; or
- Resulted from releases of a hazardous substance from which such damages resulted have occurred wholly before the enactment of CERCLA; or
- Resulted from the application of a pesticide product registered under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 USC 135–135k; or
- Resulted from any other Federally permitted release, as defined in Section 101 (10) of CERCLA; or
- Resulted from the release or threatened release of recycled oil from a service station dealer described in Section 107 (a)(3) or (4) of CERCLA if such recycled oil is not mixed with any other hazardous substance and is stored, treated, transported or otherwise managed in compliance with regulations or standards promulgated pursuant to Section 3014 of the Solid Waste Disposal Act and other applicable authorities; or
- Resulted from a discharge that meets one or more of the exclusions provided in Section 311 (a)(2) or (b)(3) of the CWA.[3]

3. CWA exclusions generally cover permitted discharges.

The Trustees have determined that none of the potential injuries resulting from hazardous substance releases at the Site meet any of the above exclusion criteria, nor are they subject to any other exceptions to liability provided under Sections 107 (f), (i), and (j); and 114(c) of CERCLA.[4]

3. Preliminary Identification of Potentially Injured Natural Resources

This section presents a preliminary identification of natural resources potentially at risk from hazardous substances released from the Site pursuant to NRDA regulations. Section 3.1 describes pathways of exposure [43 CFR § 11.25(a)]. Section 3.2 summarizes the areas and resources that have been exposed to hazardous substances [43 CFR § 11.25(b)]; and presents concentrations of hazardous substances in these areas [43 CFR § 11.25(d)], including in exposed water [43 CFR § 11.25(c)]. Section 3.3 describes natural resources and services that are potentially affected because of exposure to hazardous substances [43 CFR § 11.25(e)].

Operations at the mill either used or produced hazardous chemicals on site. These included semi-volatile organic compounds (SVOCs), heavy metals, and bleaching chemicals. Using chlorine to bleach pulp produced chlorinated compounds, including dioxins and furans. Releases of chemicals in OU2 may have contaminated soils and groundwater with dioxins/furans, PCBs, metals, and SVOCs. The treatment and storage of wastewater and solids in upland areas within OU3 may have contaminated soils and groundwater with dioxins/furans and metals. Floodplain soils and sediments may have been contaminated due to settling of residual fine sediments in holding ponds within the floodplain. Sediments and surface water may have been contaminated with dioxins/furans, PCBs, metals, and SVOCs from the discharge of treated wastewater to the Clark Fork River (U.S. EPA, 2017d).

3.1 Pathways

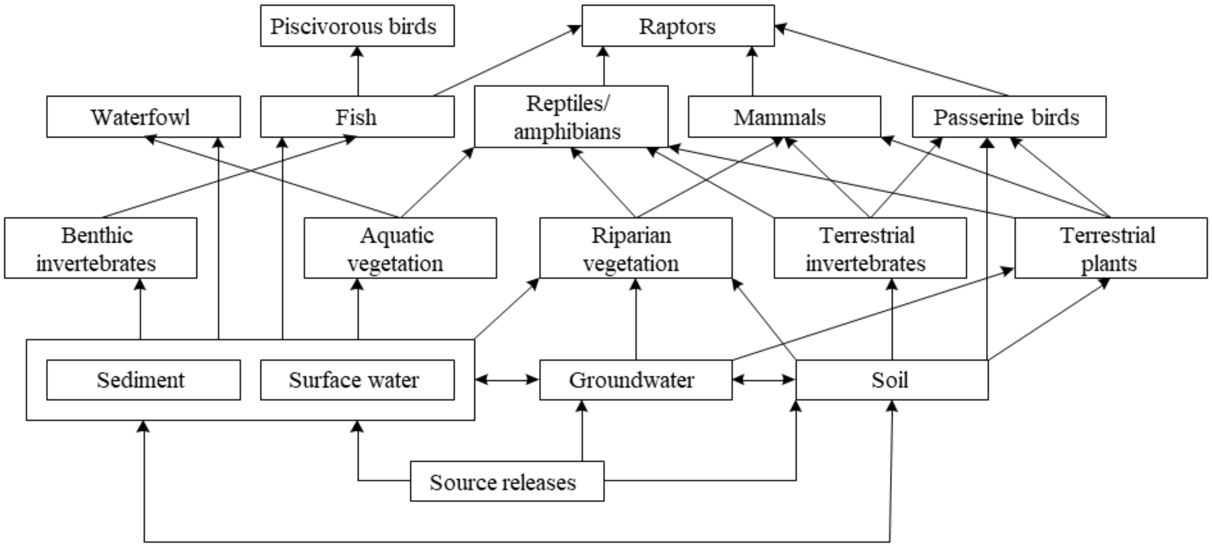
As described in Section 2, potential sources of hazardous substances at the mill include sludge ponds, the emergency spill pond, aeration basins, polishing ponds, wastewater storage ponds, landfills, the industrial area, the land farming area, and storage tanks. These sources have contaminated groundwater, soils, sediments, and surface water that can in turn act as secondary sources of hazardous substances to Trustee natural resources. Hazardous substances released from these primary and secondary sources may be transported to natural resources by groundwater, surface water, aerial transport, and food chain pathways (Figure 7). Pathways of hazardous substance transport at the Site are described in more detail below.

3.1.1 Pathways to Soils

When mill waste containing hazardous substances is deposited on the ground surface, soils are exposed to hazardous substances through direct contact. Similarly, when mill waste containing hazardous substances is deposited into inundated waste ponds, and the ponds are subsequently drained, the substrate at the bottom of the pond becomes soil exposed to hazardous substances via contaminated surface water and solids that were present when the pond was inundated.

4. These exceptions include permitted releases, application of a registered pesticide product, and the acceptance of used motor oil by a service station dealer.

Figure 7. Pathways by which Trustees resources are potentially exposed to hazardous substances at the Site.



The landfill areas and land farm area are all areas where mill waste was directly deposited to the soil. The sludge ponds, the emergency spill pond, and the holding ponds are areas where hazardous substances were likely entrained in wastewater and deposited in sediment which became soil after the ponds were drained. Surface runoff from ponds, the landfill, and the land farm area during snowmelt and precipitation events also serve as pathways of hazardous substances to soils. Aerial deposition from stack emissions may have occurred when the mill was operating, and aerial redistribution of contaminated surficial soils through wind events may also occur. Soils exposed to hazardous substances either directly from deposited mill waste or through runoff or aerial transport can provide a pathway of exposure to surface water, groundwater, and biological resources.

3.1.2 Pathways to Groundwater

The pathway to groundwater at the Site is primarily through the percolation of wastewater through the bottom of the unlined ponds. The Montana Department of Health and Environmental Services (MDHES; the predecessor to MDEQ) reported that pond wastes entered both the shallow aquifer underlying the ponds and the deep aquifer near the plant (MDHES, 1974, as cited in URS, 2011). From 1974 to 1983, much of the wastewater was placed in rapid infiltration basins designed to transport wastewater into shallow groundwater. In 1977, 63% of the wastewater (roughly 3.5 million gallons) was routed through these rapid infiltration ponds (URS, 2011). Additional contamination to the groundwater may have occurred from leaks and spills from the storage tanks. The contaminated groundwater can provide a pathway of exposure to surface water, sediment, and biota in the Clark Fork River, where groundwater enters the river through springs and upwelling through the streambed. The contaminated groundwater may also provide a pathway to soils in the vadose zone. In addition, soils may periodically come into direct contact with the water table due to groundwater fluctuations resulting from storm events, spring runoff, and irrigation return flows.

3.1.3 Pathways to Surface Water Resources

Surface water resources at the Site include surface water and sediment in the Clark Fork River and O'Keefe and Lavalle creeks, as well as water and sediment in the ponds within the Clark Fork River floodplain. O'Keefe and Lavalle creeks flow through the southern end of the mill property before discharging into the Clark Fork River, which runs adjacent to the mill property (see Figures 1 and 2). Surface water and sediments in the Clark Fork River may have been directly exposed to hazardous substances through direct discharge of wastewater or discharge of contaminated groundwater.

Some holding ponds in the floodplain have become seasonal wetlands (U.S. EPA, 2017d). Surface water and sediments in these ponds have been exposed to hazardous substances via direct discharge of contaminated wastewater. The ponds may have been exposed to aerial deposition from stack emissions when the mill was operating. The ponds may also be exposed to hazardous substances via surface runoff from contaminated soils during snowmelt and precipitation events, and aerial deposition of windblown-contaminated soil.

In addition, hazardous substances in ponds, the industrial area, landfill areas, the land farm area, and contaminated soils may be transported to the Clark Fork River and nearby creeks by surface runoff during spring snowmelt, seasonal precipitation, and storm events. The surface water and sediment in the Clark Fork River subsequently serve as a transport pathway to downstream natural resources. The extent of downstream transport and exposure is not yet known.

3.1.4 Pathways to Biological Resources

Terrestrial biota (e.g., invertebrates, birds, and mammals) may be exposed to hazardous substances through dermal contact, inhalation, ingestion, and food chain pathways. For example, passerine birds may be exposed by ingesting contaminated invertebrates living in the soils of dry ponds. Terrestrial vegetation may be exposed to hazardous substances in soil and soil pore water through root uptake (Figure 7).

Aquatic biota in the Clark Fork River and adjacent creeks, and any aquatic biota that may be in the floodplain ponds, may come into direct contact with hazardous substances through exposure to contaminated surface water, direct contact with contaminated sediment, and via food chain pathways. Potentially exposed aquatic biota include fish and benthic macroinvertebrates. In addition, piscivorous birds and waterfowl may be exposed to hazardous substances in aquatic resources via direct contact, ingestion, and aquatic food chain pathways (Figure 7).

Food chain pathways are particularly relevant for dioxins and furans, which are toxic to exposed biological resources and have been shown to bioaccumulate and biomagnify through the food chain. These compounds have caused multiple species of birds, fish, reptiles, and mammals to exhibit developmental toxicity, reproductive impairment, compromised immunologic function, and other adverse effects (Jones et al., 1993; White and Birnbaum, 2009; King-Heiden et al., 2012).

3.2 Areas and Resources Exposed to Hazardous Substances

Natural resources such as groundwater, soils, surface water (including sediment), and biological resources, in both aquatic and terrestrial habitats, have been exposed to hazardous substances released at the Site. This section presents examples of concentrations of hazardous substances that have been measured in natural resources. This is not intended to be a comprehensive review of all studies that have been conducted at the Site. Rather, this section presents examples that confirm exposure of natural resources to hazardous substances, drawn from a rapid review of the readily available Site data, reports, and literature.

This PAS focuses on exposure to natural resources on the mill property and in downstream reaches of the Clark Fork River that are part of the Site. The primary sources of data are remedial investigations that have occurred at the Site since 2014 (see Section 2.2.4). EPA compiled these data in their Scribe database; EPA provided a copy of the data to NRDP and Abt Associates in the fall of 2017. Much of the exposure data provided in this section come from the fall 2017 version of the EPA Scribe database.

As noted previously, the Site Investigation data from 2011 (URS, 2012) are not included in the Scribe database because RockTenn (2014) challenged the validity of these data. In some cases, we present the 2011 data if the data differ from the data in Scribe or were collected in locations where no subsequent samples have been collected. The Trustees will re-evaluate the validity of the 2011 data and may use the data in the NRDA.

3.2.1 Soils

Soils exposed to hazardous substances at the Site include areas that were dry when originally exposed to contamination, as well as areas in former sludge ponds and holding ponds that were inundated when originally exposed and have since dried out.

EPA contractors performed a Site Inspection in 2011 that included a chemical analysis of soil samples (URS, 2012). For this preliminary analysis, in which EPA was collecting data for a hazard-ranking score, sites with hazardous substance concentrations more than three times the concentrations of background samples were considered to be sources of contamination. They concluded that four sludge ponds (3, 4, 5, and 17 in OU3), emergency spill pond 8 (OU3), an exposed soil pile adjacent to Landfill A (OU3), wastewater storage pond 2 (OU3), and the land farm (OU2) were sources of metals and dioxins/furans (URS, 2012). The highest concentrations of hazardous substances were typically found in Sludge Pond 3 and Landfill A (Table 3).

In the 2017 SLERA for OU2 and OU3, U.S. EPA (2017d) identified numerous COPECs that exceeded risk-based ecological benchmarks for soil. At least 14 different analytes exceeded SLERA thresholds in surface soils (generally 0–2 feet below ground), including aluminum, antimony, arsenic, barium, cadmium, copper, lead, manganese, mercury, nickel, selenium, dioxins/furans (expressed as 2,3,7,8-TCDD TEQ), vanadium, and zinc (Table 4). The SLERA compared measured concentrations of contaminants in soils to conservative thresholds that suggest potential risk to sensitive flora and fauna. When concentrations of contaminants exceed thresholds such as EPA ecological soil screening levels (EcoSSLs) or plant risk thresholds developed at the Oak Ridge National Laboratory (ORNL), EPA includes those contaminants in a baseline ecological risk assessment (BERA) to evaluate actual risk to organisms at the Site. The BERA for OU2 and OU3 will be conducted in 2018.

While exceedances of SLERA thresholds in soils do not necessarily indicate that habitats and organisms exposed to contaminants have been harmed (injured), the likelihood of injury increases as concentrations of contaminants increase and the spatial area of contamination increases. At the mill property, hundreds of samples have had contaminant concentrations exceeding SLERA thresholds, and many have been measured at concentrations exceeding the threshold by orders of magnitude (Table 4).

Table 3. Hazardous substances present at more than three times background levels in the Site Inspection

Analyte	Background concentration (mg/kg)	Maximum concentration (mg/kg)	Location of maximum concentration
Arsenic	8.5	71.4	Sludge Pond 3
Cadmium	1.5	17.9	Sludge Pond 3
Chromium	11	45.1[b]	Landfill A
Dioxins/furans[a]	2.16×10^{-6}	2.93×10^{-4}	Sludge Pond 3
Lead	19.6	108	Sludge Pond 3
Manganese	435	6,840	Sludge Pond 3
Nickel	9.8	80.3[b]	Landfill A
Silver	1.1[b]	3.6	Sludge Pond 17
Zinc	235	1,300	Sludge Pond 3

a. Expressed as 2,3,7,8-TCDD toxic equivalency (TEQ).

b. Estimated value (J qualifier).

Source: URS, 2012.

Table 4. Surface soil benchmark exceedances, based on data collected between 2014 and 2017. The maximum magnitude of exceedance is the ratio of the highest measured concentration to the benchmark.

Analyte	Benchmark (mg/kg)	Number of exceedances	Maximum magnitude of exceedance	Benchmark source
Aluminum	50	179	614	ORNL Plants
Antimony	0.27	12	15	Mammal EcoSSL
Arsenic	10	6	4	ORNL Plants
Barium	330	27	4	Soil Invert EcoSSL
Cadmium	0.36	28	23	Mammal EcoSSL
Copper	28	26	3	Bird EcoSSL
Dioxin TEQ	1.99×10^{-7}	84	3,800	Mammal EcoSSL
Lead	11	72	9	Bird EcoSSL
Manganese	220	122	14	Plant EcoSSL
Mercury	0.1	20	80	ORNL Soil Invert
Selenium	0.52	27	3	Plant EcoSSL
Vanadium	2	178	60	ORNL Plants
Zinc	46	120	15	Bird EcoSSL

Data source: EPA Scribe database, October 2017.

The highest concentrations of hazardous substances measured on the mill property are generally in the area of primary treatment ponds (i.e., settling ponds or sludge ponds) and holding ponds closest to the primary treatment ponds. Concentrations of cadmium, manganese, mercury, and zinc exceed the SLERA thresholds by at least a factor of 4 in many samples from those locations, with maximum concentrations ranging from 14 to 80 times higher than the SLERA threshold (Figures 8–11; Table 4). This spatial distribution of elevated metals concentrations suggests that the mill wastewater stream is the source of contamination.

Figure 8. Surface soil samples where cadmium concentrations exceeded the SLERA risk-based threshold, highlighting samples exceeding the threshold by at least a factor of 4. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.

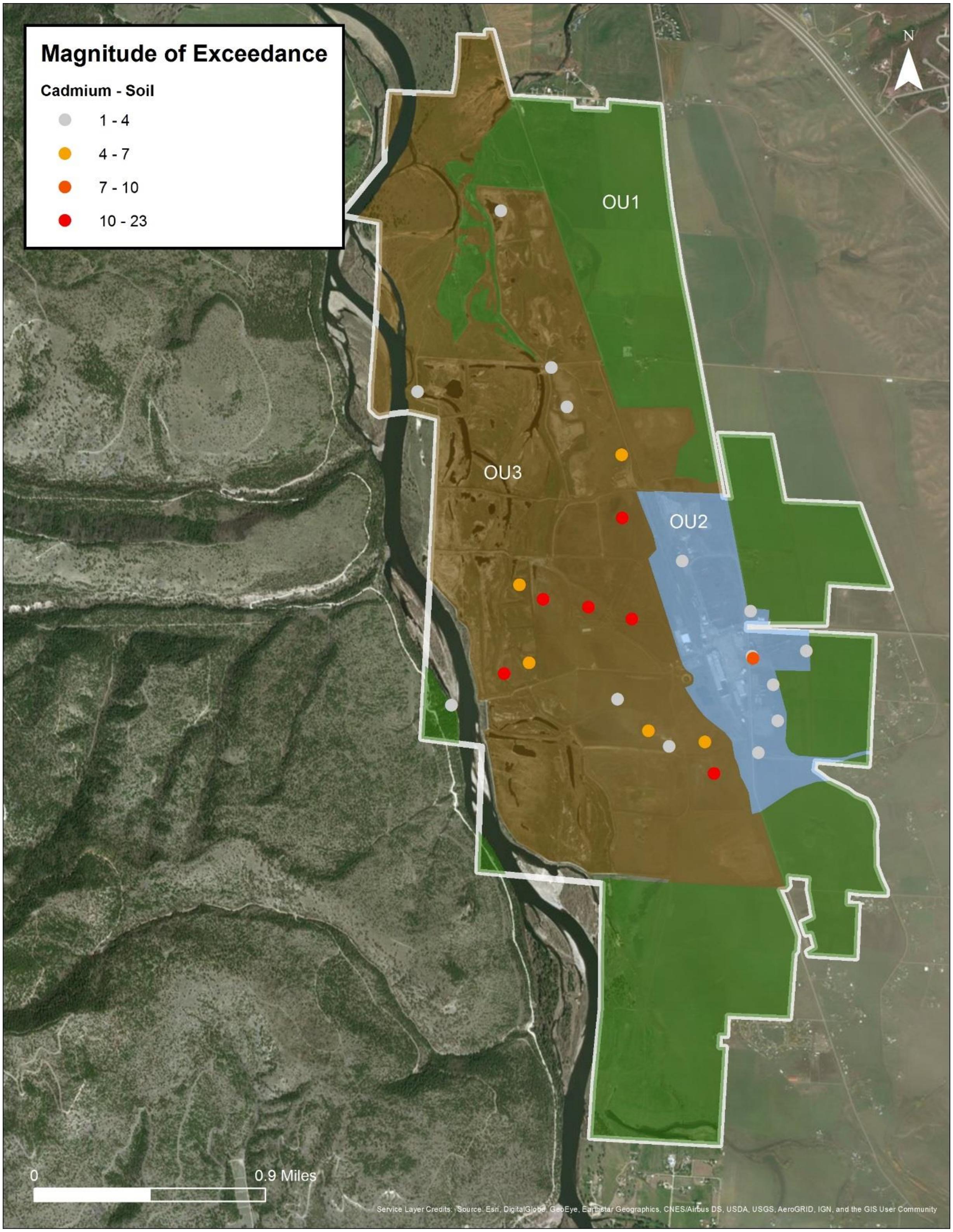


Figure 9. Surface soil samples where manganese concentrations exceeded the SLERA risk-based threshold, highlighting samples exceeding the threshold by at least a factor of 4. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.

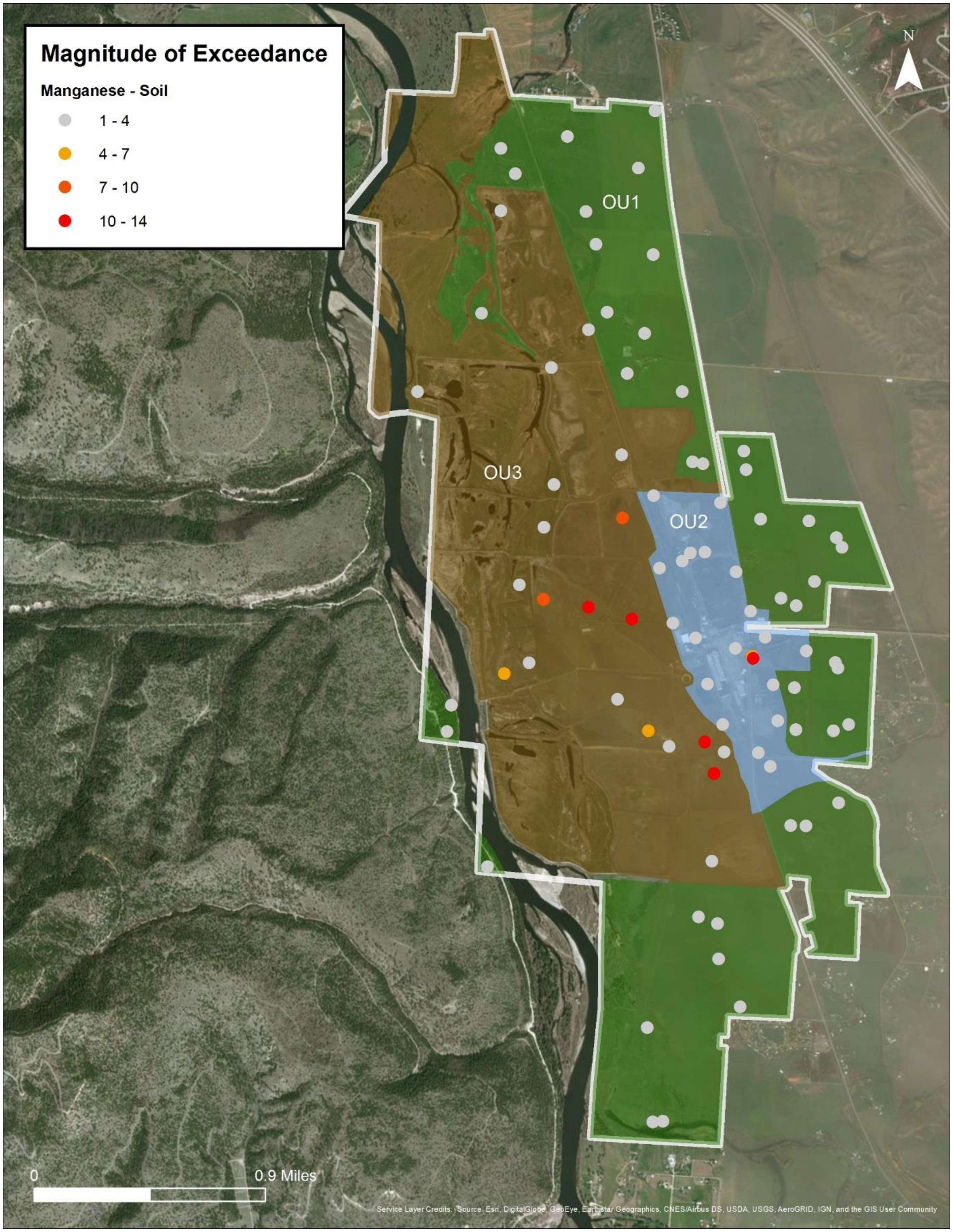


Figure 10. Surface soil samples where mercury concentrations exceeded the SLERA risk-based threshold, highlighting samples exceeding the threshold by at least a factor of 4. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.

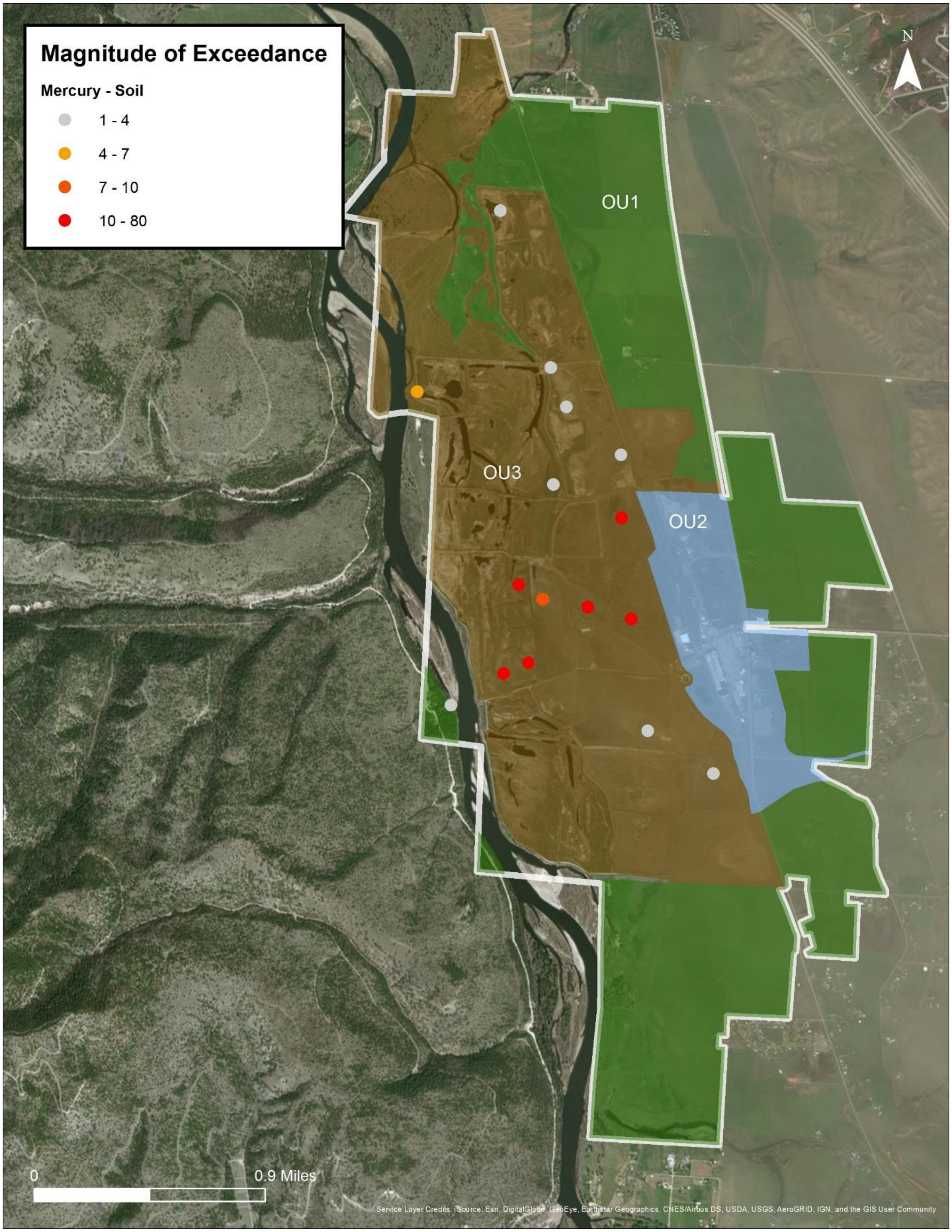
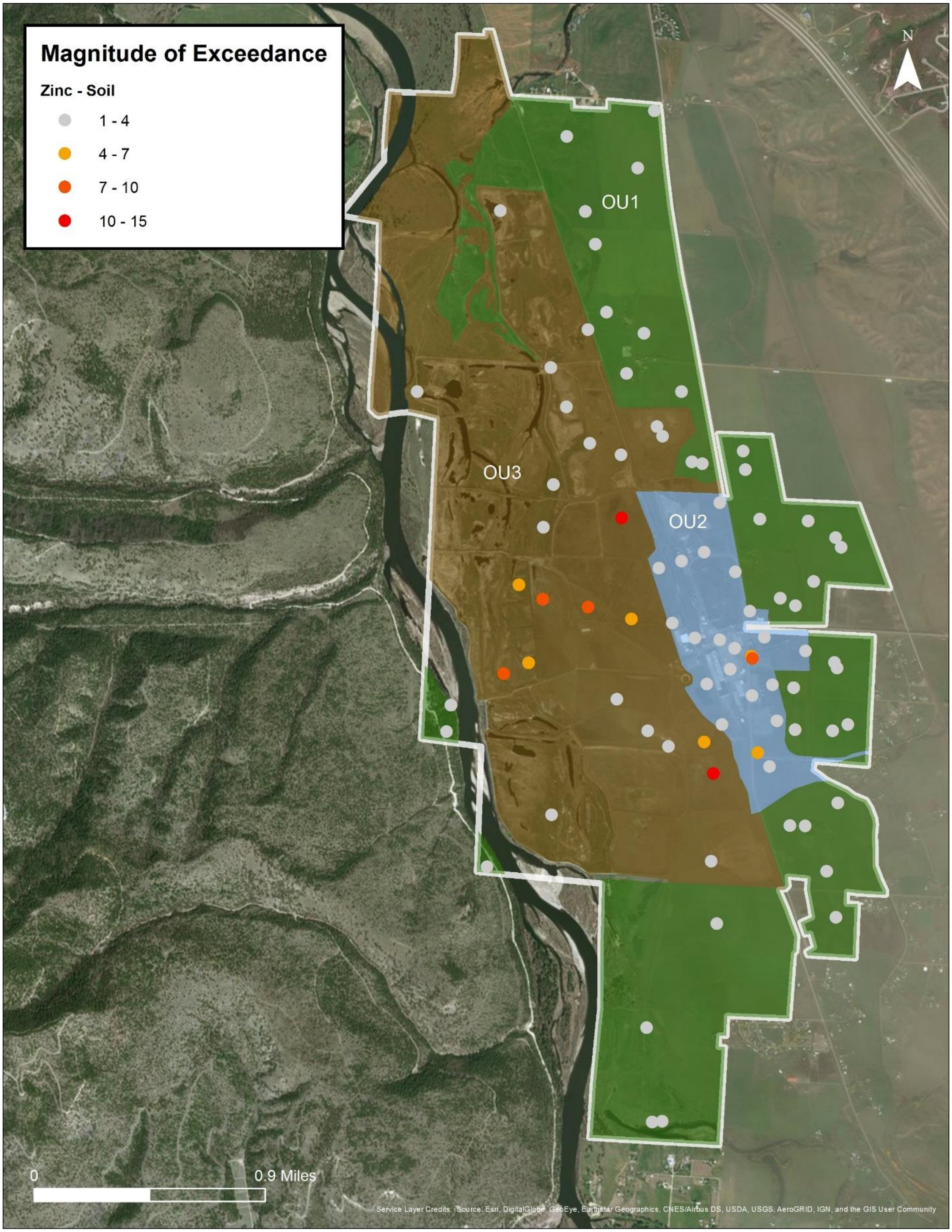


Figure 11. Surface soil samples where zinc concentrations exceeded the SLERA risk-based threshold, highlighting samples exceeding the threshold by at least a factor of 4. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.



Dioxin contamination is more widespread (Figure 12). In surface soils, 84 samples had dioxin concentrations exceeding the TCDD TEQ threshold, with the maximum concentration exceeding the threshold by a factor of 3,800 (Table 4). The TCDD TEQ threshold in the SLERA is lower than the Montana statewide background dioxin concentration of 3.7 ng/kg (or 3.7 x 10^{-6} mg/kg; MDEQ, 2011b). In the surface soil data in the EPA Scribe database, 28 samples contained TCDD TEQ concentrations that exceeded this Statewide background concentration. Concentrations in those samples range from 3.8 to 756 ng/kg of TCDD TEQ (Figure 12).

MRL evaluated dioxin/furan contamination in surface soils along the Rail Spur Line, in the area where the spur bridges OU1 and OU2 (see Figure 5). In November 2015, dioxin/furan concentrations in the upper 2 inches of soil ranged from 39 to 84 ng/kg TEQ, and the concentrations between 2 and 6 inches ranged from 5.3 to 23 ng/kg TEQ (Olympus, 2017). Thus, all samples from this area exceeded both the SLERA threshold and the Statewide background concentration.

3.2.2 Groundwater

Hazardous substance released at the Site have contaminated shallow alluvial groundwater underlying OU2 and OU3. NewFields (2017a, 2017b) has identified manganese, arsenic, and dioxins/furans (TCDD TEQ) as groundwater contaminants of concern. The arsenic groundwater quality standard under both the Montana Circular DEQ-7 Numeric Water Quality Standards (MDEQ, 2017) and the EPA Safe Drinking Water Act (SDWA) Maximum Contaminant Level (MCL; U.S. EPA, 2018b) is 10 µg/L. NewFields (2017a, 2017b) shows that groundwater in 14 wells contain arsenic exceeding this standard, with concentrations as high as 60 µg/L (Figure 13). During the 2011 Site Inspection for EPA, URS (2012) collected groundwater samples from 27 wells and reported several wells with arsenic measured above the 10-µg/L standard, with a maximum reported concentration of 133 µg/L.

The EPA SDWA Secondary MCL for manganese is 50 µg/L (U.S. EPA, 2018b). NewFields (2017a, 2017b) showed that groundwater in 39 wells contain manganese exceeding this standard, many exceeding by orders of magnitude, with concentrations in some wells exceeding 10,000 µg/L (Figure 14). By contrast, the concentrations of manganese in wells identified as background wells were approximately 1 µg/L (Figure 14). During the 2011 Site Inspection for EPA, URS (2012) similarly reported elevated manganese concentrations, with a maximum concentration of 14,600 µg/L. The highest concentrations of both arsenic and manganese are downgradient of the primary and secondary water treatment ponds (NewFields, 2017b), suggesting that the Site wastewater stream is the source of the contamination.

The TCDD TEQ groundwater quality standard under the Montana Circular DEQ-7 Numeric Water Quality Standards (MDEQ, 2017) is 2 pg/L. NewFields (2017a, 2017b) shows that TCDD TEQ concentrations (calculated using one-half of the detection limit for congeners that were undetectable) exceeded 2 pg/L in approximately 28 wells (Figure 15). One background well is shown to exceed 2 pg/L; however, NewFields (2017b) notes that no dioxins or furans were actually detectable in the sample (the calculated TEQ exceeded the water quality standard because the detection limits for dioxins and furans were high, resulting in a TEQ calculation that exceeded the water quality standard when using one-half of the detection limit for undetected congeners). During the 2011 Site Inspection for EPA, URS (2012) also detected dioxins/furans in groundwater in their October 2011 sampling effort.

Figure 12. Concentrations of TCDD TEQ at the mill property. The risk-based threshold in the SLERA is 0.199 ng/kg, and the Statewide background concentration is 3.7 ng/kg (MDEQ, 2011b). OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.

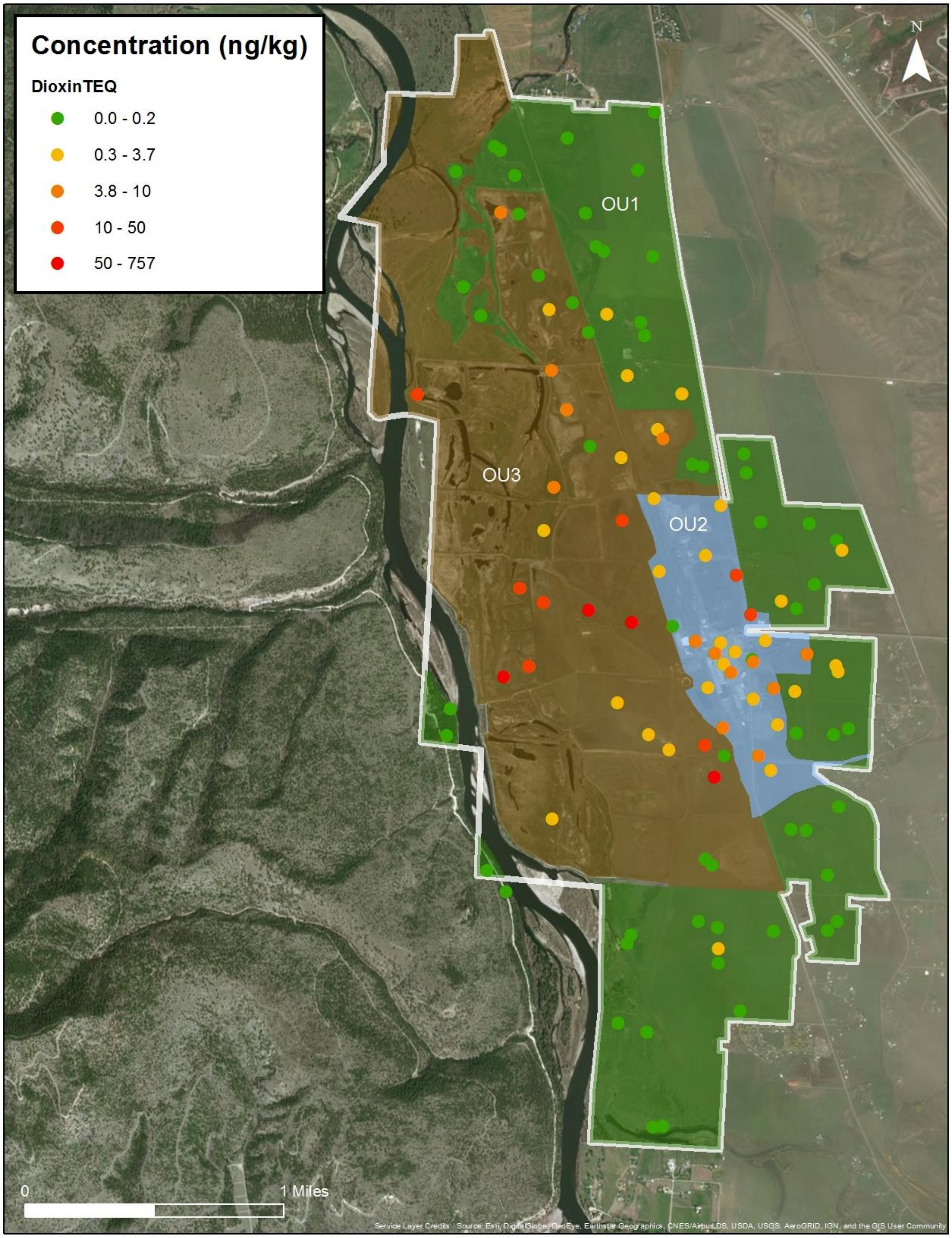
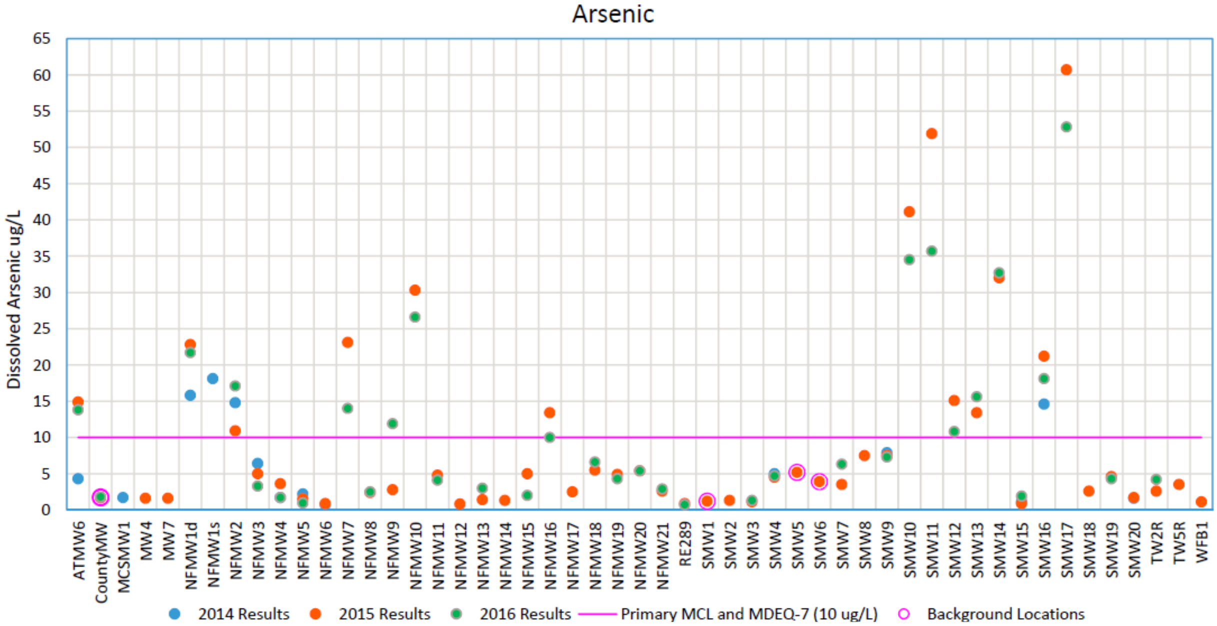
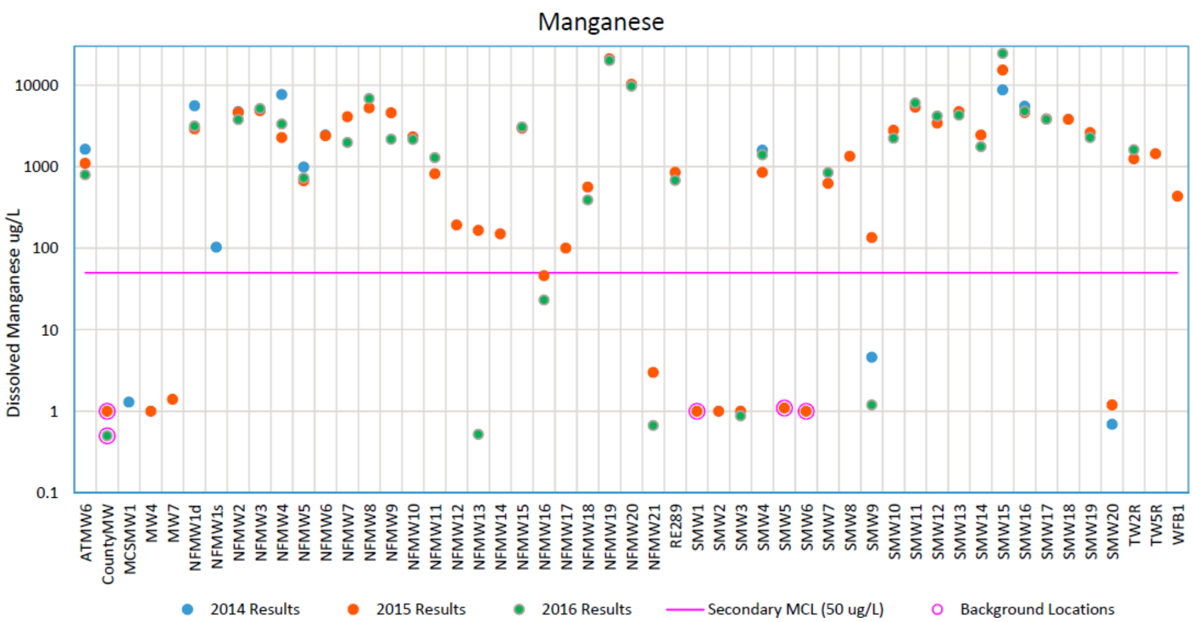


Figure 13. Arsenic concentrations in shallow groundwater.



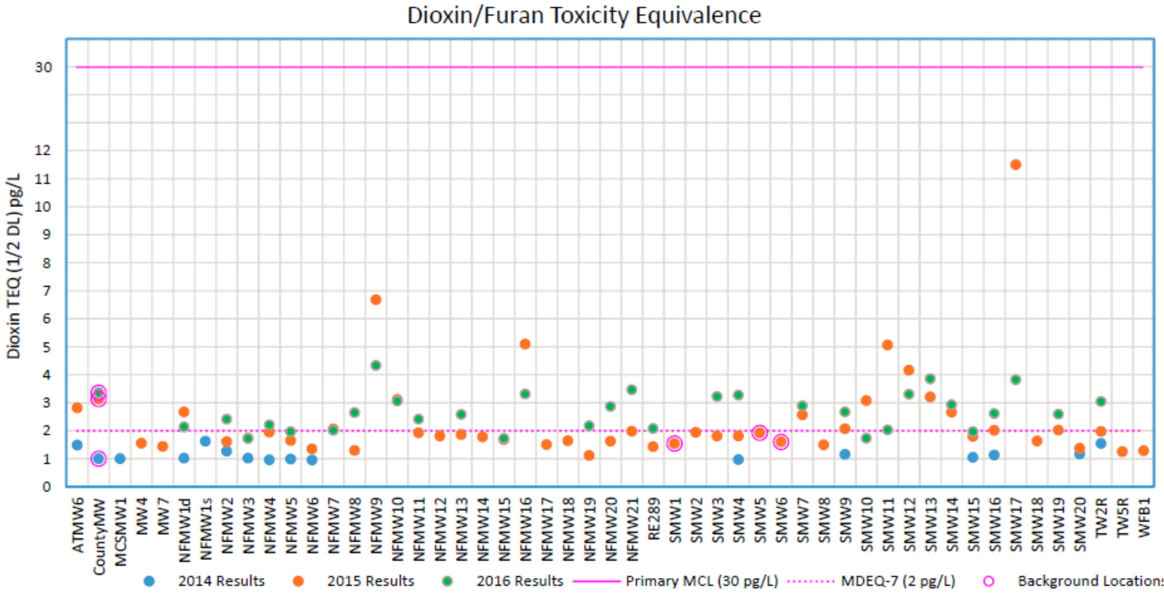
Source: NewFields, 2017a, Figure 4a.

Figure 14. Manganese concentrations in shallow groundwater. Note the logarithmic scale on the Y axis.



Source: NewFields, 2017a, Figure 4b.

Figure 15. Dioxin/furan (TCDD TEQ) concentrations in shallow groundwater.



Source: NewFields, 2017a, Figure 4c.

3.2.3 Surface Water Resources

Surface water resources include both surface water and sediments [43 CFR § 11.14(pp)]. Surface water resources potentially exposed to Site hazardous substances include abandoned ponds in the floodplain that have become seasonal wetlands, as well as O'Keefe and Lavalle creeks and the Clark Fork River.

Surface Water

Surface water samples have been collected from the Clark Fork River at locations upstream, adjacent to, and downstream of the mill property, as well as from Lavalle Creek upstream of the mill property and O'Keefe Creek alongside the mill property. URS (2012) collected samples for EPA as part of the 2011 Site Assessment, and NewFields (2016c) collected samples in 2015. We are unaware of any surface water samples collected from the OU3 ponds in the floodplain.

In November 2015, NewFields (2016c) analyzed 10 surface water samples from the Clark Fork River and O'Keefe Creek for dioxins/furans. Of these 10 samples, only one was collected adjacent to the mill property, near Outfall 4 (which is well north of most of the contamination; see Figure 4). Two samples were collected downstream of the mill property, and the remaining seven samples were collected upstream of the mill property. Hence, this sampling event provided limited characterization of potential dioxin/furan releases to the river.

Dioxins/furans concentrations were generally between 1 and 1.7 pg/L TCDD TEQ in all samples, both upstream and downstream of the mill property, when including undetectable congeners at half the detection limit. These exceeded the water quality standard of 0.05 pg/L, but the downstream concentrations were not higher than the upstream concentrations. Using only detectable congeners, the only samples that exceeded the water quality standard were in Lavalle and O'Keefe creeks upstream of the primary contaminant source areas (NewFields, 2016c).

NewFields (2016c) analyzed additional surface water samples collected adjacent to the mill property for metals and other hazardous substances. Arsenic and manganese concentrations did not exceed water quality standards in any of the November 2015 samples.

The results from the 2015 sampling were consistent with the results from the 2011 Site Inspection for EPA (URS, 2012), although URS (2012) collected more samples adjacent to the mill property. Specifically, they collected three surface water samples from O'Keefe Creek and seven samples in the Clark Fork River (one upstream station and six stations adjacent to the mill property). Samples were analyzed for dioxins/furans, SVOCs and volatile organic compounds (VOCs), PCBs, and metals. SVOCs/VOCs and PCBs were not detected. Dioxins/furans in the samples collected along the Clark Fork River and O'Keefe Creek ranged from 0.67 to 1.08 pg/L TCDD TEQ. Like in 2015, these concentrations are above the Montana Circular DEQ-7 Numeric Water Quality Standard of 0.05 pg/L (MDEQ, 2017), but are similar to or less than the upstream background concentration of 0.77 pg/L. Metals such as arsenic and manganese were detected in most samples but were not above any thresholds (URS, 2012).

Sediment

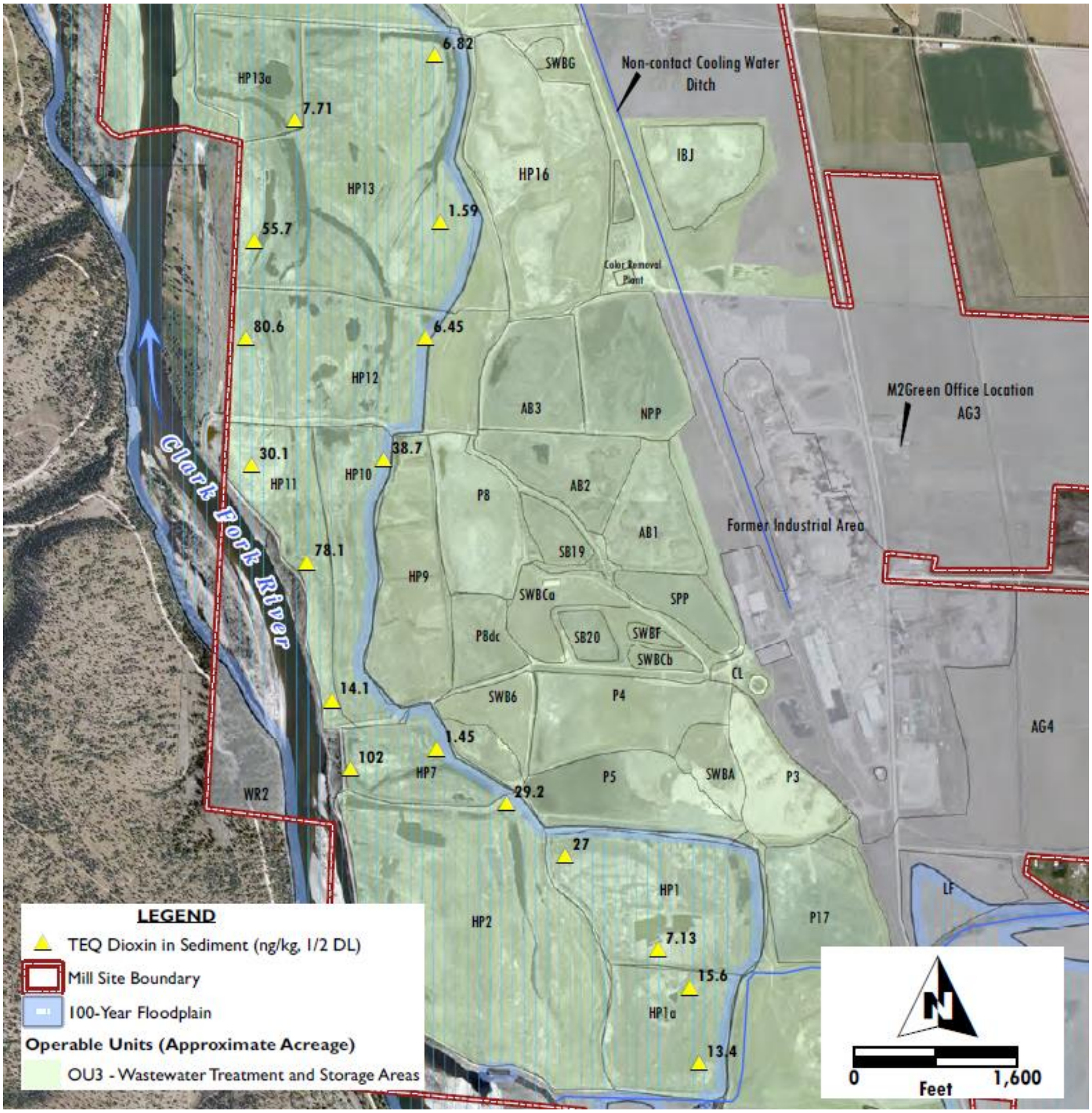
Sediment samples were collected in November 2015 from the Clark Fork River and the adjacent creeks. However, as with the surface water, the vast majority of samples were collected upstream of the mill property (NewFields, 2016c), providing little information on potential exposure of surface water resources to hazardous substances released from the mill. Manganese concentrations in both bed and flood fringe sediments increased in samples collected adjacent to the mill property, with some concentrations exceeding the SLERA threshold (U.S. EPA, 2017d). Additional sampling is required to determine potential exposure in the Clark Fork River.

In the 2011 Site Inspection for EPA, URS (2012) collected sediment samples co-located with the surface water stations. Dioxins/furans were detectable at sample locations adjacent to the mill property, but not at concentrations that exceeded the background concentration. Arsenic, cadmium, manganese, and zinc were detected in most sediment samples but did not exceed thresholds.

Unlike surface water samples, sediment samples were collected from ponds in OU3. Several metals exceeded the risk-based SLERA thresholds (U.S. EPA, 2017d), including arsenic, cadmium, manganese, mercury, and zinc (NewFields, 2017c). The TCDD TEQ threshold in the SLERA is 0.85 ng/kg. All of the onsite sediment samples exceeded this threshold, some by two orders of magnitude (Figure 16), suggesting likely exposure of natural resources to dioxins/furans in these abandoned waste treatment ponds.

Although many birds and mammals have been observed at or in the vicinity of the Site, including 27 species of migratory shorebirds, with upwards of 1,000 individual birds using the settling ponds within OU3 during the peak of southward migration (U.S. EPA, 2017d), few data have been collected on potentially exposed biological resources. For example, waterfowl use the abandoned ponds in OU3 when the ponds contain water (U.S. EPA, 2017d). Some ponds have had measured TCDD TEQ concentrations in sediments that exceed the SLERA threshold by up to two orders of magnitude. Similarly, invertebrates, terrestrial mammals, and passerine birds that utilize the dry upland ponds as habitat are likely exposed to the contaminated soils. However, data quantifying the potential exposure of these biota to Site hazardous substances have not yet been collected.

Figure 16. TCDD TEQ concentrations (ng/kg) in OU3 pond sediments. The risk-based threshold from the SLERA is 0.85 ng/kg. Nearly all analyzed congeners were detectable in all samples. OU3 also includes locations in the Clark Fork River where hazardous substances from the Site have come to be located.



Source: Modified from NewFields, 2016c, Figure 18.

3.2.4 Biological Resources

Montana Fish, Wildlife, and Parks (MFWP) personnel evaluated potential exposure of fish to metals and dioxins/furans downstream of the mill property in 2013, quantifying dioxins/furans, PCBs, selenium, and mercury in the muscle tissues of sport fish in the Clark Fork River (Schmetterling and Selch, 2013). They collected northern pike in backwater sloughs within 10 km downstream of the mill property, and rainbow trout from the main channel of the Clark

Fork River immediately downstream of the mill property. The objective was to assess potential health risks to recreational anglers by analyzing contaminants in skin-off fillets that anglers typically eat. Dioxins are lipophilic and thus most likely to accumulate in fatty tissues, which were not analyzed. Regardless, the TCDD concentrations in just the muscle tissue of all composite samples were sufficient to warrant fish consumption advisories (FCAs) for both rainbow trout and northern pike. In addition, mercury was detected in all samples, at concentrations in northern pike that exceeded an FCA threshold. PCB concentrations (Aroclor 1254) in large northern pike were also higher than an FCA threshold (Schmetterling and Selch, 2013). As a result of the study, MFWP posted a "do not eat" advisory for large northern pike and a "limit consumption to four meals per month" advisory for rainbow trout in the reach of the Clark Fork River near the mill property (MFWP, 2013, 2015).

Selch (2015) analyzed skin-off fillets of northern pike from Noxon Reservoir, on the Clark Fork River about 145 river miles downstream of Frenchtown. TCDD TEQ concentrations in fillets of large northern pike were sufficient to require a "do not eat" consumption advisory for large fish, and various monthly consumption limits for smaller fish (MFWP, 2015). Six of the 13 dioxin and furan congeners detected in northern pike near the mill property were also detected in northern pike in Noxon Reservoir (Selch, 2015). Additional research is required to assess the possibility that dioxin/furans released from the mill property may have accumulated in fish in the lower reaches of the Clark Fork River, either because of direct exposure to the released hazardous substances through downstream transport of particulates via the surface water pathway [43 CFR § 11.25(b)(2)], or indirect exposure because fish were exposed to hazardous substances closer to Frenchtown and subsequently migrated downstream [43 CFR § 11.25(b)(3)].

To date, no studies have examined dioxin/furan concentrations in whole fish (or in fillets with skin and fatty tissue intact), nor have studies examined the potential exposure of piscivorous birds and mammals to dioxins/furans released at the Site. The preliminary fish muscle tissue data summarized herein suggest that these resources could be potentially exposed to dioxins/furans and other hazardous substances released at the Site.

3.3 Potentially Affected Natural Resources and Services

The data presented above confirm that soils in floodplain habitat, surface water resources (including sediment), and groundwater have been exposed to elevated concentrations of hazardous substances. Potentially affected natural resources include, but are not limited to:

- Groundwater resources in the shallow alluvial aquifer under and downgradient of the waste ponds, basins, and landfills
- Surface water resources (surface water and sediments), including seasonally inundated wetlands and ponds in the OU3 floodplain, and potentially the Clark Fork River
- Floodplain/riparian habitats, including soils and sediments in abandoned waste ponds, basins, and landfills adjacent to the Clark Fork River
- Biological resources that utilize floodplain/riparian habitats, such as birds, mammals, invertebrates, and vegetation

- Biological resources in the Clark Fork River, such as macroinvertebrates, fish, and piscivorous birds.

The natural resource services that have been potentially affected by the release of and exposure to hazardous substances from the Site include both ecological and human use services. Natural resource services are the physical and biological functions performed by the resource, which are the result of the physical, chemical, or biological quality of the resource [43 CFR § 11.14(nn)]. Potentially affected ecological services include the provision of uncontaminated aquatic and terrestrial habitat. These habitats provide foraging, shelter, breeding, and rearing for fish, birds, and other wildlife. Hazardous substances that are released into or have come to be located in these habitats reduce the quality of the habitat and associated ecological services.

Natural resource services also include human uses of natural resources [43 CFR § 11.14(nn)]. Potentially affected human use of natural resources include:

- Surface water and groundwater use for consumption, irrigation, livestock, and other uses
- Consumptive and non-consumptive outdoor recreation, including fishing, hunting, hiking, wildlife viewing, and photography
- Passive use, including bequest and option values.

FCAs such as those that have been issued for the Clark Fork River often affect the consumptive use of fish, for both recreational anglers and Tribal members, who may use harvested fish for subsistence. Nonuse values can be diminished as well when hazardous substances adversely affect natural resources.

4. Preliminary PAS Criteria Determinations

This section presents an evaluation of the preassessment determination criteria [43 CFR § 11.23(e)]. The information presented and summarized in this section confirms:

- A release of hazardous substances has occurred
- Natural resources have been or likely have been adversely affected by releases of hazardous substances
- The quantity and concentration of the released hazardous substances are sufficient to potentially cause injury
- Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost
- Response actions will not sufficiently remedy the injury to natural resources without further action.

The information supporting these conclusions is presented below.

4.1 Criterion 1 – A Discharge of Oil or a Release of a Hazardous Substance has Occurred

Preliminary site investigations show that releases of hazardous substances have occurred at the Site (see Section 3.2). Hazardous substances released include, but are not be limited to:

- Arsenic
- Cadmium
- Dioxins/furans (TEQ)
- Manganese
- Mercury
- Zinc.

Although the full scope of environmental exposure to hazardous substances is not yet known, investigators have documented that elevated concentrations of hazardous substances in soils, groundwater, surface water resources, and other resources have resulted from releases at the Site. Based on the data in Section 3.2, the Trustees have confirmed that releases of hazardous substances have occurred at the Site.

4.2 Criterion 2 – Natural Resources for Which the Trustees May Assert Trusteeship under CERCLA Have Been or Are Likely to Have Been Adversely Affected by the Release

Although the full nature and extent of natural resource injuries at the Site is not yet fully characterized, existing data indicate that natural resources [as defined in 43 CFR § 11.14(z)] for which the Trustees may assert trusteeship have been adversely affected by releases of hazardous substances. These natural resources include, but are not necessarily limited to, groundwater resources, surface water resources, geologic resources, and biological resources, including supporting aquatic and floodplain habitats for biological resources. Elevated concentrations of hazardous substances have been found in geologic resources (soils), groundwater, surface water resources, and downstream fish tissues. Further, these hazardous substances are present at concentrations sufficient to potentially cause injury, as described in Section 4.3.

4.3 Criterion 3 – The Quantity and Concentration of the Released Hazardous Substance is Sufficient to Potentially Cause Injury to Natural Resources

The quantity and concentration of the released hazardous substances is sufficient to potentially cause injury natural resources including, but not limited to, groundwater resources, surface water resources, and downstream biota.

4.3.1 Groundwater

The definition of injury in the DOI regulations includes the following:

> Concentrations of substances in excess of drinking water standards, established by Sections 1411–1416 of the SDWA, or by other Federal or State laws or regulations that establish such standards for drinking water, in groundwater that was potable before the discharge or release [43 CFR § 11.62(c)(1)].

Applicable drinking water standards include the National Primary Drinking Water Regulations under the SDWA (U.S. EPA, 2018b) and the Montana Numeric Water Quality Standards Circular DEQ-7 (MDEQ, 2017). Hazardous substances released at the Site that exceed these criteria in shallow groundwater include, but may not be limited to, arsenic, manganese, and dioxins/furans (see Section 3.2.2).

4.3.2 Surface Water Resources

Surface water resources include both surface water and sediments [43 CFR § 11.14(pp)]. The DOI regulations include the following definition of injury to surface water resources:

> Concentrations and duration of substances sufficient to have caused injury… to ground water, air, geologic, or biological resources, when exposed to surface water, suspended sediments, or bed, bank, or shoreline sediments [43 CFR § 11.62(b)(1)(v)].

As discussed in Section 3.2.3, no surface water samples have been collected in the abandoned ponds in the Clark Fork River floodplain, and few samples have analyzed dioxins/furans in Clark Fork River samples collected adjacent to the most contaminated areas of the mill property. Few samples were collected and analyzed for dioxins/furans when the mill was producing bleached pulp and was directly discharging wastewater to the Clark Fork River. Potential injuries to surface water remains a data gap.

The majority of bed and bank sediment samples collected in the Clark Fork River have been collected upstream of the mill property. Although the few samples collected adjacent to and downstream of the mill property did not contain hazardous substance concentrations likely to cause injury, potential injuries downstream remain a data gap.

Hazardous substance concentrations in sediments collected from abandoned ponds in the floodplain are sufficient to potentially cause injury to exposed biological resources. Arsenic, cadmium, manganese, mercury, and zinc concentrations exceed screening-level risk thresholds. Most or all of the dioxin and furan congeners analyzed in those sediment samples were detectable; the TCDD TEQ threshold was exceeded in all samples, some by two orders of magnitude (see Section 3.2.3).

4.3.3 Biological Resources

Biological resources are freshwater aquatic and terrestrial species; game, nongame, and commercial species; and threatened, endangered, and State-sensitive species. Other biota encompass shellfish, terrestrial and aquatic plants, and other living organisms not otherwise listed in this definition [43 CFR § 11.14(f)].

The DOI regulations include numerous definitions of injury to biological resources [43 CFR § 11.62(f)], including:

> An injury to a biological resource has resulted from the release of a hazardous substance if the concentration of the substance is sufficient to exceed levels for which an appropriate State health agency has issued directives to limit or ban consumption of such organism [43 CFR § 11.62(f)(1)(iii)].

MFWP banned the consumption of large northern pike and limited the consumption of rainbow trout in the vicinity of the mill property after detecting elevated concentrations of dioxins/furans and other hazardous substances in the tissues of fish collected near the mill property (MFWP, 2013, 2015; see Section 3.2.4). This suggests a likely injury to biological resources.

The exposure of biota to hazardous substances released from the mill have the potential to cause many different injuries. White and Birnbaum (2009) and King-Heiden et al. (2012) note that dioxin and dioxin-like compounds have caused multiple species of birds, fish, reptiles, and mammals to exhibit developmental toxicity, reproductive impairment, compromised immunologic function, and other adverse effects. The cat bird has been shown to be highly sensitive to dioxin toxicity (Eng et al., 2017). The bull trout, a listed threatened species for which Clark Fork River is a designated critical habitat [75 FR 2269], is one of the most sensitive fish species to the developmental toxic effects of dioxins (King-Heiden et al., 2012). Thus, the releases of these compounds at the Site have potentially caused injury to other biological resources.

4.4 Criterion 4 – Data Sufficient to Pursue an Assessment Are Readily Available or Are Likely to Be Obtained at Reasonable Cost

Data relevant to conducting an assessment of natural resource damages at the Site are being collected as part of remedial and ecological assessment activities. Such data include information on hazardous substance sources, releases, pathways, and concentrations in the environment. Additional data collection efforts are ongoing.

In the DOI regulations, reasonable cost means that "the Injury Determination, Quantification, and Damage Determination phases have a well-defined relationship to one another and are coordinated . . . and the anticipated cost of the assessment is expected to be less that the anticipated damage amount" [43 CFR § 11.14 (ee)]. Although the specific elements of injury determination, quantification, and damage determination have not yet been developed for this Site, the Trustees anticipate a well-defined and coordinated process. The Trustees expect that additional data collection to assess other trust resources and services can be conducted at reasonable cost, as defined in the regulations, and that these costs will be less than the anticipated damage amount.

4.5 Criterion 5 – Response Actions Carried out or Planned Do Not or Will Not Sufficiently Remedy the Injury to Natural Resources without Further Action

Response activities have not remedied natural resource injuries. Past natural resource injuries have not been addressed, and the Trustees are unaware of any plan to address them. The information available at this time suggests the likelihood of injuries to natural resources extending downstream in the Clark Fork River. Rehabilitation, restoration, or replacement of natural resources is required to reduce future injuries and compensate the public for interim losses of natural resources and the services they provide.

5. Determination

Following the review of the information as described in this PAS, the Trustees have made the determination that the criteria specified in the DOI regulations have been met. The Trustees have further determined that there is a reasonable probability of making a successful claim for damages with respect to natural resources over which the Trustees have trusteeship. Therefore, the Trustees have determined that an assessment of natural resource damages is warranted.

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