Preassessment Screen: U.S. Steel Site

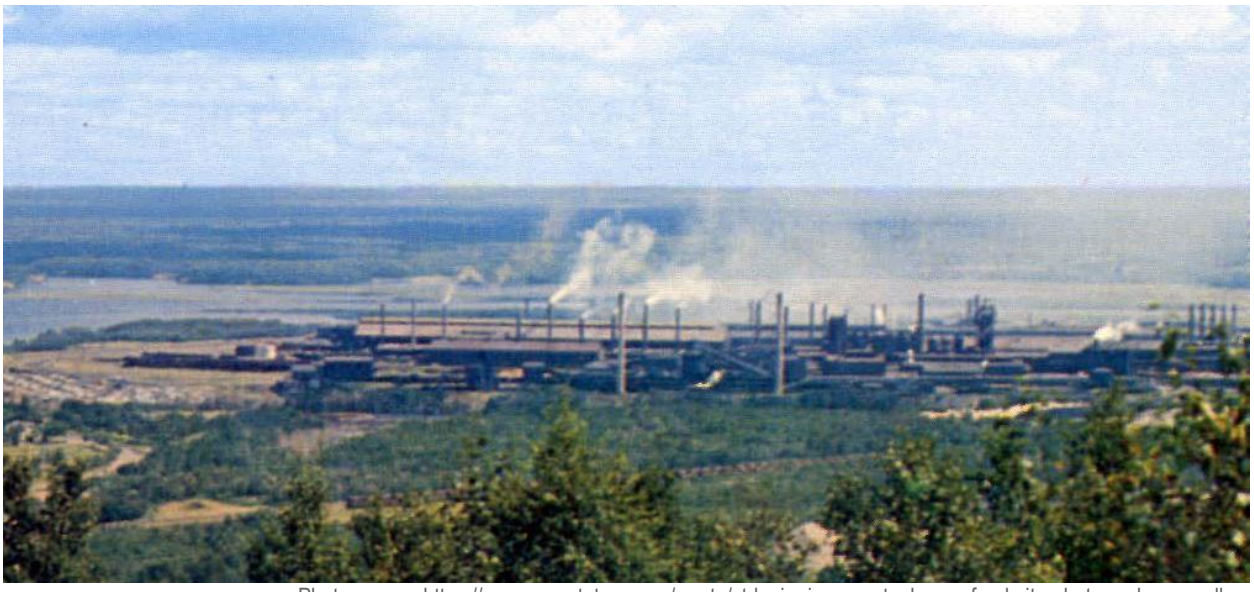

Photo source: https://www.pca.state.mn.us/waste/st-louis-river-us-steel-superfund-site-photo-and-map-gallery

Prepared by:

1854 Treaty Authority (governed by the Bois Forte and Grand Portage Bands of Lake Superior Chippewa)
Fond du Lac Band of Lake Superior Chippewa
Minnesota Department of Natural Resources
Minnesota Pollution Control Agency
United States Department of Commerce (represented by the National Oceanic and Atmospheric Administration)
United States Department of the Interior (represented by the Fish and Wildlife Service and Bureau of Indian Affairs)

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January 3, 2020
14582

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

Charlie Wooley

FEB 4 2020

Charlie Wooley, Regional Director
Fish and Wildlife Service, Region 3
United States Department of the Interior

Date

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

PENN.TONY.MARTIN.1365863640

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Date: 2020.02.06 09:45:35 -05'00'

Tony Penn, Chief, Assessment and Restoration Division
National Oceanic Atmospheric Administration
U.S. Department of Commerce

Date

DOLEY.CHRISTOPHER.D.1365844042

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Date: 2020.02.07 08:02:47 -05'00'

Chris Doley, Chief, Restoration Center
National Oceanic Atmospheric Administration
U.S. Department of Commerce

Date

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

Kevin DuPuis, Chairman
Fond du Lac Band of Lake Superior Chippewa

2-7-2020
Date

Ferdinand Martineau, Jr., Secretary/Treasurer
Fond du Lac Band of Lake Superior Chippewa

2-7-2020
Date

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

Millard (Sonny) Myers, Executive Director
1854 Treaty Authority

1/16/20
Date

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

Jess Richards, Assistant Commissioner
Minnesota Department of Natural Resources

2-4-2020
Date

Based on the information contained in this Preassessment Screen, we have determined that it is appropriate to conduct a natural resource damage assessment for this Site.

Laura Bishop, Commissioner
Minnesota Pollution Control Agency

2-3-2020
Date

Contents

Acronyms and Abbreviations

AOC	Area of Concern
bgs	below ground surface
BI	benthic invertebrate
BTEX	benzene, toluene, ethylbenzene and xylene
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMC	Criterion Maximum Concentration
Consent Order	Response Order By Consent
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CWA	Clean Water Act
DNA	deoxyribonucleic acid
DOI	U.S. Department of the Interior
DSPA	Duluth Seaway Port Authority
EcoSSL	Ecological Soil Screening Level
EPT	*Ephemeroptera*, *Plecoptera*, and *Trichoptera*
ERA	Ecological Risk Assessment
FOSA	Fuel Oil Storage Tanks
FS	Feasibility Study
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
IC	inhibitory concentration
ISRV	Industrial Soil Reference Value
LC	lethal concentration
MDNR	Minnesota Department of Natural Resources
MERLA	Minnesota Environmental Response and Liability Act
MPCA	Minnesota Pollution Control Agency
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment
NRRI	Natural Resources Research Institute
OU	Operable Unit
nPAH	non-carcinogenic polycyclic aromatic hydrocarbon

PAH	polycyclic aromatic hydrocarbon
PAS	Preassessment Screen
PCB	polychlorinated biphenyl
ppm	parts per million
PRG	Preliminary Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
SDWA	Safe Drinking Water Act
SEL	Severe Effect Level
Site	St. Louis River U.S. Steel Superfund Site
Spirit Lake	a reach of the St. Louis River near Duluth
SQT	sediment quality target
TPAH	total polycyclic aromatic hydrocarbon
U.S. EPA	U.S. Environmental Protection Agency
U.S. Steel	United States Steel Corporation
U.S. Steel Site	St. Louis River-U.S. Steel Superfund Site

1. Introduction

The St. Louis River U.S. Steel Superfund Site (U.S. Steel Site or Site; also referred to as the "U.S. Steel Plant Duluth Works Site"), located in Duluth, Minnesota, is a former steelmaking and wire mill facility that began operations in the early 1900s. Operations at the Site included steelmaking facilities, coke production facilities, and a wire mill. Steelmaking ceased at the Site in 1974 (MPCA, 2018b), coke production ended in 1979 (MPCA, 2013), and the wire mill stopped operating in 1986 (MPCA, 2018b). The Site was placed on the federal National Priorities List (NPL) in 1983 (MPCA, 2018a). At the time, it was listed as a single Superfund Site by U.S. Environmental Protection Agency (U.S. EPA) that combined the U.S. Steel Site and a neighboring facility, the St. Louis River Interlake/Duluth Tar Site. The U.S. Steel Site was listed on the State of Minnesota's Permanent List of Priorities in 1984, and the State assumed regulatory authority over Site remedial activities with U.S. EPA federal oversight [the St. Louis River Interlake/Duluth Tar Site was also listed separately on the State's list under the Minnesota Environmental Response and Liability Act (MERLA); MPCA, 2018a]. In 1994, the U.S. Steel Site was placed wholly under Minnesota's regulatory authority "without federal oversight/intervention," under the "Minnesota Pollution Control Agency [MPCA] Enforcement Deferral Pilot Project" (U.S. EPA, 1995).

More recently, the U.S. EPA and the United States Steel Corporation (U.S. Steel) have been working in partnership under the authority of the Great Lakes Legacy Act (GLLA) to develop and implement a comprehensive plan to clean up contaminated sediment at the U.S. Steel Site (U.S. EPA, 2018a). Remedial activities are also ongoing in upland terrestrial areas at the Site, as part of a separate State of Minnesota Superfund process (Barr Engineering and AECOM, 2015a, 2015b).

The Natural Resource Trustees are composed of the 1854 Treaty Authority (governed by the Bois Forte and Grand Portage Bands of Lake Superior Chippewa); the Fond du Lac Band of Lake Superior Chippewa; the State of Minnesota represented by the MPCA and the Minnesota Department of Natural Resources (MDNR); the U.S. Department of Commerce represented by the National Oceanic and Atmospheric Administration (NOAA); and the U.S. Department of the Interior (DOI) represented by the U.S. Fish and Wildlife Service and the Bureau of Indian Affairs (hereafter "the Trustees").

The Trustees have evaluated whether to proceed with a natural resource damage assessment (NRDA) for the Site. A Preassessment Screen (PAS) is the initial step in conducting an NRDA in accordance with DOI regulations (43 CFR Part 11). This document summarizes the Trustees' determination that there is a sufficient basis to pursue an NRDA.

1.1. Intent of the Preassessment Screen

Subpart B of the DOI regulations provides 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 the Comprehensive Environmental Response, Compensation, and Liability Act (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 evaluate the Site against 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

The DOI regulations specify that the Potentially Responsible Party(ies) are to be identified in the PAS (43 CFR 11.24(a)(6). U.S. Steel was the sole owner and operator, and is the only identified potentially responsible party at this Site.

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]:

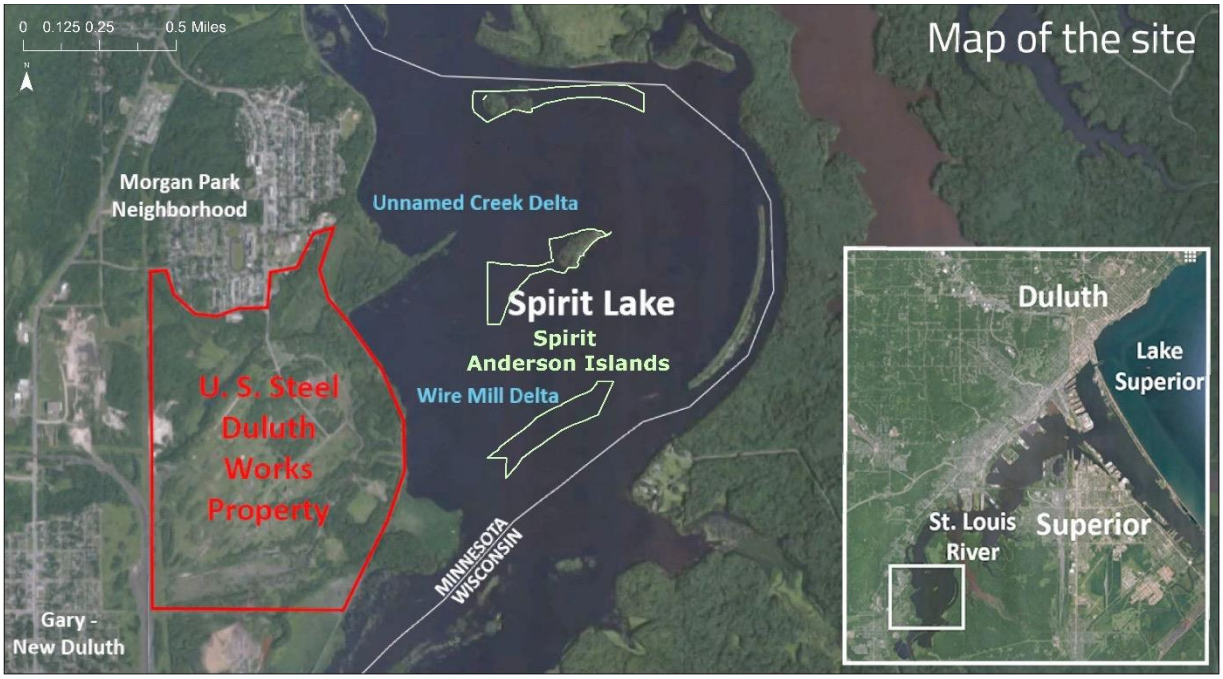
- Section 2.1 provides the location and description of the Site [43 CFR § 11.24(a)(4)]
- Section 2.2 describes the operational history and waste disposal practices at the Site [43 CFR § 11.24(a)(4)]
- Section 2.3 summarizes sources of hazardous substances [43 CFR § 11.24(a)(3)]
- Section 2.4 describes 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)].

2.1. Location and Description

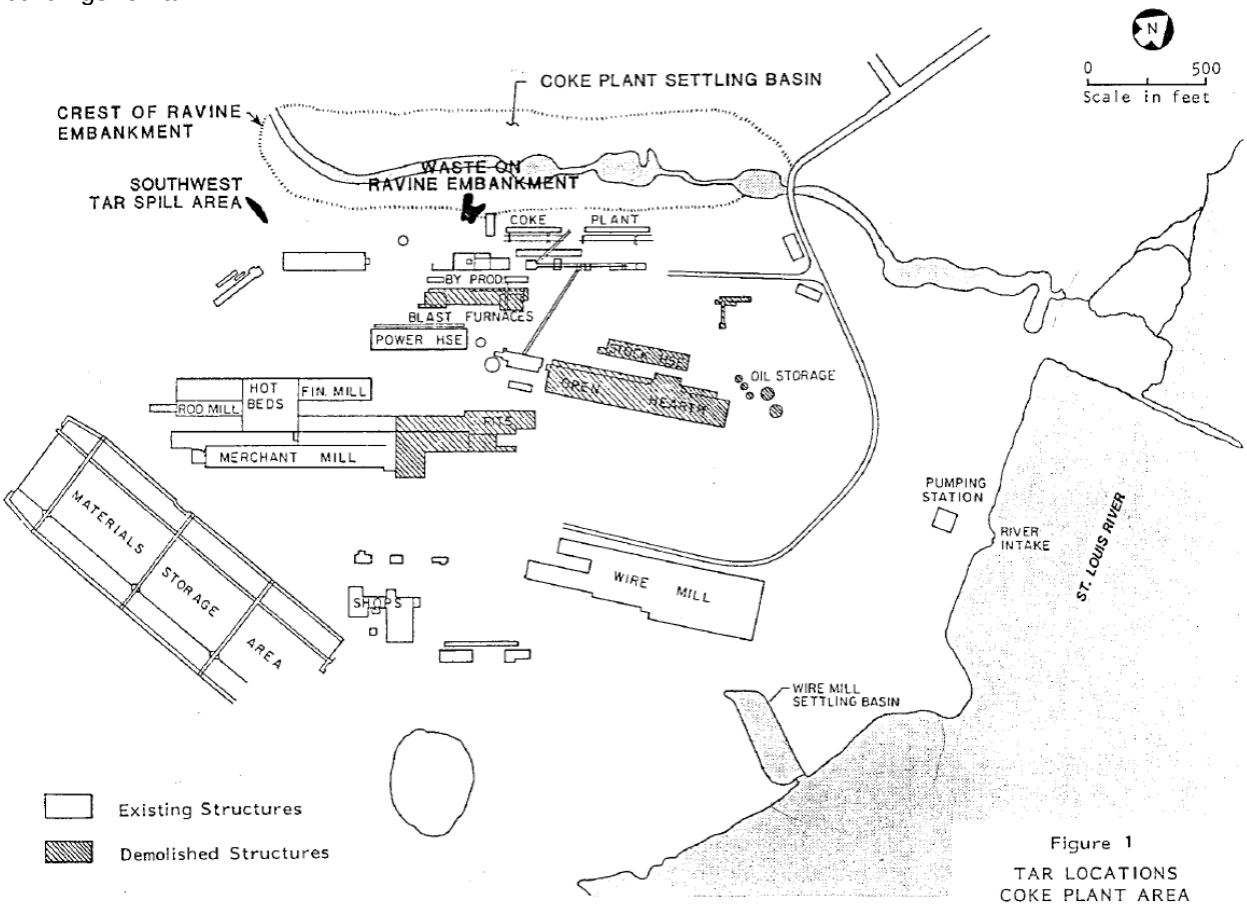
The U.S. Steel Site is located in the southern portion of the City of Duluth in St. Louis County, Minnesota (ROD, 1989; Figure 1). It is composed of the former U.S. Steel operations facility (covering approximately 500 acres of land), which consisted of an integrated steel manufacturing plant, including coke production and steel manufacturing, located adjacent to the St. Louis River (MPCA, 2013). The U.S. Steel Site is also composed of estuarine habitat within the St. Louis River adjacent to the facility, including the Unnamed Creek Delta (110 acres in size) and the Wire Mill Delta (274 acres in size; Barr Engineering and AECOM, 2015a). Surface runoff in the northern part of the U.S. Steel Site drains to Unnamed Creek, which flows in a northeasterly direction and discharges into the Unnamed Creek Delta. The Unnamed Creek originally flowed along an incised ravine. The area became partially filled with industrial materials/sediments discharged over the course of U.S. Steel operations, converting the ravine to wetland habitats. Similarly, the discharged industrial materials/sediments partially filled an embayment at the mouth of the creek that was historically open water, and extended beyond the embayment out into the Unnamed Creek Delta, forming the currently present wetlands (URS, 2014). The remainder of the U.S. Steel Site drains to the Wire Mill Delta, farther south along the St. Louis River (Figure 1). The deltas have received hazardous substances released as a result of decades of U.S. Steel operations (MPCA, 2018d).

Figure 1. General location of the U.S. Steel Site.



The U.S. Steel Site is bound by residential neighborhoods to the north (Morgan Park), property owned by the Canadian National Railway to the west and south, and the St. Louis River (Spirit Lake) to the east (Figure 2; MPCA, 2013; AECOM, 2016). The Site is located within the St. Louis River Area of Concern (AOC). AOC is a designation assigned by the U.S. EPA to areas in the Great Lakes basin that have experienced environmental degradation and significant impairment of beneficial uses as a result of human activities at the local level (U.S. EPA, 2019). The St. Louis River discharges into Lake Superior approximately eight miles downstream of the U.S. Steel Site and is the largest tributary on the U.S. side of Lake Superior (MPCA, 2013; AECOM, 2016).

Figure 2. Historical diagram of the U.S. Steel Site layout from the 1986 remedial investigation, showing the location of demolished and existing structures circa 1986. At present, none of the buildings remain.



Source: Barr Engineering, 1986.

The majority of the U.S. Steel Site is relatively flat, and sits on a bluff that is elevated above the St. Louis River to the east and Unnamed Creek to the north. Elevations range from 600 feet in the estuary to 670 feet above mean sea level in upland areas. The U.S. Steel Site rests on a combination of glacial deposits and fill materials. The fill materials were emplaced by U.S. Steel during facility construction and Site operations. Native soils in the area are formed by glacial deposits, which consist of thick lacustrine clay and silt deposits interbedded with sands that are associated with Glacial Lake Duluth (USGS, 1979; MGS, 1982). A period of low Glacial Lake levels resulted in deep incising of the lake deposits by the St. Louis River and Unnamed Creek (sometimes called Steel Creek), which were then partially filled with glacial sediment, as lake levels rose again. The fill materials overlay native soil (glacial deposits) over much of the U.S. Steel Site, and consist of sand, clay, gravel, cinders, coke fragments, and other materials. While fill depths are restricted to a few feet over most of the U.S. Steel Site, portions of the bluff area south of Unnamed Creek have been extended with 30–40-foot layers of fill (MPCA, 2013). Under the fill, native soil (formed by glacial deposits) have a thickness of 2–32 feet, and consist of red-brown clay interbedded with sand lenses (URS, 2002). The bedrock geology underlying the glacial deposits consists of the Duluth Complex, early Precambrian rocks that include multiple intrusions of gabbroic anorthosite, troctolite, gabbro, anorthosite, and felsic rocks (MPCA, 2013).

2.1.1. Habitats and Biota

The primary habitat types at the Site include upland forested areas, remnant forested wetland and shrub swamp areas, and freshwater aquatic habitats including the Unnamed Creek, the pond embayment formed by the Wire Mill Pond, and portions of the St. Louis River adjacent to the Site. Populations of cottontail rabbit, coyote, beaver, white-tailed deer, black bears, gray foxes, raccoon, and striped skunk have been observed in the area and on the Site (LimnoTech, 2012). Most of the manufacturing buildings were removed by 1988, with the remaining buildings demolished by 1999 (Barr Engineering and AECOM, 2015a), and much of the Site is now overgrown with vegetation, though the footprint of industrial activities is still discernable. In some areas, ongoing leaching of contamination is still visibly occurring (such as tar balls in the Unnamed Creek and oily sheen in the Wire Mill Pond; AECOM, 2016).

The section of the St. Louis River referred to as Spirit Lake was formed by a drowned river meander that is part of the St. Louis Estuary. Currently that area has water depths ranging from 5 to 20 feet, with limited wetland vegetation. Historically it supported extensive wetland habitats, but hydrologic changes over the past century transformed it to open water with few wetland areas (LimnoTech, 2012). A feature located within the section of the St. Louis River referred to as Spirit Lake is a small island known as Spirit Island. The St. Louis River supports aquatic biota, including a wide variety of Great Lakes potamodromous and resident fish species such as walleye, lake sturgeon, channel catfish, muskellunge, northern pike, fathead minnow, white sucker, and black crappie. Birds and wildlife that rely on aquatic habitats, including migratory and resident birds and waterfowl, reptiles and amphibians, and mammals such as beaver and river otter are also known to live on the Site (LimnoTech, 2012). More than 238 bird species have been recorded at the Site, including both migratory and resident species. Notable migratory species observed at the Site include the trumpeter swan; a wide range of waterfowl, shorebird species, and gulls are known to use the area; and two bald eagle nests have been observed in the area. A great blue heron rookery is present in an unknown location within the wooded areas

surrounding the estuary. Further, terrestrial species such as the marsh wren have also been observed (LimnoTech, 2012).

2.1.2. Groundwater

Depth to groundwater at the Site varies from 0 to 3 feet below ground surface (bgs) near the St. Louis River, to 20–25 feet bgs in upland areas (URS, 2002). Groundwater flow directions are toward the Unnamed Creek in the northern portion of the Site and toward the St. Louis River across the rest of the Site (Geraghty & Miller, 1995; URS, 2002; MPCA, 2013). In the Wire Mill Pond area, groundwater flow directions are to the east, toward the St. Louis River, with minimal fluctuation in direction. Groundwater flow directions in the Unnamed Creek Delta area are also toward the St. Louis River, but are more variable, fluctuating seasonally from the northwest in the winter to east-southeast in the summer (URS, 2002). There is also a vertical component of groundwater flow at the U.S. Steel Site. In the Wire Mill Pond area, the vertical flow is upward, with artesian conditions measured at some groundwater well monitoring locations (Geraghty & Miller, 1995). A clay confining layer that is present at the U.S. Steel Site limits this upward vertical flow from deeper portions of the aquifer, and may extend 300 feet offshore of the Wire Mill Pond area (URS, 2002). However, the clay layer is not present everywhere, as this upward flow is also expressed in seeps at the ground surface, found along the lower portion of the terrestrial area of the Site near the river, two of which are routine monitoring stations at the U.S. Steel Site (URS, 2002; MPCA, 2013). Groundwater near the Unnamed Creek also has an upward vertical gradient (Geraghty & Miller, 1995). The vertical component of flow in the Unnamed Creek Delta area fluctuates seasonally. URS (2002) reported downward flow in the winter and predominantly upward gradients from June to December. The clay layer is also present in this area, and locally confines the underlying deeper groundwater (URS, 2002).

2.1.3. Cultural Significance of the Site

Native American populations have inhabited and have hunted, fished, and gathered natural resources in and around Spirit Lake for generations, potentially dating to prehistoric times (Mulholland and Mulholland, 2013). Spirit Lake and Spirit Island are central to the Anishinaabe (Ojibway) migration story; the sixth stopping point on the Ojibwa migration from the East Coast. It was near Spirit Island where the Ojibwa encountered wild rice (“food that grows on water”), marking the end of their journey (Mulholland and Mulholland, 2013).

Further, the U.S. Steel Site lies within a geographical area that is covered by the LaPointe Treaty. This treaty was signed in 1854 and retained formal rights for Tribal uses of natural resources, including hunting, fishing, and gathering in an area called the 1854 Ceded Territory. The 1854 Ceded Territory encompasses present-day northeastern Minnesota, including the U.S. Steel Site and the St. Louis River. The Bois Forte, Fond du Lac, and Grand Portage bands exercise treaty rights in this ceded territory. Currently, the Fond du Lac Band of Lake Superior Chippewa Tribe owns Spirit Island and adjacent areas within Spirit Lake (Figure 1).

Traditional use of resources remains important today for preserving tribal culture and lifeways. However, tribal fishing in the estuary has been severely diminished in recent decades because of known and perceived contamination, including site-specific health advisories, oil blooms, odors and tainting, as well as restrictions on access. Pollution, habitat degradation, and other stressors have also significantly and adversely impacted wild rice populations in the estuary, including

Spirit Lake. Elders report actively harvesting manoomin, or wild rice, in the St. Louis River estuary as recently as the 1950s and 1960s, but harvestable stands have been nearly extirpated.

2.1.4. Recreational Activities

Common recreational activities at or near the U.S. Steel Site include angling, boating, birdwatching, trail hiking, and shoreline use. Important gamefish in the lower St. Louis River include walleye, muskellunge, smallmouth bass, black crappie, lake sturgeon, and channel catfish. The MDNR has historical data recording that the area was used for angling, hiking trails, and for birding (LimnoTech, 2012).

2.2. Operational History and Waste Disposal Practices

2.2.1. U.S. Steel Operations

Operations at the Site included coke production, iron and steel making, casting, primary rolling and roughing, hot and cold finishing, and galvanizing (MPCA, 2013). Construction of the facility began in 1907 and operations at the U.S. Steel Site began in 1915 (MPCA, 2018b).

Site operations can be divided into the "hot side" and "cold side." Hot side operations were located in the northern part of the U.S. Steel Site, and included a coke production facility with blast furnaces and open hearths for casting liquid steel (Figure 2). The blast furnaces were used to create liquid steel from iron ore, which was then cast into "ingots" and "rolled into blooms" that were sent to other U.S. Steel plants to produce final products before the onsite merchant building and mills were built (Alanen, 2007, as reported in Prairie-Works, 2018).

Cold side operations began in 1922, and included mill facilities such as the merchant mill and the wire mill, which were located in the southern part of the U.S. Steel Site (Figure 2) where rod and wire were produced. The wire was then galvanized and made into nails, barbed wire, woven wire fencing, and later (beginning in the 1950s) wire reinforcement mats for concrete highways; fence posts were also constructed at this facility from galvanized steel (Alanen, 2007, as reported in Prairie-Works, 2018).

Steel-making operations ceased in 1974 (MPCA, 2018b) and the coke production facility ceased operations in 1979 (MPCA, 2013). The blast furnaces, open hearth furnaces, fuel storage tanks, and a portion of the rolling mill were demolished that same year (MPCA, 2013). The wire mill discontinued operations in 1986 (MPCA, 2018b). By 1988 the material storage area and most of the remaining buildings were demolished (MPCA, 2013). The cleanup and demolition of the coke plant and associated facilities were completed in 1992 (MPCA, 2018b).

2.2.2. Remedial Activities

The U.S. Steel Site was placed on the NPL under CERCLA in 1983 and subsequently placed on the State of Minnesota's Superfund listing under MERLA in 1984, with MPCA as the lead regulatory agency (U.S. EPA, 1995; MPCA, 2018a). A Response Order By Consent (Consent Order) was executed in March 1985. In the summer of 1985, U.S. Steel initiated a Remedial Investigation/Feasibility Study (RI/FS) in compliance with the MPCA Consent Order. The Record of Decision (ROD) was signed by MPCA in February 1989 (MPCA, 2018b).

The ROD (1989) identified 18 Operable Units (OUs; Figure 3) for remedial action. Since then, one additional OU (OU-S) was identified, for a total of 19 OUs in both upland and aquatic areas. A more detailed description of the OUs can be found on MPCA's website (MPCA, 2018c). Initial remedial work was focused on inland operational source areas. The response action specified for the OUs that contain the Unnamed Creek, the two deltas, and the wire mill pond was "*No action, subject to the completion of a PAH-treatability study to examine implementation of alternative and innovative treatment technologies. No action includes routine inspections and water quality monitoring to verify that significant erosion has not occurred and to verify the long-term effectiveness of the response actions…Appropriate institutional controls shall be implemented to minimize future disturbance*" (ROD, 1989, p. 2). Subsequent to the ROD, a polycyclic aromatic hydrocarbon (PAH) treatability study was conducted for the St. Louis River sediment adjacent to the Site and, at the time, no feasible treatment options were identified to treat the contaminated sediments (Barr Engineering, 1990). More recent Site investigations and remedial feasibility studies conducted under the GLLA, have included a greater focus on removing and containing contaminated sediments from the St. Louis River adjacent to the Site, in addition to addressing ongoing risks associated with terrestrial resources at the U.S. Steel Site (Barr Engineering and AECOM, 2015a, 2015b). Remedial actions at OU-J and OU-P occurred in 1997 and an Explanation of Significant Differences for each was issued by MPCA (MPCA, 1997).

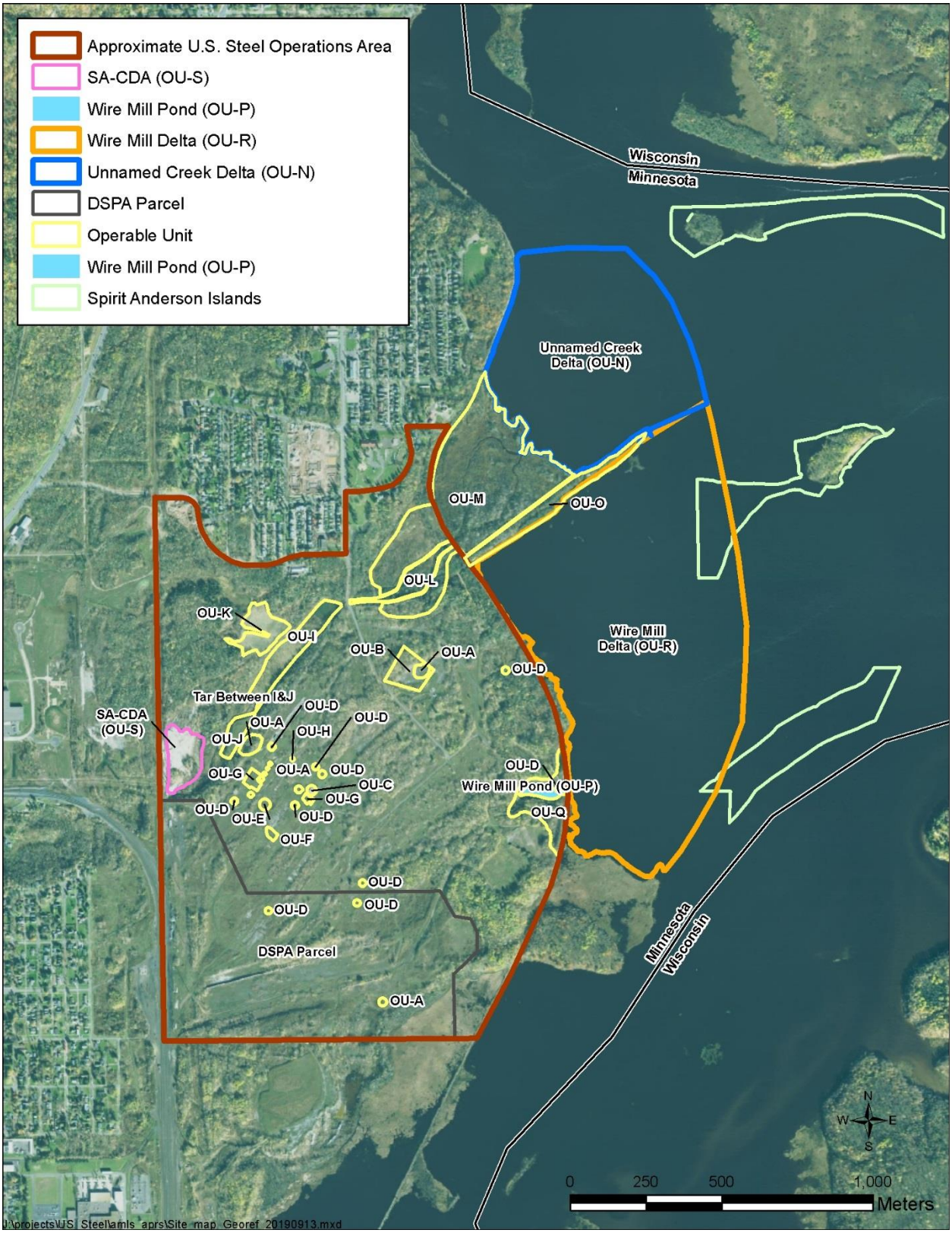
Below we describe the past cleanup activities in the Coke Plant Management Area, the Coke Plant Settling Basin Management Area, and the Wire Mill Settling Basin Management Area. According to MPCA (2018a), cleanup has been completed in 16 of the OUs. We then describe future remedial activities that are anticipated to begin in 2020, which are occurring under GLLA (see the "On Going Remedial Actions" section below).

Coke Plant Management Area

Remedial actions, specified in the 1989 ROD (ROD, 1989) that occurred in the 1980s and 1990s in OUs associated with the Coke Plant Management Area, include (MPCA, 2018c):

- OU-A, tar and tar contaminated soil: contaminated materials were removed in 1995
- OU-B, contaminated water in tanks and pipelines: contaminated water in tanks and pipelines was discharged to the sanitary sewer for treatment at the Western Lake Superior Sanitary District Plant in 1985, 1988, and 1989
- OU-C, solids in large and small gas holders: solids were removed and shipped to hazardous waste landfills in 1993
- OU-D, tar and coking by-products in tanks: residual contents of tanks were recycled as fuel or disposed of offsite in 1985 and 1989
- OU-E, tar and coking by-products in pipelines: pipelines were dismantled and cleaned in 1989, materials were placed in staging areas onsite or disposed of offsite; a portion of the underground pipes was excavated and cleaned in 1992: tar was stored at the U.S. Steel Site and cleaned pipe was disposed of as scrap metal; the remaining buried coke oven gas lines (7,800 feet) were removed, cleaned, and disposed of in 1999

Figure 3. Site overview, illustrating the approximate location of U.S. Steel OUs. (The DSPA parcel is the proposed Duluth Seaway Port Authority parcel.)



- OU-F, polychlorinated biphenyl (PCB) liquids: PCB liquids were removed offsite and incinerated in 1989
- OU-G, ammonium sulfate: materials were removed and recycled in two batches in 1993
- OU-H, lubricants, paints, solvents, fuel oils, water, metal shavings: contents of drums were determined and either disposed of in the winter of 1989–1990, or shipped offsite for use as fuel or incinerated in 1993.

OU locations that are currently of concern as potential ongoing sources to the Unnamed Creek and Wire Mill deltas include OUs A, I, J, L, M, and Q; and Unnamed Creek and Wire Mill deltas (illustrated in Figure 3). Removal actions are also ongoing within OU A. Locations of the other OUs are shown in Figure 3 and additional information is available on MPCA's website (MPCA, 2018c).

Coke Plant Settling Basin Management Area

Remedial actions that have occurred to date in the Coke Plant Settling Basin Management Area were specified in the 1989 ROD (ROD, 1989), and include:

- OU-I, no action area identified in the 1989 ROD: The Third Five-Year Review report states that the remedy is not protective because the contaminants present an unacceptable risk to benthic organisms and this area receives contaminants from upgradient sources (MPCA, 2013).
- OU-J, tar and tar contaminated soil: the ROD specified emplacement of a slurry wall in OU-J. Instead, as summarized in an Explanation of Significant Difference (MPCA, 1997), materials were solidified in place and a seven-foot cap was placed over the unit and vegetated in 1997.
- OU-K, dredge spoil material: top dressing of the cells of dredge spoil material and rehabilitation of a culvert in 1992 (Barr Engineering, 1994).
- OU- L, stream channels: no action pending a PAH treatability study; the study found that there were no feasible treatment options for the large volume of contaminated sediment.
- OU-M, delta and stream channel area: no action.
- OU-N, Unnamed (Steel) Creek Estuary: no action.
- OU-O, Spit of Land: no action.
- OU-S, cement slag: this OU was identified subsequent to the ROD. The response action is currently being decided by the MPCA (Susan Johnson, MPCA, personal communication, July 2019).
- Tar between OU-I and OU-J: the ROD stated that material would be excavated and used as fuel, but no clear record of this past remediation has been identified. No references have been found regarding remediation of this area.

The ROD (1989) states that appropriate institutional controls shall be implemented in OUs I, L, M, N, and O; these have not yet been implemented.

Based on the results of recent five-year reviews and Site investigations, further cleanup activities are planned for some of these OUs, in particular OUs L, M, and N, and the area between OU-I and OU-J, which is being addressed through the GLLA process described further below (Barr Engineering and AECOM, 2015a, 2015b).

Wire Mill Settling Basin Management Area

Remedial actions that have occurred to date in the Wire Mill Settling Basin Management Area were specified in the 1989 ROD (ROD, 1989), and include:

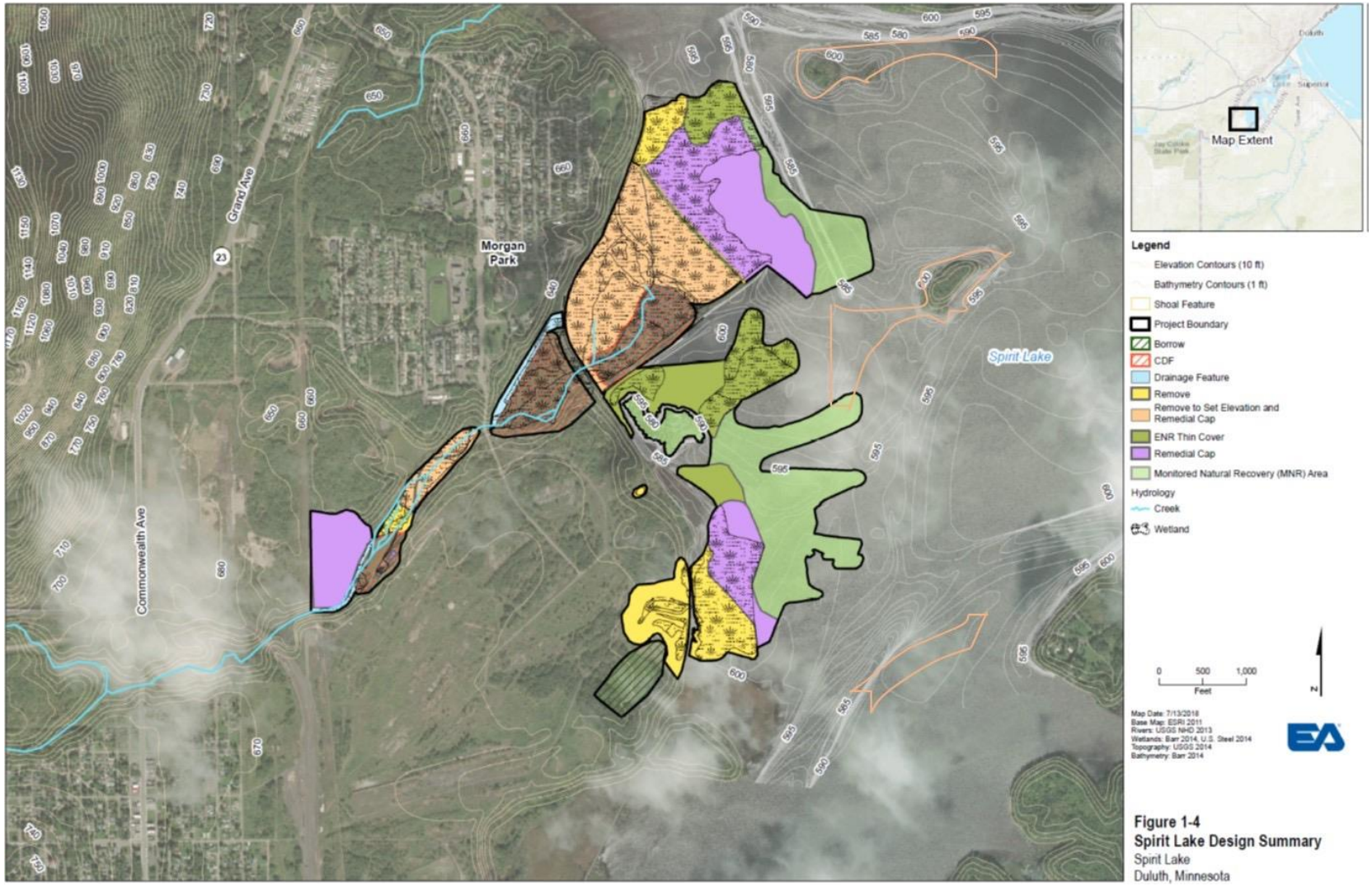
- OU-P, Wire Mill Pond: no-action; based on a 1996 response plan and Explanation of Significant Difference (MPCA, 1997), contaminated sediments were partially moved to an industrial waste landfill and the pond was lined, backfilled with clean sand, and planted with native wetland vegetation in 1997
- OU-Q, dredge spoil area: no action
- OU-R, Wire Mill Pond: no action.

Ongoing Remedial Actions

Remedial work at the U.S. Steel Site is ongoing. Past remedial work in the three management areas (described above) focused primarily on contaminated soil and sediment in the former operations area of the U.S. Steel Site. As presented in the third five-year review for the U.S. Steel Site (MPCA, 2013), many of the remedial actions undertaken in the past did not sufficiently reduce risks to human health and the environment, and did not address contamination in the Unnamed Creek and Wire Mill deltas. As a result, additional Site investigations have been implemented and future remedial actions are planned to further remove and contain hazardous substances (MPCA, 2013; Barr Engineering and AECOM, 2015a). MPCA has been the main regulatory agency overseeing remedial activities up until 2016, when the U.S. EPA became engaged in the cleanup of aquatic areas at the Site, through the GLLA (MPCA, 2016). .

As mentioned in Section 1, the St. Louis River including Spirit Lake is a U.S. EPA Great Lakes National Program Office AOC, and the focus of a GLLA cleanup project, the "Spirit Lake Legacy Act Cleanup." The U.S. EPA Great Lakes National Program Office (GLNPO) and U.S. Steel are engaged in a partnership in the cleanup, and most of the current sediment cleanup at the U.S. Steel Site will occur under this partnership. The U.S. EPA GLNPO and U.S. Steel have selected the final remedial plan, and are in the process of developing the final design, with implementation anticipated to begin in 2020. The plan includes sediment dredging and capping actions in Spirit Lake, the Wire Mill Pond area, the Unnamed Creek Delta, and associated wetland areas (Figure 4; Barr Engineering and AECOM, 2015a, 2015b; EA Engineering, Science, and Technology, 2018).

Figure 4. Conceptual diagram of U.S. EPA's final remedial plan for the Site. The orange outlined areas represent the approximate boundaries of the Spirit Anderson Islands. Confined Disposal Areas are shown in dark brown. The GLLA remedial plan is focused on sediment cleanup and does not address upland areas, which may undergo cleanup under separate state regulatory authority.



Source: EA Engineering, Science, and Technology, 2018.

U.S. Steel and other parties are also evaluating and planning remedial actions in the southern portion of the former operations area (i.e., the upland DSPA property identified in Figure 3) for future development. This work is being conducted by U.S. Steel in accordance with Section V of the March 26, 1985 Consent Order issued by MPCA as part of the State's Superfund process. While occurring under different cleanup programs, the 2015 revised FS (Barr Engineering and AECOM, 2015a, 2015b) combined the upland and aquatic investigations to help identify areas where complementary actions could be implemented (e.g., consolidating onsite disposal facilities; Barr Engineering and AECOM, 2015b). Additional upland investigations are also required prior to any future ownership transfer.

2.3. Sources of Hazardous Substances

The sources of hazardous substances can be differentiated between hot side and cold side areas. Hot side hazardous substances are related to coke production; while cold side hazardous substances are related to wire processing, including galvanizing (Barr Engineering, 1986). The information presented below about sources comes primarily from the 1986 RI (Barr Engineering, 1986), the MPCA U.S. Steel Superfund Site website (MPCA, 2018b), and the third five-year review report for the U.S. Steel Site (MPCA, 2013).

2.3.1. Hot Side Sources

Coke Plant Area and Coke Plant Settling Basin

While the U.S. Steel Site was in operation, much of the waste from the coke plant and from the hot side of the steel plant was discharged into the Coke Plant Settling Basin (Figure 2; Barr Engineering, 1986). This settling basin was formed by a control structure constructed directly in Unnamed Creek, built in 1954 (at that time referred to as Steel Creek; MPCA, 2013, 2018b). Waste observed in and around Unnamed Creek included soft and hard tar, coke, and coke breeze; and was up to 11-feet deep in some areas (Barr Engineering, 1986). These waste materials are a source of PAHs and other hazardous substances exposing natural resources at the Site. Contaminated water and suspended materials from the settling basin flowed down Unnamed Creek, and discharged into the St. Louis River (MPCA, 2013). The Trustees have not found documentation detailing disposal practices prior to 1954, but aerial imagery suggests that industrial materials/sediments were discharged directly into Unnamed Creek, resulting in the partial filling of the historical ravine and the embayment, and extending out into Unnamed Creek Delta (URS, 2014). Contaminated soil and sediment can also be secondary sources of hazardous substances, exposing other natural resources that come into contact with them, including, for example, surface water resources and biological resources through direct contact and/or ingestion.

Other sources of hazardous substances on the hot side include a tar spill area along the edge of the Coke Plant Settling Basin, tanks that held by-products and operational wastes, buried coke oven gas and tar lines between buildings, indoor and above-ground coke oven gas and tar lines, and a large number (approximately 270) of transformers and circuit breakers containing oil (Barr Engineering, 1986).

Dredge Spoil Area

The Coke Plant Settling Basin was dredged multiple times during operations and dredge spoil materials were placed into an area northwest of the settling basin (Barr Engineering, 1986;

MPCA, 2013). Four potential disposal sites were identified within the larger dredge spoil area and were investigated during the 1985 RI. These were identified based on the presence of visible coke plant waste, including hard waste layers, oily coke residue, and coke fines and dust; and an oily sheen was observed in dredge spoil borings (Barr Engineering, 1986).

Area between Coke Plant Settling Basin and Unnamed Creek Delta

Waste in the area between the Coke Plant Basin and the Unnamed Creek Delta was observed in the streambed, and in a silted-in area that was formerly open water near the mouth of the creek. Waste material was observed 5–7 feet deep, and consisted of primarily coke, sand, and fibrous organic material (Barr Engineering, 1986). This area also includes the "spit of land" that was constructed to dispose of slag from U.S. operations; it contained up to 5 feet of coke waste (Barr Engineering, 1986).

2.3.2. Cold Side Sources

Wire Mill Settling Basin (or Wire Mill Pond)

The Wire Mill Pond was used for Site-wide stormwater and sewage disposal, as well as disposal of oils and greases that were used in the milling process at merchant mill buildings. Sediment in the Wire Mill Pond contained waste material and hazardous substances related to wire processing and sewage disposal. The Wire Mill Pond was dredged and reshaped between 1953 and 1969, and the dredged material was placed south of the present basin. Dredged material included a mixture of waste and native soil material up to 22 feet deep in some areas (Barr Engineering, 1986).

Oil Storage and Tar Loading Area

The storage tanks in the "oil storage" area (Figure 2) historically contained a variety of materials, including fuel, tar, and wastes. Soft tars were visibly present on the ground in this area during 1985 RI activities. Waste materials, including hard and soft tar layers, were found up to 10 feet bgs (Barr Engineering, 1986). Later investigations identified contamination to soil and groundwater from fuel oil that had been stored in fuel oil storage tanks (FOSAs); this area is now often referred to as the FOSA area (MPCA, 2012).

2.4. Hazardous Substances Released

During operations, the mill produced solid, semi-solid, and liquid wastes that were discharged to portions of the land surface as well as to the coke plant and wire mill settling basins described above, both of which discharge to the St. Louis River (MPCA, 2018a). Wastes that were discharged include coal tar decanter sludge and other coal tar sludges. Hazardous substances released at the Site include but are not limited to PAHs and metals such as arsenic, cadmium, copper, chromium, lead, mercury, nickel, and zinc (Table 1; MPCA, 1985; Barr Engineering and AECOM, 2015a). Water quality surveys conducted in 1928, 1948, and 1973 showed a progressive deterioration of water quality in Spirit Lake and the St. Louis River, based on parameters that were measured at that time. For example, in 1973, water quality levels in the St. Louis River exceeded the MPCA surface water standards for cyanide, phenols, and other substances (MPCA, 2018a).

Table 1. Examples of released hazardous substances, and CAS number[a]

Hazardous substance	CAS number
PAHs	A broad category, including, e.g., 50328
Arsenic	7440382
Cadmium	7440439
Chromium	7440473
Copper	7440508
Lead	7439921
Mercury	7439976
Nickel	7440020
Zinc	7440666

a. Additional hazardous substances may have been released at the Site.

CAS = Chemical Abstracts Service number.

In 1979, MPCA requested a hydrological study of the U.S. Steel Site. U.S. Steel subsequently submitted two reports: the "Soil and Ground Water Investigation" report in 1981 and the "River Water Quality Impact Investigation" report in 1983 (MPCA, 2018a). These 1981 and 1983 reports, and a Site inspection by U.S. EPA in 1982, determined that wastes containing PAHs were discharged into the Unnamed Creek Settling Basin and heavy metal wastes were discharged into the Wire Mill Settling Basin (MPCA, 1985). Subsequent evaluations have determined that metals were also a component of wastes and were discharged into the Unnamed Creek Settling Basin in addition to the Wire Mill Settling Basin (Barr Engineering and AECOM, 2015a).

As described above, the Coke Plant Settling Basin was constructed in the channel of Unnamed Creek. The 1986 RI estimated that there were approximately 140,000 cubic yards of non-native (waste) materials in the settlement basin. The major hazardous substances of concern in Unnamed Creek are PAHs, though metals are also present. Concentrations as high as 35,000 mg/kg of total PAH (TPAH) were measured in 1986 (Barr Engineering, 1986) and remain elevated in the creek (Barr Engineering and AECOM, 2015a). In the 1986 RI, it was reported that, on average, non-native material in the Coke Plant Settling Basin was approximately 10-feet thick (Barr Engineering, 1986).

A survey in 1973 observed that the Wire Mill Settling Basin (also referred to as the Wire Mill Pond) had filled with sediment (Barr Engineering, 1986). Based on this survey, MPCA issued a National Pollutant Discharge Elimination System permit to monitor effluent from the basin and stream water quality was found to exceed surface water standards for ammonia, cyanide, and phenols (MPCA, 2018a).

2.5. Time, Quantity, Duration, and Frequency of Releases

The Site operated as an integrated steel manufacturing plant, including coke production and steel manufacturing from 1907 through 1986. Releases of hazardous substances may have occurred at any time over the 80 years that the facility was operating. Wastes from the hot side operations were discharged via the Unnamed Creek. Discharges from the cold side operations were channeled into the Wire Mill Settling Basin. Waste material from all of the Site operations (hot and cold side) included a mixture of PAH-generating materials (e.g., tar, coke) and metals, though the specific constituents differed slightly across the operational areas.

Remedial activities in the Unnamed Creek and Wire Mill Pond areas removed some sources of contamination and reduced the amount of hazardous substances reaching the St. Louis River. However, contaminated sediments in the St. Louis River were not treated, and areas of tar, coke, and other waste materials are still present in upland areas.

The 1989 ROD estimated that there were 900,000 to 1,400,000 cubic yards of waste and soil contaminated by waste from the coke plant, an additional 300,000 cubic yards of waste from the "cold" side of the steel plant, and approximately 6,000 cubic yards of tar and tar-contaminated soil with concentrations up to 36,000 parts per million (ppm) carcinogenic PAH (cPAH) and 200,000 ppm non-carcinogenic PAH (nPAH). It was estimated that there were one million cubic yards of waste material in the settling basin, the delta, and the river, including a partially submerged tar deposit near the outlet of the settling basin (ROD, 1989). As noted above, PAH concentrations in sediment samples collected adjacent to the U.S. Steel Site ranged up to 1,500 ppm (Figure 6; NOAA, 2018). Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc) have been measured in the Unnamed Creek and Wire Mill deltas and, in some locations, exceed MPCA sediment quality targets (SQTs) by up to an order of magnitude (Barr Engineering, 2013). In particular, lead concentrations as high as 590 ppm have been measured in the Unnamed Creek delta and 510 ppm in the Wire Mill Pond delta; and zinc concentrations up to 3,780 ppm in the Unnamed Creek delta and 2,500 ppm in the Wire Mill Pond delta (NOAA, 2018). The total quantity of hazardous substances released at the Site is unknown.

2.6. Damages Excluded from Liabilities

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 the release 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 311a)(2) or (b)(3) of the CWA.[1]

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.[2]

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)].

3.1. Pathways

As described in Section 2, primary source areas at the Site include the Coke Plant Area, the Dredge Spoils Area, the Coke Plant Settling Basin and Estuary, the Wire Mill Settling Basin, the Oil Storage and Tar Loading Area, and the Underground Fuel Tanks (Barr Engineering, 1986; Figure 2). The key pathways at the U.S. Steel Site include abiotic pathways in which contaminants are transported through surface water, sediment, groundwater, air, and soil; and biotic pathways in which contaminants are transported through the food chain.

3.1.1. Pathways from Terrestrial Source Areas

Terrestrial source areas at the U.S. Steel Site include, but are not limited to, the Coke Plant Area, the Dredge Spoils Area, and terrestrial habitats within the area between the Coke Plant Settling Basin and the St. Louis River. Soil in these areas were exposed to hazardous substances through direct deposition when historical manufacturing practices and disposal methods deposited contamination onto the soil surface (see Section 2.3). Surface runoff from these contaminated areas and aerial deposition of windblown soil may have transported hazardous substances to downslope and downwind aquatic and terrestrial habitats. In addition, percolation of precipitation through contaminated soil can result in the transport of hazardous substances to underlying groundwater. Pathways to groundwater may also include direct contact with contaminated soil in the subsurface, in areas with leaky underground storage tanks such as in the FOSA. Biological resources may be directly exposed to hazardous substances through dermal contact, inhalation, and ingestion of contaminated soil; or indirectly exposed by consuming contaminated prey and other food items. Terrestrial vegetation may be exposed to hazardous substances in soil through root uptake. Hence, contaminated soil in terrestrial source areas can serve as a pathway of exposure to other terrestrial areas at the U.S. Steel Site when they are

1. CWA exclusions generally cover permitted discharges.

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

transported by surface water runoff, into groundwater by infiltration, and to biological resources through direct contact or through the food chain.

3.1.2. Pathways from the Unnamed Creek and Settling Ponds

These source areas include the Unnamed Creek and the Coke Plant Settling Basin, and the Wire Mill Settling Basin (or Pond). Historical practices of releasing manufacturing wastes directly into Unnamed Creek (by placing waste in the Coke Plant Settling Basin) and the Wire Mill Pond (see Section 2.3) resulted in the direct release of metals, metalloids, and PAHs to surface water and sediment. These hazardous substances may then be transported downstream via surface water pathways to the St. Louis River (specifically the Unnamed Creek and Wire Mill deltas; Figure 3).

This downstream transport of metals, metalloids, and PAHs in surface water, which may occur in both the dissolved and particulate phases, and as suspended sediment, is confirmed by elevated metals and PAH concentrations in St. Louis River sediment. Figure 5 illustrates this pathway, showing locations in the Unnamed Creek and the Wire Mill Pond with visible oily sheen on the surface water. Section 3.2.1 presents St. Louis River sediment data that confirm this pathway.

Aquatic biota in the creeks and the St. Louis River, such as benthic invertebrates (BIs), fish, and amphibians, may come into direct contact with hazardous substances through dermal contact and ingestion of contaminated surface water, and through direct contact and ingestion of contaminated sediment. They may also be exposed to released hazardous substances indirectly, via food chain pathways.

3.2. Areas and Resources Exposed to Hazardous Substances

Natural resources such as surface water and sediment, biological resources in both aquatic and terrestrial habitats, groundwater, and soil have been exposed to hazardous substances released at the Site. This section describes areas and resources that have been exposed to hazardous substances, based on measured concentrations of hazardous substances in the environment at the Site. 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 an initial review of the readily available Site data, reports, and literature.

3.2.1. Surface Water and Sediment

Surface water and sediment are defined in the DOI NRDA regulations as:

> … the waters of the United States, including the sediment suspended in water or lying on the bank, bed, or shoreline and sediment in or transported through coastal and marine areas [43 CFR § 11.14(pp)].

For the purposes of the PAS, the Trustees focused primarily on evaluating sediment data because a relatively extensive body of sediment data have been collected, and are readily available in a database format. Surface water data have also been collected at the U.S. Steel Site, but are more limited, and have not yet been compiled into a database format.

Figure 5. Waste containment and PAH sheens are visible in surface waters in Unnamed Creek (top photograph) and the Wire Mill Pond (bottom photograph).

Source: Photographs provided by MPCA.

Sediment Exposure

The Trustees confirmed that sediment in the Unnamed and Wire Mill deltas is exposed to hazardous substances, based on an analysis of the sediment data available in DIVER (NOAA, 2018). The DIVER dataset includes data collected over a range of dates and sediment depths, with some sampling locations that have been sampled multiple times and at multiple depth intervals. For this preliminary evaluation, the Trustees used the highest-reported concentration over time and depth at each location in the analyses. The Trustees may choose to complete more complex data analyses in future phases of the NRDA.

The Trustees confirmed that sediment exposed to hazardous substances, based on elevated concentrations and the spatial pattern in which sediment concentrations for all of the hazardous substances evaluated, are highest closest to the shores in the Unnamed Creek and Wire Mill deltas, where hazardous substances were discharged from Site source areas; and decrease at distances farther away (east and north, or downstream) from the two delta areas. This pattern of exposure is shown in Figures 6–8 for PAHs, lead and zinc, and copper and nickel, respectively. The Trustees also evaluated arsenic, mercury, and cadmium concentration data (data not shown), which showed similar spatial patterns to those presented here.

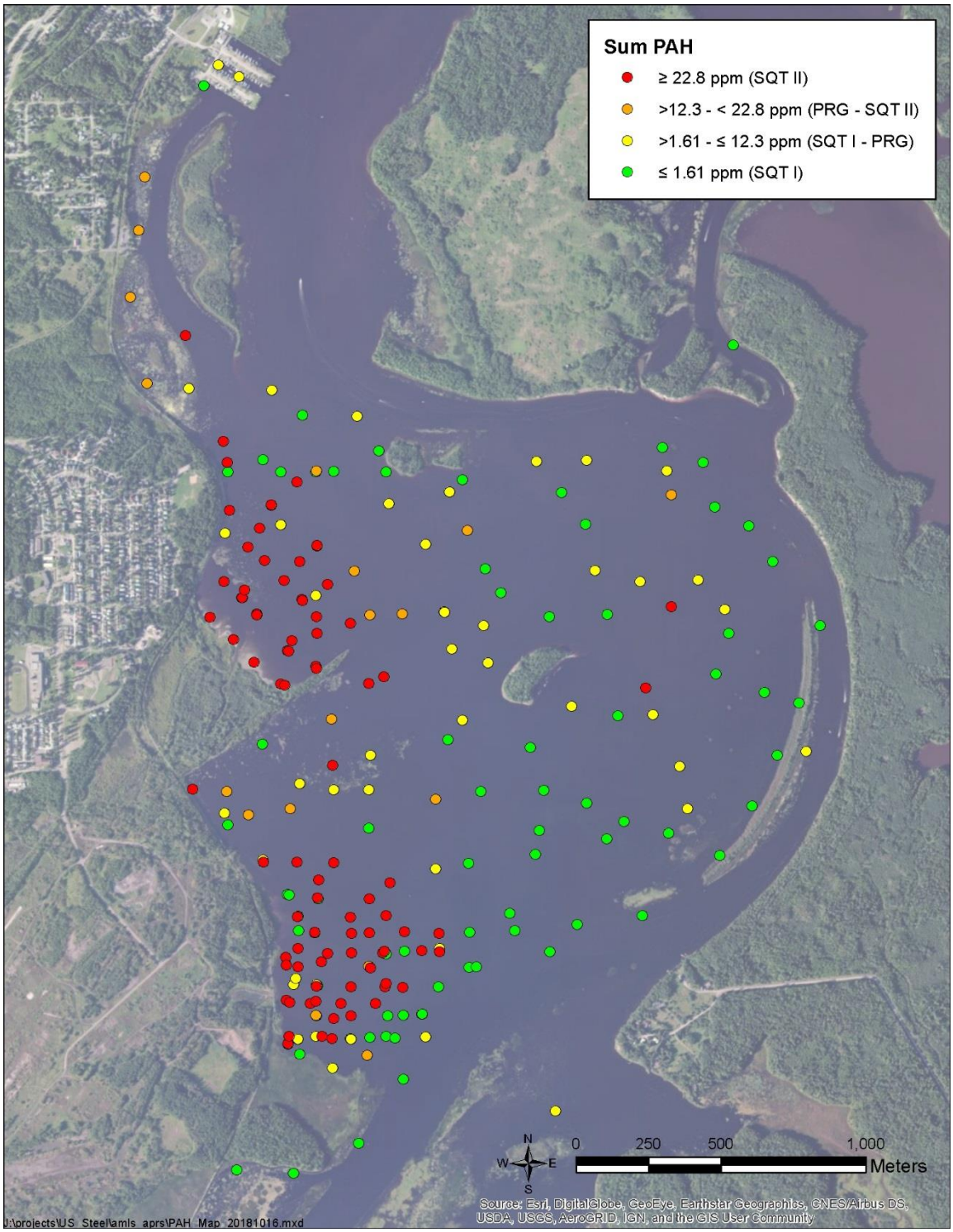
Sediment in Mud Lake has also been exposed to hazardous substances (MPCA, 2018e). Mud Lake is a wetland area upstream of and adjacent to the U.S. Steel Site that is approximately 4,000 feet long and 1,000 feet wide. From 1948 to 1984, slag from the U.S. Steel Site was deposited in upland portions of Mud Lake at the toe of the main slag impoundment (MPCA, 2018e). The Trustees have not yet compiled environmental data for this area. While Mud Lake is not addressed further in this PAS, the Trustees may do so as a part of future NRDA activities.

The Trustees also confirmed that sediment at the Site is exposed to hazardous substances by comparing concentrations of hazardous substances in sediment to levels indicative of adverse effects to biota. In this analysis, the Trustees used PRGs set for the U.S. Steel Site by MPCA as a part of the remedial cleanup, the State of Minnesota's SQTs, and "Severe Effect Levels" (SELs) reported in the literature (Table 2).

Table 2. Sediment PRGs, SQTs, and SELs used in the sediment analysis

Abbreviation	Effects level	Description	Source
SEL	Severe Effect Level	A concentration above which severe adverse effects are expected to occur and be detrimental to the majority of sediment-dwelling organisms	Persaud et al., 1993
SQT I	Level I Sediment Quality Target	Intended to identify contaminant concentrations below which harmful effects to sediment-dwelling organisms are unlikely [based on MacDonald et al. (2000) Threshold Effect Concentration]	Crane and Hennes, 2007
SQT II	Level II Sediment Quality Target	Intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are likely [based on MacDonald et al. (2000) Probable Effect Concentration]	Crane and Hennes, 2007
PRG	Preliminary Remediation Goal	Developed for the U.S. Steel Site and established as the mid-point between the SQT I and II values	Barr Engineering and AECOM, 2015a

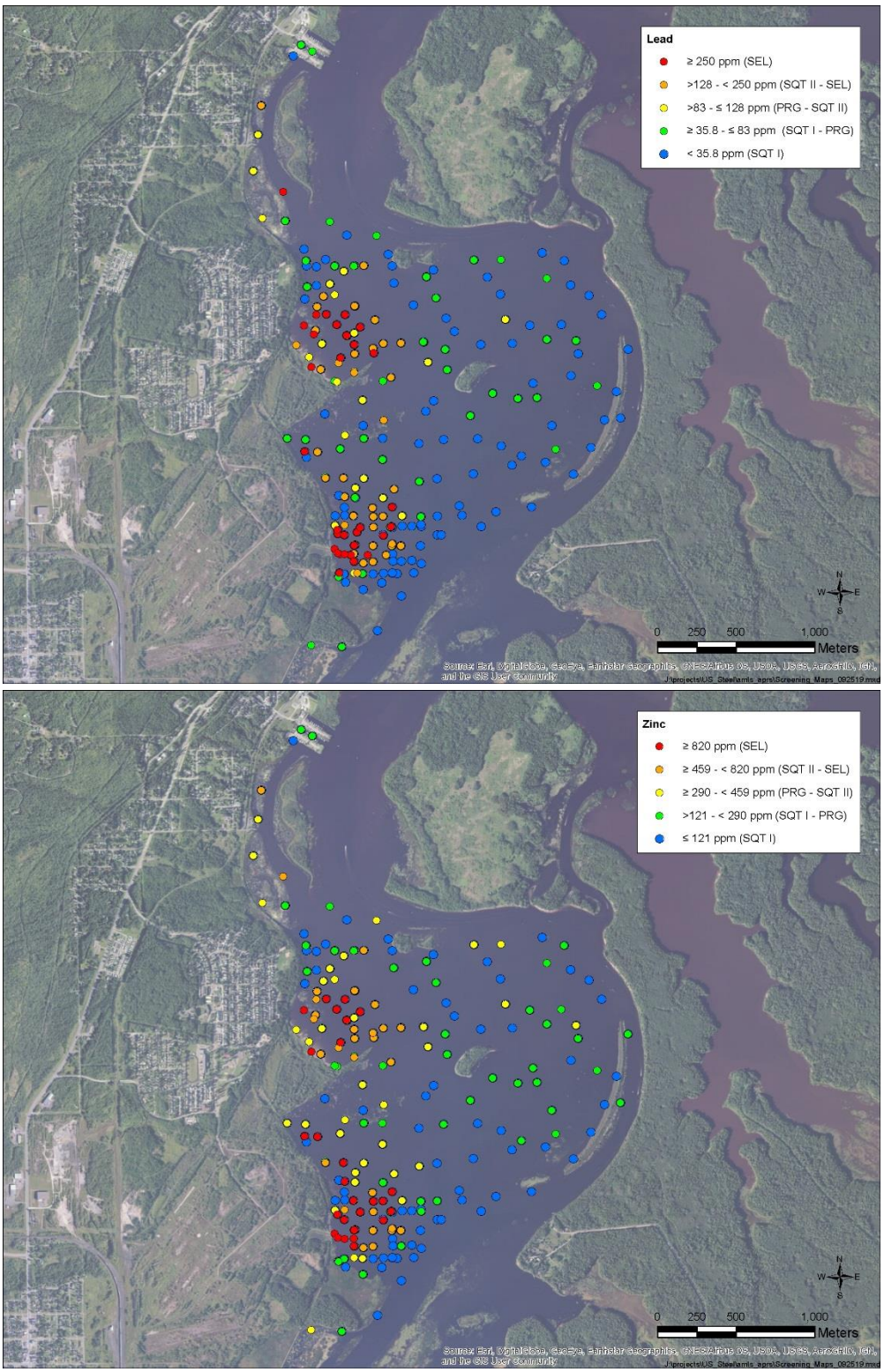
Figure 6. Sediment PAH concentrations in the St. Louis River. For locations that have been sampled multiple times and at multiple depths, the maximum concentration is shown. The "Sum PAHs" is the sum of 13 PAHs[a] to allow comparison to MPCA's SQTs.



a. PAH13 includes the following PAH compounds: acenaphthene, acenaphthylene, anthracene, fluorine, 2-methylnaphthalene, naphthalene, phenanthrene, benz(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, and pyrene.

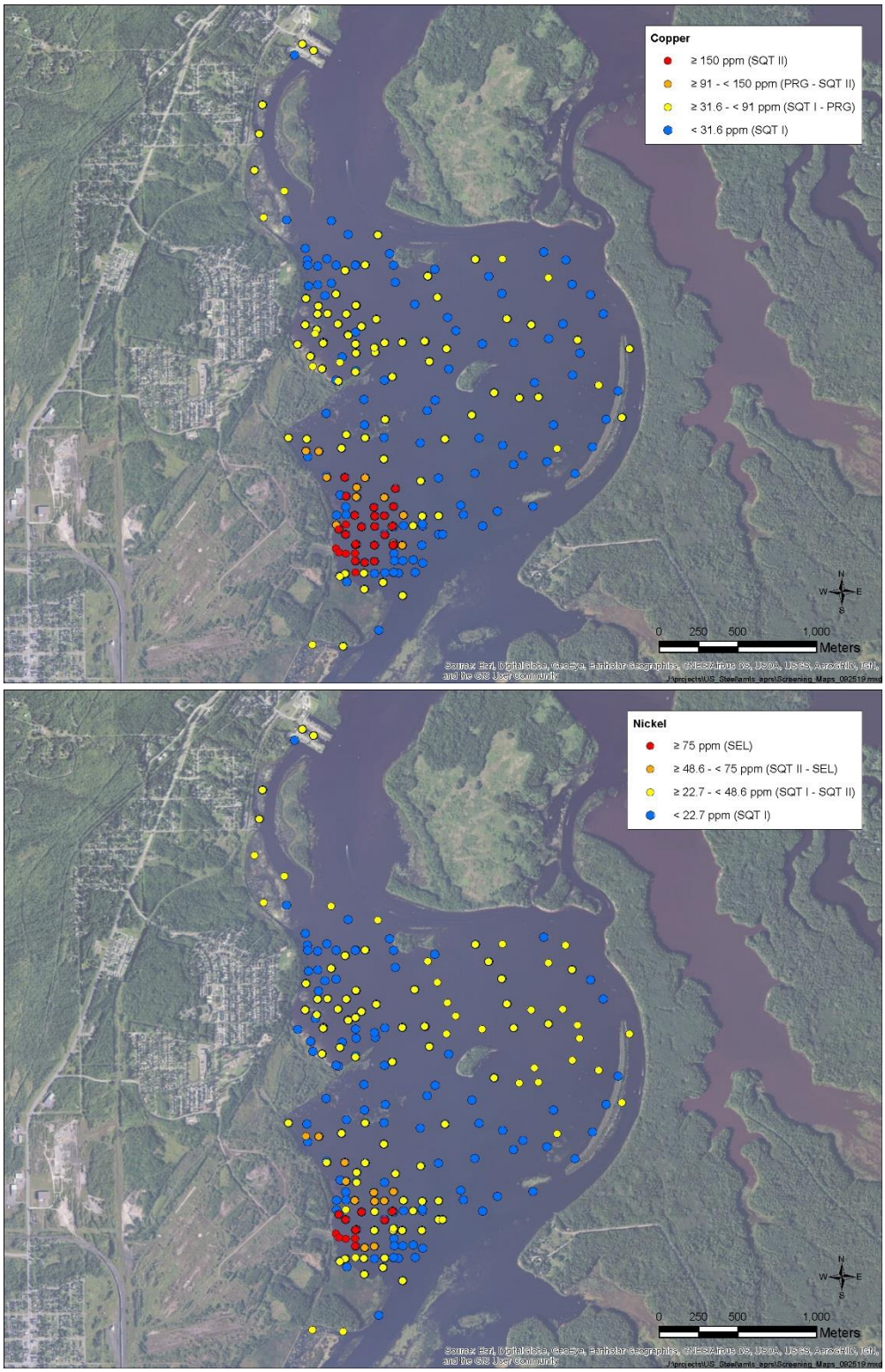
Data source: NOAA, 2018.

Figure 7. Sediment lead (panel A) and zinc (panel B) concentrations in the St. Louis River. For locations that have been sampled multiple times and at multiple depths, the maximum concentration is shown.



Data source: NOAA, 2018.

Figure 8. Sediment copper (panel A) and nickel (panel B) concentrations in the St. Louis River. For locations that have been sampled multiple times and at multiple depths, the maximum concentration is shown.



Data source: NOAA, 2018.

PAHs

PAH concentrations in sediment were compared to the Minnesota SQT I and II values, and the U.S. Steel Site PRG values (Table 3). These levels represent PAH concentrations above which adverse effects to sediment-dwelling organisms may occur. The SQT and PRG values are based on a PAH13 summation; therefore, the Trustees calculated PAH13 totals from the DIVER data using the same 13 PAH compounds, as identified by Crane and Hennes (2007), for this analysis. While this analysis is confined to the 13 PAHs, additional PAH compounds are known to be present in the aquatic areas on the Site; thus, a more severe exposure likely exists and could be evaluated by the Trustees in the future, using toxicity benchmarks that incorporate more PAHs. As shown in Figure 6, sediment concentrations in much of the St. Louis River adjacent to the Site are above these effects levels, indicating that sediment is exposed to PAH levels above which adverse effects to biological resources are expected to occur.

Table 3. Hazardous substance effects levels used in the analysis of Site sediment data

Hazardous substance	Effect levels	Value(s)	Source
PAHs	Level I SQT (PAH13)	1.61 ppm	Crane and Hennes, 2007
	PRG (PAH13)	12.3 ppm	Barr Engineering and AECOM, 2015a
	Level II SQT (PAH 13)	22.8 ppm	Crane and Hennes, 2007
Lead	Level I SQT	35.8 ppm	Crane and Hennes, 2007
	PRG	83.0 ppm	Barr Engineering and AECOM, 2015a
	Level II SQT	128.0 ppm	Crane and Hennes, 2007
	SEL	250.0 ppm	Persaud et al., 1993
Zinc	Level I SQT	121.0 ppm	Crane and Hennes, 2007
	PRG	290.0 ppm	Barr Engineering and AECOM, 2015a
	Level II SQT	460.0 ppm	Crane and Hennes, 2007
	SEL	820.0 ppm	Persaud et al., 1993
Copper	Level I SQT	31.6 ppm	Crane and Hennes, 2007
	PRG	91.0 ppm	Barr Engineering and AECOM, 2015a
	Level II SQT	150.0 ppm	Crane and Hennes, 2007
Nickel	Level I SQT	23.0 ppm	Crane and Hennes, 2007
	Level II SQT	49.0 ppm	Crane and Hennes, 2007
	SEL	75.0 ppm	Persaud et al., 1993

Metals/Metalloids

Lead: Lead concentrations were compared to Minnesota SQT I and II values, the U.S. Steel Site PRG, and the SEL value developed by Persaud et al. (1993; Table 3). As shown in Figure 7, multiple sampling locations within the two deltas in the St. Louis River adjacent to the Site are elevated above some or all of these values, indicating that sediment is exposed to lead concentrations above levels at which adverse effects to sediment-dwelling organisms are likely to occur.

Zinc: Zinc concentrations were compared to Minnesota SQT I and II values, the U.S. Steel Site PRG, and the SEL value developed by Persaud et al. (1993) (Table 3). As shown in Figure 7, multiple sampling locations within the two deltas in the St. Louis River adjacent to the Site are elevated above some or all of these values, indicating that sediment is exposed to zinc concentrations above levels at which adverse effects to sediment-dwelling organisms are likely to occur.

Copper: Copper concentrations were compared to Minnesota SQT I and II values and the U.S. Steel Site PRG (Table 3). As shown in Figure 8, multiple sampling locations within the two deltas in the St. Louis River adjacent to the Site are elevated above some or all of these values, indicating that sediment is exposed to copper concentrations above levels at which adverse effects to sediment-dwelling organisms are likely to occur.

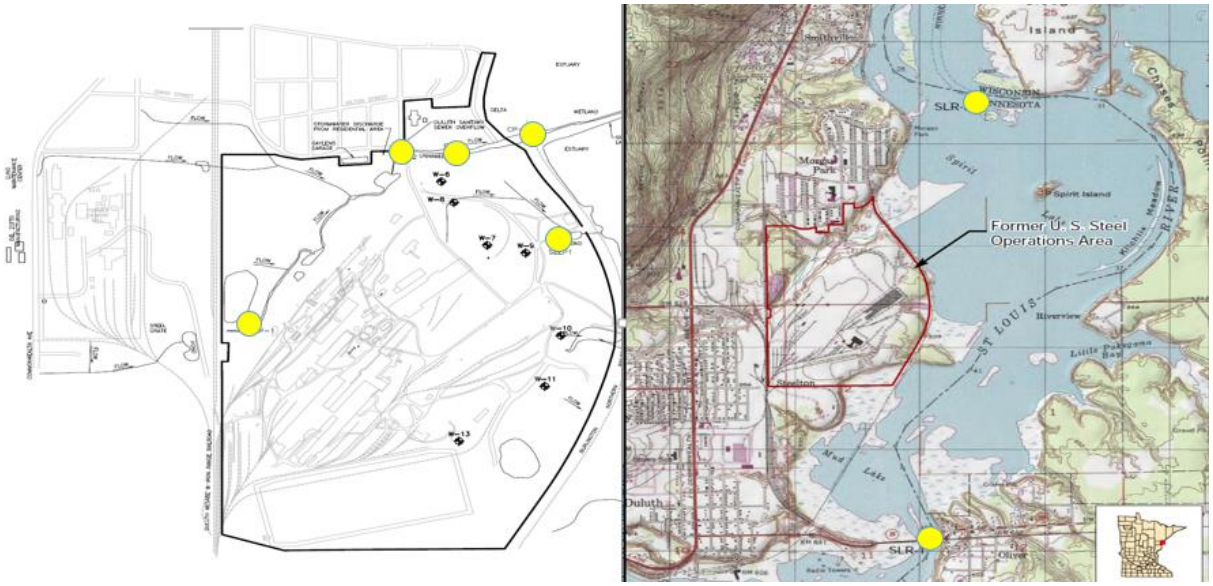
Nickel: Nickel concentrations were compared to Minnesota SQT I and II values and a SEL value developed by Persaud et al. (1993; Table 3). As shown in Figure 8, multiple sampling locations within the two deltas in the St. Louis River adjacent to the Site are elevated above some or all of these values, indicating that sediment is exposed to nickel concentrations above levels at which adverse effects to sediment-dwelling organisms are likely to occur.

Other hazardous substances, including mercury and arsenic, followed similar spatial patterns and also exceeded the respective values summarized in Table 3.

Surface Water Exposure

As noted above, surface water quality data have not yet been compiled into a database for the purposes of NRDA activities. As such, the Trustees' review of surface water data was focused on surface water monitoring results presented in the annual and five-year monitoring reports completed for the U.S. Steel Site. Routine water quality monitoring stations have been established at the Site; four in the Unnamed Creek, two in the St Louis River (one upstream and one downstream of the Site), and at a seep near the Wire Mill pond (Figure 9). For this PAS, the Trustees focused on data provided in the 2016 Annual Monitoring and Inspection Report, which summarized data collected between 1993 and 2015 (AECOM, 2016). Table 4 summarizes the maximum cadmium, copper, lead, and zinc concentrations measured during this time period. These concentrations are elevated compared to results reported for the sampling station upstream of the Site on the St Louis River. These results provide confirmation that surface water is exposed to hazardous substances released from the Site.

Figure 9. Routine water quality monitoring stations depicted in yellow; four in Unnamed Creek (left), one at a seep near Wire Mill Pond (left), and two in the St Louis River (right).



Source: Modified from AECOM (2016, Figures 1 and 2).

Table 4. Maximum concentrations measured at monitoring stations at the Site and at the station in the St. Louis River upstream of the Site between 1993 and 2015

Metal	St Louis River upstream measured result (µg/L)	Maximum measured result at Site (µg/L)
Cadmium	Not detected	1
Copper	7	20
Lead	2.9	91
Zinc	22	203

Additional surface water quality data are provided below in Section 3.2.2, from the perspective of concentrations of hazardous substances in surface water sufficient to expose and cause adverse effects to aquatic life, including fish.

3.2.2. Aquatic Biota

Aquatic biological resources have likely been exposed to the elevated levels of hazardous substances in sediment and surface water described above. These include benthic invertebrates (BI), fish, aquatic plants, birds, and mammals. The following sections focus on confirming exposure to BI and fish. In future NRDA activities, the Trustees may also evaluate exposure of aquatic plants, migratory and resident birds, and mammals and their supporting habitats to hazardous substances.

Benthic Invertebrate Exposure

Benthic invertebrates are encompassed by the definition of biological resources under DOI regulations: "those natural resources referred to in section 101(16) of CERCLA as fish and wildlife and other biota. … Other biota encompass shellfish … and other living organisms not otherwise listed in this definition" [43 CFR § 11.14(f)]. More specifically, BI are small aquatic animals including the aquatic larval stages of insects, snails, worms, and beetles, which do not have a backbone, are visible without the aid of a microscope, and are found in and around waterbodies during some period of their lives. BIs are commonly found burrowed into bottom sand and sediment; or attached to rocks, vegetation, and logs (U.S. EPA, 2018c).

Given that many BI taxa live part or all of their lifecycle in or on aquatic sediment (U.S. EPA, 2018c), they can be exposed to hazardous substances present in sediment through direct contact and by ingesting sediment during feeding. Section 3.2.1 established that Site sediment contains elevated levels of hazardous substances, including PAHs, metals, and metalloids (see Figures 6–8). Thus, BIs living in St. Louis River sediment have likely been exposed to hazardous substances from the U.S. Steel Site through direct contact and ingesting contaminated sediment. Below we provide confirmation of BI exposure to hazardous substances based on sediment and community data.

Benthic Invertebrate Exposure: Sediment Data

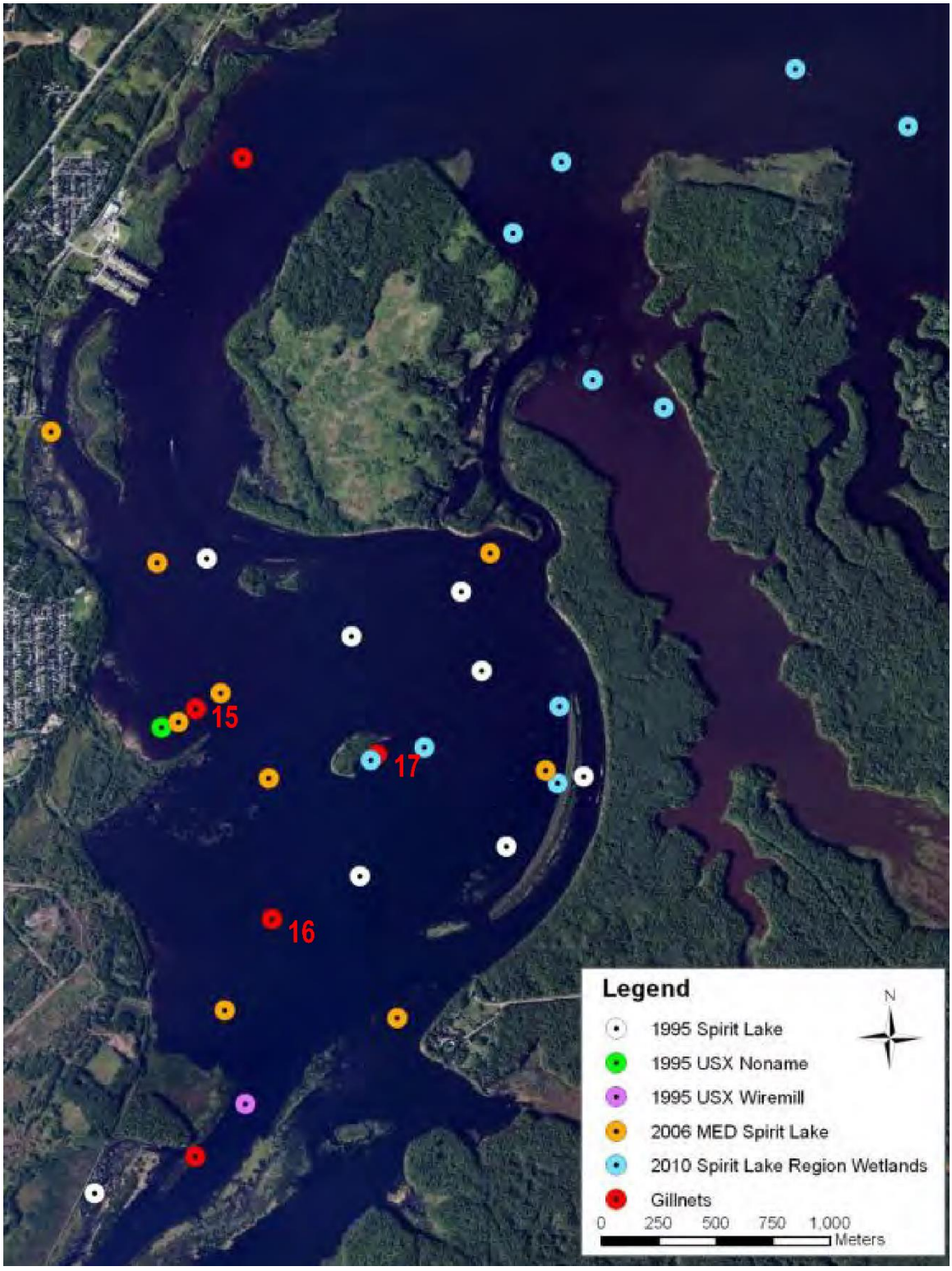
As described above in Section 3.2.1, the Trustees compared concentrations of PAHs and metals in the sediment found at the U.S. Steel Site to sediment adverse effects levels for PAHs and metals reported in the literature, and set by MPCA, the state regulatory agency. The Trustees found that concentrations of PAHs, lead, zinc, arsenic, cadmium, copper, mercury, and nickel in the St. Louis River exceeded multiple effects levels, including MPCA SQTs, the U.S. Steel Site PRGs, as well as literature-based SELs (see Figures 6–8). Concentrations of PAHs, lead, zinc, and nickel were particularly elevated, with many samples exceeding even the highest threshold; the SELs reported by Persaud et al. (1993). Hazardous substance concentrations in sediment above these thresholds and effects levels confirms that BIs are exposed to hazardous substances.

Benthic Invertebrate Exposure: Community Data

The Trustees reviewed data from BI surveys conducted by the University of Minnesota, Duluth, Natural Resources Research Institute (NRRI) in 2005 and 2010, as reported in LimnoTech (2012). During these surveys, NRRI sampled BIs using a ponar grab method in the Unnamed Creek and Wire Mill deltas; throughout the St. Louis River east of the U.S. Steel Site; and downstream of Spirit Island where the St. Louis River narrows and re-opens as it flows toward Lake Superior (Figure 10).

The reference site used for the study is within Spirit Lake, near Spirit Island (location 17 in Figure 10). While this area has lower concentrations of hazardous substances compared with the Unnamed Creek and Wire Mill Delta areas (see Figures 6–8, Section 3.2.1), it may not be a suitable reference, given its relatively close proximity to the U.S. Steel Site and Spirit Lake. Despite this concern, large differences were observed between this "reference" and Unnamed Delta and Wire Mill Delta BI communities.

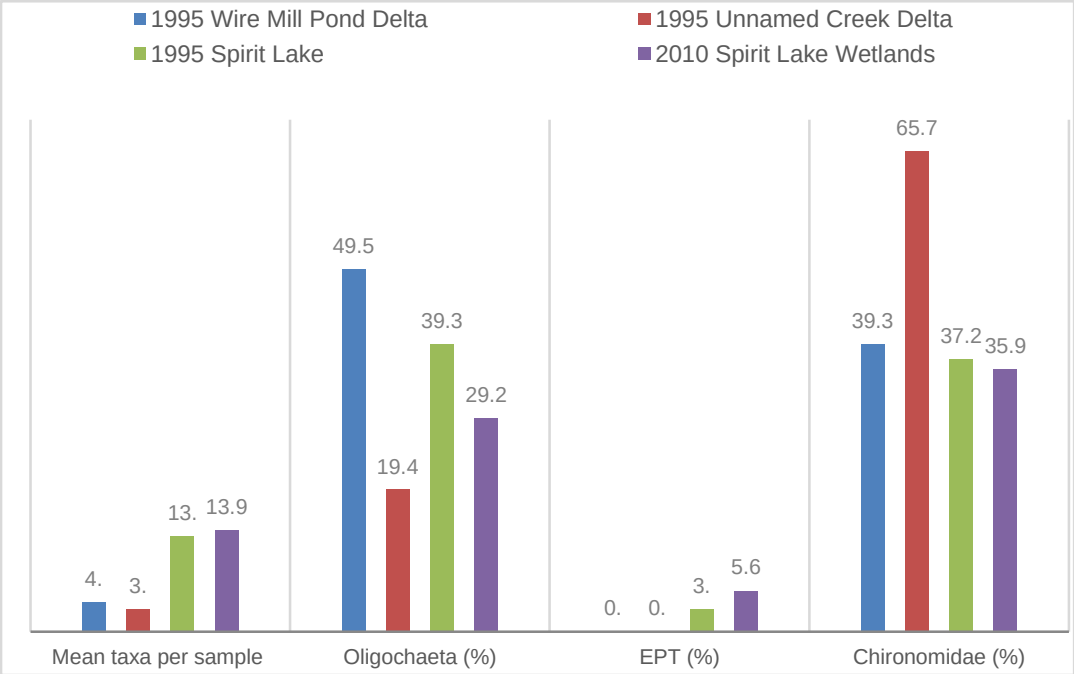
Figure 10. BI sampling locations. The Trustees included locations in green (Unnamed Creek Delta), purple (Wire Mill Pond), white (Spirit Lake), and blue (Spirit Lake wetlands) in their analysis.



Source: Limnotech, 2012.

The results from the 2005 and 2010 surveys indicate that contamination from the U.S. Steel Site may have negative impacts on BI communities (Figure 10). There were fewer taxa at the sampling locations in the Unnamed Creek Delta and in the Wire Mill Pond Delta compared to samples collected farther out in Spirit Lake, at the reference location adjacent to Spirit Island, and in the Spirit Lake wetlands (blue dots downstream of Spirit Lake shown in Figure 10). Taxa that are sensitive to pollution [i.e., *Ephemeroptera*, *Plecoptera*, and *Trichoptera* (EPT)] were absent from the sampling locations in the Unnamed Creek Delta and in the Wire Mill Pond Delta (Figure 11). The sampling location in the Wire Mill Pond Delta had an abundance of *Oligochaeta* and the sampling location in the Unnamed Creek Delta had an abundance of *Chironomidae*, taxa that are highly tolerant to pollutants (Figure 11). The results of the community data surveys suggest that BIs may have been harmed as a result of exposure to hazardous substances in Spirit Lake.

Figure 11. Number of benthic invertebrates sampled by NRRI in 1995 and 2010.



Source: Modified from LimnoTech, 2012.

Fish Exposure

The St. Louis River Estuary is home to ecologically important potamodromous and resident fish species, including, but not limited to:

- Walleye
- Lake sturgeon
- Muskellunge
- White sucker
- Black crappie
- Channel catfish
- Northern pike.

Fish are specifically named as biological resources in DOI regulations [43 CFR § 11.14(f)]. As aquatic organisms, fish can be exposed to hazardous substances present in surface water and sediment. To evaluate the exposure of fish to hazardous substances at the Site, the Trustees compared surface water and sediment concentrations to adverse effects levels reported in the literature and to criteria set by MPCA.

Fish Exposure: Surface Water

The Trustees compared surface water concentrations of cadmium, copper, lead, and zinc measured in surface water locations in the Site for which data were available to Aquatic Life Criteria that are designed to be protective of aquatic organisms and their uses (Stephen et al., 1985). More specifically, we compared Site data to acute Criterion Maximum Concentrations (CMCs) developed for cadmium, copper, lead, and zinc. The acute CMCs for all four metals are based on the hardness of the exposure water (U.S. EPA, 1996; Minnesota Administrative Rule Part 7050.0222). Therefore, exceedances of CMCs are evaluated using the measured hardness of the surface water in question. In general, the toxicity of these metals to aquatic organisms decreases as water hardness increases. We compared surface water data from the Site to CMCs for metals adjusted using average water hardness values representative of the surface water hardness at the U.S. Steel Site in the St. Louis River and Unnamed Creek (68 mg/L calcium carbonate and 207 mg/L calcium carbonate, respectively; AECOM, 2016). Further, CMC values are based on dissolved metals concentrations, while the listed U.S. Steel Site surface water values are reported as total metals by AECOM (2016); thus, this is a preliminary evaluation and the Trustees may complete additional evaluations in future to confirm these findings. Using this approach we found that copper, lead, and zinc concentrations in surface water samples from the U.S. Steel Site creeks and adjacent St. Louis River exceeded the acute CMCs (hardness 68 mg/L; Table 5), confirming that fish are likely exposed to hazardous substance above levels that may cause adverse effects.

Table 5. Exceedances of total metals in surface water

Metal	Acute CMC[a] (µg/L; hardness 68 mg/L)	Acute CMC[a] (µg/L; hardness 207 mg/L)	Maximum measured result[a] (µg/L)
Cadmium	1.3	3.5	1
Copper	9.3	27	20
Lead	42	141	91
Zinc	85	217	203

a. As noted in the text, CMC values are based on dissolved metals concentrations and listed U.S. Steel Site surface water values are total metals.

The Trustees also compared concentrations of cadmium, copper, and zinc measured in the Site to literature-based values shown to cause adverse effects to juvenile fish (Table 6). The maximum measured concentration of cadmium in the Site was 1 µg/L, which is above effect levels causing mortality and growth effects in fish (Table 6). Copper concentrations as low as 11.4–55 µg/L are reported in the literature to cause adverse effects in fish (Table 6). The maximum measured concentration of copper at the U.S. Steel Site was 20 µg/L, which is above effect levels that can

cause growth effects in fish. The maximum measured concentration of zinc at the U.S. Steel Site was 203 µg/L, which is above effect levels shown to cause mortality in fish (Table 6).

Table 6. Adverse effects in fish caused by cadmium, copper, and zinc in the surface water.
Effects concentrations reported are for juvenile life stages.

Hazardous substance	Maximum concentration measured at the Site 1993–2015 (µg/L)	Effect concentration (µg/L)	Water hardness (mg/L)	Response	Species	Data source
Cadmium	1	0.35	20	LC50	Cutthroat trout	EVS, 1996
		0.79	30	Reduced mortality, total length, and weight	Bull trout	Hansen et al., 1999
		0.84	20	LC50	Rainbow trout	EVS, 1997
		0.90–0.95	30	LC50	Bull trout	Hansen et al., 1999
		2.18	90	LC50	Rainbow trout	Hansen et al., 1999
		5.01	90	LC50	Bull trout	Hansen et al., 1999
Copper	20	11.4	110	IC 50 biomass	Fathead minnow	Besser et al., 2001
		17	180	IC 50 growth	Brook trout	Besser et al., 2001
		17	180	IC 50 biomass	Brook trout	Besser et al., 2001
		29	180	LC50	Brook trout	Besser et al., 2001
		35	110	LC50	Fathead minnow	Besser et al., 2001
		55	110	IC 50 growth	Fathead minnow	Besser et al., 2001
Zinc	203	24.3–54.0	30	LC50	Rainbow trout	Hansen et al., 1999
		37.2–81.6	30	LC50	Bull trout	Hansen et al., 1999
		202–270	90	LC50	Rainbow trout	Hansen et al., 1999
		315–413	90	LC50	Bull trout	Hansen et al., 1999

LC = lethal concentration, IC = inhibitory concentration.

The Trustees also compared PAHs measured in surface water at the Site to site-specific evaluation criteria. As described above, the Trustees relied on data from routine water quality monitoring stations (AECOM, 2016). The Trustees found that concentrations of PAHs in the surface water exceeded site-specific post-removal performance criteria based upon MPCA derived performance limits (AECOM, 2016).

These data indicate that potamodromous and resident fish may be exposed to hazardous substances above adverse effects levels in surface water.

Fish Exposure: Sediment

The Trustees compared concentrations of PAHs in the Site sediment, reported in the DIVER database, to literature-based values that were shown to cause adverse effects to fish. The Trustees also compared the sediment concentrations to the PRG (12.3 mg/kg) developed for U.S. Steel Site cleanup (Barr Engineering and AECOM, 2015a). As reported in the literature, TPAH concentrations ranging from 0.28 to 39.8 mg/kg can cause adverse effects to fish (Table 7; Figure 12). These effects levels are based on the sum of 15 to 18 PAHs, depending on the study (Table 7). For the PAS, the Trustees focused on comparing the sum of 17 PAHs (TPAH17) measured in Site sediment samples to the adverse effects levels reported in the literature. There was a high level of overlap between the congeners included in the sum of 17 PAHs from the U.S. Steel Site and the congeners contributing to the literature-derived adverse effects levels (Table 7). For the 318 samples analyzed for TPAH17 in the DIVER dataset, the average concentration was 78 mg/kg TPAH17, and the values ranged from 0.01 to 1,894 mg/kg. More than half the samples exceeded effects levels known to cause adverse effects to fish, confirming that fish have likely been exposed to PAHs in sediment above levels expected to cause adverse effects.

Figure 12. A comparison of PAHs in sediment samples from the U.S. Steel Site to adverse effect levels. In addition to the effect levels listed in this figure, samples also exceeded Level I SQT (1.61 ppm PAH 13) and Level II SQT (22.8 ppm PAH 13) values.

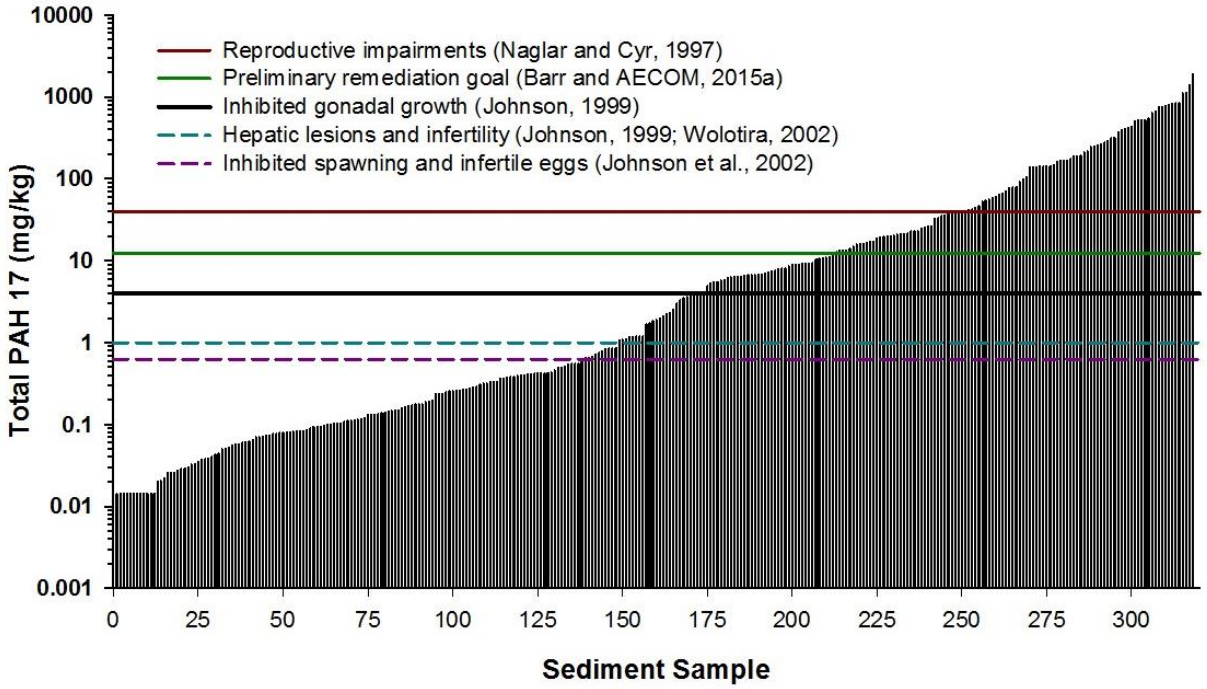


Table 7. Adverse effects in fish caused by PAHS in the sediment

Concentration (mg/kg TPAH)	PAHs in TPAH	Response	Species	Data source
0.28	18	Deoxyribonucleic acid (DNA) damage	English sole	Johnson et al., 2002
0.63	18	Inhibited spawning and infertile eggs	English sole	Johnson et al., 2002
1	16	Hepatic lesions and infertility	English sole	Johnson, 1999; Wolotira, 2002
4	18	Inhibited gonadal growth	English sole	Johnson et al., 2002
39.8	15	Reproductive impairments	European flounder	Naglar and Cyr, 1997

3.2.3. Groundwater

This section presents information about groundwater exposure to hazardous substances. Groundwater is defined in DOI regulations as "water in a saturated zone or stratum beneath the surface of land or water and the rocks or sediment through which ground water moves. It includes ground water resources that meet the definition of drinking water supplies" [43 CFR § 11.14(t)]. Figure 13 shows groundwater elevation contours at the Site. Groundwater flows perpendicular to this contours, generally toward the St Louis River, and toward the Unnamed Creek in the northern part of the Site.

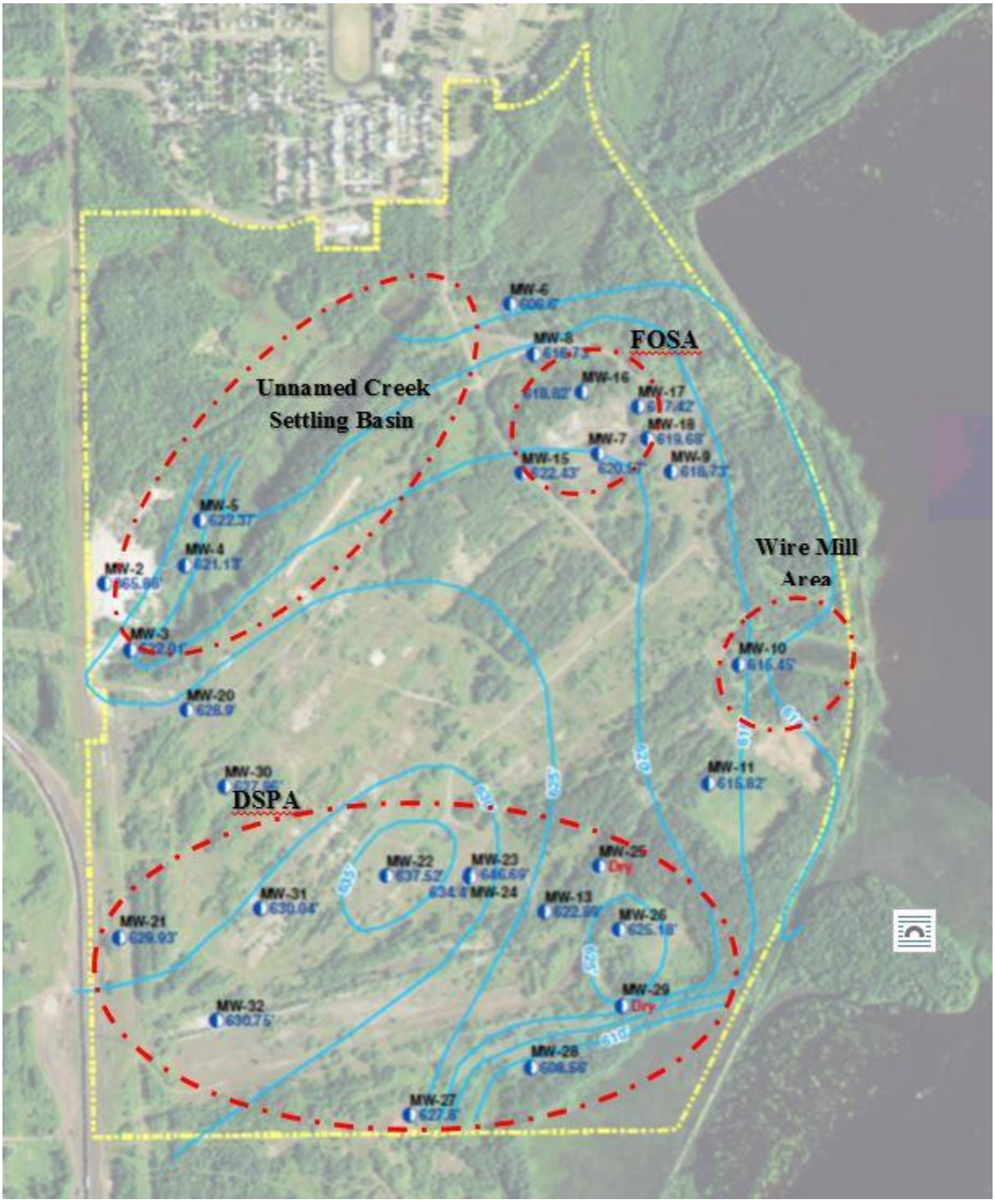
The Trustees are currently identifying data sources and compiling available data for the U.S. Steel Site, but do not yet have groundwater physical parameter or groundwater chemistry databases for the Site. As such, the Trustees reviewed existing reports and documents, mainly generated as a part of the Superfund Site RI/FS process, in preparing the PAS.

The Trustees' review of relevant U.S. Steel Site documents has confirmed that groundwater is exposed to hazardous substances that have been released from multiple sources at the U.S. Steel Site. Below we provide illustrative examples of this exposure.

Unnamed Creek Settling Basin area: U.S. Steel's contractor, Barr Engineering, performed RIs in this area in 1985 (Barr Engineering, 1986). Two temporary wells were installed in the Unnamed Creek Settling Basin, one at the upper, eastern end; and the other at the lower, western end (closer to the delta). Samples were collected and analyzed for PAHs. PAH concentrations were very elevated, with the upper well containing 4,000 µg/L PAH, and the lower well containing 4,600 µg/L PAH (Barr Engineering, 1986). Metals were not reported for these two locations in the RI report (Barr Engineering, 1986). Phenol (4,046 µg/L), M-Cresol (29 µg/L), and P-Cresol (12 µg/L) were also detected. In further characterization of the Unnamed Creek Settling Basin area, U.S. Steel's contractor Geraghty & Miller installed additional wells in the Unnamed Creek Settling Basin in the early 1990s, and also reported elevated PAH concentrations ranging from 66 to 420 µg/L PAH (Geraghty & Miller, 1995). These results confirm that groundwater in the area of the Unnamed Creek Settling Basin were exposed to hazardous substances released from U.S. Steel operations.

Wire Mill area: Groundwater sampling in the Wire Mill area during the original RI found elevated levels of metals, including zinc, nickel, and magnesium, though groundwater standards were not exceeded (Barr Engineering, 1986). Since 2008, the only hazardous substance to exceed a standard in the Wire Mill area routine monitoring wells is zinc (AECOM, 2016).

Figure 13. Unnamed Creek Settling Basin area. Groundwater elevation at routine monitoring wells and groundwater table elevation contours. Groundwater flow direction is perpendicular to, and from higher to lower elevations. The red circles show approximate areas of known groundwater contamination within the Site.



Source: AECOM, 2016.

FOSA: Sampling in the FOSA has shown that soil and shallow groundwater are contaminated with free fuel oil product within a 3.7-acre area in the vicinity of where these ground storage tanks were formerly located. Sampling downgradient of this area has shown that shallow groundwater is contaminated with arsenic, cadmium, chromium, copper, lead, nickel, and zinc above State and/or U.S. EPA groundwater standards, as total metals concentrations. Arsenic, chromium, lead, and cadmium also exceeded groundwater standards, for both total and dissolved concentrations. PAHs were mostly not detected, or when detected, were less than 0.2 µg/L. Sampling at groundwater monitoring wells completed in the deeper underlying sand aquifer (separated from the contaminated surficial fill by the clay layer) did not show exceedances of groundwater standards for metals or PAHs, with the exception of arsenic and lead, as total metals concentrations. Sampling of the deep aquifer also showed that benzene, toluene, ethylbenzene and xylene (BTEX); naphthalene; and gasoline range organics were mostly below detection at these wells. Hence, the shallow groundwater in the FOSA is exposed to fuel oil free product. The fuel oil appears to be relatively immobile, with limited downward migration, and with limited detection of dissolved phase downgradient of the free product. Shallow groundwater downgradient of the FOSA is contaminated with elevated levels of metals, including arsenic, cadmium, chromium, copper, lead, nickel, and zinc. There is no evidence that the contamination has reached the deeper aquifer, which is separated from the fill by a clay layer.

DSPA: U.S. Steel and the DSPA have entered into a purchase agreement for the transfer of a 132-acre property in the southern portion of the historical U.S. Steel operations area. As a part of this property transfer, a Phase II Investigation Comprehensive Report was prepared in 2012 (URS, 2012). As a part of the investigation, groundwater beneath this part of the Site was characterized, revealing elevated concentrations of multiple hazardous substances. For example, under historical shop buildings (now dismantled) in this area, elevated total petroleum hydrocarbons (1,500 mg/L) and diesel range organics (1,300 mg/L) were measured in groundwater. At the topographic plateau south of the former materials storage area, there were exceedances of groundwater standards for trichloroethylene (330 µg/L) and methylene chloride (12 µg/L); and south of the materials storage area, there were exceedances of groundwater standards for arsenic (14 µg/L) and lead (20 µg/L).

These are illustrative examples of groundwater exposure at the Site. Additional studies have been completed that the Trustees may evaluate in the future, such as, for example, additional investigations into petroleum groundwater contamination outside the FOSA (USS, 2014).

3.2.4. Terrestrial Natural Resources

This section presents information about the exposure of terrestrial natural resources to hazardous substances at the site, including soil and biota. Soil is defined in the DOI NRDA regulations as a geologic resource, which includes "... those elements of the Earth's crust such as soil, sediment, rocks, and minerals, including petroleum and natural gas, that are not included in the definitions of ground and surface water resources" [43 CFR § 11.14(s)].Terrestrial biological resources are "… terrestrial species; game, nongame, and commercial species; and threatened, endangered, and State-sensitive species" [43 CFR § 11.14(f)].

Soil concentration data reported in URS (2012) for the parcel of land located in the southern portion of the Site terrestrial area (DSPA 132-acre target property identified in Figure 14) are elevated in multiple hazardous substances, confirming that the soil in this area is exposed. The Trustees qualitatively evaluated and compared hazardous substance concentrations in soil collected in the DSPA land parcel reported by URS (2012) to U.S. EPA's Ecological Soil Screening Levels (EcoSSLs; U.S. EPA, 2018b) and to the Industrial Soil Reference Values (ISRVs) reported by URS (2012). Metals (arsenic, cadmium, copper, nickel, lead, and zinc) and total PAH concentrations measured in soil exceed U.S. EPA's EcoSSLs and the ISRVs for multiple endpoints at multiple locations throughout the U.S. Steel Site. The soil screening levels are intended to be protective of plants, soil invertebrates, birds, and mammals. There was also a cement plant on the Site that may have released hazardous substances to the Site soil and surface water. While the cement plant is not addressed further in this PAS, the Trustees may do so as a part of future NRDA activities.

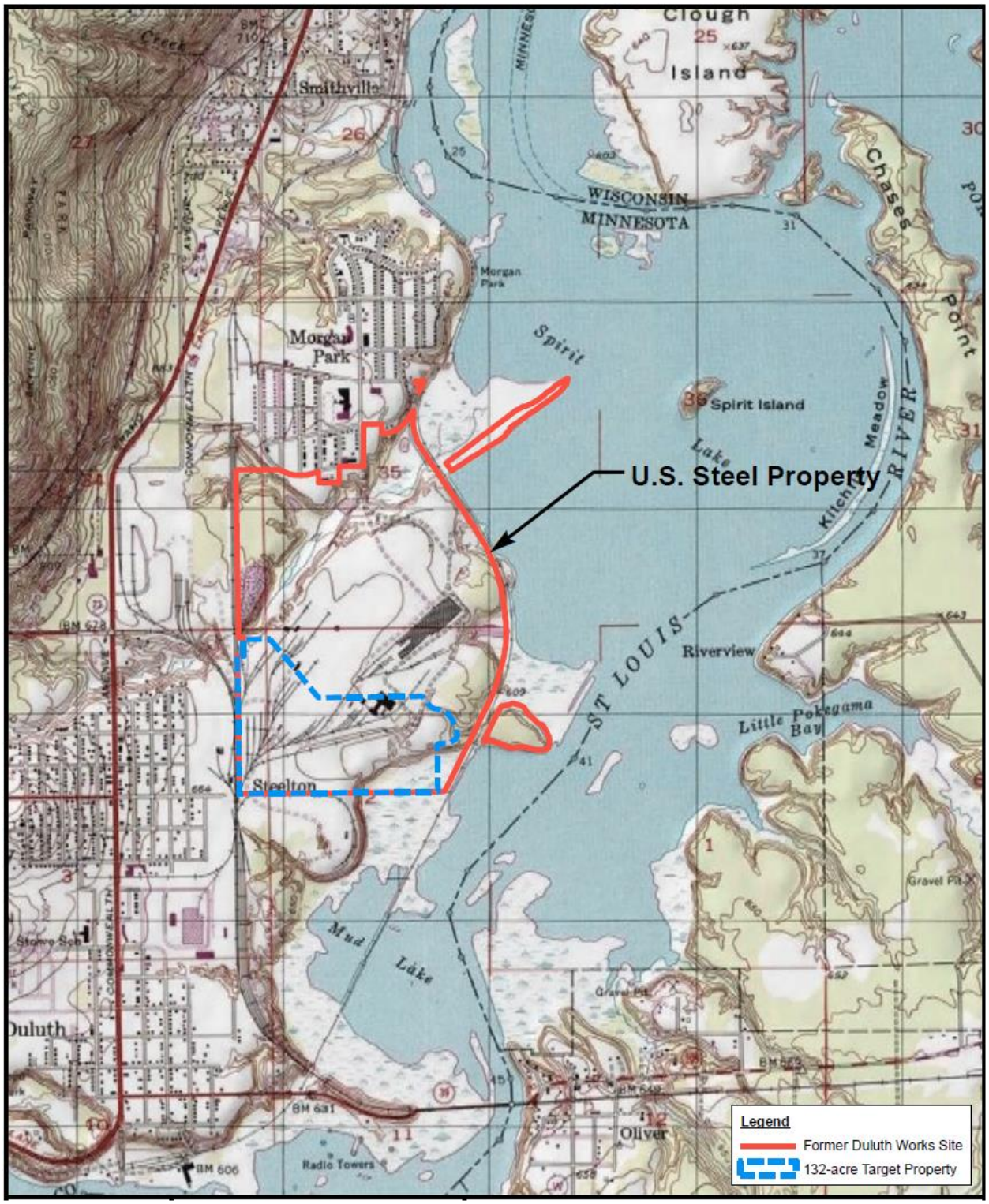
The Trustees are not aware of any biological tissue or other samples that directly confirm terrestrial biota exposure to hazardous substances at the U.S. Steel Site. However, it is reasonable to assume that terrestrial biota have likely been exposed to hazardous substances present in soil within the Site. Terrestrial biota, including plants, birds, mammals, and amphibians, can be exposed to hazardous substances in soil through direct contact, incidental ingestion, uptake (plants), and through the food chain by consuming other biota (e.g., soil macroinvertebrates, prey) that have also been exposed to hazardous substances. Further, many biota rely on surface water for drinking or bathing, and may have also contacted hazardous substances present in surface water and sediment at the U.S. Steel Site. The Trustees have anecdotal evidence, including wildlife sightings (e.g., bear dens present in areas with tar contamination and wildlife footprints in areas with visible tar product) that terrestrial biota use the Site and are likely exposed to hazardous substances as a result (e.g., Figure 15).

To further confirm the exposure of terrestrial biota to hazardous substances, the Trustees reviewed results of the Ecological Risk Assessment (ERA) completed for the U.S. Steel Site, as presented in Barr Engineering and AECOM (2015a). Based on comparison to adverse effects levels, the ERA found adverse effects to terrestrial plants, soil invertebrates, invertivorous birds, and mammals. Plants and invertebrates had reduced viability and function due to exposure to PAHs, lead, and zinc. Invertivorous birds and mammals had reduced survival, growth, and reproduction due to exposure to PAHs, lead, and zinc (Barr Engineering and AECOM, 2015a). The ERA found a low potential for risk to herbivorous birds and carnivorous vertebrates exposed to soil and aquatic open areas (Barr Engineering and AECOM, 2015a). These results indicate that some terrestrial biota are exposed to hazardous substances released at the U.S. Steel Site at levels that are sufficiently elevated to cause adverse effects.

3.2.5. Human Services

Natural resource services are "the physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource" [43 CFR § 11.14(a,nn)]. Human services can include use services, such as recreational services; and non-use or passive use services, including existence value (the value of knowing the resource persists), option value (the option to use the resource in the future), and bequest value (the ability to pass along uncontaminated natural resources to future generations). Tribal and recreational services have been affected by the release of hazardous substances at the U.S. Steel Site.

Figure 14. U.S. Steel Site location outlining the 132-acre target property intended for sale to DSPA.



Source: URS, 2012, Figure 1.

Figure 15. Wildlife footprints visible in tar-contaminated sediment in the Site. Photograph taken in 2007.

Source: Photograph provided by MPCA.

Tribal Services

As noted above, Native Americans have had a presence in the area encompassing the Site for multiple generations (Mulholland and Mulholland, 2013). Spirit Lake and Spirit Island in particular are central to the Anishinaabe (Ojibway) migration story. Spirit Island is the sixth stopping point on the Ojibwa migration from the East Coast, and is a culturally significant location where ceremonies and other traditions are practiced to this day. It was near Spirit Island where the Ojibwa encountered wild rice ("food that grows on water"), marking the end of their journey (Mulholland and Mulholland, 2013).

Tribal services provided by natural resources in the area encompassing the Site include hunting fishing and gathering, and, as noted above, the LaPointe Treaty, signed in 1854, retained these practices as formal rights for Tribes in the area called the 1854 Ceded Territory. The Bois Forte, Fond du Lac, and Grand Portage bands exercise treaty rights in this ceded territory, and the Fond du Lac Band owns Spirit Island and adjacent areas within Spirit Lake (Figure 1).

The Tribes report that both use and non-use services have been diminished within the Site as a result of released hazardous substances. Key concerns of the Tribes include that natural resources

at the Site are contaminated with hazardous substances and have been injured, and are thus less able to provide ecological and human services, including a loss of provisioning of healthy resources. In addition, natural resources at the Site, including fish, wildlife, plants, and Spirit Island in particular, have cultural importance to the Tribes due to the very nature of their existence. Consequently, there are also passive use values that stem from the natural resources at the Site, including the value of knowing the resource persists (existence value), the option to use the resource in the future (option value), and the ability to pass along uncontaminated natural resources to future generations (bequest value). From a holistic perspective, all natural resources provide services to the Tribes, where uncontaminated natural resources support a healthy ecosystem and continuity of life.

Recreational Uses of Natural Resources

Recreational use data collected by the MDNR indicates that the area was used for angling, hiking trails, and for birding (LimnoTech, 2012). Additional recreational activities common at or near the U.S. Steel Site include boating and other shoreline use activities. Important gamefish for the lower St. Louis River include walleye, muskellunge, smallmouth bass, black crappie, lake sturgeon, and channel catfish. As a result of the contamination of natural resources, including sediment, surface water, soil, and biological resources, there may be reduced enjoyment when the public engages in recreational activities in the Site. Further, there are use restrictions in the area, including posted warnings that sediment is contaminated; and swimming, wading, boating, and fishing should be avoided in the area (Figure 16). Fish consumption advisories in the lower St. Louis River are in effect due to unsafe levels of PCBs and mercury in fish; while mercury is a contaminant of concern for the U.S. Steel Site, PCBs are not. The Trustees may decide to compile available information and data on recreational use at the Site as part of the next steps in the NRDA.

3.3. Potentially Affected Natural Resources and Services

The data presented above confirm that natural resources at the Site have been exposed to elevated concentrations of hazardous substances. Potentially affected natural resources include, but are not limited to:

- Surface water and sediment in the Unnamed Creek and Wire Mill, and their respective deltas
- Aquatic biota including benthic invertebrates, fish, and other aquatic biota
- Groundwater in aquifers underlying the Site
- Soil and terrestrial biota in upland areas where operations and disposal activities occurred.

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 [43 CFR § 11.14(nn)]. Potentially affected ecological services include the provision of uncontaminated aquatic and terrestrial habitats. 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.

Figure 16. Sign at the U.S. Steel Site warning the public that sediment is contaminated.

Source: MPCA, 2018d.

Natural resource services also include human uses of natural resources [43 CFR § 11.14(nn)]. Potentially affected human use of natural resources include both passive (e.g., existence or bequest values) and active uses such as hunting, gathering, ceremonial practices, and recreation and may include:

- Tribal uses of natural resources, which include treaty rights for hunting, fishing, gathering in the St. Louis River and surrounding areas; passive services including existence, option, and bequest values; and culturally important uses for ceremonies. Of particular note, Spirit Island is a culturally important location for Tribal members, particularly for ceremonial practices.
- Recreational uses of natural resources, including fishing and boating in the St. Louis River, and other activities such as bird watching and shoreline use.

4. 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, for which Federal or State agency or Indian tribe may assert Trusteeship under CERCLA, 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 to those natural resources
- 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:

- PAHs
- Arsenic
- Cadmium
- Copper
- Lead
- Mercury
- Nickel
- 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 surface water and sediment, soil, groundwater, and other resources have resulted from releases at the Site (Figures 6, 7, and 8). 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

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, surface water and sediment, biological resources, geologic resources, and groundwater resources. Elevated

concentrations of hazardous substances that were released from the Site have been found in surface water and sediment, groundwater, and geologic resources (soil). Further, these hazardous substances are present at concentrations sufficient to potentially cause injury, as described below 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, surface water and sediment, and biological resources.

4.3.1. Surface Water and Sediment

The DOI regulations include several definitions of injury to surface water resources (which include surface water and sediment), but for the purposes of this PAS, the Trustees focused on the following definition:

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

The elevated concentrations in sediment (see Section 3.2.1) and surface water (see Sections 3.2.1 and 3.2.2), which exceed multiple adverse effects levels for multiple hazardous substances, indicate that sediment and surface water may be injured at the Site, according to [43 CFR § 11.62(b)(1)(v)].

4.3.2. Aquatic Biota

The DOI NRDA regulations provide the following definition of injury to biological resources, including BIs and fish:

> An injury to a biological resource has resulted from the discharge of oil or release of a hazardous substance if concentration of the substance is sufficient to: …Cause the biological resource or its offspring to have undergone at least one of the following adverse changes in viability: death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations [43 CFR § 11.62(f,1,i)].

To evaluate potential injury to aquatic biota, including BIs and fish, the Trustees compared sediment concentrations measured in the St. Louis River adjacent to the Site to adverse effects levels/criteria, evaluated BI and fish community diversity and abundance data, and compared concentrations of hazardous substances in Site sediment and surface water to published toxicity effects thresholds for BI and fish.

Based on an evaluation of readily available data and information that is presented in Section 3.2.2 aquatic biota have likely been injured by the released hazardous substances at the U.S. Steel Site according to 43 CFR § 11.62(f,1,i).

4.3.3. 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 Safe Drinking Water Act (SDWA; U.S. EPA, 2018b). Hazardous substances released at the Site that exceed these criteria in groundwater include, but may not be limited to, PAHs, arsenic, cadmium, chromium, copper, lead, nickel, and zinc (see Section 3.2.3) Thus, groundwater that was potable prior to the release may be injured at the Site based on 43 CFR § 11.62(c)(1).

4.3.4. Terrestrial Resources

The DOI NRDA regulations provide the following definition of injury to biological resources:

> An injury to a biological resource has resulted from the discharge of oil or release of a hazardous substance if concentration of the substance is sufficient to: …Cause the biological resource or its offspring to have undergone at least one of the following adverse changes in viability: death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions in reproduction), or physical deformations [43 CFR § 11.62(f,1,i)].

To evaluate potential injury to terrestrial biota, including upland and riparian species, the Trustees evaluated the results of the ERA as presented in Barr Engineering and AECOM (2015); the ERA found some risk of adverse effects to terrestrial biota. This evaluation indicates that terrestrial biota could be injured due to hazardous substances at the Site (see Section 3.2.4).

4.3.5. Human Use Services

Human use services are "the physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource" [43 CFR § 11.14(a,nn)]. Human services can include use services, such as recreational services; and non-use or passive use services, including existence bequest and option values.

To evaluate potential injuries to human use services, we evaluated existing information about Tribal cultural practices and recreational activities. Information available, including from discussions with Tribal representatives and state resource managers, indicates that human use services have been reduced by the release of hazardous substances at the Site (see Section 3.2.5).

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 have been collected as part of remedial and ERA activities. Such data include information on hazardous

substance sources, releases, pathways, and concentrations in the environment. Additional data may be collected in the future as part of remedial and/or NRDA assessment activities.

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 completed to date have not sufficiently remedied natural resource injuries and future planned response activities will not sufficiently remedy injury to natural resources without further action. Past natural resource injuries have not been addressed, and ongoing actions at the Site are not expected to sufficiently address them in the future. 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. Response actions will not sufficiently remedy the injury. The response actions at the Site are directed toward control of the source and removal of contaminants. Injuries resulting from the releases of contaminants (prior to remediation), from the remedial actions themselves, and the residual injuries remaining after remediation is complete will not be restored by remedial actions undertaken or anticipated. Therefore, it has been determined by the Trustees that response actions carried out or currently planned will not remedy injuries to the natural resources of the Site without further action.

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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