Final Focused Feasibility Study Report

Milwaukee Bay Project Area, Milwaukee Estuary AOC
Milwaukee, Wisconsin

EPA GLAES II Contract
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Executive Summary

This Focused Feasibility Study (FFS) report develops and presents a recommended remedial alternative for the Milwaukee (MKE) Bay Project Area within the Milwaukee Estuary Area of Concern (AOC) in Milwaukee, Wisconsin. The U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office (GLNPO) and project partners (Wisconsin Department of Natural Resources [WDNR], Milwaukee County Parks, City of Milwaukee, Milwaukee Metropolitan Sewerage District, and We Energies) have selected Alternative 5 (focused dredging in South Slip Number 2 (#2), focused sand cover placement in portions of the Summerfest Lagoon Quiet Basin and the Northern Outer Harbor, and continued natural recovery in the Summerfest Lagoon, Southern Outer Harbor, and Northern Outer Harbor) as the recommended alternative to address contaminated sediment in the MKE Bay Project Area. Dredged sediment will be transported to and placed in a dredged material management facility to be constructed in MKE Bay adjacent to the existing confined disposal facility. The recommended alternative will achieve the site-specific remedial action objectives (RAOs) by reducing the mass, volume, and concentrations of contaminants of concern (COCs) in the MKE Bay Project Area sediments, reducing risks to human health and the environment from exposure to COCs in sediment, and maintaining depth requirements within the authorized Federal Navigation Channel (FNC) portion of the MKE Bay.

The purpose of the FFS process is to develop and evaluate remedial alternatives and support selection of a remedy that is protective of human health and the environment. The remedy will contribute to the eventual removal of beneficial use impairment (BUIs) and delisting of the Milwaukee Estuary AOC.

The FFS includes the following:

- A conceptual site model summarizing physical site characteristics, nature and extent of contamination, historical and ongoing sources of contamination, recontamination potential, and exposure pathways and receptors.
- Site-specific RAOs and development of remediation target areas.
- Identification and screening of remedial technologies.
- Description of remedial alternatives.
- Comparative analysis of the alternatives against seven evaluation criteria.
- Identification and rationale for a recommended remedial alternative.

The following site-specific RAOs for the MKE Bay Project Area include remedial goals to improve the portion of the AOC where the project is located, and support removing BUIs and delisting the AOC:

- Reduce the mass, volumes, and concentrations of COCs in the sediment. This will be achieved by addressing sediment with COCs exceeding the cleanup goals (CUGs), thereby reducing exposure and risk to ecological and human receptors. The remediation of contaminated sediment in the project area will make progress towards eliminating sediment-related BUIs.
- Reduce risks to human health and the environment from exposure to COCs in sediment. This will largely be accomplished by supporting the removal of BUIs through remediation of sediment with COC concentrations above the CUGs.
- Maintain depth requirements within the authorized FNC portion of the MKE Bay.

Representative remedial technologies were identified and screened. Remedial technologies that remained following screening were assembled into the five remedial alternatives summarized in Exhibit ES-1.

Exhibit ES-1. Conceptual Remedial Alternatives for the MKE Bay Project Area

Alternative	McKinley Marina, Summerfest Lagoon, South Slip #2 Subareas	Northern and Southern Outer Harbor Subareas
1	No Action	No Action
2	Dredge sediment with COC concentrations exceeding PECs for PAHs or metals or exceeding 1 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding PECs for PAHs or metals or 1 mg/kg PCBs
3	Dredge sediment with COC concentrations exceeding 3 times the PEC values for PAHs or metals or 1 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs
4	Dredge sediment with COC concentrations exceeding 3 times PECs for PAHs or metals or 3 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding 3 times PECs for PAHs or metals or 3 mg/kg PCBs
5	Focused dredging in South Slip #2 Focused sand cover in Summerfest Lagoon Quiet Basin for areas with COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs Continued natural recovery outside focused dredging and sand cover areas where COC concentrations are already below screening levels in surface sediment and are above screening levels in subsurface sediment	Focused sand cover in Northern Outer Harbor for areas with surface sediment COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs Continued natural recovery outside focused sand cover areas where COC concentrations are already below screening levels in surface sediment and are above screening levels in subsurface sediment

PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
PEC = Probable Effect Concentration
mg/kg = milligram(s) per kilogram

Each remedial alternative, except for Alternative 1 (No Action), meets the threshold criterion (compliance with environmental laws and standards). Alternative 2 has the greatest long-term effectiveness because it is based on the most conservative (lowest) set of CUGs. Alternatives 3, 4, and 5 have progressively lower reductions in COC mass and volume or smaller areas targeted for remediation compared to Alternative 2.

Alternative 5 is the most implementable because it requires the least amount of capacity for dredge material disposal and the lowest volume of cover material. Alternatives 4, 3, and 2 are progressively less implementable than Alternative 5.

Alternative 5 would be completed in the shortest time and would impact the smallest area. Alternative 5 was selected as the recommended alternative based on evidence that natural recovery has already occurred and is expected to continue in the MKE Bay Project Area, the relatively lower levels of contamination observed in the MKE Bay Project Area compared to other project areas in the Milwaukee Estuary AOC, and consideration of project costs and disposal capacity for the dredged materials management facility (DMMF) on an AOC-wide basis. Dredged material volume estimates for Alternatives 2 through 4 exceed the available DMMF capacity, and capping is not a cost-effective approach for remediating the large areas of diffuse, lower-level contamination in the Outer Harbor. Sediment core data indicate that natural deposition of relatively cleaner sediment is resulting in the gradual burial and isolation of subsurface contamination, and the quality of the depositional sediments is expected to improve as remedial actions are completed on the Milwaukee, Menomonee, and Kinnickinnic Rivers. The recommendation considers the relatively lower levels of contamination observed in the MKE Bay Project Area compared to other project areas in the Milwaukee Estuary AOC and focuses the dredging and sand cover actions in areas where potential current or future risks to human and ecological receptors are the greatest. Additional sampling will be performed in remedial design to refine the focused dredging and sand cover placement areas.

The recommended alternative will be further refined during remedial design. The alternative was the subject of public outreach efforts accomplished during four separate public informational meetings held in 2023 and 2024. This Final FFS Report was prepared in consideration of public comments received.

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Acronyms and Abbreviations

Acronym	Definition
§	Section
3D	three-dimensional
AOC	area of concern
BRRTS	Bureau for Remediation and Redevelopment Tracking System
BUI	beneficial use impairment
CBSQG	Consensus-Based Sediment Quality Guideline
CDF	confined disposal facility
the City	City of Milwaukee
COC	contaminant of concern
CSM	conceptual site model
CSO	combined sewer overflow
CUG	cleanup goal
CY	cubic yard(s)
Discovery World	Discovery World Science and Technology Museum
DMMF	dredged materials management facility
EPA	U.S. Environmental Protection Agency
ERP	environmental remediation project
EVS	Earth Volumetric Studio
FNC	Federal Navigation Channel
FFS	focused feasibility study
ft^3/s	cubic feet per second
GLLA	Great Lakes Legacy Act

Acronym	Definition
GLNPO	Great Lakes National Program Office
GLWQA	Great Lakes Water Quality Agreement
HDPE	high-density polyethylene
IGLD	International Great Lakes Datum
LSPP	(Historical) Lakeside Power Plant
LUST	leaking underground storage tank
LWD	low water datum
M	million
max	maximum
mg/kg	milligram(s) per kilogram
MKE Bay	Milwaukee Bay
MMSD	Milwaukee Metropolitan Sewerage District
NAVD88	North American Vertical Datum of 1988
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	probable effect concentration
RAE	Remedial Alternatives Evaluation
RAETM	Remedial Alternatives Evaluation Technical Memorandum
RASTM	Remedial Alternatives Screening Technical Memorandum
RAO	remedial action objective
RAP	remedial action plan
RTA	remediation target area
SMC	South Menomonee Canal
SSP	steel sheet pile

Acronym	Definition
TM	technical memorandum
TSCA	Toxic Substances Control Act
UAS	unmanned aerial system
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
UWM	University of Wisconsin – Milwaukee
VOC	volatile organic compound
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System
WWTP	wastewater treatment plant

1. Introduction

This Focused Feasibility Study (FFS) Report summarizes site conditions, remedial action objectives (RAOs), remediation target areas (RTAs), remedial technology screening, and remedial alternatives development and evaluation, and presents a recommended remedial alternative for the Milwaukee (MKE) Bay Project Area within the Milwaukee Estuary Area of Concern (AOC) in Milwaukee, Wisconsin. In accordance with Task Order Number 68HE0520F0069 under Contract Number 68HE0519D00007, Jacobs[1] prepared this FFS with the Great Lakes National Program Office (GLNPO) as part of the Great Lakes Legacy Act (GLLA) work. This evaluation also aligns with the process outlined in Wisconsin Administrative Code Section (§)NR 722.07 for the selection of remedial alternatives. The Milwaukee Estuary AOC also includes portions of three watersheds along the Milwaukee River, Menomonee River, and Kinnickinnic River, two former industrial canals, and the nearshore areas of Lake Michigan (Figure 1-1).

The outer harbor is generally described as a zone approximately 11 miles long inside the breakwater along the western shoreline of Lake Michigan, extending north and south of the Milwaukee and Kinnickinnic Rivers' confluence with Lake Michigan. This FFS addresses a portion of the outer harbor that consists of five subareas including (from north to south) McKinley Marina, Summerfest Lagoon, Northern Outer Harbor, South Slip Number 2 (#2), and Southern Outer Harbor, collectively referred to as the MKE Bay (Figure 1-2)[2].

This document consists of the following sections:

- Section 1 provides an introduction and summarizes the regional setting within the Milwaukee Estuary AOC, project background and beneficial use impairments (BUIs), general site and background information for the MKE Bay, and the most recent site investigations and their associated reports.
- Section 2 presents the conceptual site model (CSM) for the MKE Bay including descriptions of physical site conditions, the nature and extent of contamination, historical and ongoing sources of contamination, recontamination potential, and potential exposure pathways and receptors.
- Section 3 provides an overview of how RAOs are developed for remedial actions to be conducted in the Milwaukee Estuary AOC for GLNPO in partnership with non-federal sponsors as part of the GLLA work. Site-specific RAOs, threshold screening levels, and development of RTAs for the MKE Bay are also presented.
- Section 4 summarizes the results of the remedial technology screening for the MKE Bay to focus remedial alternatives development on only those technologies most applicable to the site and presents the conceptual remedial alternatives that are further developed in Section 5.
- Section 5 describes five remedial alternatives for the MKE Bay, including the No Action alternative.
- Section 6 presents the detailed analysis of alternatives; the evaluation criteria are described first, followed by an analysis of the individual alternatives relative to the evaluation criteria and comparative analysis between alternatives.

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[1] On December 15, 2017, CH2M HILL Companies Ltd. and its subsidiaries including CH2M HILL, Inc. became part of Jacobs.

[2] The entrance channel extends from the harbor entrance at the breakwater to the confluence with the Milwaukee and Kinnickinnic Rivers (Figure 1-2). The *100% Final Site Investigation Report – Characterization of Sediments in Kinnickinnic River and Milwaukee Bay of the Milwaukee Estuary of Concern* (Anchor QEA 2021a) referred to the portion of the entrance channel between the rivers' confluence and the shoreline of the outer harbor as the "connection channel" but that term is not used herein.

- Section 7 describes the Recommended Alternative, as discussed with project partners.
- Section 8 presents the reference documents cited in this FFS Report.

1.1 Purpose

The purpose of FFS process is to develop and evaluate remedial alternatives and support selection of a remedy that is protective of human health and the aquatic environment. The remedy will contribute to the eventual removal of BUIs and delisting of the Milwaukee Estuary AOC.

The FFS task constitutes the third of three tasks completed for the MKE Bay. The first task established RAOs and general response actions, identified and screened remedial technologies, and presented the conceptual remedial alternatives. The second task was the remedial alternatives evaluation in which the remedial alternatives were further developed to support cost estimates and were analyzed individually and against each other. Results were documented in the *Remedial Alternatives Evaluation Technical Memorandum* (RAETM) *for the Milwaukee Bay Project Area* (Jacobs 2023a).

The third task consists of completing this Final FFS Report, which includes the recommended remedial alternative. A Draft Final FFS Report was completed in October 2023 (Jacobs 2023e). This Final FFS Report incorporates information relevant to four public information meetings that were held after completion of the Draft Final FFS Report, review comments received relevant to the Draft Final FFS Report, and changes relevant to compliance with Section 508 of the 1973 Rehabilitation Act (29 United States Code [U.S.C.] 794d).

The FFS for the MKE Bay Project Area was developed during the same timeframe as FFSs for other project areas within the Milwaukee Estuary AOC including the Milwaukee River Floodplains Reach, the Milwaukee River Downtown Reach, South Menomonee Canal (SMC), and the Kinnickinnic River. The remediation strategies and approaches for all project areas are being coordinated to the degree possible to achieve overall program objectives.

1.2 Milwaukee Estuary Area of Concern Background

The Milwaukee Estuary was identified as an AOC in 1987 by the International Joint Commission constituted to manage lakes and river systems along the border between Canada and the United States under the Great Lakes Water Quality Agreement (GLWQA) signed by both countries in 1972. The Milwaukee Estuary AOC has a long history of ecological degradation and pollution. Under the GLWQA, the first Milwaukee Estuary Remedial Action Plan (RAP) was completed in 1991 (WDNR 1991). Historical discharges from point and non-point sources near to and/or upstream of the AOC resulted in sediment in the AOC waterways being contaminated with various pollutants, including metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs). The RAP is updated periodically, most recently in June 2022 (WDNR 2022b). The following 11 BUIs are assigned for the Milwaukee Estuary AOC with 7 (indicated by ***bold italics*** and an asterisk [*]) of the BUIs specific to contaminated sediment:

- ***Restrictions on fish and wildlife consumption****
- Eutrophication or undesirable algae
- ***Degradation of fish and wildlife populations****
- Beach closings (recreational restrictions)
- ***Fish tumors or other deformities****
- ***Bird or animal deformities or reproduction problems****
- ***Degradation of benthos****

- Degradation of phytoplankton and zooplankton populations
- ***Restriction on dredging activities****
- ***Loss of fish and wildlife habitat****
- Degradation of aesthetics (U.S. Environmental Protection Agency [EPA] approved removal of this BUI as of September 8, 2021)[3]

Impacted sediment can be toxic to bottom-dwelling benthic organisms as they feed. Fish, piscivorous birds and mammals, and humans may be exposed to bioaccumulative chemicals, such as mercury and PCBs, via diet. Impacted sediment also has the potential to be resuspended and transported by high flow conditions, seiche effects, and vessels.

1.3 Milwaukee Bay Project Area Features and Background

The Milwaukee Harbor area on the western shore of Lake Michigan began as a natural feature with protected access to an inland river system consisting of the Milwaukee, Menomonee, and Kinnickinnic Rivers, which converge and flow into the lake at a central point. The rivers have been developed with shoreline facilities and expanded through channel improvements and dredging to support commercial and industrial development.

The western lakeshore's dynamic hydrological environment eventually required further protection from fluctuations between high and low lake levels and major storm surge events (ASCE 2013). Eventually an outer harbor and breakwater was constructed to support more and larger shipping operations (ASCE 2013). The Milwaukee Harbor's breakwater, originally constructed in 1881 (Bence 2018), consists of steel sheet pile (SSP) wall, concrete, and riprap breaker wall.

The Federal Navigation Channel (FNC) within the MKE Bay Project Area connects Lake Michigan to the interior waterways of the Milwaukee, Menomonee, and Kinnickinnic Rivers, as well as extends into the Southern Outer Harbor subarea (Figure 1-2). The FNC in the outer harbor was originally dredged in 1966 and is maintained to an elevation of -28 feet low water depth (LWD)[4] or 550 feet North American Vertical Datum of 1988 (NAVD88).

Navigational dredging is primarily conducted within the entrance channel, occurring at a frequency of two to three times per decade with dredged material disposed of in the Milwaukee confined disposal facility (CDF) (Figure 1-2) (Anchor QEA 2021a). A large portion of the entrance channel between the breakwater wall and the Pierhead Lighthouse was dredged in 1990, and a smaller portion of the entrance channel, extending approximately 1,000 feet east from the Pierhead Lighthouse, was dredged in 2019 (Figure 1-2) (Anchor QEA 2021a).

Jacobs conducted a shoreline survey of the MKE Bay Project Area in October 2021, documenting the visible portions of structures above the water line for shoreline construction type (Figures 1-3 through 1-8) and structural condition (Jacobs 2022a). The structural condition evaluation did not provide a

[3] A letter addressed to WDNR from GLNPO dated September 8, 2021, approved WDNR's request to remove the Degradation of Aesthetics BUI for the Milwaukee Estuary AOC (EPA 2021). Although various factors historically combined to limit recreational use and diminish the scenic value of the waters within the AOC boundaries (visible debris, trash, floating oil and grease, concrete-lined reaches, and overdevelopment on shorelines), many federal and state water quality regulations, local initiatives, and volunteer programs were implemented to reduce pollution and improve water quality throughout the AOC.

[4] The LWD for Lake Michigan is established at an elevation of 577.5 feet International Great Lakes Datum (IGLD) or 578 feet NAVD88. NAVD88 is used as the vertical datum for all the Milwaukee Estuary AOC project areas (including the MKE Bay Project Area). All elevation data reported relative to IGLD 1985 have been converted as follows:
NAVD88 = 0.5 feet + IGLD 1985.

quantitative assessment of structural stability, particularly with respect to potential removal of sediment at the foot of constructed walls. The general criteria used to classify bulkhead conditions were as follows:

- Excellent – No significant defects – slight imperfections may exist
- Good – Minor deterioration or defects evident
- Fair – Sound structure with clear evidence of deterioration
- Marginal – Moderate deterioration
- Poor – Serious deterioration in some portions of the structure
- Very Poor – Extensive deterioration

The shoreline within the MKE Bay Project Area generally consists of a mix of SSP wall, concrete bulkhead, timber piles, riprap breaker wall, sand beach, and natural shoreline with or without riprap protection. GLNPO performed a qualitative shoreline assessment in October 2021, as reported in the Final *Milwaukee Bay Project Area: Shoreline Assessment Technical Memorandum* (Jacobs 2022a). The qualitative assessment included the visible portion of the shoreline structures above the waterline. A structural assessment to thoroughly evaluate stability of the structures, particularly with respect to potential removal of sediment at the foot of the bulkhead walls, was not performed. Shoreline characteristics are summarized for the various subareas of the MKE Bay Project Area in the subsections that follow.

Shoreline parcels north of the rivers' confluence with Lake Michigan are designated primarily as open space and commercial. Shoreline parcels to the south of the confluence are zoned for industrial uses and are used for transportation, communications, and utilities (City of Milwaukee 2022).

The conditions of five subareas that are the focus of this FFS are described in the following subsections[5]. Laboratory and/or geotechnical test results for several locations sampled outside of these regions are also included herein, where relevant.

1.3.1 McKinley Marina Subarea

The McKinley Marina is located at 1750 N. Lincoln Memorial Drive and is Milwaukee County's only public lakefront marina, owned and operated by Milwaukee County Parks. The marina consists of approximately 82 acres located between the shoreline and inner breakwater (Figure 1-2). The northeastern perimeter of the marina area consists of the boat launch ramps. The marina has 655 slips in three floating dock sections (North, South, and Center Sections) (MCP 2022; McBOAT 2022). The marina offers full-service fuel docks with pump out facilities, seasonal slip rentals, boat launch facility, boat storage, marine maintenance and safety supply stores, and venue rentals (MCP 2022). The marina houses recreational clubs such as the Milwaukee Yacht Club and Milwaukee Community Sailing Center.

The intake for the north side flushing tunnel is located on the northern portion of the marina (Figure 1-3). The station was built in the late 1800s and used a large pump to move water from Lake Michigan to the Milwaukee River through an underground tunnel, providing a flushing action to the river (ASME 2022). The building has been converted to a commercial venue and MMSD clarified that the flushing tunnel no longer operates and is not anticipated to be used in the future (Wetzel, pers. comm. 2023).

The bulkhead systems within McKinley Marina primarily consist of SSP wall, concrete, and riprap. SSP bulkhead systems accounted for 69 percent of the McKinley Marina's shoreline with 98 percent of the SSP construction rated in excellent or good condition (Jacobs 2022a). Concrete bulkhead wall accounted for

[5] Wisconsin Department of Natural Resources (WDNR) performed the data evaluations to identify areas to include in the FFS and areas to be excluded from future remedial work. EPA communicated this information to Jacobs and the project partners on March 17, 2021, and the Jacobs' scope of work associated with the MKE Bay Project Area was modified accordingly.

13 percent of the shoreline (Figure 1-3). A riprap wall is present along McKinley Marina's eastern boundary, forming a breakwater wall separating the marina from Lake Michigan. This inner riprap wall forms the study area boundary for McKinley Marina. A concrete walkway is present on top of some portions of the outer breakwater wall (Figure 1-3).

1.3.2 Summerfest Lagoon Subarea

The Summerfest Lagoon subarea is composed of the Maritime Basin and the Quiet Water Basin adjacent to the Henry Maier Festival Park (Summerfest Grounds) (Anchor QEA 2021a). The subarea is part of a constructed set of features (collectively referred to as the North Harbor Tract), designed adjacent to the Summerfest Grounds to enhance a local cultural district with museums, a cruise ship center, fishing access, gathering spaces, and connections to regional recreational pathways (ASCE 2013). The lagoon occupies an area of approximately 35 acres and extends for approximately 0.6 mile along the shoreline. The northern Maritime Basin covers approximately 15 acres, and the southern Quiet Water Basin covers approximately 20 acres. The two basins are separated by an isthmus and an overhead pedestrian bridge that connects the Summerfest Grounds to Lakeshore State Park (Figure 1-4).

The Summerfest Grounds site is constructed on landfill material and was historically used as an airfield (Maitland Field) from 1927 to 1956, and as an antiaircraft missile site from 1956 to 1970, when the City of Milwaukee's (the City's) Harbor Commission leased the site to Summerfest (UWM 2022).

Lakeshore State Park was constructed on fill created by excavated material from the Deep Tunnel sewer system (UWM 2022), dredged material retained by SSP wall, and armor stone protection (Anchor QEA 2021a). Lakeshore State Park is located on the eastern side of the basin and has sand beaches, fishing piers, and hiking and biking trails. Boat slips are located near the southern end of Maritime Basin (north of the park).

The Maritime Basin is connected to the outer harbor through a 100-foot-wide channel. Pier Wisconsin is located along the northern shoreline of the Maritime Basin. The pier was originally developed in the 1900s and served as the former location of the Lake Michigan car ferry until 1970; it currently houses Discovery World Science and Technology Museum (Discovery World), support buildings, an event venue, docks, and breakwater pier (Anchor QEA 2021a). The water depth in the Maritime Basin during 2020 sampling events was approximately 21 feet to the top of the sediment surface (Anchor QEA 2021a) and ranged between 17 and 20 feet to the top of the sediment surface in October of 2021 (Jacobs 2022b).

The Quiet Water Basin is further subdivided into a smaller northern basin (approximately 7 acres) and a southern basin (approximately 13 acres). A 60-inch-diameter corrugated metal pipe culvert near the southeastern corner of the southern basin connects the basin to the outer harbor although its condition is unknown (Figure 1-4). The University of Wisconsin – Milwaukee (UWM) planned and designed a fish habitat rehabilitation project in the Quiet Water Basin with the intent to implement the work through the AOC program (Ramboll 2020). This project is referred to as the "Outer Harbor (Summerfest Lagoon) Aquatic Enhancements" and is a management action for the BUI, "degradation of fish and wildlife populations" (WDNR 2022c). Two woody habitats consisting of log structures and inverted root wads, a spawning bed habitat, and a gravel bed habitat are planned (Figure 1-4).

Shoreline types encountered in Summerfest Lagoon include natural shoreline, SSP, concrete, riprap, and dry stack stone wall systems (Jacobs 2022a). The primary shoreline type identified at Summerfest Lagoon is natural (with or without riprap), which occupies 60 percent of the shoreline (Figure 1-4). Most of the natural shoreline features are located in the Quiet Water Basin (Figure 1-4). SSP bulkhead systems occupy 13 percent of the shoreline (totaling 1,232 feet) and are mostly within the Maritime Basin (801 feet). The

SSP wall system is also along the Quiet Water Basin shoreline coincident with BMO Harris Pavilion (339 feet) (Figure 1-4). A riprap wall occupying approximately 14 percent of the lagoon's shoreline is present along the eastern boundary of Maritime Basin. Approximately 518 lineal feet of the shoreline just north of Discovery World could not be evaluated during the shoreline assessment (Jacobs 2022a) because of the presence of a permanent wooden deck system supported on pipe pilings that extend several feet into the water (Figure 1-4).

1.3.3 South Slip #2 Subarea

The South Slip #2 subarea is in the outer harbor terminal area that serves both lake and ocean-going vessels (Figure 1-5). In the 1930s, the outer harbor was developed by Port Milwaukee (formerly the Harbor Commission) with terminals, warehouses, rail connections and heavy-lift cranes. South Slip #2 is currently leased to Federal Marine Terminal, which offers terminal handling and logistic services for the unloading and loading of ocean and lake vessels, barges, railcars and trucks (Port 2022; FEDMAR 2022). The entire shoreline of South Slip #2 is an SSP bulkhead system (totaling 2,293 feet). Rubber or steel bumpers are present along most of the features.

1.3.4 Northern Outer Harbor Subarea

The Northern Outer Harbor subarea is east of the Summerfest Lagoon and extends from Veterans Park southward to the FNC, connecting the breakwater to the Pierhead Lighthouse (Figure 1-6); the northern breakwater forms the eastern boundary in this area. The shoreline is primarily SSP and concrete bulkhead systems (Figure 1-6) (Jacobs 2022a). A continuous SSP bulkhead wall system (spanning 3,826 feet) accounts for 59 percent of the Northern Outer Harbor shoreline. Two concrete wall sections with a total length of 2,573 feet account for 40 percent of the shoreline.

1.3.5 Southern Outer Harbor Subarea

The Southern Outer Harbor subarea includes the region adjacent to South Slip #2 and extending south to the South Shore Cruise Dock (Figure 1-2). The area is approximately 1.4 mile long and 0.5 mile at its widest section east of the proposed dredged materials management facility (DMMF) (Figure 1-2). The breakwater forms the eastern and southern boundary of the outer harbor and portions of this subarea fall within the FNC (Figure 1-2).

The shoreline features (Figures 1-7 and 1-8) primarily consist of concrete (85 percent) and natural areas with riprap (14 percent) (Jacobs 2022a). Concrete shoreline is present primarily along the eastern and southern boundary forming the breakwater wall that protects the inner harbor area; natural areas with riprap are present along the western boundary of the area, near the CDF.

1.4 Recent Site Investigations and Documents

Recent investigations within the MKE Bay Project Area that are relevant to the FFS include those completed in 2020 and 2021:

- 2020 Kinnickinnic River and Outer Harbor /Nearshore Area Sediment Investigation (WDNR)
- 2021 Kinnickinnic River and MKE Bay Data Gap Sediment Investigation (WDNR)
- 2021 MKE Bay Shoreline Assessment and Geotechnical Sampling Investigation (GLNPO)

WDNR performed field investigations in 2020 to characterize the nature, degree, and extent of contaminated sediment in the "outer harbor and nearshore waters" portion of their "Milwaukee Bay Investigation Area" (Anchor QEA 2021a). Sediment cores were collected from locations in the open portion of Lake Michigan (outside of the breakwater); McKinley Marina; Summerfest Lagoon; a region north of the FNC and within the breakwater east of Summerfest Lagoon; the outer harbor port area; the Southshore Park Mooring Basin; South Slip Nos. 1, 2, and 3; and a zone south of the existing DMMF (within the breakwater). Samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc), PAHs and PCBs. Total volatile organic compounds (VOCs) were also analyzed in samples from a subset of 13 locations (Anchor QEA 2021a). Geotechnical field and laboratory testing were conducted to measure sediment strength and characterize geotechnical engineering properties.

A drone survey was performed in fall 2020, before WDNR's sediment investigation. Aerial overhead video footage was collected by a Federal Aviation Administration-certified remote pilot using a small unmanned aerial system (UAS; DJI Phantom 4 Professional). Video footage was collected from both upstream and downstream views. In addition to the video footage, aerial photographs of features within the investigation areas were captured with the UAS. WDNR also completed a bathymetric survey and a side-scan sonar survey to identify features along the shoreline that may obstruct sediment remediation activities. The most recent bathymetric survey data were obtained in fall 2020 (Seaworks 2020). WDNR also conducted a mobile LiDAR Survey of the banks, walls, and structures (Anchor QEA 2021a).

In 2021, additional sediment cores were collected to provide additional spatial coverage within the McKinley Marina, Summerfest Lagoon, the Northern Outer Harbor, South Slip #1 and #2, and the Southern Outer Harbor area (WDNR 2022b). Samples were analyzed for metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc), PCBs and PAHs (Anchor QEA 2021b). Following the review and evaluation of data collected as part of the 2020 and 2021 investigations, WDNR, in consultation with GLNPO, revised the extent of the project area for the purposes of the FFS to the current boundaries of the MKE Bay Project Area (Figure 1-2).

GLNPO performed the qualitative shoreline assessment in October 2021 as reported in the Final *2021 Milwaukee Bay Project Area: Shoreline Assessment Technical Memorandum* (Jacobs 2022a) and collected four sediment cores for geotechnical analysis from the McKinley Marina and Summerfest Lagoon subareas during November of 2021 as reported in the Final *2021 Geotechnical Sediment Sampling Technical Memorandum* (Jacobs 2022b). Individual sediment samples were analyzed for some combination of the following geotechnical parameters: moisture content, organic content, Atterberg limits, grain size (Jacobs 2022b).

2. Conceptual Site Model

The CSM summarizes the physical characteristics of the MKE Bay Project Area, describes the nature and extent of contamination, and identifies potential sources of contamination, migration pathways, and potential receptors. The CSM is visually depicted on Figure 2-1, which shows spatial relationships between potential sources, contaminant transport pathways, receiving waters, and potential receptors.

2.1 Hydrology and Bathymetry

The hydrology within the larger Milwaukee Estuary AOC project area is a complex system influenced by a combination of Lake Michigan water elevations and river discharge. Lake Michigan oscillates between its western and eastern shores as a result of strong winds or atmospheric pressure changes because it is essentially an enclosed system. Because wind and/or atmospheric conditions are almost never static, seiche events are almost always occurring on Lake Michigan. When water is pushed toward the western shore of Lake Michigan, it flows upstream into the various Milwaukee Estuary AOC rivers (Figure 1-1). In addition to average water levels varying approximately 6 feet over the last 100 years, the offshore areas of Lake Michigan are subject to large wave events based on the lake size and water depth, with the waves being mainly wind-driven and the largest formations taking place during storm events (Foth 2020).

Wind-generated waves travel in the same direction as the wind, with the waves propagating until breaking along a shoreline feature or other solid body. Wave heights exceeding 20 feet are listed in an approximate 40-year data set of United States Army Corps of Engineers (USACE) wave data recorded for the Lake Michigan coastline station nearest to the Milwaukee Harbor (WIS Station 94050). Northeasterly wind events result in the highest occurrence of large waves to the harbor area (Foth 2020).

Inside the breakwater wave conditions are complex due to waves interacting with various structures. Fifty-year storm events reportedly produce 8-foot waves inside the breakwater (ASCE 2013). A site-specific numerical model was created during design tasks for the proposed DMMF located along the southern portion of the harbor (Figure 1-2). Conclusions drawn from the model results include the following (Foth 2020):

- The difference between calculated waves inside the breakwater differed significantly from those outside, as the breakwater effectively reduces the wave height of the generating wave.
- The largest significant wave heights are typically in the fall and winter, corresponding to time periods of storm events.
- The influence of water levels on average wave conditions is significantly less than with the influence from extreme storm events.
- The model evaluation shows the maximum expected average wave height at the DMMF site is 3.3 feet and occurs during the winter.

The MKE Bay Project Area receives a combined discharge from the Milwaukee, Menomonee, and Kinnickinnic Rivers, the three major river systems that drain the Greater Milwaukee area (Figure 1-1). A United States Geological Survey (USGS) stream gauge (Gauge Number 04087170) is located at the mouth of the rivers near the Daniel Hoan Memorial Bridge. Data presented in Exhibit 2-1 represent monthly average flow rates and associated statistics for data collected at the USGS station from January 2010 through August 2020.

Exhibit 2-1. Monthly Discharge Rates for USGS 04087170 from January 2010 through August 2020

Discharge Rate (ft^3/s)	January	February	March	April	May	June	July	August	September	October	November	December
Overall Monthly Average (2010-2020)	679	746	1554	1914	1372	979	754	528	471	686	658	717
Monthly Average Maximum	1321	1453	2575	3842	2236	1968	2167	1282	1106	2702	1486	1561
Monthly Average Minimum	252	263	560	941	556	185	148	193	101	250	195	304

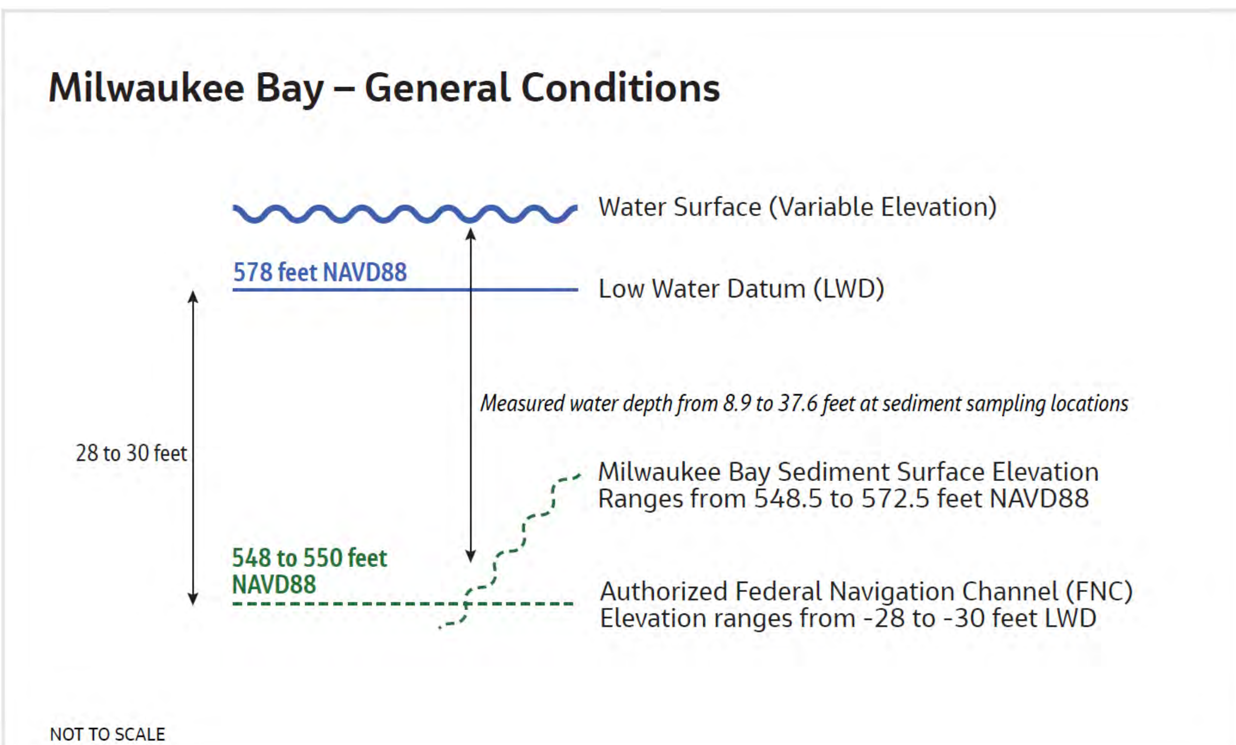
Note: Data included (USGS 2022) from January 2010 through August 2020 (data only available through August 2020).

ft^3/s = cubic feet per second

As measured at the gauging station, monthly average flow discharging into the MKE Bay Project Area varies, ranging from 471 to 1914 ft^3/s (187,000 to 859,000 gallons per minute). Peak annual flow rates are generally observed during March and April, after the spring snow melt. The annual low flow conditions are observed during August and September.

Bathymetric and hydrologic features specific to the MKE Bay Project Area are summarized on Exhibit 2-2.

Exhibit 2-2. Milwaukee Bay Project Area Established Elevations (NAVD88)



Immediately outside of the breakwater, Lake Michigan typically has water depths ranging from 30 to 50 feet (Anchor QEA 2021a). Inside the breakwater, water depth measurements collected during 2020 and/or 2021 field events within the various subareas ranged as follows (Anchor QEA 2021a, 2021b; Jacobs 2022b):

- Summerfest Lagoon: 14.0 feet to 23.7 feet (17 locations)
- McKinley Marina: 8.3 feet to 19.3 feet (7 locations)
- South Slip #2: 32.0 feet to 34.5 feet (3 locations)
- Northern Outer Harbor: 12.9 feet to 30.4 feet (13 locations)
- Southern Outer Harbor: 30.7 feet to 34.4 feet (5 locations)

The 2020 bathymetric dataset includes a range of sediment surface elevations for each subarea as follows:

- Summerfest Lagoon: 560.5 to 568.5 feet NAVD88
- McKinley Marina: 560.5 to 570.5 feet NAVD88
- South Slip #2: 548.5 to 567.5 feet NAVD88
- Northern Outer Harbor: 554.5 to 572.5 feet NAVD88
- Southern Outer Harbor: 548.5 to 568 feet NAVD88

2.2 Sediment Characteristics

Physical characteristics of both the loose sediment and underlying native material were established for the MKE Bay Project Areas during data collection events. In general, the term "native material" is used to represent the relatively firm, compacted glacial material in place before more recent deposition of loose sediment, generally referred to herein as "soft sediment". Geotechnical samples of both the soft sediment and native material were collected throughout the project area (Anchor QEA 2021a, 2021b; Jacobs 2022b).

The uppermost portion of the soft sediment is variable both within and between the individual subareas, as described herein. Native material that underlies the soft sediment is of glacial origin and is composed of much denser silt or clay with low-to-no organic content and trace coarse material.

Surficial sediment in the McKinley Marina was described as sand or silty sand with trace gravel (Anchor QEA 2021a, 2021b). Geotechnical boring logs documented silt with organic material and trace sand in the top 2 feet overlying silty sand then clay (clay at a depth of 8.7 feet below top of sediment surface) (Jacobs 2022b). The native material, where encountered (five of seven boring locations) is described as clay or silty clay with low plasticity.

Within the Summerfest Lagoon subarea, the surficial sediment in the Maritime Basin is characterized as clayey silt, whereas the Quiet Water Basin sediment is characterized as a mixture of clayey silt and silty sand (Anchor QEA 2021a, 2021b). Geotechnical cores in the Maritime Basin had low plasticity silt in the upper portion of a core at one location and 1 foot of well graded gravel at another (Jacobs 2022b). Native material within the Summerfest Lagoon (observed at 9 of 16 boring locations) generally consists of clay or silty clay of varying colors (brown or grey).

Three borings completed within the South Slip #2 subarea had clayey silt or sand in the upper 1 foot overlying a clayey sand or silty sand layer with silt at depths greater than 5.5 feet below sediment surface. Native material was not encountered at any of the three boring locations completed in the South Slip #2 (Anchor QEA 2021a, 2021b).

In the Northern Outer Harbor subarea, the sediment was primarily described as clayey silt or silty sand with medium sand immediately above the native material. Native material encountered in 9 of 13 completed borings was described as grey-brown clay, silty clay, or sandy clay with medium plasticity (Anchor QEA 2021a, 2021b).

In the Southern Outer Harbor subarea, adjacent to Port of Milwaukee parcels, the sediment was clayey silt and transitioned to sand, gravel, or cobbles southward toward the South Shore Mooring Basin (Anchor QEA 2021a, 2021b). Native material was encountered at two of the five completed borings in this subarea and was described as silty clay with trace sand (Anchor QEA 2021a).

The top of native material elevations is generally deeper in the Northern and Southern Outer Harbor subareas and shallower in McKinley Marina and Summerfest Lagoon subareas. Native material elevation ranges reported in previous documents are summarized as follows (Anchor QEA 2021a, 2021b; Jacobs 2022b):

- McKinley Marina: 555.9 to 560.2 feet NAVD88
- Summerfest Lagoon: 555.3 to 565.9 feet NAVD88
- Northern Outer Harbor: 546.2 to 552.6 feet NAVD88
- Southern Outer Harbor: 547.2 to 547.3 feet NAVD88

2.3 Habitat

The Milwaukee Harbor is the habitat interface between river and Great Lakes estuary habitats. Some areas of the river tributaries and harbor are manufactured canals or are dredged for commercial shipping. Although the harbor area has been highly altered since presettlement, a diverse number of native and non-native fish and wildlife species are supported, with potential for significant habitat improvement.

The harbor region has lost much of its historical lateral, vertical, and longitudinal connectivity over time, which has significantly impacted habitat. Water temperature and quality are impacted by development and the complexity of a lake estuary system. Side-scan imaging and biomonitoring have identified localized areas of modified habitat substrates as well as vast areas with significantly less biologically productive habitat. Most shoreline areas are armored or have vertical seawalls. Natural riparian communities that remain exist in very narrow corridors or have altered soil and hydrology.

A 2018 report summarized shoreline conditions for the harbor as a whole and estimated that 59 percent of the approximately 37-mile shoreline of the harbor is hardened with breakwalls or riprap (Dow 2018). Water surface temperature follows seasonal trends with the highest peaks in late August. Larger water temperature fluctuations in the inner and outer harbors are affected by Lake Michigan upwelling and seiche events (Dow 2018).

The USGS performed fish abundance and distribution surveys from 2014 to 2016 and compared the results to 1983 surveys to assess whether fish populations had improved (USGS undated). Four native species are considered indicator species that represent the major ecological niches and are considered proxies for numerous other species that occupy the same type of habitat: northern pike, greater redhorse, lake sturgeon, and walleye. Smallmouth bass were also included in the USGS evaluation due to their widespread occurrence in the area. Briefly, the survey results indicated:

- A total of 58 species (47 native, 11 non-native) were captured in 2014 to 2016, compared to a total of 40 species (31 native, 9 non-native) in 1983.
- Fish populations in the outer harbor have improved since 1983.

- Some transient species of salmonids appear to have declined, but almost all other resident species have increased except for yellow perch and white sucker.

Spawning bed areas for *Centrarchidae* (sunfish) species have been identified in five locations on gravel/cobble or quagga mussel (live or dead) substrates. The Summerfest Lagoon and Discovery World locations were the most productive for observing fish spawning.

Efforts are ongoing to upgrade fish habitat in the Summerfest Lagoon as previously described in Section 1.3.2. Development of the Summerfest Lagoon incorporated an emphasis on green and environmental design, to minimize impervious surfaces and runoff volume into the lagoon (Figure 1-4). The fish habitat project would be completed after sediment in the Summerfest Lagoon has been remediated, although the cost has not been determined and is not included in the remedial alternative cost estimates provided in Section 6. Onshore landscapes used native plants able to withstand the extreme coastal conditions of the island feature (Lakeshore State Park). The basins are lined with filter fabric and installed with wetland plants. Anecdotal evidence provided by park employees and visitors report a wide variety of migratory and shore birds, red and silver fox, and mink (ASCE 2013).

USACE is working with other stakeholders, including WDNR, EPA, and UWM, to develop conceptual designs for aquatic enhancements to a portion of the Northern Outer Harbor subarea. The proposed project work limits are within the Milwaukee Outer Harbor from the Discovery World to the south, Veterans Park to the north, Milwaukee Art Museum to the west, and approximately 1,800 feet east from the western shoreline of Lake Michigan (USACE 2022).

2.4 Nature and Extent of Contamination

Recent investigations within the MKE Bay Project Area included characterization of the following contaminants of concern (COCs): PCBs, PAHs, and select metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc). The total PAH and metals concentrations in sediment were compared to the Probable Effect Concentrations (PECs), which are the recommended thresholds for evaluating sediment COC concentrations as discussed in *Wisconsin Consensus-based Sediment Quality Guidelines* (CBSQGs) (WDNR 2003). Detected concentrations were also compared to values corresponding to three times and five times the PECs, to identify more highly impacted locations. PCB concentrations were compared to 1 milligram per kilogram (mg/kg), 3 mg/kg, and 5 mg/kg threshold levels. PCB concentrations were also compared to the 50 mg/kg Toxic Substances Control Act (TSCA) threshold. The complete data set is provided in Appendix A, which includes color coding to denote whether results exceed the threshold levels. The comparisons indicate that MKE Bay Project Area sediment contains elevated concentrations of PCBs[6], metals, and PAHs[7].

Several metals exceed the PEC-based threshold levels, including chromium, mercury, lead, nickel, arsenic, cadmium, copper, and zinc. Chromium, mercury, and lead exhibit the greatest magnitude and frequency of PEC exceedances (Appendix A). The other metals, where concentrations exceed the PEC, are typically less than the 3 times the PEC value threshold level. Appendix B provides an analysis confirming that PEC exceedances of other metals in the MKE Bay Project Area are co-located with elevated concentrations of PAHs, PCBs, chromium, mercury, or lead. Therefore, the FFS uses the exceedance extent of the following constituents as the basis for developing RTAs: total PCBs, total PAHs, chromium, lead, and mercury.

[6] Total PCBs are calculated as the sum of detected Aroclors. Nondetected results are reported as the maximum reporting limit for the individual Aroclors.

[7] Total PAHs are calculated as the sum of 18 PAH compounds. Nondetected results are included in sums as 1/2 of the reporting limit. Where all PAH compounds are nondetected, the sum is reported as the maximum reporting limit for the individual PAHs included in the sum.

As shown in Exhibit 2-3, the mean and maximum detected COC concentrations in sediment from the MKE Bay Project Area are lower than those observed in sediment from the other project areas within the AOC (Milwaukee River Downtown Reach, Menomonee River OU1, the SMC, and the Kinnickinnic River).

Exhibit 2-3. Mean and Maximum Detected COC Sediment Concentrations in the AOC and MKE Bay (mg/kg)

Project Areas	PCB Mean	PCB Max	PAH Mean	PAH Max	Chromium Mean	Chromium Max	Mercury Mean	Mercury Max	Lead Mean	Lead Max
Other AOC Project Areas	3.20	280	63.6	6,390	259	40,000	0.72	31.1	217	5,380
MKE Bay Project Area	0.28	4.4	15.3	142	143	1,270	0.40	4.1	55.6	256

Note: MKE River Floodplains Reach data excluded from AOC statistics.

Max = maximum

Figures 2-2A through 2-2F were compiled for the purposes of the FFS to summarize the laboratory analytical data used for the MKE Bay Project Area. Figure 2-2A identifies surface[8] and subsurface locations with exceedances of the threshold levels for total PAHs, total PCBs, chromium, lead, or mercury. The left panel illustrates the surface results, and the right panel presents the maximum subsurface result at each location. As indicated in Figure 2-2A, the surface sediment in the MKE Bay Project Area is generally less contaminated than the subsurface sediment; the exceptions are in South Slip #2, where threshold exceedances are higher in surface sediment at several locations, and in the McKinley Marina subarea where the threshold exceedances in surface and subsurface sediment are approximately the same (Figure 2-2A).

The distribution of PCBs in surface and subsurface sediment is illustrated on Figure 2-2B. PCBs greater than the 50 mg/kg TSCA threshold were not observed. PCB concentrations in surface sediment are lower than the 1 mg/kg threshold except at two locations: one in McKinley Marina that exceeded the 1 mg/kg threshold and one location in the Northern Outer Harbor subarea that exceeded the 3 mg/kg threshold. Subsurface sediment with PCB concentrations exceeding 1 mg/kg is present at three locations in the Northern Outer Harbor subarea and at one location within the Summerfest Lagoon. Subsurface sediment with PCB concentrations exceeding 3 mg/kg is present at two locations in the Summerfest Lagoon, at one location in South Slip #2, and at one location on the northern edge of the Southern Outer Harbor subarea. There were no exceedances of the 1 mg/kg total PCBs threshold value in any of the 29 samples of native material (Anchor QEA 2021a, 2021b).

Figure 2-2C presents the distribution of total PAHs in surface and subsurface sediment. The surface sediment PAH concentrations are predominantly lower than the PEC (22.8 mg/kg). Eight surface locations had PAH concentrations that exceeded the total PAH PEC: two in McKinley Marina (both exceed the PEC), three in the Northern Outer Harbor subarea (one surface location exceeding one times the PEC, two locations exceeding 3 times PEC), one location in South Slip #2 (exceeds 1 time PEC), and two locations in or on the edge of the Southern Outer Harbor subarea (both exceed 1 time PEC). The highest total PAH concentrations in the subsurface sediment are generally observed at the southern end of the Northern Outer Harbor subarea (three locations: one exceeding 5 times PEC and two exceeding 3 times PEC), and at one location within the Summerfest Lagoon (exceeds 3 times PEC). There were no exceedances of the total PAH 1 time PEC threshold in any of the 29 samples of native material (Anchor QEA 2021a, 2021b).

8 The surface interval is 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet (Appendix A).

The surface and subsurface distributions of chromium, lead, and mercury (the maximum observed detected value for the subsurface samples) are presented in Figures 2-2D, 2-2E, and 2-2F, respectively. Similar to the organic contaminants, the surface sediment chromium and lead concentrations are typically below their respective PECs; mercury did not exceed the PEC in any surface sampling locations. Chromium exceeds the PEC in the surface sediment at 12 locations scattered among the subareas except Summerfest Lagoon; one of these locations in the Northern Outer Harbor subarea also exceeds the 3 times PEC threshold, and one location in South Slip #2 exceeds the 5 times PEC threshold. Surface concentrations of lead exceed the PEC at three locations in the Northern Outer Harbor subarea and one location in South Slip #2.

Subsurface PEC exceedances for all three metals are present throughout the MKE Bay subareas, with chromium typically exhibiting greater magnitudes of exceedance (Figure 2-2D) relative to lead and mercury (Figures 2-2E and 2-2F). Subsurface sediment in the Northern and Southern Outer Harbor subareas and on the northern and southern ends of the Summerfest Lagoon generally have higher metals concentrations. There was only one exceedance of a chromium, lead, or mercury PEC in the 29 samples of native material: 1 time the chromium PEC is exceeded at sample location MKE-20-083 (Outer Northern Harbor subarea, 5- to 5.3-foot depth).

Figures 2-3 through 2-7 present more detailed surface and subsurface sediment COC profiles relative to the 1 time, 3 times, and 5 times PEC threshold levels for PAHs and metals and the 1 mg/kg, 3 mg/kg, and 5 mg/kg threshold levels for PCBs. The concentration and elevation information presented in this figure set were incorporated into computer modeling that was used to develop RTAs and the associated volumes (see Section 3.2).

The presence of comparatively less contaminated surface sediment relative to deeper, more contaminated sediment previously described and shown on Figures 2-3 through 2-7 indicates that many areas of the Outer Harbor have recovered naturally over time. The predominant recovery mechanism is deposition and accumulation of relatively cleaner sediment as upstream contaminant sources have been reduced and controlled. The Milwaukee, Menomonee, and Kinnickinnic Rivers deliver sediment to MKE Bay, which is protected by breakwaters around the Northern and Southern Outer Harbor Areas. Current speeds decrease as the river flow enters MKE Bay, promoting deposition of the sediment load. The breakwaters reduce the potential for wind-driven waves to build, which reduces the potential for resuspension of the bed sediments. Sediment accumulation rates in the Outer Harbor are not known; however, this process is expected to continue. As conditions in the upstream reaches have improved, the quality of sediment delivered to the bay has improved, as reflected in the core profiles previously described. COC concentrations in the incoming sediment are expected to continue to decline as the upstream project areas within the Milwaukee Estuary AOC are remediated.

2.5 Historical and Potential Ongoing Sources

Potential contaminant sources to the MKE Bay Project Area are presented here as a component of the CSM, with a general depiction of potential source types shown on Figure 2-1. Review of historical data in the WDNR's Bureau for Remediation and Redevelopment Tracking System (BRRTS) revealed more specific potential sources on sites adjacent to the project area. In addition, Jacobs reviewed current industrial, stormwater, and construction discharge permits in the public record. Figure 2-8 indicates the locations of potential sources of contamination to the MKE Bay Project Area.

The following subsections note potential sources of contaminants to the MKE Bay using several categories:

- Potential Point Sources
- Potential Non-Point Sources

- WDNR Remediation and Redevelopment Sites
- Upstream Sites

Additional detail is provided in the *Evaluation of Potential for Recontamination of Sediment Report* (Recontamination Report) (WNDR 2022b), which was prepared by WDNR and the other non-federal sponsors to support the Milwaukee Estuary AOC remediation planning activities.

2.5.1 Potential Point Sources

Within the Milwaukee Estuary AOC's MKE Bay Project Area, the shoreline north of the confluence of the Milwaukee and Menomonee Rivers and the outer harbor of Lake Michigan has historically been dominated by open space and recreation, with that designation continuing into the present day (City of Milwaukee 2022). South of the confluence, the City's main water reclamation facility at Jones Island and the Port of Milwaukee operations dominate (Figures 1-2 and 2-8).

Point sources of pollution have discrete discharges, usually from a pipe or outfall. Major reductions in point source activity were accomplished with the advent of the Clean Water Act and the subsequent regulation and permitting of all outfalls. Discharges from pipes or outfalls are regulated under the Wisconsin Pollutant Discharge Elimination System (WPDES) permitting program. As of spring 2022, 11 WPDES permits (all either "stormwater industrial" or "stormwater construction") were active within the MKE Bay Project Area (Table 2-1). Modernized operations, monitoring, and control of discharged water quality reduce the potential contaminant load at currently active industrial and municipal outfalls.

The Milwaukee Metropolitan Sewerage District (MMSD) holds the municipal WPDES permit for combined sewer discharge to the Milwaukee inner and outer harbor areas and Lake Michigan via its facilities at Jones Island (WDNR 2022b). In the MKE Bay Project Area, the storm sewer and sanitary sewer systems are commonly combined, with the resultant flow being conveyed in a set of combined sewers to an MMSD wastewater treatment plant (WWTP). However, during periods of heavy rain, the capacity of the WWTP is sometimes exceeded and the combined sewer overflows (CSOs) may enter the MKE Bay, but usually in only very limited locations. CSOs contain common urban pollutants from stormwater runoff as well as from residential, commercial, and industrial users of the WWTP. Figure 2-8 shows the locations of numerous CSO outfalls and stormwater discharge points along the MKE Bay Project Area. Although not listed on Table 2-1, the Discovery World facility (Figure 1-4) reportedly discharges approximately 5,000 to 25,000 gallons of treated wastewater per day (when discharging) to the Maritime Basin portion of the Summerfest Lagoon (Anchor QEA 2021a).

The number and volume of CSOs that negatively impact the water quality in the estuary has decreased significantly with the completion of the "deep tunnel" project in 1994 (MMSD 2022). Between 1994 and 2021, MMSD has captured and treated more than 98.5 percent of the stormwater and wastewater that has entered the regional sewer system totaling over two trillion gallons (MMSD 2022). Over that same period, the annual overflow of untreated stormwater and wastewater released through the CSOs to area waterways during periods of heavy precipitation ranged between 1,500 gallons and 4.4 billion gallons (MMSD 2022). Furthermore, CSO discharges are 90 to 95 percent stormwater and groundwater (MMSD 2022).

2.5.2 Potential Non-Point Sources

Much of the land adjacent to the MKE Bay is either open grassy space or is currently occupied by buildings, parking lots or structures, and other paved areas typical of an urban environment. During precipitation events, the majority of stormwater is conveyed into the sewer system with a limited amount flowing over land and entering the surface water as a non-point source.

Releases to the watershed and sediment environments that are associated with urban runoff may include PCBs, PAHs, or metals. Potential sources of contamination include:

- Construction or environmentally contaminated sites
- Paved or other impermeable surfaces
- Bulk soil or materials storage piles
- Bank soil erosion
- Surface spills
- Atmospheric deposition of airborne contaminants

A previous study conducted in the Milwaukee area concluded that the primary source of PAHs to sediment in urban area waterways are worn particles of coal-tar-based pavement sealants that are transported by stormwater runoff from parking lots (Baldwin et al. 2016). A recent research study to determine "the distribution and potential health effects of aerially deposited PAHs in soil within the urban core of metropolitan Milwaukee" suggests that aerial deposition is another source of PAHs to urban waterway sediment. The research was conducted at 27 areas in Milwaukee parks that were evaluated as being undisturbed for at least 80 years. The study concluded that "diffuse multiple point source [air] emissions contribute equally to PAH deposition throughout the area" (Siemering and Thiboldeaux 2020). Surface soil (0 to 7 centimeters) sampling locations were chosen specifically to only represent aerial deposition; concentrations of several individual PAHs in the sampled areas exceed their respective WDNR residual contaminant limits per Wisconsin Administrative Code NR720 for soil cleanup standards. According to the Recontamination Report, the City of Milwaukee banned coal-tar sealants using a substitute ordinance in 2017, at least in part due to the research study (WDNR 2022b).

The potential for unpermitted discharges or spills exists in urban waterways, especially those that are transportation hubs like the Milwaukee Estuary AOC rivers and receiving waters where significant waste hauling and management activities occur. Potential non-point sources of contamination associated with remediation and/or redevelopment near the MKE Bay Project Area are addressed through applicable stormwater and erosion control requirements. There is a local effort to incorporate green and environmental design components during redevelopment that minimizes impervious surfaces and runoff volume (ASCE 2013). Sustainable designs used during redevelopment of the harbor's North Harbor Tract (including, but not limited to, Summerfest Lagoon and Lakeshore State Park construction) are recent examples of this effort to increase water quality (ASCE 2013).

2.5.3 Wisconsin Department of Natural Resources Remediation and Redevelopment Sites

Jacobs used publicly available data from WDNR to identify several types of historical and current industrial facilities. A review of remediation sites adjacent to the MKE Bay Project Area on the WDNR BRRTS sites map (WDNR 2022a) identified the presence of multiple historical and current potential sources of metals (for example, arsenic, lead, and mercury), cyanide, VOCs, PAHs, and petroleum compounds.

Table 2-2 lists WDNR BRRTS sites near the MKE Bay Project Area and Figure 2-8 shows the approximate locations. The BRRTS sites are classified as either open or closed environmental remediation project (ERP) or open or closed leaking underground storage tank (LUST) sites adjacent to the MKE Bay. The potential discharge of contaminated groundwater from nearby sites or from hazardous material spills can represent an additional potential source to the surface water. Impacted media at each of these sites may include soil, groundwater, and/or vapor. WDNR regulates remedial actions and monitoring at ERP and LUST sites.

Because of the proximity of the sites to the MKE Bay, each could have contributed historically to the contamination of the bay sediment.

The Recontamination Report (WDNR 2022b) summarizes completed or planned remedial activities for several BRRTS sites within the Milwaukee Estuary AOC. The WDNR report mentions one site located in the City of St. Francis, Wisconsin: the historical Lakeside Power Plant (LSPP) site (BRRTS Identification Number 02-41-550938) (Figure 1-2). The 1990s-era site investigations at the LSPP indicated relatively low concentrations of metals and semi-VOCs in sediment collected from locations both north and south of the LSPP site, in the onsite sediment basin, and in the site's intake pond. A 2020 investigation of sediment collected immediately adjacent to the LSPP, north of the LSPP in the Southshore Park Mooring Basin, and south of the LSPP, indicated the presence of several metals, PCBs, and PAHs, but the detected concentrations were below their respective PECs. WDNR concluded that it is unlikely that the sediment adjacent to the LSPP or Southshore Park would be recontaminated from sources originating or remaining at the LSPP (WDNR 2022b).

2.5.4 Upstream Sites

Pollutants from historical or current agricultural or industrial areas upstream of the MKE Bay Project Area may contribute to contaminated sediment in those regions, with the potential for contaminated sediment being washed downstream into the outer harbor area from the inland rivers and inner harbor. Environmental monitoring and engineering measures, such as those associated with WPDES permitting, and remedial actions completed or planned for additional project areas within the Milwaukee Estuary AOC, will reduce the pollution emanating from upstream sites. Information regarding potential point and non-point sources along the rivers (Kinnickinnic, Milwaukee, Menomonee) with eventual discharge to the MKE Bay Project Area is available in the following documents:

- FFS Report: Menomonee and Milwaukee Rivers, Milwaukee Estuary AOC (CH2M 2019)
- Recontamination Report (WDNR 2022b)
- Draft Final FFS Report: Milwaukee River Floodplains Reach, Milwaukee Estuary AOC (Jacobs 2023b)
- Draft Final FFS Report: Kinnickinnic River Project Area, Milwaukee Estuary AOC (Jacobs 2023c)
- Draft Final FFS Report: SMC, Milwaukee Estuary AOC (Jacobs 2023d)
- Draft Final FFS Report: Milwaukee River Downtown Reach, Milwaukee Estuary AOC (Jacobs 2023f)

2.6 Contaminant Release Mechanisms and Potential Migration Pathways

Figure 2-1 shows a general depiction of contaminant release mechanisms for the MKE Bay Project Area. Permitted and historically unpermitted discharges and overland flow transport particulate and dissolved contaminants directly to surface water. CSOs may occur during large precipitation events. Groundwater impacted by contaminants may upwell through the sediment and discharge to surface water. PCBs, PAHs and metals in these releases tend to adsorb to fine-grained sediment and organic material and may be incorporated into the sediment. Deposition and accumulation of relatively cleaner sediment over time results in the gradual burial of historical contamination, which is observed in the contaminant profiles shown on Figures 2-3 through 2-7.

The contaminated sediment in the lake bed may be resuspended by various in-water conditions or in-water construction activities. Resuspended sediment can be transported and redeposited in nearby areas. Wave action and seiche effects may also play a role in resuspending contaminated solid particles and redepositing them. Impacted sediment may also release dissolved-phase chemicals into the surface water that can then move from one area to another.

2.7 Recontamination Potential

The potential for recontamination of the MKE Bay Project Area after remedial action is considered to be low and will be further reduced upon completion of remedial actions in the Milwaukee, Menomonee and Kinnickinnic Rivers. Potential recontamination sources include point source discharges, non-point sources, releases from former industrial or commercial sites, and inflow from the three main rivers that feed the MKE Bay. Of the potential sources, non-point source runoff is anticipated to continue to transport relatively minor amounts of COCs to MKE Bay following remediation because of the current land use being a mix of greenspace and impervious surfaces typical of an urban environment. The effort to incorporate green and environmental design components during redevelopment along the lakefront (ASCE 2013) will decrease runoff volumes and increase water quality.

As discussed in Section 2.5.1, major reductions in point source activity were achieved by the Clean Water Act and the associated regulation and permitting of outfalls under WPDES. Many of the facilities that once operated with discharges to the bay or rivers have either ceased operations or have been demolished. Further, the number and volume of CSOs that negatively impact the water quality in the estuary has decreased significantly since 1994; between 1994 and 2021, MMSD has captured and treated more than 98 percent of the stormwater and wastewater entering regional sewer system (MMSD 2022). Management and monitoring at MMSD's Jones Island facility are ongoing in accordance with effluent limitations, monitoring requirements, and other permit conditions (WDNR 2022b), continuing to improve sewer infrastructure of waters feeding into the MKE Estuary AOC.

Recontamination potential from former industrial or commercial sites as identified in Section 2.5.3 is low because of permitted monitoring of point sources and various additional WDNR requirements for investigation and mitigation of these sites. Remediation and monitoring efforts at historically contaminated sites along waterways upstream of the MKE Bay are ongoing. The implemented control measures have succeeded in reducing the amount of contaminant loading from entering the system (WDNR 2022b).

2.8 Potential Receptors

As previously stated, 7 of the 11 BUIs in the Milwaukee Estuary AOC are related to contaminated sediment. The main receptors include benthic invertebrates and higher trophic-level organisms, including fish, some wildlife (piscivorous mammals and birds), and humans (Figure 2-1).

Benthic invertebrates live and feed in direct contact with sediment, pore water, and surface water and the contaminants present in these environmental media. Bottom-dwelling organisms form the base of the aquatic food web and are exposed to impacted sediment through the direct contact and ingestion pathways.

Fish serve as prey to piscivorous birds, mammals, and humans. Fish are exposed to contaminants in surface water via gill exchange and diets that include benthic organisms and smaller fish that feed on benthic organisms. This results in bioaccumulation in fish: fish tissue concentrations increase as smaller species are eaten by larger predatory species over time. Piscivorous birds and mammals are primarily exposed to bioaccumulative chemicals, such as mercury and PCBs in surface water and sediment, via diet when they consume prey (invertebrates and fish) that is in direct contact with such chemicals. Humans are also potential receptors of the contaminants through the consumption of fish or when exposed to contaminants in the water and sediment of the MKE Bay during recreational activities.

3. Remedial Action Objectives and Remediation Target Areas

RAOs are statements that describe the overall goals that remedial action should achieve to provide adequate protection of human health and the environment while meeting regulatory requirements. GLNPO applies the following general RAOs to the remedial actions conducted as part of the GLLA:

- Reduction of exposure to COCs in sediment and pore water
- Reduction of COCs in biota
- Reduction of sediment-related toxicity
- Improvement of biota and biological communities
- Improvement in habitat quality
- Remediation of sediment contamination based on volume, area, and/or mass basis

Screening levels are COC concentrations that are used to develop RTAs that include areas and volumes of media (sediment) targeted for active remediation. After a preferred alternative is recommended, quantitative cleanup goals (CUGs) will be established for the project using site-specific screening levels as a starting point.

3.1 Site-specific Remedial Action Objectives

The site-specific RAOs for the MKE Bay Project Area include remedial goals to improve environmental quality in the portion of the AOC where the project is located, and to support removing BUIs and delisting the AOC. The following site-specific RAOs have been established for the MKE Bay Project Area:

- Support removal of BUIs within the Milwaukee Estuary AOC by reducing the mass, volumes, and concentrations of COCs in the sediment. This will be achieved by addressing sediment with COCs exceeding the CUGs, thereby reducing exposure and risk to ecological and human receptors. The remediation of contaminated sediment in the project area will make progress towards eliminating the following sediment-related BUIs:
  - Restrictions on fish and wildlife consumption
  - Degradation of fish and wildlife populations
  - Fish tumors or other deformities
  - Bird or animal deformities or reproduction problems
  - Degradation of benthos
  - Restrictions on dredging activities
  - Loss of fish and wildlife habitat

  Evaluation of the pre- and post-remediation status for the listed BUIs will be included in RAP Updates for the Milwaukee Estuary AOC completed outside of this project.

- Reduce risks to human health and the environment from exposure to COCs in sediment. This will largely be accomplished by supporting the removal of BUIs through remediation of sediment with COC concentrations above the CUGs.

- Maintain depth requirements within the authorized FNC portion of the MKE Bay.

3.2 Screening Levels and Remediation Target Areas

Sediment screening levels were selected in consultation with EPA and WDNR with the goal of consistent application across the various sediment project areas within the Milwaukee Estuary AOC (Menomonee River, Milwaukee River Downtown Reach, SMC, Kinnickinnic River, and MKE Bay). Screening levels for total PAHs and metals (chromium, lead, and mercury) are based on PECs defined in the WDNR's CBSQG (WDNR 2003), as well as values based on 3 times the PECs. Screening levels for total PCBs are 1 mg/kg and 3 mg/kg.

RTAs were developed using three different screening level scenarios to provide flexibility in developing remedial alternatives for the MKE Bay Project Area and to facilitate planning for the overall Milwaukee Estuary AOC. The three screening level scenarios are based on EPA and project partner agreement as follows:

- Scenario 1: PECs for PAHs and metals and 1 mg/kg PCBs
- Scenario 2: 3 times PECs for PAHs and metals and 1 mg/kg PCBs
- Scenario 3: 3 times PECs for PAHs and metals and 3 mg/kg PCBs

The RTAs for each screening level scenario were developed using a Thiessen Polygon network approach instead of Earth Volumetric Studio (EVS) modeling (as was used for other areas in the Milwaukee Estuary AOC). The selection of a Thiessen Polygon approach was determined to be the most applicable following review of the data distribution within each of the five MKE Bay subareas. This review concluded that several subareas (Northern Outer Harbor, Southern Outer Harbor, and Slip #2) have insufficient data densities to perform three-dimensional (3D) kriging in EVS. While the McKinley Marina and Summerfest Lagoon subareas have sufficient data for kriging, the same methodology was used for all MKE Bay Project subareas to determine RTAs and volume estimates for consistency of methodologies.

Sediment sample data sets used to develop the Thiessen Polygons include:

- 2020 Kinnickinnic River and Outer Harbor /Nearshore Area Sediment Investigation performed by Anchor QEA on behalf of WDNR (Anchor QEA 2021a)
- 2021 Kinnickinnic River and MKE Bay Data Gap Sediment Investigation performed by Anchor QEA on behalf of WDNR (Anchor QEA 2021b)

The Thiessen Polygon layout was established in ArcGIS using the MKE Bay Project Area sediment sampling locations. Each of the subarea boundaries was superimposed on the polygon layout established for the project area. The Thiessen Polygon area and the depth of contamination at each sample location with concentrations exceeding the COC screening levels for each scenario were used to estimate RTA areas and volumes. A vertical overdredge allowance of 0.5 feet was added to account for variability in sediment removal through dredging. The volumes presented in Table 3-1 assume all sediment is removed; sediment associated with potential utility or shoreline offsets or side slopes was not deducted from the Table 3-1 volumes.

The RTAs for the McKinley Marina, Summerfest Lagoon, and South Slip #2 subareas are presented in Figures 3-1, 3-2, and 3-3, respectively, with RTAs for three screening level scenarios depicted in separate panels on each figure. The RTAs for the Northern Outer Harbor and Southern Outer Harbor subareas are presented for each screening level scenario on Figures 3-4 and 3-5, respectively.

The estimated contaminated sediment volumes associated with each screening level scenario for each MKE Bay subarea are summarized in Table 3-1. Quantity estimates for the Northern and Southern Outer Harbors subareas are based on 18 sample locations (13 and 5 locations, respectively) across 560 acres (260 and 300 acres, respectively) resulting in an average data density of greater than 31 acres per location. This data density results in an elevated level of uncertainty for estimated target remediation volumes for these subareas.

Note that the remediation removal volume estimated quantities are based on screening level exceedances as previously described; however, actual dredge volumes may change during the remedial design phase of the project because of additional information and engineering considerations pertaining to shorelines, in-water structures, and utilities. In addition, the IGLD 1985 is in the process of being revised and will be replaced by IGLD 2020 (NOAA 2022). As part of this process, the LWD and authorized elevation for the FNC may also be revised, with current proposals indicating a lowering by 1 foot (USACE 2022). The changes to the IGLD and the LWD are anticipated to be implemented by 2027. Any changes to the dredging elevations and volumes for FNC in the MKE Bay Project Area in response to the IGLD update will be incorporated during the remedial design.

4. Remedial Technology Screening and Conceptual Alternatives Development

This section describes the identification and screening of potentially applicable remedial technologies and process options based on the RAOs and RTAs for the MKE Bay Project Area, and introduces the concepts used for identifying conceptual remedial alternatives.

4.1 Remedial Technology Screening

The technologies and process options identified for screening are presented in Table 4-1. The objective of technology screening is to retain the best technology types and process options and streamline the development and evaluation of remedial alternatives. There are multiple process options associated with some of the technologies included in the table. The remedial technologies were evaluated using the qualitative screening criteria of effectiveness, implementability, and relative cost.[9] The last column in Table 4-1 provides a summary screening comment for each remedial technology and process option.

Each technology screening criterion considered the following:

- **Effectiveness**: Key considerations include:
  - The extent the technology and/or process option would be protective of human health and the environment and meet the RAOs.
  - The level of treatment and removal that could be achieved.
  - The extent to which the technology and process option has been demonstrated at similar sites.

  Protection of human health and the environment refers to the effectiveness of the technology in reducing the toxicity and mobility of contaminants in the sediment or in meeting RAOs. The level of treatment and removal refers to the degree to which the technology reduces contaminant mass.
- **Implementability:** Refers to the feasibility and/or availability of a given process option for this project area. Feasibility is further assessed based on technical and/or administrative considerations. Technical feasibility refers to the ability to adequately treat and remove the COCs given site-specific conditions. Certain options may be able to address the COCs but cannot be implemented because of factors like space limitations or unacceptable subsurface conditions. Administrative feasibility refers to the ability to meet factors such as local and state permitting requirements or regulatory reviews for approval. Potential permit requirements are listed in Appendix C to this document. Availability refers to factors such as the geographic location of the site and the extent to which the remedial option is commercially available.
- **Relative Costs:** Table 4-1 presents relative differences in cost magnitude (low, moderate, or high) taking into consideration anticipated capital and operations and maintenance costs. As such, cost considerations are provided for general assessment and were not used singly for technology screening decisions unless substantial cost differences are identified that would immediately preclude further consideration.

[9] These evaluation criteria are used for the technology screen only; additional evaluation criteria are used in Section 6 to evaluate the conceptual remedial alternatives.

Based on the evaluations performed for the MKE Bay Project Area, and WDNR's disposal alternatives evaluation (WDNR 2020) the following technologies were retained for further evaluation as components of remedial alternatives as summarized in Table 4-1:

- No Action (required and retained for comparison to other technologies)
- Continued Natural Recovery
- Sediment Removal
- Residuals Management
- Sediment Disposal
- Sediment Dewatering
- Sand Cover
- Sediment Stabilization and Solidification
- Particle Size Segregation and Washing

While dredging is the preferred remedial approach for sediment in the other Milwaukee Estuary AOC project areas, the large volumes estimated for the Northern and Southern Outer Harbor subareas (a total of over 3 million cubic yards as shown in Table 3-1) exceed the available capacity in the DMMF. Overall, COCs are more widely dispersed and present at lower concentrations in the MKE Bay Project Area compared to other AOC project areas (see Section 2.4). Although additional sampling would provide more refined volume estimates for these subareas, refined volume estimates likely would still exceed available DMMF capacity and the high cost of offsite disposal of dredged sediment would be prohibitive. Therefore, dredging has been screened out as a remedial technology for the Northern and Southern Outer Harbor subareas.

Dredging in the other MKE Bay subareas (McKinley Marina, Summerfest Lagoon, and Slip #2) may be constrained by various site conditions, including the bulkhead walls, utility crossings, pier structures within the marina, and other infrastructure elements. Remedial design for removal of contaminated sediment adjacent to in-water structures and utilities will require additional information and engineering considerations to address structural stability during and following remedial action.

The shoreline assessment for the MKE Bay Project Area (Jacobs 2022a) included visual observation of above-water natural or constructed shoreline materials (Figures 1-3 through 1-8), qualitative notation of structural conditions, critical structures, utility crossings, and sewer outfalls within the MKE Bay Project Area. The shoreline assessment does not provide structural evaluations for the suitability of construction activities near the existing bulkhead system.

The overall lack of as-built bulkhead data is a limiting factor for optimizing the design for sediment removal. The risk of bulkhead movement during proposed sediment removal should be discussed with the stakeholders during the development of the remedial design. These discussions should consider the impact of bulkhead movement on existing facilities, methods of mitigating the anticipated bulkhead movement during construction, sequencing of dredging operations, and imposing limits on the vertical and horizontal extent of sediment removal and possible replacement of material with aggregate.

Capping also has been screened out as a remedial technology for the Northern and Southern Outer Harbor. The RTAs for these subareas cover more than 500 acres, and engineered caps are not a cost-effective approach for risk reduction. Additionally, engineered caps would require institutional controls and long-term monitoring and maintenance over a large area, which is not warranted given the relatively low levels of contamination compared to other Milwaukee Estuary AOC project areas.

Instead of capping, placement of sand cover is a more cost-effective approach for reducing COC concentrations in surface sediment, helping isolate subsurface contamination, and enhancing the natural recovery (that is, deposition and accumulation of relatively cleaner sediment) that is already occurring and is expected to continue. Sand cover is effective in rapidly decreasing COC concentrations in the surface sediment, thereby reducing ecological and human health risks.

As discussed in the last paragraph of Section 2.4, site characterization data indicate that many areas of the Outer Harbor have recovered naturally through the deposition and accumulation of relatively cleaner sediment over time as upstream contaminant sources have been reduced or controlled. These natural recovery processes are expected to continue and to be further enhanced after remediation of the rivers delivering sediment to the MKE Bay Project Area. Continued natural recovery is expected to reduce COC concentrations in surface sediment and further bury and isolate subsurface contamination.

4.2 Conceptual Remedial Alternatives

The conceptual remedial alternatives for the MKE Bay Project Area are summarized in Exhibit 4-1. The remedial alternatives for the McKinley Marina, Summerfest Lagoon, and South Slip #2 subareas are different than the alternatives for the Northern and Southern Harbor subareas because dredging has been screened out as a technology for the latter.

Exhibit 4-1. Conceptual Remedial Alternatives for the MKE Bay Project Area

Alternative	McKinley Marina, Summerfest Lagoon, South Slip #2 Subareas	Northern and Southern Outer Harbor Subareas
1	No Action	No Action
2	Dredge sediment with COC concentrations exceeding PECs for PAHs or metals or exceeding 1 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding PECs for PAHs or metals or 1 mg/kg PCBs
3	Dredge sediment with COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs
4	Dredge sediment with COC concentrations exceeding 3 times PECs for PAHs or metals or 3 mg/kg PCBs	Place sand cover over sediment outside the FNC with COC concentrations exceeding 3 times PECs for PAHs or metals or 3 mg/kg PCBs
5	Focused dredging in South Slip #2 Focused sand cover in Summerfest Lagoon Quiet Basin for areas with COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs Continued natural recovery outside focused dredging and sand cover areas where COC concentrations are already below screening levels in surface sediment and are above screening levels in subsurface sediment	Focused sand cover in Northern Outer Harbor for areas with surface sediment COC concentrations exceeding 3 times PECs for PAHs or metals or 1 mg/kg PCBs Continued natural recovery outside focused sand cover areas where COC concentrations are already below screening levels in surface sediment and are above screening levels in subsurface sediment

For the McKinley Marina, Summerfest Lagoon, and South Slip #2 subareas, Alternatives 2, 3, and 4 were developed using the same approach, common set of technologies, and methodology used for the other Milwaukee Estuary AOC project areas. Sediment that can be feasibly removed is dredged and isolation technologies are applied to the sediment remaining in place. Therefore, Alternatives 2, 3, and 4 differ from each other only with respect to the screening levels used to establish the RTAs and the associated removal volume estimates, which directly reflect the screening scenarios shown in Exhibit 4-1. The extent and characteristics of the sediment that remains in place after dredging is different for each screening level scenario. The RTAs for Alternatives 2, 3, and 4 for the McKinley Marina, Summerfest Lagoon, and South Slip #2 subareas are presented on Figures 3-1 through 3-3, respectively. Note that there is no Alternative 4 for the McKinley Marina because there are no applicable screening level exceedances.

For the Northern and Southern Outer Harbor subareas, Alternatives 2, 3, and 4 assume sand cover instead of dredging. The FNC in the Southern Outer Harbor subarea, which has a sediment elevation that is currently near or at the authorized elevation of 550 feet NAVD88, will not be covered because dredging would be required to ensure that the top of the sand cover would not interfere with FNC maintenance requirements.[10] The Northern and Southern Outer Harbor cover areas are shown on Figure 4-1 as overlays on surface and subsurface COC exceedance information.

Alternative 5 focuses dredging and sand cover placement in areas where potential current or future risks to human and ecological receptors are the greatest as summarized herein for each subarea. The Scenario 2 screening levels (3 times PECs for PAHs or metals or 1 mg/kg PCBs) used in Alternative 3 are also used for Alternative 5. In areas with no screening level exceedances in the top 1 foot of sediment and screening level exceedances in sediment below 1 foot, the surface sediment layer is expected to minimize the exposure of biota to the subsurface COCs. Although the site-specific thickness of the biologically active zone in MKE Bay sediment was not determined for the FFS, EPA recommends 15 to 20 cm (6 to 8 inches) for decisions related to ecological assessment or remediation in low energy freshwater environments (EPA 2015).

Alternative 5 includes the following components for each subarea:

- McKinley Marina: No Action
  - Metals and PAH concentrations do not exceed 3 times PECs.
  - PCB concentrations in surface sediment samples range from 0.052 mg/kg to 1.9 mg/kg, with an average of 0.67 mg/kg. The PCB concentration in one surface sediment sample exceeds 1 mg/kg by less than a factor of two (1.9 mg/kg at MKE-20-077). Given the overall low levels of contamination in the marina (Figure 2-3), this isolated exceedance is not targeted for remediation.
- Summerfest Lagoon Maritime Basin: Continued Natural Recovery
  - Surface sediment with COC concentrations less than applicable screening levels minimizes exposure to subsurface sediment with COC concentrations above screening levels at three sample locations (Figure 4-2). Natural recovery processes are expected to continue to add cleaner sediment to the surface.
- Summerfest Lagoon Quiet Water Basin: Focused Sand Cover Placement
  - Focused sand cover placement at the south end of the Quiet Water Basin where COC concentrations in subsurface sediment exceed applicable screening levels (Figure 4-2) and where a fish habitat rehabilitation project is also planned (Section 1.3.2 and Figure 1-4).

[10] Sand cover installation within the FNC requires sediment removal up to 3.5 to 4.5 feet below the authorized elevation to account for 1 foot of overdredge allowance beyond the authorized depth, 2 feet of clearance from the final remediation surface per USACE recommendations for navigation channels, and 0.5 to 1.5 foot of depth for the application of the sand cover.

- South Slip #2: Focused Dredging
  - Focused dredging in the northeastern portion of the slip to address applicable screening level exceedances in subsurface sediment in an area that may be subject to periodic maintenance dredging and disturbances from vessel traffic (Figure 4-3).
- Northern Outer Harbor: Focused Sand Cover Placement and Continued Natural Recovery
  - Focused sand cover placement in the southern portion of the Northern Outer Harbor where applicable screening levels in surface sediment are exceeded at three sample locations (Figure 4-4).
  - Continued natural recovery in the northern portion of the Northern Outer Harbor where surface sediment with COC concentrations less than the applicable screening levels minimizes exposure to subsurface sediment with COC concentrations exceeding screening levels at five sample locations (Figure 2-6). Natural recovery processes are expected to continue to add cleaner sediment to the surface.
- Southern Outer Harbor: Continued Natural Recovery
  - Surface sediment with COC concentrations less than applicable screening levels minimizes exposure to subsurface sediment with COC concentrations exceeding screening levels at three sample locations (Figure 2-7). Natural recovery processes are expected to continue to add cleaner sediment to the surface.

In subareas designated for continued natural recovery, the potential for future exposure to sediment below the top 1 foot may need to be assessed if Alternative 5 is selected as the preferred alternative. Additional details regarding the remedial alternatives are provided in Section 5.

5. Remedial Alternatives Description

The remedial technologies and process options that remained after screening (Table 4-1) are incorporated into the following remedial alternatives for the MKE Bay Project Area:

- **Alternative 1:** No Action
- **Alternatives 2, 3, and 4:** Dredging alternatives for McKinley Marina, Summerfest Lagoon, and South Slip #2 subareas, and sand cover alternatives for the Northern and Southern Outer Harbor subareas for the RTAs shown on Figures 3-1 through 3-5, respectively.
- **Alternative 5:** Focused sand cover placement in Summerfest Lagoon Quiet Water Basin (Figure 4-2), focused dredging in South Slip #2 (Figure 4-3), focused sand cover placement in the Northern Outer Harbor subarea (Figure 4-4) and continued natural recovery in Summerfest Lagoon Maritime Basin and portions of the Northern and Southern Outer Harbors. No remediation would be performed in McKinley Marina.

The details and assumptions for each alternative are the basis for the cost estimates that are provided in Appendix D. Additional specificity for each element (for example, means and methods, equipment sizes and numbers, and production rates) will be developed during the remedial design. Additional process options may be evaluated during remedial design.

5.1 Alternative 1: No Action

The No Action alternative is included in the alternatives for comparison purposes. Under Alternative 1, no remedial actions are conducted to control exposure to contaminated sediment. Existing fish consumption advisories likely remain in place and BUIs are not addressed through sediment remediation. Natural degradation of contaminants is not likely to occur at a measurable rate or within a reasonable time period, although contaminated sediment may be gradually buried over time by deposition of sediment at urban background concentrations from upstream.

5.2 Alternatives 2, 3, or 4

Dredging the sediment with COC concentrations greater than the applicable CUGs is accomplished in the area covering each RTA (Figures 3-1, 3-2, 3-3, respectively). There was no TSCA-level sediment identified in the RTAs. A summary of the estimated quantities associated with the alternatives (sediment removal, residual cover, sand cover placement and water treatment) is provided in Table 5-1. The in-water work during remedial action is estimated to take approximately 13 months for Alternative 2 and 10 months for Alternatives 3 or 4, and is primarily dependent on the area designated for cover placement. A summary of remedial actions associated with each Alternative (2, 3, 4, or 5) is depicted on Figures 5-1 through 5-3 along with concentration and screening level exceedance information for surface and subsurface sediment.

5.2.1 Sediment Removal

The sediment will be hydraulically dredged and transported by pipeline to the DMMF, with mechanical dredging used only for debris or material too deep to reach with hydraulic methods. Turbidity control and monitoring, such as use of a silt or bubble curtain, may be implemented to prevent migration of suspended sediment for either dredging technology. The staging area(s) to be used for processing debris and staging cover material will be identified during remedial design, with the goal of locating the staging area as near as possible to the work area(s).

Hydraulic dredging is more cost effective than mechanical dredging for the MKE Bay conditions, minimizing a need for barges that are susceptible to poor weather conditions, minimizing turbidity, and reducing impact to commercial and recreational vessel traffic. Sediment is loosened by a hydraulic cutter and removed by suction along with adjacent water into a leak-tight, high-density polyethylene (HDPE) pipeline; sediment slurry is then pumped through the pipeline directly to the DMMF. The water depth within subareas of MKE Bay, sediment removal depth, production rates, and the water volume generated indicate that the cutter suction dredge diameter would range between 8- and 14-inches depending on location and remedial alternative. Dredge sequencing for the various subareas would be determined during remedial design. Approximately 18,000 lineal feet of HDPE and an estimated six booster pumping stations would be repositioned during active dredging work depending on subarea location (also to be sequenced during remedial design).

For the areas requiring mechanical dredging, a crane or excavator is placed on a floating barge. An environmental bucket that minimizes the loss of sediment and entrained water is used to remove sediment to the specified dredge cut elevation, with the dredged material screened at the dredge barge, slurried, and pumped to the DMMF.

5.2.2 Residuals Management – Sand Cover

In areas where the full vertical extent of contamination above the CUGs is removed, a 0.5-foot-thick residual sand cover will be placed on the post-dredge surface to reduce the mobility of dredging residuals and lower residual COC concentrations in post-dredge surface sediment. The sand cover may also accelerate re-establishment of benthic communities disrupted during the dredging activities. Sand placement methods will be selected to provide a controlled application by either casting or directly placing the sand to avoid displacement or significant penetration into the underlying sediment. Means to verify the final thickness of the residual sand cover will be specified in the remedial design documents.

A residual sand cover thickness of 0.5 foot assumes placement of 0.75 feet to achieve a minimum 0.5-foot cover thickness. It is assumed that the sand will be obtained at an offsite source, but particle size segregation and washing (see Section 5.2.4), if determined to be feasible from treatability study results, may also provide an opportunity for beneficially reusing the coarse grained fraction of dredged material for sand cover. Sand placement and thickness verification methods will be specified in the remedial design documents.

5.2.3 Sediment Transport, Dewatering, and Disposal

Hydraulically and mechanically dredged sediment will be transported to the DMMF via pipeline, where it will be passively dewatered (settling and evaporation). The sediment may be treated with an appropriate coagulant, flocculant, or combination thereof to aid suspended sediment sedimentation rates (determined based on treatability testing being performed during 2023). The pipeline will be submerged in the water in some areas to minimize navigational disruption to the waterways and monitored during pumping to assure rapid and appropriate repairs of leaks or other malfunctions. The pipeline will surface at booster pumps located on barges and at the DMMF.

A temporary water treatment system will be constructed near the DMMF for the treatment of supernatant water from the DMMF before discharge to Lake Michigan under a WPDES permit. The treatment process required to meet the WPDES permit requirements is expected to consist of an ultra-high capacity clarifier, metals precipitation, sand filters, bag filters, and granular activated carbon treatment system.

It is assumed that the DMMF will be designed to provide sufficient settling time for hydraulically pumped sediment. The minimum residence time required will be finalized based on the results of the treatability study.

Excess free water generated from mechanical dredging will be pumped from the scows to the DMMF with the dredge slurry.

5.2.4 Particle Size Segregation and Washing

If feasible, particle size segregation for non-TSCA regulated sediment may be considered. Grain size data indicate that sediment in the MKE Bay Project Area contains a variable level of sand (average of 35 percent coarse fraction by weight) and depending on the quantity removed under Alternatives 2, 3, or 4, it may be suitable for beneficial reuse for cover material within the project area or for other purposes. Vibrating screens, hydrocyclones, and wash bars would be used to separate sand from the fine-grained fraction, allowing disposal of only fine-grained material with higher COC concentrations in the DMMF.

Particle size segregation and washing would require water as part of the process. Reusing the treated water for washing purposes reduces the need for handling and treatment of additional water at the DMMF. The benefits of reusing sand as cover material may outweigh the disadvantages of acquiring and transporting large volumes of sand. An additional benefit of reusing the sand from dredged sediment is a reduction in the amount of material that requires DMMF disposal, thereby reducing DMMF capacity requirements.

The feasibility and cost effectiveness of particle size segregation will be further investigated as part of the ongoing treatability study and during the remedial design. Washing and testing will be performed to confirm that chemical concentrations of the segregated sand meet project requirements. For the purposes of the FFS, it is conservatively assumed that particle size segregation will not be feasible, and all hydraulically pumped sediment will be placed in the DMMF.

5.2.5 Sand Cover Placement

Sand cover will be placed to decrease COC concentrations in surface sediment and help isolate subsurface contamination. For sand cover areas, the cost estimate assumes that a 1.5-foot-thick sand layer will be placed in areas where COC concentrations in the surface sediment exceed the applicable CUGs (Figures 5-1 through 5-3). In areas where COC concentrations exceed the CUGs in subsurface sediment only, a 0.5-foot-thick sand layer will be placed to reduce the potential for subsurface sediment to be exposed (Figures 5-1 and 5-2). Cover thickness and material requirements, as well as placement and thickness verification methods, will be specified in the remedial design documents.

The remedial design will further examine beneficial reuse opportunities to source sand cover materials. The cost estimates provided herein assume quarry sand will be used for the sand cover component of the remedy.

5.2.6 Confirmation Sampling and Other Verification Activities

Post-dredging sediment confirmation sampling is anticipated to be required in dredged areas only, and not areas not designated for sand cover placement. Results of confirmation sampling will be used to assess the success of dredging in reducing COC concentrations below CUGs in accordance with the post-dredge management plan developed during design. The final thicknesses of the sand cover areas will be verified using sampling methods such as coring or collection pan testing. A post-remediation bathymetric survey also will be performed to confirm final post-remediation elevations. Specific confirmation sampling and verification approaches will be documented in the appropriate remedial design document, such as a Construction Quality Assurance/Construction Quality Control plan and the associated field sampling plans.

5.2.7 Debris Removal and Disposal

The types and amount of debris in each MKE Bay subarea have not been quantified. Side-scan sonar and magnetometer surveys will be conducted during remedial design to quantify and locate large debris that will require removal. Debris will be removed using mechanical means. The size of debris that can be removed will be limited by the lift capacity of the mechanical equipment that the contractor has onsite. Additional costs to the project will be incurred if the contractor is required to mobilize additional, larger equipment or perform diver-assisted removal. For cost estimating purposes it is assumed that debris impacting the dredging operation will be removed using mechanical means and transported by barge to the DMMF for disposal. Debris management and disposal, including identification of potential recycling opportunities, will be addressed further in remedial design.

5.3 Alternative 5

Alternative 5 includes a combination of remedial actions for the various subareas, as follows:

- Focused dredging – South Slip #2 subarea
- Focused sand cover – Portions of the Summerfest Lagoon Quiet Water Basin and Northern Outer Harbor subareas
- Continued natural recovery –Summerfest Lagoon and the Northern and Southern Outer Harbors.
- No action – McKinley Marina

The focused dredging and sand cover footprints for Alternative 5 are shown on Figures 4-2 through 4-4. Table 5-1 summarizes the areas identified for dredging and sand cover, the estimated removal volumes, and the sand volume required for the cover. In areas where focused dredging is planned, the work would be implemented using mechanical dredging (described in Section 5.2.1) due to the limited volume removed and proximity to the DMMF. Following dredging a residual sand cover would be applied as described in Section 5.2.2.

Continued natural recovery processes will add additional clean sediment to the surface in areas where COC concentrations are already below CUGs in surface sediment and are above CUGs in subsurface sediment.

The material specifications, thicknesses, and placement methods for the sand cover in the Summerfest Lagoon Quiet Basin and the Northern Outer Harbor subarea will be determined during the remedial design. Alternative 5 assumes that 1 foot of sand cover will be placed in the southern portion of the Summerfest Lagoon Quiet Basin because this area is a bathymetric depression and additional materials will be placed on top of the cover as part of the planned habitat improvement project (Ramboll 2020). For costing purposes, a 1.5-foot-thick sand layer has been assumed for the Northern Outer Harbor (Figure 5-1).

Pre-design sampling will be performed to refine the area of sand cover placement in the Northern Outer Harbor. Shipwrecks and the presence of other historical or cultural resources could limit the extent of sand placement in some areas. The potential for future exposure to contaminated sediment below the top 1 foot should be assessed in areas identified for continued natural recovery.

The anticipated construction timeframe for Alternative 5 is 5 months.

6. Detailed Analysis of Alternatives

6.1 Evaluation Criteria

The remedial alternatives developed in Section 5 were evaluated using the criteria described herein to support selection of a recommended remedy. The criteria provide the basis for comparing expected alternative performance and are used to identify the advantages and disadvantages of each alternative and trade-offs between alternatives. The evaluation criteria consider both EPA's nine criteria for evaluating remedial alternatives in feasibility studies[11] and WDNR's evaluation criteria for selecting remedial actions.[12] The criteria are divided into three groups: threshold, balancing, and modifying criteria summarized as follows:

- **Threshold Criteria**
  - Compliance with environmental laws and standards
- **Balancing Criteria**
  - Long-term effectiveness
  - Short-term effectiveness
  - Implementability
  - Restoration time frame
  - Cost
- **Modifying Criteria**
  - Project partner acceptance

6.1.1 Threshold Criteria

Threshold criteria must be met by an alternative for it to be eligible for selection as a remedial action. The single threshold criterion is compliance with environmental laws and standards. To be eligible for selection, an alternative must meet applicable federal, state, and local regulations, or justification must be provided that a waiver is appropriate.

Compliance with applicable federal, state, and local regulations is one of the statutory requirements of remedy selection. Applicable regulations are cleanup standards, standards of control, and other substantive environmental statutes or regulations. Applicable requirements address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a site. The assessment of this criterion describes how the alternative complies with applicable federal, state, and local regulations or presents the rationale for waiving an applicable requirement. The identification of potentially applicable regulations and associated permits relative to the remedial alternatives is summarized in Appendix C.

6.1.2 Balancing Criteria

Unlike the threshold criteria, the balancing criteria weigh the trade-offs between alternatives. A low rating for one balancing criterion can be compensated for by a high rating for another criterion. The five

[11] 40 Code of Federal Regulation § 300.430 (e)(9)(iii)
[12] WDNR Chapter NR 722.07(4) and NR 722.09 (2)

balancing criteria described in the following subsections are used to identify the advantages and disadvantages of each alternative and weigh the trade-offs between alternatives.

6.1.2.1 Long-term Effectiveness

This criterion considers the degree to which an alternative will protect human health and the environment over time. Long-term effectiveness considers the ability of the alternative to achieve RAOs and contribute to BUI removal. It includes evaluation of the amount of residual contamination anticipated to be left in place, the adequacy and reliability of long-term controls in preventing exposure to residual contamination that is left in place, and the potential for recontamination following the remedial action. Long-term effectiveness also evaluates the expected performance of the alternative in response to extreme storm events and climate change.

6.1.2.2 Short-term Effectiveness

The short-term effectiveness criterion assesses potential adverse impacts on public health, safety, welfare, and the environment during the construction and implementation of the alternative. It considers protection of workers during the remedial action, protection of community during the remedial action, and environmental impacts of the remedial action. It also considers the time until the RAOs are achieved.

6.1.2.3 Implementability

This criterion considers both technical and administrative feasibility of the alternative. The technical feasibility evaluation considers the ease of implementation, reliability, constructability, availability of goods and services needed for its implementation, and identifies potential difficulties and constraints associated with onsite construction or offsite disposal and treatment. The administrative feasibility evaluation considers the activities and time needed to obtain necessary licenses, permits or approvals, the need for institutional controls, and degree of coordination with other agencies.

6.1.2.4 Restoration Timeframe

The restoration timeframe criterion considers the time required to restore trees, vegetation and habitat that were cleared or disturbed to access work areas and conduct the remedial action.

6.1.2.5 Cost

Cost encompasses the design, engineering, construction, and operations and maintenance costs incurred over the life of the project. The assessment of this criterion is based on the estimated capital costs, annual operations and maintenance costs, and total present worth of the costs for each alternative. Present worth is a method of evaluating expenditures that occur over different lengths of time. This allows costs for remedial alternatives to be compared by discounting the costs to the year in which the alternative is implemented. The present worth of a project represents the amount of money, which if invested in the initial year of the remedy and disbursed as needed, would be sufficient to cover the costs associated with the remedial action. These estimated costs are expected to provide an accuracy of plus 50 percent to minus 30 percent. Appendix D provides a breakdown of the cost estimate for each alternative that is described in Section 5.

The cost range applies only to the alternatives as they are described and does not account for changes in the scope of the alternatives. Selection of specific technologies or processes to configure remedial alternatives is intended not to limit flexibility during remedial design but to provide a basis for preparing cost estimates. The specific details of the remedial actions and cost estimates are refined during the remedial design.

6.1.3 Modifying Criteria

The modifying criterion is project partner acceptance. This criterion will be evaluated after the project partners have reviewed and provided comments on the remedial alternatives and associated individual and comparative alternative analyses. Project partner acceptance will be considered when selecting the recommended alternative, which will be presented in the FFS report.

6.2 Alternatives Analysis

Alternatives 1 through 5 were evaluated using the threshold and balancing evaluation criteria. Evaluation results for each criterion are summarized in Table 6-1. The differences in Alternatives 2 through 4 arise from differences in the CUGs and associated areas and volumes of each RTA; Alternative 5 relies on focused dredging to reduce removal volumes and sand cover placement to decrease COC concentrations in surface sediment and help isolate subsurface contamination. Key findings of the alternatives analysis are as follows:

- Alternatives 2, 3, 4, and 5 can be designed to comply with applicable federal, state, and local regulations, and therefore meet the threshold criterion.
- Alternative 2 has the greatest long-term effectiveness because it is based on the most conservative (lowest) set of CUGs. It results in the greatest reduction of mass, volume, and concentration of COCs in sediment compared to Alternatives 3, 4, and 5.
- Alternative 5 has the greatest short-term effectiveness because the remedy would be completed in the shortest time and would impact the smallest area. Short-term effectiveness does not apply to Alternative 1.
- Alternative 5 is the most implementable because it requires the least amount of DMMF capacity and sand cover material.
- The technical and administrative challenges are similar for Alternatives 2, 3, and 4, with Alternatives 4, 3, and 2 being progressively less implementable than Alternative 5.
- The restoration time frames are similar for Alternatives 2, 3, 4, and 5.
- Alternative 5 has the lowest estimated cost ($46.2 million [M]). Alternatives 4, 3, and 2 are substantially more costly compared to Alternative 5 ($126.3M, $141.9M, and $241.8M, respectively). Alternative 5 also has the shortest estimated construction timeframe of 5 months, as compared to 13 months for Alternative 2, and 10 months each for Alternatives 3 and 4.

7. Recommended Alternative

The project partners have identified Alternative 5 (shown on Figures 4-2, 4-3, and 4-4) as the recommended alternative for the MKE Bay Project Area. Alternative 5 addresses sediment with COC concentrations exceeding CUGs (3 times PECs for PAHs and metals, and 1 mg/kg for PCBs) through focused dredging in the South Slip #2 subarea, and focused sand cover placement in portions of the Summerfest Lagoon Quiet Water Basin and the Northern Outer Harbor subareas. Subareas where COC concentrations exceed CUGs in subsurface sediment only (Summerfest Lagoon, the northern portion of the Northern Outer Harbor, and the Southern Outer Harbor) will be managed using continued natural recovery. Natural recovery has occurred in these subareas and is anticipated to continue following remediation of sediment in the upstream tributaries to the Bay. The recommended alternative will achieve the site-specific RAOs by reducing the mass, volume, and concentrations of COCs in the MKE Bay Project Area sediments, reducing risks to human health and the environment from exposure to COCs in sediment, and maintaining depth requirements within the authorized FNC portion of the MKE Bay. The remedy will contribute to the eventual removal of BUIs and delisting of the Milwaukee Estuary AOC.

Alternative 5 was selected based on evidence that natural recovery has already occurred and is expected to continue in the MKE Bay Project Area, the relatively lower levels of contamination observed in the MKE Bay Project Area compared to other project areas in the Milwaukee Estuary AOC, and consideration of project costs and disposal capacity for the DMMF on an AOC-wide basis. Dredged material volume estimates for Alternatives 2 through 4 exceed the available DMMF capacity, and capping is not a cost-effective approach for remediating the large areas of diffuse, lower-level contamination in the Outer Harbor. Sediment core data indicate that natural deposition of relatively cleaner sediment is resulting in the gradual burial and isolation of subsurface contamination, and the quality of the depositional sediments is expected to improve as remedial actions are completed on the Milwaukee, Menomonee, and Kinnickinnic Rivers. The recommendation considers the relatively lower levels of contamination observed in the MKE Bay Project Area compared to other project areas in the Milwaukee Estuary AOC and focuses the dredging and sand cover in areas where potential current or future risks to human and ecological receptors are the greatest. Additional sampling will be performed in remedial design to refine the focused dredging and sand cover placement areas.

The recommended alternative was the subject of public outreach efforts accomplished during four public informational meetings held on the following dates: November 02, 2023; February 15, 2024; April 25, 2024; and June 14, 2024. These meetings were conducted to share information regarding the FFS recommended alternatives and to answer questions regarding the reports and the AOC-wide project. Questions posed at the meetings or posted to an online website were summarized into a Frequently Asked Questions document included as Appendix E to this Final FFS Report.

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Tables

Table 2-1. Summary of Permitted Discharges - Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Site Name	Site Address	Permit Type	Permit Identification	Permittee	Permit Status
Milwaukee County South Shore Park Beach Improvements	2900 South Shore Drive	Stormwater Construction	S067831	Milwaukee County	6 - Permit Coverage Granted
American Family Insurance Amphitheater Improvements	200 North Harbor Drive	Stormwater Construction	S067831	Milwaukee World Festival Inc	6 - Permit Coverage Granted
Federal Marine Terminals	1200 South Lincoln Memorial Drive	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	Federal Marine Terminals	6 - Permit Coverage Granted
Milwaukee Bulk Terminal- East Bay Street	1201 East Bay Street	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	Kinder Morgan Bulk Terminals Milwaukee Bulk Terminal	6 - Permit Coverage Granted
Kinder Morgan Milwaukee Bulk Terminals	1900 South Harbor Drive	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	Kinder Morgan Milwaukee Bulk Terminals	6 - Permit Coverage Granted
Kinder Morgan Milwaukee Bagging Terminal	1500 South Lincoln Memorial Drive	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	Kinder Morgan Terminal	6 - Permit Coverage Granted
South Shore Yacht Club	2300 East Nock Street	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	South Shore Yacht Club	6 - Permit Coverage Granted
United States Coast Guard Base Milwaukee	2420 South Lincoln Mem Drive	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	United States Coast Guard Base Milwaukee	6 - Permit Coverage Granted
United States Venture Inc – United States Oil Milwaukee Jones Island Terminal	1626 South Harbor Drive	Stormwater - Industrial	S067857 - Storm Water Industrial Tier 2 Permit	United States Venture Incorporated	6 - Permit Coverage Granted
War Memorial Center Parking Lot Renovation	Parcels addressed as 700 North Art Museum Drive and 750 North Lincoln Memorial Drive	Stormwater Construction	S067831	Milwaukee County Site	6 - Permit Coverage Granted
Buried North Filtered Water Reservoir Waterproofing Repairs	Linnwood Water Treatment Plant	Stormwater Construction	S067831	Milwaukee Water Works	6 - Permit Coverage Granted

Information Sources (accessed April 2022):

Wisconsin Pollutant Discharge Elimination System main page

Search Construction

Search Industrial

Search Municipal

Note:

A municipal stormwater discharge permit associated with University of Wisconsin Milwaukee was identified during the search, but a physical address was not included in the permit details. It is not clear if this permit is relevant to the Milwaukee Bay Project Area.

Table 2-2. Summary of Bureau of Remediation and Redevelopment Tracking System Sites – Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Figure Identification	Wisconsin Department of Natural Resources Bureau for Remediation and Redevelopment Tracking System Number	Site Location	Site Address	Bureau for Remediation and Redevelopment Tracking Site, Site Status and Type	Impacted Material	Substance Type	Contamination Type
01	341184337	North Point Pumping Station	2275 North Lincoln Memorial Drive	Closed LUST	Soil	Petroleum - Unknown Type (2,500 gallon)	Petroleum
02	341001127	Milwaukee County - McKinley Marina	1750 North Lincoln Memorial Drive	Closed LUST	Soil	Gasoline - Unleaded and Leaded	Petroleum
03	341000710	Milwaukee Yacht Club	1700 North Lincoln Memorial Drive	Closed LUST	Soil	Petroleum - Unknown Type	Petroleum
04	341198284	United States Coast Guard Station - Former	1750 North Lincoln Memorial Drive	Closed LUST	Soil, GW	Petroleum - Unknown Type; Diesel Fuel	Petroleum
05	241584510	Lakeshore Park	750 North Lincoln Memorial Drive	Open ERP	Soil	PAHs, Metals, Arsenic, Lead, Mercury	Petroleum, Metals
06	341184845	Milwaukee Art Museum	750 North Lincoln Memorial Drive	Closed LUST	Soil	Petroleum - Unknown Type (two, 10,000-gallon heating oil underground storage tanks)	Petroleum
07	241525163	Pier Wisconsin Schooner Museum	500 North Harbor Drive	Closed ERP	No indication of impacted material(s) provided from the BRRTS database and no documentation was available to assess impacted material(s).	PAHs, VOCs	Petroleum, VOC
08	241001212	Milwaukee World Festival	200 North Harbor Drive	Open ERP	Soil	PAHs, Petroleum - Unknown Type, Cyanide	Petroleum, Industrial Chemical
09	341557220	Milwaukee World Festival Inc	200 North Harbor Drive	Open LUST	Soil, GW	Fuel Oil	Petroleum
10	341000420	Milwaukee City (Harbor Term Number 1)	1034 South Lincoln Memorial Drive	Closed LUST	Soil, GW	No indication of substance type from BRRTS Database. Diesel Fuel is inferred from the analytical results of the site closure request.	Petroleum
11	341000136	Milwaukee City	1200 South Lincoln Memorial Drive	Closed LUST	Soil, GW	Diesel Fuel	Petroleum
12	341004408	Climate Control Warehouses	1119 and 1123 South Lincoln Memorial	Open LUST	Soil, GW	Gasoline - Unleaded and Leaded, Diesel Fuel	Petroleum
13	341000135	Milwaukee City Harbor Term Number 4	1500 South Lincoln Memorial Drive	Closed LUST	GW	Diesel Fuel	Petroleum
14	341285702	Former PTW Incorporated	1414 South Harbor Drive	Closed LUST	Soil, GW	PAHs	Petroleum
15	241285695	Former PTW Incorporated	1414 South Harbor Drive	Closed ERP	Soil, GW	Petroleum - Unknown Type	Petroleum
16	241562075	United States Oil Milwaukee Jones Island Terminal	1626 South Harbor Drive	Closed ERP	Soil, GW	VOCs, PAHs, Petroleum - Unknown Type	VOC, Petroleum
17	341000825	Shell Oil Company (Jones Harbor)	1626 South Harbor Drive	Closed LUST	Soil, GW	Petroleum - Unknown Type	Petroleum
18	241115624	Jacobus Liquid Asphalt Pipeline	1726 South Harbor Drive	Closed ERP	Soil	Asphalt (Asphalt Oil)	Petroleum
19	341270187	Jacobus Jones Island Bulk	1726 South Harbor Drive	Closed LUST	Soil, GW	Diesel Fuel, PAHs	Petroleum
20	341582743	Jacobus Quick Fuel Number 1006 (Former)	1726 South Harbor Drive	Closed LUST	Soil	Diesel Fuel	Petroleum
21	241547267	Port of Milwaukee-Milwaukee, Wisconsin	1900 South Harbor Drive	Closed ERP	Soil	Urea	Industrial Chemical

Figure Identification	Wisconsin Department of Natural Resources Bureau for Remediation and Redevelopment Tracking System Number	Site Location	Site Address	Bureau for Remediation and Redevelopment Tracking Site, Site Status and Type	Impacted Material	Substance Type	Contamination Type
22	341000749	RUAN Leasing Company	1050 East Bay Street	Closed LUST	Soil, GW	Gasoline - Unleaded and Leaded	Petroleum
23	341215665	Naval and Marine Corps Reserve Centre Milwaukee	2401 South Lincoln Memorial	Closed LUST	Soil	Petroleum - Unknown Type (one, 4,000 grams)	Petroleum
24	341001636	Wisconsin Department of Transportation United States Coast Guard Base	2420 South Lincoln Memorial Drive	Open LUST	Soil and GW impacts inferred from the Actions section of the BRRTs database. No document explicitly states the type of impacted material on this site.	Gasoline - Unleaded and Leaded, Diesel Fuel	Petroleum
25	341227903	Trommel, Dorothy Residence	2603 South Shore Drive	Closed LUST	Soil	Petroleum - Unknown Type	Petroleum
26	341107254	South Shore Yacht Club	2300 East Nock Street	Closed LUST	GW	Gasoline - Unleaded and Leaded (6,000 gallon), Diesel Fuel (6,000 gallon)	Petroleum
27	241246343	RD Woods Company at South Shore Pavilion Site	2900 South Shore Drive	Open ERP	Potentially soil, no documentation is provided from the BRRTS database regarding impacted material.	RCRA Subtitle C Wastes	RCRA

Source: Wisconsin Department of Natural Resources (WDNR). 2022. Brownfields: Redevelopment Opportunities. RR Site Maps. Accessed April and December 2022.

BRRTS = Bureau for Remediation and Redevelopment Tracking System

ERP = Environmental Remediation Project

GW = groundwater

LUST = Leaking Underground Storage Tank

PAH = Polycyclic Aromatic Hydrocarbon

RCRA = Resource Conservation and Recovery Act

VOC = Volatile Organic Compounds

Table 3-1. Estimated Remediation Target Area Quantities - Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Screening Scenario	Subareas	Modeled Volume[a] (cubic yards)	Remediation Target Area[b] (acres)
Scenario 1 PCBs >1 mg/kg, or metals (Cr, Pb, Hg) or PAHs >PEC	McKinley Marina	360,300	68
	Summerfest Lagoon	94,000	13
	South Slip #2	22,000	7
	Northern Outer Harbor	2,434,000	260
	Southern Outer Harbor	1,917,000	300
	Total	**4,827,300**	**648**
Scenario 2 PCBs >1 mg/kg, or metals (Cr, Pb, Hg) or PAHs >3xPEC	McKinley Marina	90,300	36
	Summerfest Lagoon	64,000	9
	South Slip #2	17,000	5
	Northern Outer Harbor	2,013,000	260
	Southern Outer Harbor	1,715,000	250
	Total	**3,899,300**	**559**
Scenario 3 PCBs >3 mg/kg, or metals (Cr, Pb, Hg) or PAHs >3xPEC	McKinley Marina	0	Not applicable
	Summerfest Lagoon	64,000	9
	South Slip #2	17,000	5
	Northern Outer Harbor	1,849,000	260
	Southern Outer Harbor	1,715,000	250
	Total	**3,645,000**	**523**

Source:

Wisconsin Department of Natural Resources (WDNR). 2003. *Wisconsin Consensus-based Sediment Quality Guidelines. Recommendations for Use and Application, Interim Guidance RR-088*. December.

[a] Modeled volume of sediment containing concentrations exceeding the screening levels including overburden and 0.5 foot of overdredge allowance. Modeling was performed using Thiessen polygons.

[b] Represents surface area of remediation extent.

> = greater than

#2 = Number 2

3x = three times

Cr = chromium

CY = cubic yard

Hg = mercury

mg/kg = milligram(s) per kilogram

PAH = polycyclic aromatic hydrocarbon

Pb = lead

PCB = polychlorinated biphenyl

PEC = Probable Effect Concentration (PEC) for Cr, Hg, PAHs, and Pb from WDNR 2003.

Table 4-1. Remedial Technologies Screening Summary – Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Remedial Technologies	Process Options	Description	Screening Criterion Effectiveness	Screening Criterion Implementability	Screening Criterion Relative Cost	Screening Comment
No Action	None	No further actions to address contaminated sediment.	Natural recovery may occur as contaminants of concern (COCs) slowly biodegrade over time and/or are covered by clean sediment; however, no monitoring would be performed to assess these changes. Does not meet the remedial action objectives (RAOs) for the project as a stand-alone alternative.	Not applicable.	None	Required for comparison.
Natural Recovery	Monitored Natural Recovery	Allow naturally occurring physical, chemical, and biological processes to reduce the bioavailability and/or toxicity of COCs to acceptable levels. Burial of contaminated sediment by cleaner sediment is occurring given the lower surface COC concentrations compared to concentrations in subsurface sediment and quiescent conditions conducive to deposition of suspended sediment.	Same as no action except monitoring would be performed to assess contaminant biodegradation and clean sediment deposition.	Easily implementable if monitoring is administratively feasible. Requires additional data collection and interpretation to estimate net sedimentation rates within the MKE Bay Project Area. Analytical data indicate that surface COC concentrations are lower than subsurface concentrations in most areas. The quality of newly deposited sediment should be comparable to urban background conditions within the project area. Not implementable within the Federal Navigation Channel (FNC) for sediment shallower than the authorized elevation. May also require institutional controls.	Low	Not retained for further evaluation because long-term monitoring would be required and no mechanism for conducting the monitoring component is currently available.
Natural Recovery	Continued Natural Recovery	Continued natural recovery relies on naturally occurring processes, primarily burial by cleaner sediment, to continue isolating contaminated subsurface sediment in areas where COC concentrations in surface sediment are below cleanup goals.	Continued natural recovery is expected to be effective in continuing to bury and isolate subsurface sediment with COC concentrations above screening levels. The Milwaukee (MKE) Bay Project Area appears to be a net depositional area where contaminated subsurface sediment is buried by relatively cleaner sediment delivered by the Milwaukee, Menomonee, and Kinnickinnic Rivers, as shown in sediment COC core profiles. Sediment remediation in the rivers delivering sediment to the MKE Bay Project Area is expected to enhance the natural recovery that has already occurred and is expected to continue. Additionally, the conceptual site model indicates that recontamination potential is low.	Easily implementable if COC concentrations in the surface sediment layer (top 1 foot) are already below cleanup goals and no monitoring is required.	Low	Retained for further evaluation.
Sediment Removal	Dredging	Dredging removes sediment either through hydraulic or mechanical methods. The dredge location and elevation are controlled by global positioning system-integrated software for real-time positioning. Hydraulic dredging removes sediment with hydraulic suction to a specified dredge-cut elevation. Common hydraulic dredges include cutterhead, plain suction, pneumatic submersible pumps, and diver-assisted hand-held hydraulic suctions. Sediment is then pumped through a pipeline to a staging area or disposal site for dewatering and processing. Mechanical dredging uses a clamshell bucket operated from a crane or excavator on a floating barge or the shoreline to remove the sediment to a specified dredge-cut elevation. Dredged sediment is typically placed in barges for transport to a staging area or disposal site.	Effective. Contaminated sediment is removed from the river, eliminating the direct contact human exposure and the fish/benthic community exposure pathways. Suspended solids that are released during the dredging activities can be minimized using engineering controls. May disrupt the fish/benthic community initially but provides a cleaner sediment surface for recolonization.	Implementable. Requires permits. Limitations may include removal of sediment adjacent to shorelines and other in-water structures, which may require the addition of shoreline stabilization or reinforcement before, during, or following dredging activities, and low clearance for bridge crossings. For hydraulic dredging, constant monitoring of the pipeline for leaks and water treatment for a relatively large volume of water from the dredged sediment are needed. The dredged sediment can be readily transported through a pipeline to the dredged materials management facility (DMMF) with limited impacts to waterway traffic and therefore requires less coordination with waterway users. This option typically generates fewer sediment residuals than mechanical dredge methods and may not require active turbidity control (e.g., silt curtains). The presence of debris can severely reduce production rate. The depth of water influences the size of hydraulic dredge and its efficiency during dredging operations.	Moderate to High	Dredging is retained for further evaluation in conjunction with sediment disposal technologies for McKinley Marina, Summerfest Lagoon, and South Slip #2. Dredging in the Northern and Southern Outer Harbor subareas is not retained for further evaluation due to insufficient DMMF capacity for onsite disposal and the high cost of offsite disposal. Hydraulic dredging is expected to be more efficient and cost effective than mechanical dredging in the McKinley Marina, Summerfest Lagoon, and Slip #2 subareas because of the complexities associated with barge transport under a low clearance bridge (Summerfest Lagoon), numerous vessels and piers in the marina, and possible high wave conditions, potentially leading to

Remedial Technologies	Process Options	Description	Screening Criterion Effectiveness	Screening Criterion Implementability	Screening Criterion Relative Cost	Screening Comment
				The DMMF will not have sufficient capacity to accept large volumes of dredged sediment from the Northern and Southern Outer Harbor Areas. Sediment dredged from these areas would need to be disposed offsite. For mechanical dredging, barge transport of dredged sediment may be limited by various obstructions and by episodic high waves from Lake Michigan. Barge transport would affect waterway traffic and require more coordination with the waterway users. Debris has a relatively smaller impact on production rate for mechanical dredging than for hydraulic dredging. It typically generates more sediment residuals than hydraulic dredging and requires implementation of mechanical dredge best management practices (BMPs) and active turbidity control (e.g., silt curtains). Generates a relatively small volume of water to be treated.		longer project duration and higher costs. Mechanical dredging may be used in some circumstances such as for removal of debris or sediment inaccessible with a hydraulic dredge.
Residuals Management	Residual Management Cover	After sediment removal, a 6-inch cover layer of clean sand is placed over the residual material to reduce the COC concentrations to which biota are exposed. This clean cover layer is not a cap because it is expected to mix with the dredge residuals rather than to isolate the underlying sediment. Placement of a cover layer can effectively reduce the residual COC concentrations.	Can effectively reduce the residual COC concentrations in areas where sediment has been removed. However, may require additional dredging to enable clean layer placement to be below the authorized depth of the FNC. Provides cleaner surface for the biota, facilitating replenishment of the benthic community.	Easily implementable. Needs verification to confirm that the required thickness of clean cover material is placed. Insufficient material may be ineffective.	Low to Moderate	Retained for further evaluation in conjunction with sediment removal technologies.
Sediment Disposal	Offsite Disposal – DMMF	The DMMF planned for the Milwaukee Estuary Area of Concern (AOC) is an in-water facility designed for containment of contaminated dredged sediment that provides control of potential releases of COCs to the environment. Dredged sediment is placed directly into the DMMF for disposal prior to dewatering.	Effective. The engineering controls implemented in the DMMF provide control of potential releases of COCs to the environment. Verification of engineering controls may be required to confirm containment of COCs.	Implementable, but requires permitting through the U.S. Army Corps of Engineers (USACE). It is assumed that Toxic Substance Control Act (TSCA)-level or non-aqueous phase liquid (NAPL)-impacted sediment will not be allowed for disposal in the DMMF (neither TSCA-level nor NAPL-impacted sediment has been identified in the MKE Bay Project Area). Available capacity in the proposed DMMF and removal volumes from multiple project areas within the AOC need further evaluation.	Low to Moderate. Expected to be less expensive than offsite disposal, due to savings on stabilization, transportation and disposal fees.	Currently retained for further evaluation. The proposed DMMF is currently in the design phase. Requires close coordination with the United States Environmental Protection Agency, Wisconsin Department of Natural Resources (WDNR), USACE, and Port of Milwaukee and requires federal and non-federal sponsors. Volume of sediment to be removed from the AOC collectively is currently being evaluated.
Sediment Disposal	Offsite Disposal - Subtitle C or Subtitle D Landfill	Disposal of dewatered sediment at an offsite facility. Characterization data collected to date in the MKE Bay Project Area demonstrate that sediment concentrations are non-TSCA (PCBs < than 50 mg/kg) and nonhazardous (other constituents below the Resource Conservation and Recovery Act [RCRA] hazardous waste toxicity levels), allowing sediment to be permanently disposed in a non-TSCA and non-Subtitle C landfill approved for special waste disposal.	Effective. Would permanently remove COC mass from the project site.	Local landfills within the project vicinity are approved for special waste disposal of sediment with less than 50 mg/kg PCBs and nonhazardous waste levels of other COCs. The acceptability of the sediment by the offsite disposal facility would need to be evaluated in greater detail during remedial design; disposal requirements for emerging contaminants are uncertain.	Moderate	Not retained for further evaluation. The sediment handling, dewatering, and transportation costs are much higher compared to disposal in the DMMF. This option may be reconsidered if DMMF capacity becomes an area-wide issue for all the MKE Estuary AOC reaches.

Remedial Technologies	Process Options	Description	Screening Criterion Effectiveness	Screening Criterion Implementability	Screening Criterion Relative Cost	Screening Comment
Sediment Dewatering						
Sediment Disposal	Dewatering: DMMF disposal	Pumping of dredged sediment at a low solids concentration directly to the DMMF. The sediment is passively dewatered by settling of solids and evaporation of overlying water. Remaining free water on top is treated and discharged to Lake Michigan under a Wisconsin Pollutant Discharge Elimination System (WPDES) permit. Requires an onsite wastewater plant of sufficient capacity to allow for continuous dredging operations and prevent accumulation of large quantities of water in the DMMF.	Sediment slurry is pumped as a controlled flow from the hydraulic dredge to the DMMF facility through submerged pipes that do not interfere with waterway traffic. Dependent on the discharge criteria and the efficiency of the treatment processes. Removes COCs and turbidity before discharging into Lake Michigan. An effluent monitoring system is required to monitor the discharge concentrations.	Easily implementable and cost effective. Extended dewatering duration and an effective water treatment system are essential for uninterrupted dredging operations. Water treatment for a relatively large volume of water from the dredged sediment needed. Typically requires treatability testing to select reagent and mix to improve sediment dewatering and for design of water treatment system.	Moderate to High	Retained for further evaluation because hydraulic dredging and pipeline transport to the DMMF is likely to be used on an AOC-wide basis.
Sediment Disposal	Dewatering: Upland Management and Disposal	Excess free water generated from mechanical removal of sediment is pumped from watertight scow barges to a storage tank, then treated and discharged. Dredged sediment is then offloaded to a staging pad where it dewaters by gravity drainage and is stabilized as needed for transport and upland disposal. The excess water is then physically and chemically treated to remove suspended solids and COCs before being discharged back into the waterbody or to the publicly owned treatment works (dependent on permitting).	Dependent on the discharge criteria and the efficiency of the water treatment processes. An effluent monitoring system is required to monitor the discharge concentrations.	Limited by availability of upland staging areas for equipment and drying and transloading of sediment.	Moderate to High	Retained for further evaluation as offsite landfill disposal may be used in some currently unanticipated circumstances.
Sediment Containment	Cap	Place one or more layers of clean material over the surface of contaminated sediment to isolate the sediment left in place and reduce COC flux to the environment. A cap could be constructed in areas along the shoreline where sediment cannot be removed due to stability concerns, or in other areas where dredging is not cost effective. Amendments that enhance sequestration or degradation of COCs could be added to the cap if needed to inhibit COC migration. Provides long-term risk reduction to human and ecological receptors.	Can be effective if cap remains in place. Isolates the COCs from human and ecological receptors and prevents resuspension of contaminated sediment. Regular cap inspection and maintenance may be required to address eroded or disturbed areas. The cap dimensions and materials need to be carefully designed to avoid head cutting and scouring effects. May provide habitat for benthic organisms and fish species depending on cap materials used. Treatability testing may be needed to support design of an active (amended) cap, which would reduce contaminant flux by increasing sorptive capacity of cap materials and/or by enhancing degradation. Long-term effectiveness is dependent on cap thickness, material selection, and maintenance.	Implementable for areas with PCB concentrations below TSCA levels. Installation within the FNC requires the cap surface to be 3.5 to 4.5 feet below the authorized FNC elevation. Requires permits. May disrupt the existing dock areas and waterway users. May require long-term monitoring and institutional controls. Requires staging areas for cap material close to the remediation location. Cap extents must be mapped and reported in applicable WDNR databases. Most materials and equipment are readily available. Slower construction may be necessary for active caps to reduce placement variability of layers containing reactive materials.	Low to Moderate. Long-term costs include periodic monitoring of the cap and cap maintenance as required. Costs for active capping would be moderate to high.	Capping is not retained for further evaluation because it is not a cost effective technology for remediating the large areas of relatively low COC concentrations in the MKE Bay Project Area compared to other Milwaukee Estuary AOC project areas and because capping would require institutional controls and long-term monitoring and maintenance over large areas.
Sediment Containment	Sand Cover	Placement of a sand cover to reduce COC concentrations in surface sediment, provide partial isolation of underlying sediment, and accelerate the process of physical isolation (natural sediment deposition and accumulation).	Effective if sand cover remains in place or is mixed with underlying sediment. Effectiveness is enhanced by natural sediment deposition. Reduces exposure to COCs and reduces resuspension of contaminated sediment. Provides habitat for benthic organisms depending on materials used. Long-term effectiveness is dependent on cover thickness, type, and ability to remain in place.	Implementable except within the FNC for sediment shallower than the authorized elevation. Availability of a sufficient volume of sand cover material may be a constraint. Needs verification to confirm that the required thickness of clean cover material is placed. Requires staging areas for cover material close to the remediation location. Most materials and equipment are readily available. Does not require institutional controls, monitoring, or maintenance.	Low to moderate	Retained for further evaluation for areas where dredging is not implementable or cost-effective.
In Situ Treatment	Activated Carbon	This technology involves mixing activated carbon (e.g., granular activated carbon, SediMite, or other amendment) into surficial sediment to adsorb hydrophobic organic contaminants and reduce contaminant bioavailability. Carbon amendments can be mixed into the sediment using mechanical methods or natural biological activity (bioturbation).	Effective for reducing bioavailability of hydrophobic organic contaminants but may not be effective for metals. Long-term effectiveness and permanence are uncertain.	Implementable in areas with PCB concentrations below TSCA levels outside of the FNC. Amendments can be placed using conventional equipment. Can be used to treat areas under bridges or against bulkheads where other technologies would be difficult to implement. Would require staging areas for stockpiling materials. May require additional institutional controls and long-term monitoring.	Moderate to High. Depends on area to be treated.	Not retained for further evaluation. Long-term effectiveness and permanence are uncertain and long-term monitoring and maintenance would be needed.

Remedial Technologies	Process Options	Description	Screening Criterion Effectiveness	Screening Criterion Implementability	Screening Criterion Relative Cost	Screening Comment
In Situ Treatment	Fixation/ Stabilization	Involves applying or mixing of an amendment into sediment through mechanical means (using augers, for instance) to immobilize COCs by physically binding or enclosing the sediment within a stabilized mass or chemically treating these to become immobile.	In situ treatment technologies can achieve immediate risk reduction by reducing the bioavailability and mobility of a range of organic and metal COCs in environmentally sensitive environments or in areas where sediment removal or capping are not implementable.	Implementable with limitations. Requires permits. Can be implemented at discrete depth intervals to target a specific layer of impacted sediment. May allow for management of contaminated sediment adjacent to retaining and support structures, which are often aged and require structural analysis and support prior to dredging or removal activities. Requires bench-scale testing for selecting the suitable stabilization/ solidification amendment. May require a protective surface structure (such as rip rap or articulated mat) depending on the strength of treated sediment and erosional forces present. Requires staging area for the storage and preparation of stabilization/solidification amendment.	Moderate to High	Not retained for further evaluation. In situ stabilization is not likely to be necessary near bulkheads to protect shoreline stability in the MKE Bay project area.
Ex Situ Treatment	Sediment Stabilization/ Solidification	Dewatered sediment is mixed with an additive (fly ash, Portland cement) to decrease the leachability of COCs and meet transportation and disposal requirements.	Effective as a secondary dewatering technology for sediment following passive dewatering techniques. Can improve the chemical and physical properties of the sediment for disposal.	Requires mixing amendments into the sediment following excavation and passive dewatering prior to disposal. Typically requires bench scale testing for selecting the suitable stabilization/solidification amendment. After stabilization/solidification, sediment will be loaded into trucks for offsite disposal.	Moderate	Retained for further consideration in the unanticipated event that dredged material is transported to an upland disposal facility.
Ex Situ Treatment	Particle Size Segregation and Washing	Vibrating or fixed screens, hydrocyclones, or gravity separation used to segregate particle sizes in sediment allowing separate disposal of fine-grained material with higher COC concentrations.	Effective. Can be a good source of fill materials for beneficial reuse if sufficient quantity of sand and/or gravel exists within sediment to be removed.	Easily implemented along with hydraulic dredging. Requires staging area for implementation. The quantity of sand and/or gravel that exists within the dredged sediment to be evaluated for cost effectiveness. Pilot/bench-scale testing is required.	Moderate	Retained for further evaluation to reduce the volume of material requiring disposal in DMMF. Minimizing the amount of waste requiring disposal in the DMMF can decrease the amount of space consumed and facilitates the effective management of contaminated sediment from other project areas in the AOC.
Ex Situ Treatment	Sediment Washing	PCBs sorbed onto fine sediment particles are separated from bulk sediment in an aqueous-based system based on particle size. Wash water may be augmented with a basic leaching agent, surfactant, pH adjustment, or chelating agent to help remove organics.	Considered a transfer technology in that the COCs are not destroyed but transferred to another media. Consequently, the resulting concentrated sediment must be disposed of appropriately. Varying concentrations and mix of COCs at the site create a complex washing solution.	Requires sediment excavation, pilot/bench scale testing. Equipment and utility requirements are substantial.	High	Not retained for further evaluation due to implementability and cost concerns.

< = less than
#2 = Number 2
AOC = area of concern
BMP = best management practice
COC = contaminant of concern
DMMF = dredged materials management facility
FNC = federal navigation channel
mg/kg = milligram(s) per kilogram
MKE = Milwaukee
NAPL = non-aqueous phase liquid
PCB = polychlorinated biphenyl
RAO = Remedial Action Objective
RCRA = Resource Conservation and Recovery Act
TSCA = Toxic Substance Control Act
USACE = U.S. Army Corps of Engineers
WDNR = Wisconsin Department of Natural Resources
WPDES = Wisconsin Pollutant Discharge Elimination System

Table 5-1. Remedial Alternatives Summary - Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Remedial Alternative Element	Alternative 1 No Action	Alternative 2 Total PCBs >1 mg/kg, or metals (Cr, Pb, Hg) or Total PAHs >PEC	Alternative 3 Total PCBs >1 mg/kg, or metals (Cr, Pb, Hg) or Total PAHs >3xPEC	Alternative 4 Total PCBs >3 mg/kg, or metals (Cr, Pb, Hg) or Total PAHs >3xPEC	Alternative 5 Focused Dredging and Sand Cover[a]
Sediment Removal - McKinley Marina - Area/Volume (acres per cubic yards)	Not applicable	68/360,000	36/90,000	Not applicable	Not applicable
Sediment Removal -Summerfest Lagoon - Area/Volume (acres per cubic yards)	Not applicable	13/94,000	9/64,000	9/64,000	Not applicable
Sediment Removal - South Slip #2 - Area/Volume (acres per cubic yards)	Not applicable	7/22,000	4/17,000	4/17,000	4/17,000
Sediment Removal -Total Area (acres per cubic yards)	Not applicable	88	49	13	4
Sediment Removal -Total Removal Volume (cubic yards)[b]	Not applicable	476,000	171,000	81,000	17,000
Sediment Removal -Total Residual Cover Material Volume (cubic yards)	Not applicable	106,000	59,000	16,000	5,000
Sediment Removal -Estimated dewatered (supernatant) volume for treatment[c] (gallons)	Not applicable	1,150,000,000	410,000,000	200,000,000	850,000
Sand Cover - Northern and Southern Outer Harbor - 0.5-foot sand cover area (acres)	Not applicable	105	324	324	Not applicable
Sand Cover - Northern and Southern Outer Harbor - 1.5-foot sand cover area (acres)	Not applicable	293	75	75	75
Sand Cover - Summerfest Lagoon - 1.0-foot sand cover area (acres)	Not applicable	Not applicable	Not applicable	Not applicable	3
Sand Cover - Total Area (acres)	Not applicable	398	399	399	78
Sand Cover - Total Sand Cover Material Volume (cubic yards)	Not applicable	954,000	604,000	604,000	217,000

Source: Wisconsin Department of Natural Resources (WDNR). 2003. Wisconsin Consensus-based Sediment Quality Guidelines. Recommendations for Use and Application, Interim Guidance RR-088. December.

[a] Focused dredging in Summerfest Lagoon and South Slip #2 and focused capping in the Northern Outer Harbor. No remediation proposed in subareas with subsurface screening level exceedances only.

[b] Estimated quantity of target remediation volume accessible for removal through dredging and/or excavation.

[c] Includes pipeline transport to DMMF with dewatering and supernatant treatment at DMMF location or staging, dewatering, solidification at upland staging area with offsite transport of sediment to Subtitle D landfill; all water treated with temporary onsite water treatment plant and discharged to the river under Wisconsin Pollutant Discharge Elimination System discharge permit.

> = greater than

#2 = Number 2

3x = 3 times

Cr = chromium

CY = cubic yard

DMMF = dredged materials management facility

Hg = mercury

PAH = polycyclic aromatic hydrocarbon

Pb = lead

PCB = polychlorinated biphenyl

PEC = Probable Effect Concentration (per WDNR 2003)

Table 6-1. Remedial Alternative Evaluation Summary – Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Criterion	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4	Alternative 5
1. Threshold Criterion Compliance with applicable federal, state, and local regulations	No remedial action; therefore, not applicable.	Multiple permits would be required (see Appendix C). Alternative can be designed to comply with applicable regulations.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
2(a). Balancing Criterion: Long-Term Effectiveness Ability to achieve remedial action objectives (RAOs) and contribute to beneficial use impairment (BUI) removal; amount of residual contamination[a] anticipated to be left in place; adequacy and reliability of long-term controls; potential for recontamination; expected performance in response to extreme storm events and climate change.	RAOs not likely to be met within a reasonable timeframe. Would not contribute to removal of BUIs.	Sediment removal combined with residual cover in the McKinley Marina, Summerfest Lagoon, and South Slip #2 reliably and permanently reduces the mass, volume, and concentration of contaminants of concern (COCs) in sediment, thereby reducing exposure and risk to ecological and human receptors and contributing to the removal of BUIs. Disposal of contaminated sediment in the dredged materials management facility (DMMF) or in a permitted offsite landfill eliminates all exposure pathways. Sand cover placed over contaminated sediments in the Northern and Southern Outer Harbor reduces exposure and risk by helping isolate contaminated sediments and reducing COC concentrations in surface sediment. Ongoing deposition and accumulation of relatively cleaner sediment on the sand cover is expected to facilitate natural recovery. Alternative 2 has the greatest long-term effectiveness because it permanently removes the greatest volume of contaminated sediment (approximately 476,000 cubic yards [CY]) and has the largest remediation footprint (88 acres of dredging and 400 acres of sand cover placement) compared to Alternatives 3, 4, and 5 and the lowest concentrations of COCs remain in place. As discussed in Section 2.7 of this report, recontamination potential from other sources is low. Alternative 2 can be designed to withstand extreme storm events and be resilient in response to climate change.	Alternative 3 uses the same approaches to achieve RAOs and contribute to BUI removal as Alternative 2. However, Alternative 3 has lower long-term effectiveness than Alternative 2 because a smaller volume of sediment would be removed (approximately 171,000 CY) and the remediation footprint is smaller (49 acres of dredging and 400 acres of cover placement). Sediment remaining in place would contain higher metals (chromium, lead and mercury) and polycyclic aromatic hydrocarbon (PAH) concentrations compared to Alternative 2; PCB concentrations would be similar to Alternative 2. The long-term impact of removing less sediment on BUIs compared to Alternative 2 is uncertain because a combination of actions (including sediment remediation) will contribute to BUI removal, and natural deposition and accumulation of relatively cleaner sediment is expected to occur after the sediment remedial action is complete.	Alternative 4 uses the same approaches to achieve RAOs and contribute to BUI removal as Alternatives 2 and 3. However, Alternative 4 has less long-term effectiveness than Alternatives 2 and 3 because a smaller volume of material would be removed (approximately 81,000 CY) and the remediation footprint is smaller (13 acres of dredging and 400 acres of cover placement). Sediment remaining in place would contain higher PCB concentrations compared to Alternatives 2 and 3; metals (chromium, lead and mercury) and PAH concentrations would be the same as Alternative 3, but higher than Alternative 2. The long-term impact of removing less sediment on BUIs compared to Alternatives 2 and 3 is uncertain because a combination of actions (including sediment remediation) will contribute to BUI removal, and natural deposition and accumulation of relatively cleaner sediment is expected to occur after the sediment remedial action is complete.	Alternative 5 relies on focused dredging and placement of sand cover to address areas with the highest potential for current or future risks to human and ecological receptors. Sand cover will enhance natural recovery (deposition and accumulation of relatively cleaner sediment) that is already occurring and is expected to continue in areas where COC concentrations in surface sediment exceed the cleanup goals (CUGs). Continued natural recovery will occur In areas where COC concentrations are below the CUGs in surface sediment and above CUGs in subsurface sediment. Post-remediation COC concentrations in surface sediment (top 1 foot) for Alternative 5 would be similar to Alternative 3 because the same screening levels are used to define the remediation footprint. Approximately 17,000 CY across 4.5 acres would be dredged and 78 acres would be covered with sand (75 acres in the Outer Harbor and 3 acres in Summerfest Lagoon Quiet Basin). Long-term effectiveness for Alternative 5 is lower relative to Alternatives 2, 3, and 4 because screening level exceedances in subsurface sediment would remain in place in some areas and could be subject to future exposure in response to extreme storm events or other forces. The long-term impact of removing less sediment on BUIs compared to Alternatives 2, 3, and 4 is uncertain because a combination of actions (including sediment remediation) will contribute to BUI removal, and natural deposition and accumulation of relatively cleaner sediment is expected to occur after the sediment remedial action is complete.

Criterion	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4	Alternative 5
2(a). Balancing Criterion: Short-Term Effectiveness Potential adverse impacts on public health, safety, welfare, and the environment during construction and implementation; protection of the community during remedial action, environmental impacts of the remedial action, and time until RAOs are achieved.	No remedial action; therefore, not applicable.	(Estimated in-water remedial action time = 13 months). Potential adverse impacts on public health, safety, welfare, and the environment during construction and implementation include the following: • Reduced public access to the shoreline • Increased vessel and vehicular traffic • Increased emissions from vehicles and other construction equipment • Increased noise • Dust from the upland staging area where sand separation and sand cover materials are stockpiled • Potential risk to workers from accidents or exposure to COCs • Temporary destruction of the benthic community in dredged and covered areas • Potential environmental impacts from suspended sediment during dredging and cover placement • Potential environmental impacts from leaks in the pipeline transporting hydraulically-dredged sediment to the DMMF Engineering and operational controls will be used to reduce and manage impacts during remedy construction and implementation. Plans will be developed during remedial design to establish requirements for air quality monitoring, noise monitoring, health and safety, waste management, traffic safety, and other activities. Turbidity monitoring and controls will be used to manage potential environmental impacts from sediment resuspension during dredging. The benthic community would be temporarily destroyed over the entire remedial footprint (approximately 490 acres). The magnitude of the impacts is related to the duration of the remedial action. RAOs will be achieved when remedy construction is complete.	(Estimated in-water remedial action time = 10 months). Potential adverse impacts are the same as those for Alternative 2; however, the benthic community would be temporarily destroyed over a slightly smaller area (approximately 450 acres). RAOs will be achieved when remedy construction is complete. Construction duration for Alternative 3 is similar to Alternatives 2 and 4.	(Estimated in-water remedial action time = 10 months). Potential adverse impacts are the same as those for Alternative 2; however, the benthic community would be temporarily destroyed over a smaller area (approximately 415 acres). RAOs will be achieved when remedy construction is complete. Construction duration for Alternative 4 is similar to Alternatives 2 and 3.	(Estimated in-water remedial action time = 5 months). Potential adverse impacts are the same as those for Alternative 2; however, the duration of the remedial action is estimated to be 6 months shorter than Alternative 2 and 5 months shorter than Alternatives 3 and 4 because less sediment will be dredged and covered. The benthic community would be temporarily destroyed over a smaller area for Alternative 5 (approximately 83 acres) compared to Alternatives 2 through 4. Due to the smaller dredging and cover extent, the potential for environmental impacts from suspended sediment are lower compared to Alternatives 2, 3, and 4. RAOs will be achieved when construction is complete, which will be sooner than for Alternatives 2, 3, and 4.

Criterion	Alternative 1 No Action	Alternative 2	Alternative 3	Alternative 4	Alternative 5
2(c). Balancing Criterion: Implementability Technical feasibility, including ease of implementation, reliability, constructability, availability of goods and services, and potential difficulties or constraint associated with construction or disposal; and administrative feasibility, including activities and time needed to obtain permits and approvals, the need for institutional controls, and degree of coordination with other agencies.	Easily implementable because no remedial action would be taken.	The remediation methods associated with this alternative have been implemented at numerous other sites and have been proven to be constructible and reliable. The volume of dredged sediment for Alternative 2 is estimated to be 476,000 CY. All goods and services are expected to be readily available. Potential difficulties and constraints associated with this alternative include: • Limitations on DMMF capacity for disposal of dredged sediment. • The quantity of sand required for the cover in the Northern and Southern Outer Harbors is significant (954,000 CY) and multiple sources of cover material may be required. • Protection of utility corridors that extend into the harbor • Bulkhead stability A range of permits and approvals is required for implementing this alternative as detailed in Appendix C. This alternative requires extensive coordination with other agencies and parties including the project partners (U.S. Environmental Protection Agency, WDNR, the City of Milwaukee, Milwaukee County, Milwaukee Metropolitan Sewerage District), the Port of Milwaukee, United States Army Corps of Engineers, and affected property owners and businesses.	Same as Alternative 2 except that the volume of dredged sediment is lower and therefore disposal requires less DMMF capacity (approximately 171,000 CY estimated removal for Alternative 3).	Same as Alternative 2 except that the volume of dredged sediment is lower than for Alternatives 2 and 3 and therefore disposal requires less DMMF capacity (approximately 81,000 CY estimated for removal for Alternative 4).	Same as Alternative 2 except that the volumes of dredged sediment and cover materials required are the lowest compared to Alternatives 2, 3, and 4. Approximately 17,000 CY of sediment would be dredged for Alternative 5, requiring the least amount of DMMF capacity compared to Alternatives 2 through 4. Approximately 75 acres of cover would be placed in the Summerfest Lagoon Quiet Basin and Northern Outer Harbor compared to 400 acres for Alternatives 2 through 4, reducing the quantity of cover material to 212,000 CY.
***2(d). Balancing Criterion:* Restoration Time Frame**	No remedial action; therefore, not applicable.	The benthic community is expected to naturally recolonize the dredged and covered surfaces within several months after the remedy has been completed. Upland staging and laydown areas will be restored to the pre-remedy condition during demobilization.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2, except that the area where the benthic community would be temporarily adversely affected is significantly lower for Alternative 5 (83 acres) than for Alternatives 2 through 4 (approximately 450 to 490 acres).
2(e). Balancing Criterion: Total Cost[b] (As Estimated)	$0	$241,828,000	$141,873,000	$126,341,000	$46,159,000
3. Modifying Criterion: Project Partner Acceptance[c]	[c]	[c]	[c]	[c]	[c]

Source: Wisconsin Department of Natural Resources (WDNR). 2003. *Wisconsin Consensus-based Sediment Quality Guidelines. Recommendations for Use and Application, Interim Guidance RR-088*. December.

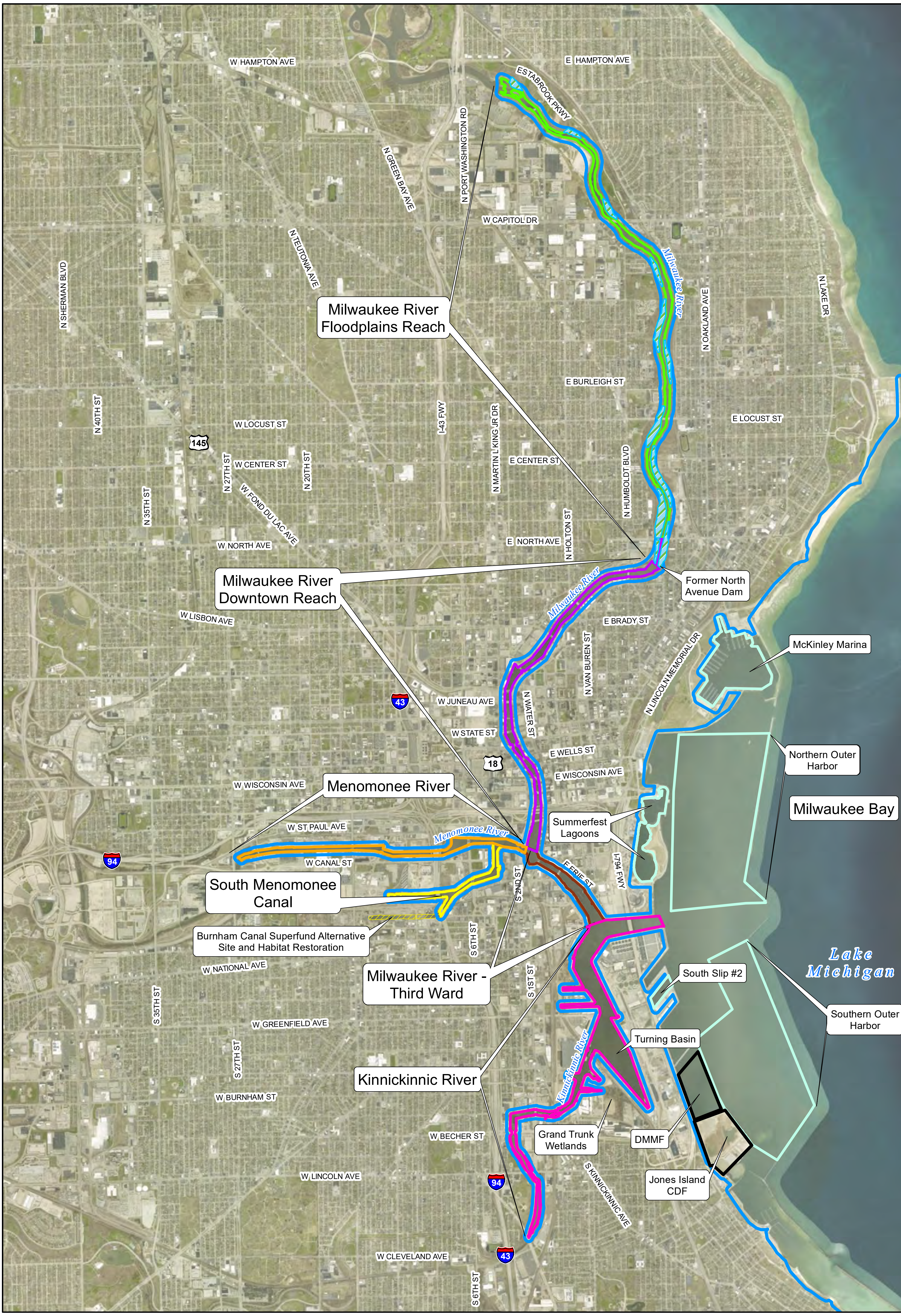
[a] "Residual contamination" and "contaminated sediment" for each alternative is defined as sediment with COC concentrations above the screening levels for that alternative.

[b] Total cost is detailed in Appendix D to this document.

[c] Evaluated after the project partners reviewed and provided comments on the remedial alternatives and associated individual and comparative alternative analyses. Project partner acceptance was considered when selecting the recommended alternative.

#2 = Number 2
BUI = beneficial use impairment
COC = contaminant of concern
CY = cubic yards
DMMF = dredged materials management facility
FNC = federal navigation channel
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RAO = Remedial Action Objective
WDNR = Wisconsin Department of Natural Resources

Figures



Notes:
1. CDF = confined disposal facility; DMMF = dredged materials management facility; GLLA = Great Lakes Legacy Act
2. 2022 Aerial Photography provided by Esri ArcGIS Online World Imagery.

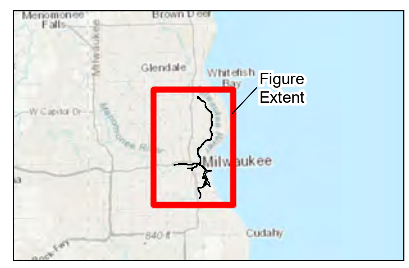


Figure 1-1 Regional Features
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\Floodplain\Figure 1-1 - Regional Features.mxd jhansen1 (7/17/2024)

Jacobs

LEGEND

- Gauging Station
- Flow Direction
- Port of Milwaukee Parcels[3]
- Federal Navigation Channel
- Proposed DMMF Area
- Milwaukee Bay Project Area

N

0 1400 2800

Approximate scale in feet

Notes:

1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. CDF = Confined Disposal Facility; DMMF = Dredged Material Management Facility; NOAA = National Oceanic and Atmospheric Administration; USGS = United States Geological Survey
3. Port of Milwaukee Parcels from PortProperty Map. Accessed March 2022. https://portmilwaukee.com/Port-Mke/Work-with-the-Port/Port-Property-Map

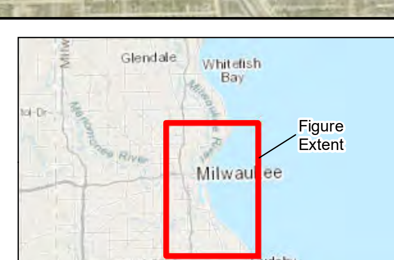
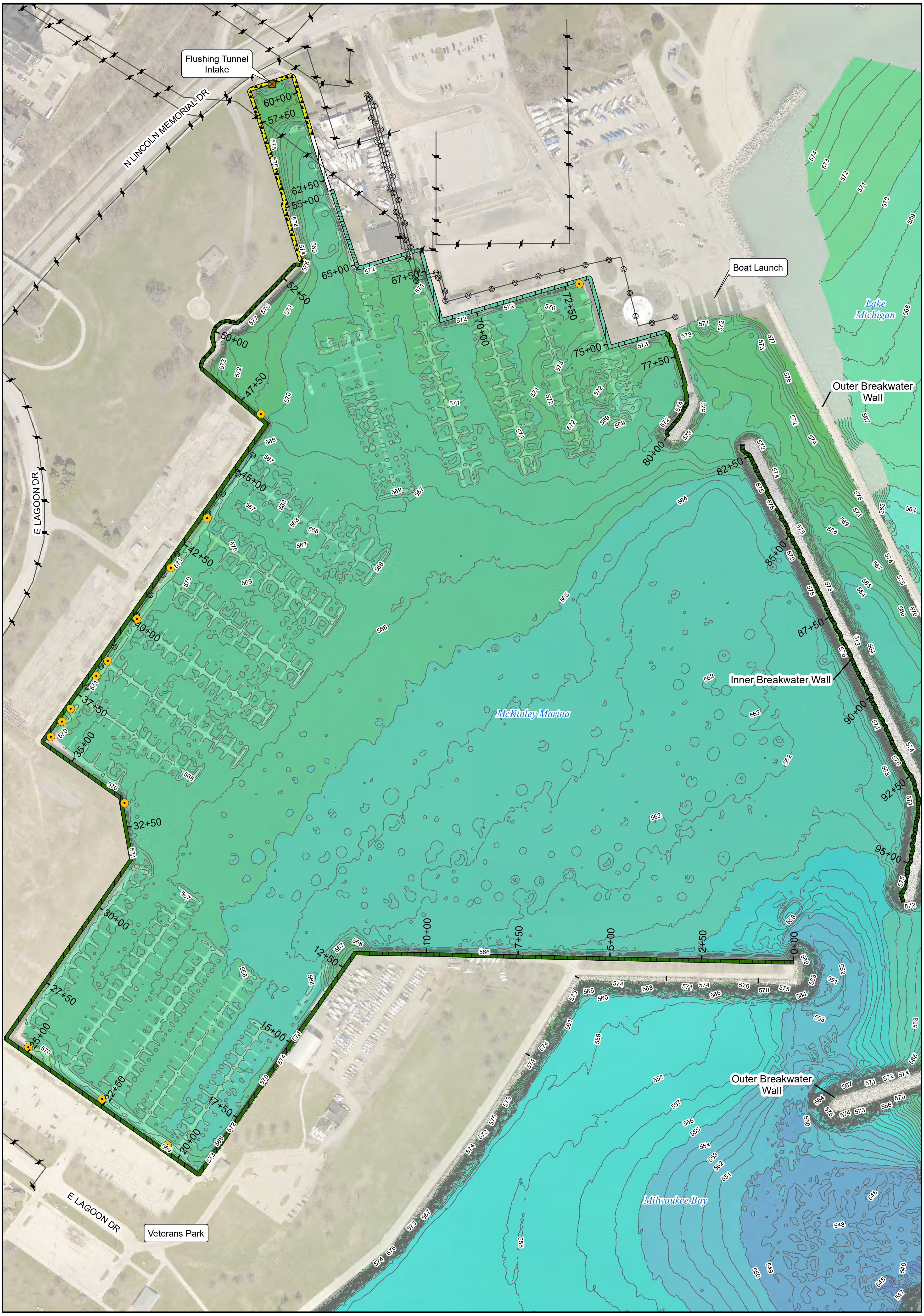


Figure 1-2
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin



LEGEND

Storm Sewer Outfall
Flushing Tunnel Intake

Utilities

Fiber Optic
Telecom

Shoreline Type

Concrete
Riprap

Steel Sheet Pile
Timber Piles

Condition Level

Excellent
Good
Fair
Unassigned

Bathymetry (feet)

Bathymetric Contour

Elevation (feet)

580 - 585
575 - 580
570 - 575
565 - 570
560 - 565
555 - 560
550 - 555
545 - 550
540 - 545

N

0 125 250
Approximate scale in feet

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).

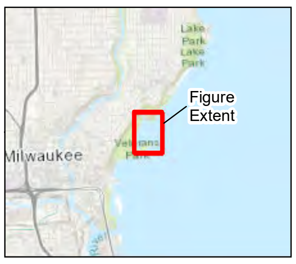
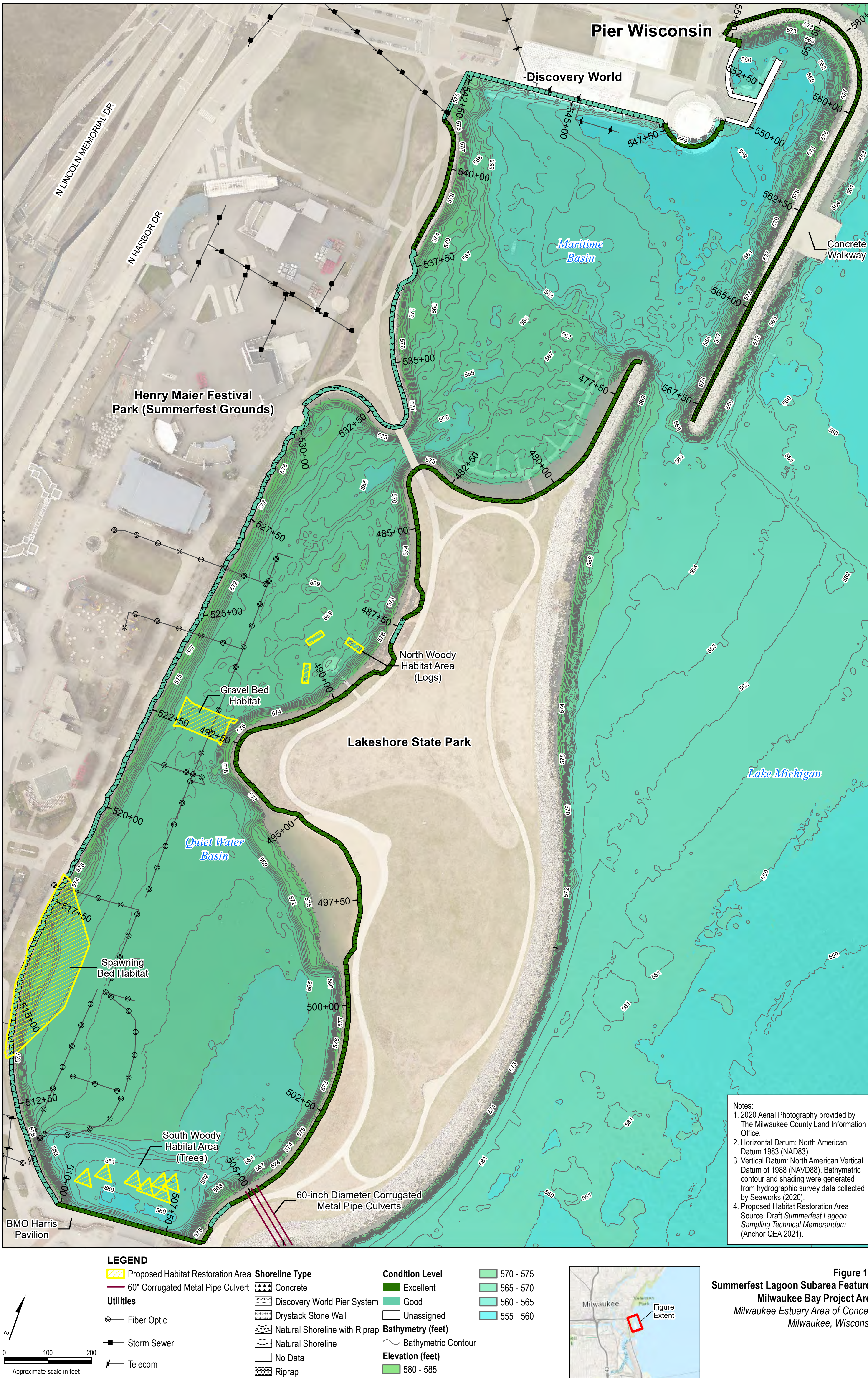


Figure 1-3
McKinley Marina Subarea Features
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-3_MKE_Bay_McKinleyMarina_Features_508.mxd AESPEJO (9/4/2024)



Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. Proposed Habitat Restoration Area Source: Draft *Summerfest Lagoon Sampling Technical Memorandum* (Anchor QEA 2021).

Figure 1-4
Summerfest Lagoon Subarea Features
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-4_MKE_Bay_SummerfestLagoon_Features_508.mxd AESPEJO (9/4/2024)

Jacobs

N

0 100 200
Approximate scale in feet

LEGEND

- Storm Sewer Outfall

Utilities

- Electric
- Fiber Optic
- Sanitary Sewer
- Water Line

Shoreline Type

- Steel Sheet Pile

Condition Level

- Excellent
- Good
- Marginal

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).

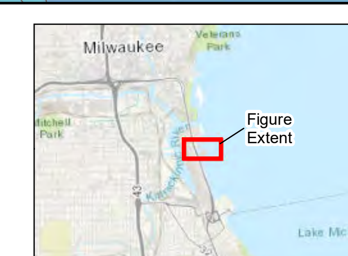
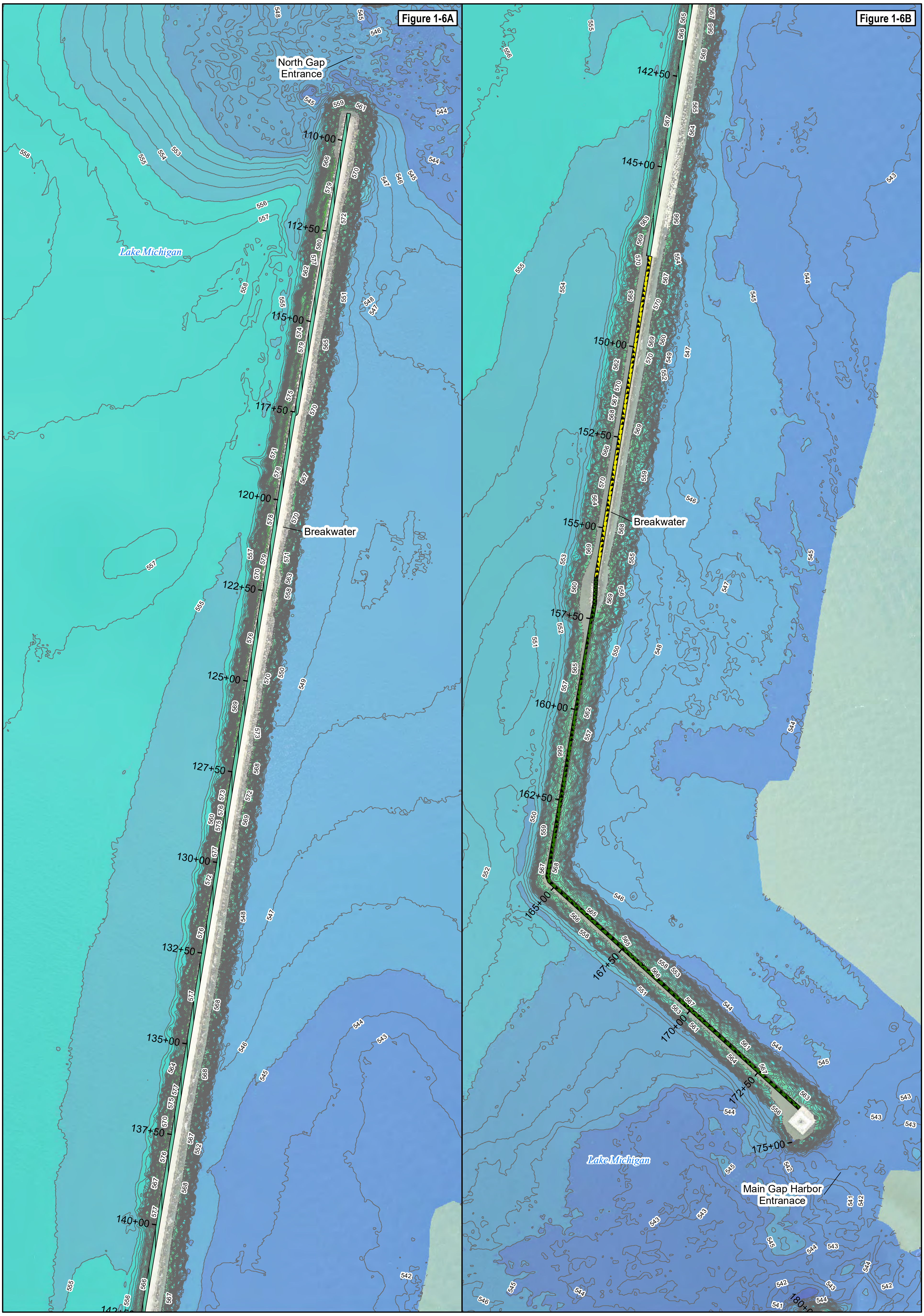


Figure 1-5
South Slip #2 Subarea Features
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-5_MKE_Bay_SouthSlip2_Features_508.mxd AESPEJO (9/4/2024)

Jacobs



LEGEND

Shoreline Type
- Concrete
- Riprap
- Steel Sheet Pile

Condition Level
- Excellent
- Good
- Fair

Bathymetry (feet)
- Bathymetric Contour

Elevation (feet)
- 580 - 585
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545

N

0 125 250
Approximate scale in feet

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).

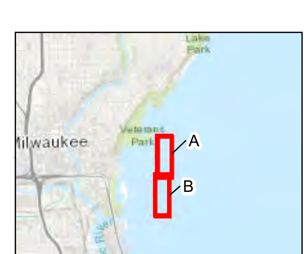
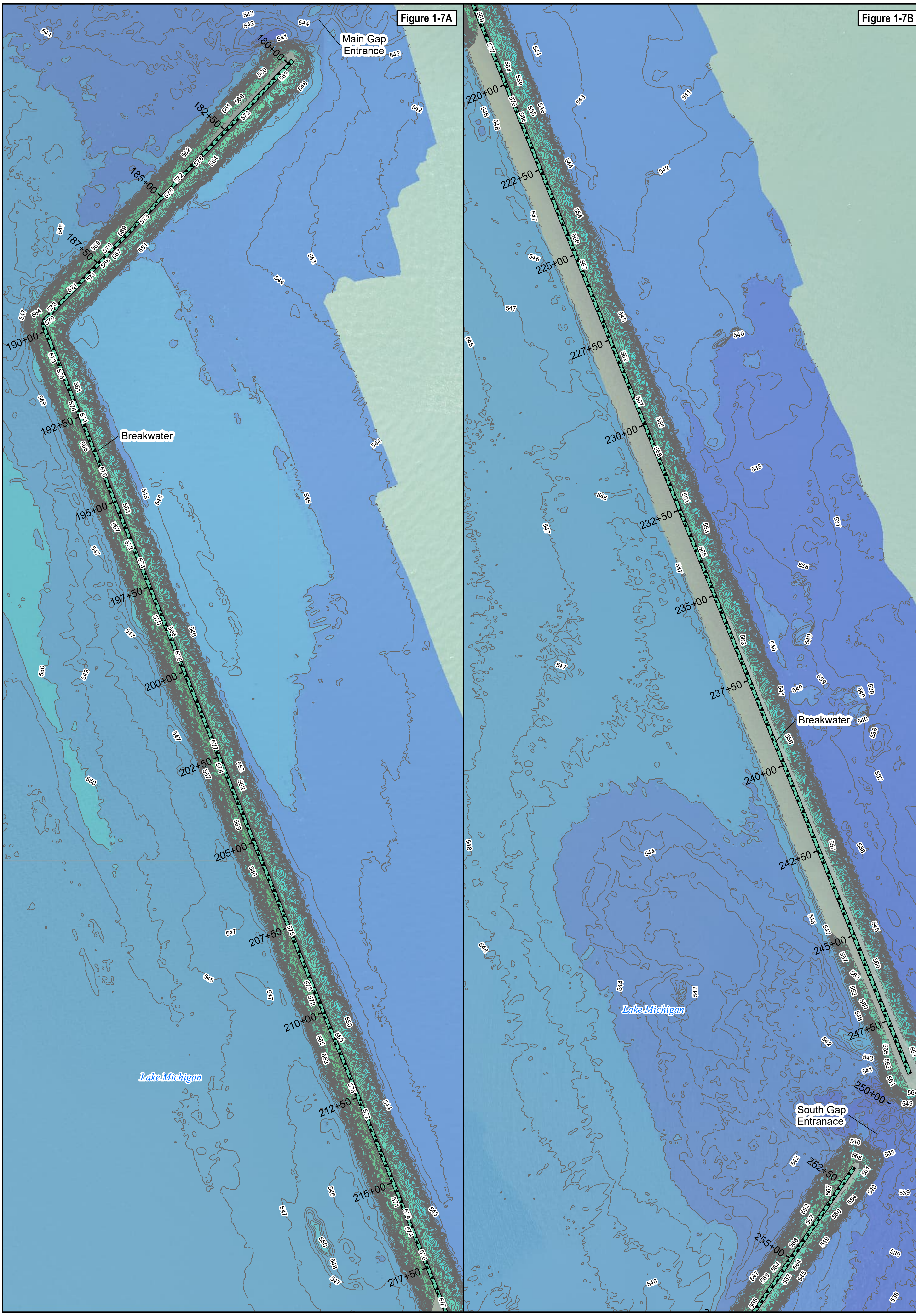


Figure 1-6
Northern Outer Harbor Subarea Features
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-6_MKE_Bay_NHarborArea_Features_508.mxd AESPEJO (9/4/2024)

Jacobs



LEGEND

Shoreline Type

Concrete

MKE Bay-Outer Harbor Condition Level

Good

Bathymetry (feet)

Bathymetric Contour

Elevation (feet)

575 - 580
570 - 575
565 - 570
560 - 565
555 - 560
550 - 555
545 - 550
540 - 545
535 - 540

N

0 125 250
Approximate scale in feet

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).

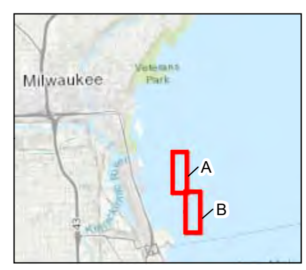
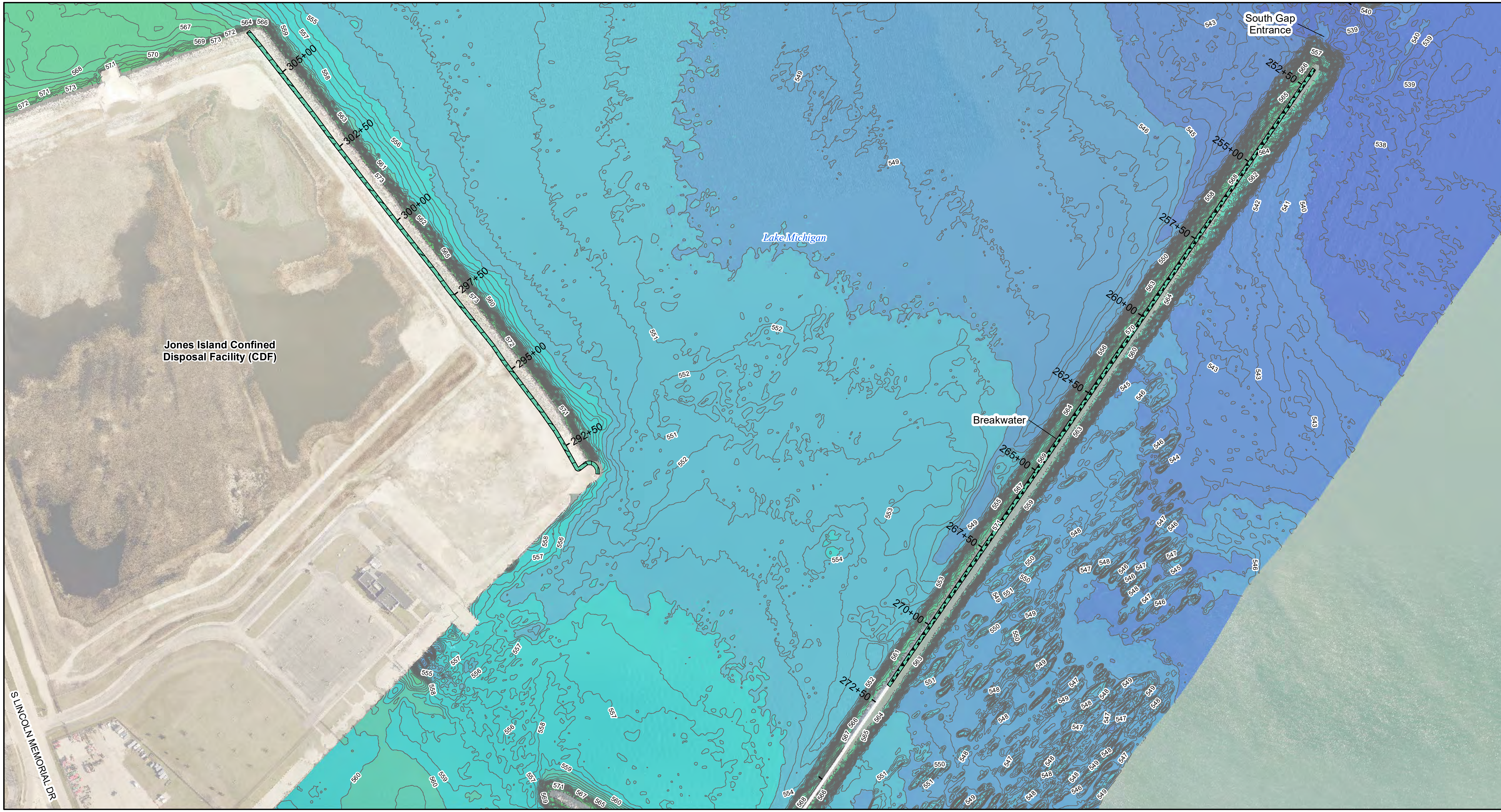


Figure 1-7
Southern Outer Harbor Subarea Features 1 of 2
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-7_MKE_Bay_SHarborArea_Features_508.mxd AESPEJO (9/4/2024)

Jacobs



LEGEND

Shoreline Type
- Concrete
- Natural Shoreline with Riprap
- Steel Sheet Pile

Condition Level
- Good

Bathymetry (feet)
- Bathymetric Contour

Elevation (feet)
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545
- 535 - 540

N

0 125 250

Approximate scale in feet

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).

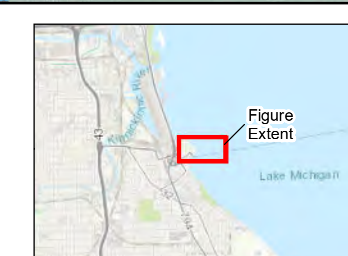


Figure 1-8
Southern Outer Harbor Subarea Features 2 of 2
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\gisproj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay\Figure1-8_MKE_Bay_SHarborArea_Features_508.mxd AESPEJO (9/4/2024)

Jacobs

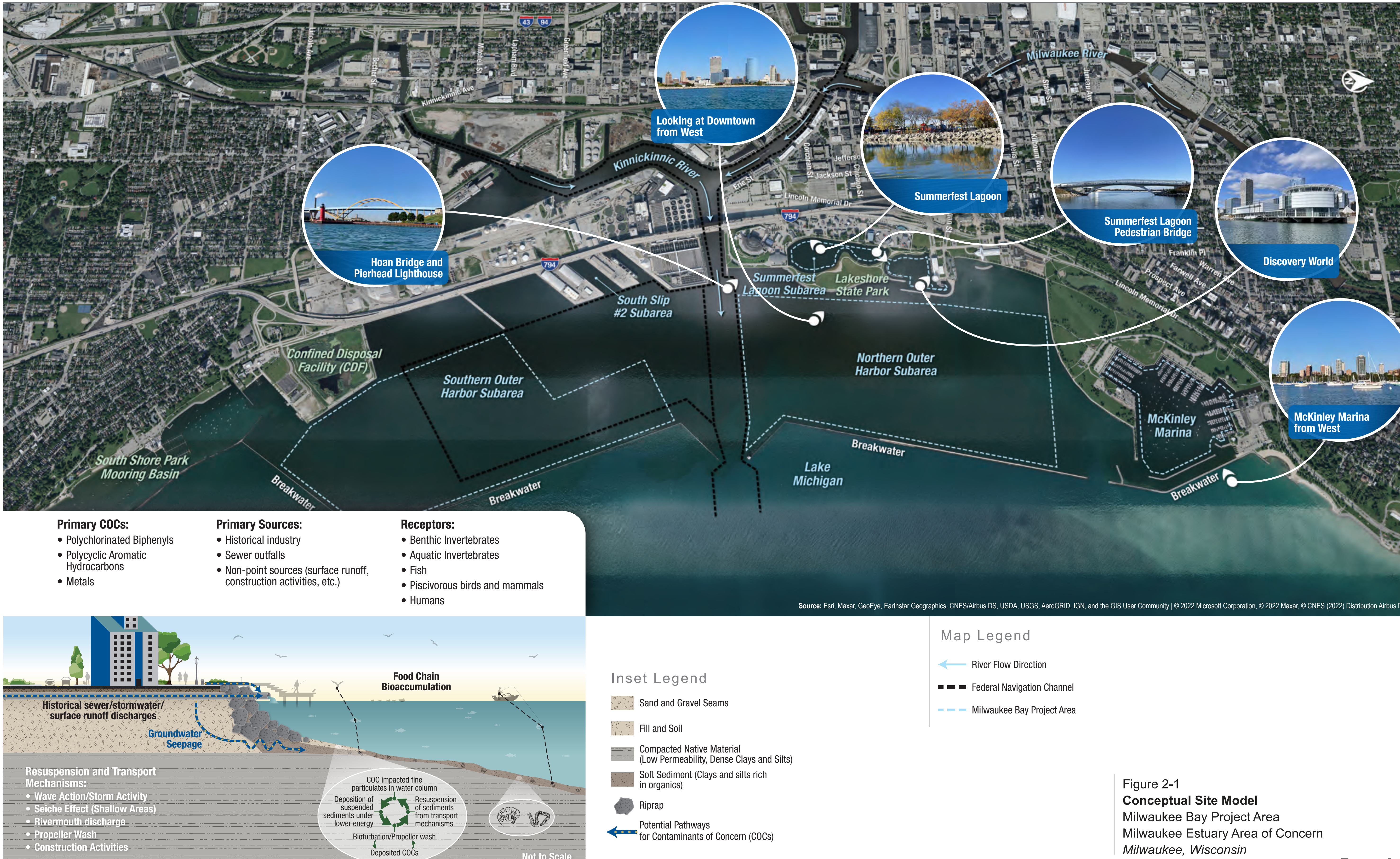
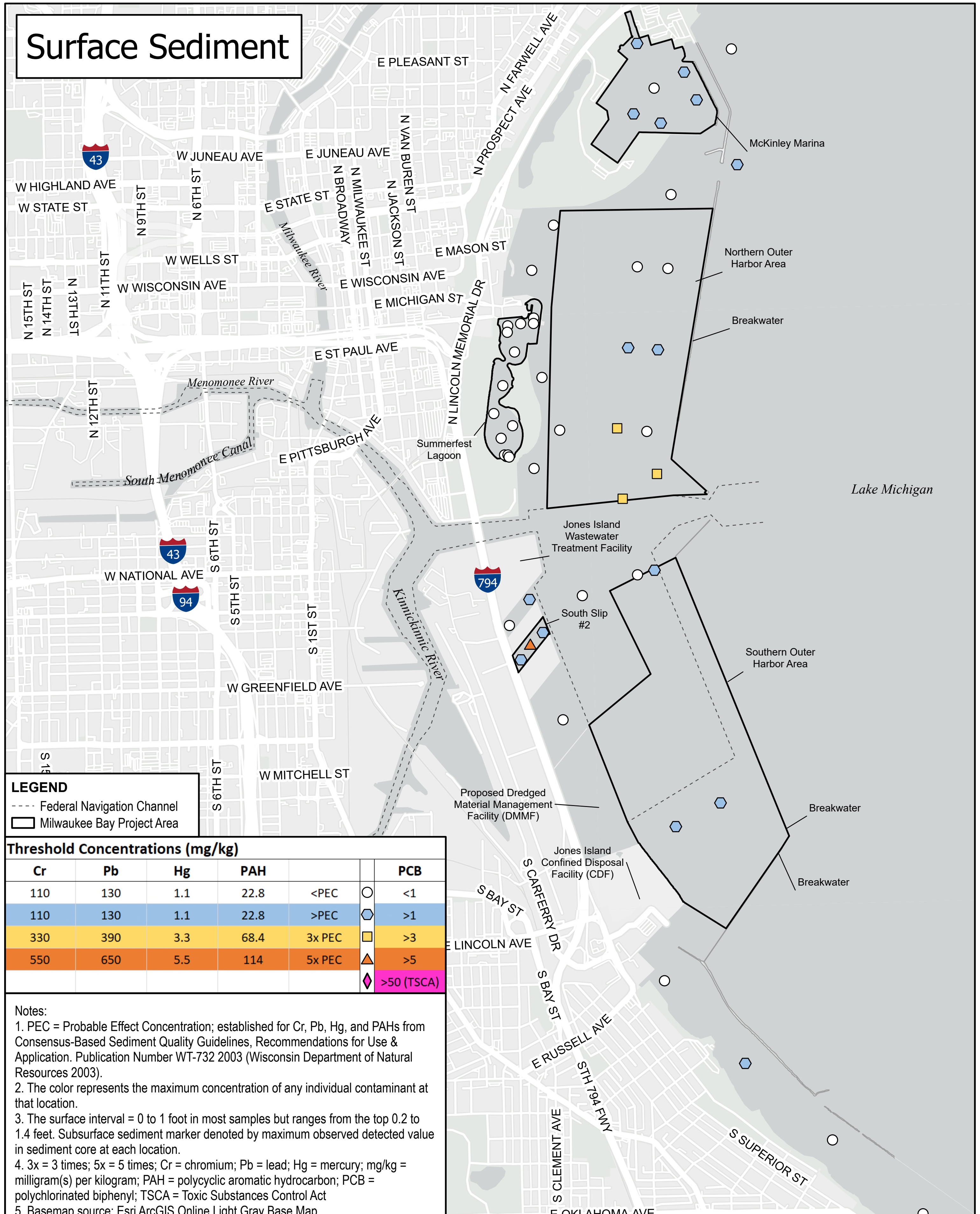
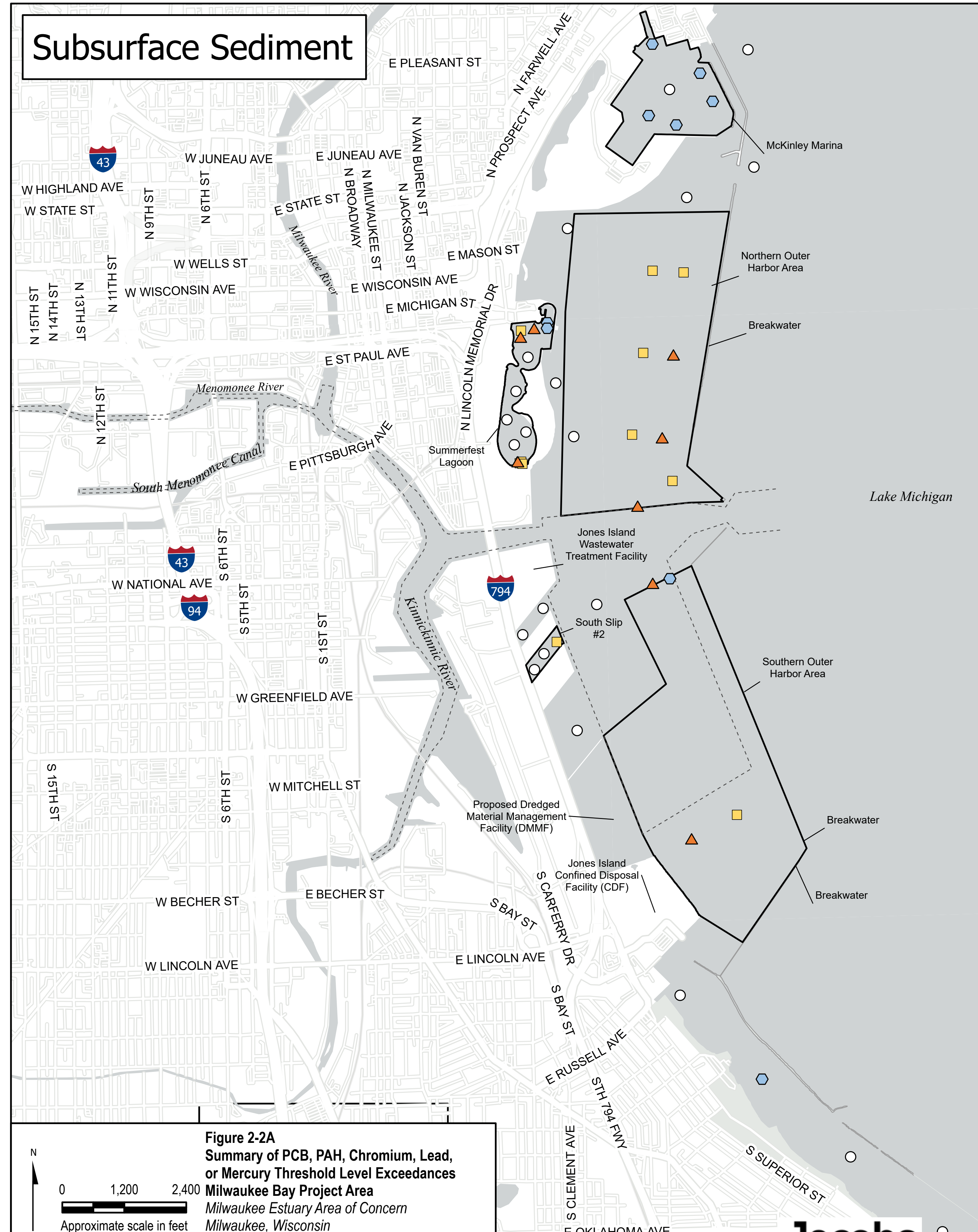


Figure 2-1
Conceptual Site Model
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs





LEGEND

Federal Navigation Channel

Milwaukee Bay Project Area

Threshold Concentrations (mg/kg)

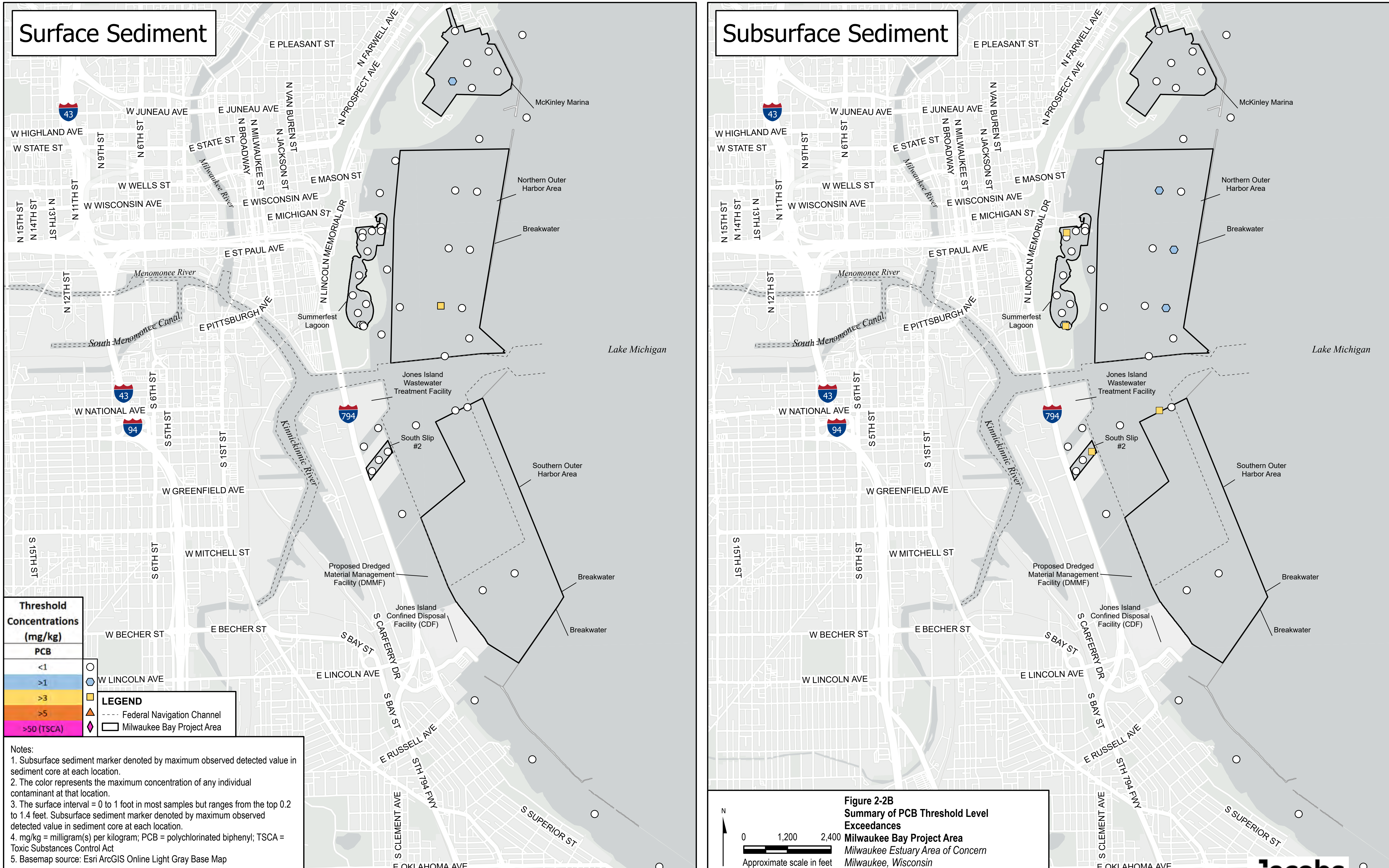
Cr	Pb	Hg	PAH			PCB
110	130	1.1	22.8	<PEC	○	<1
110	130	1.1	22.8	>PEC	⬡	>1
330	390	3.3	68.4	3x PEC	□	>3
550	650	5.5	114	5x PEC	△	>5
					◇	>50 (TSCA)

Notes:
1. PEC = Probable Effect Concentration; established for Cr, Pb, Hg, and PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; Pb = lead; Hg = mercury; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbon; PCB = polychlorinated biphenyl; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 2-2A
Summary of PCB, PAH, Chromium, Lead, or Mercury Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

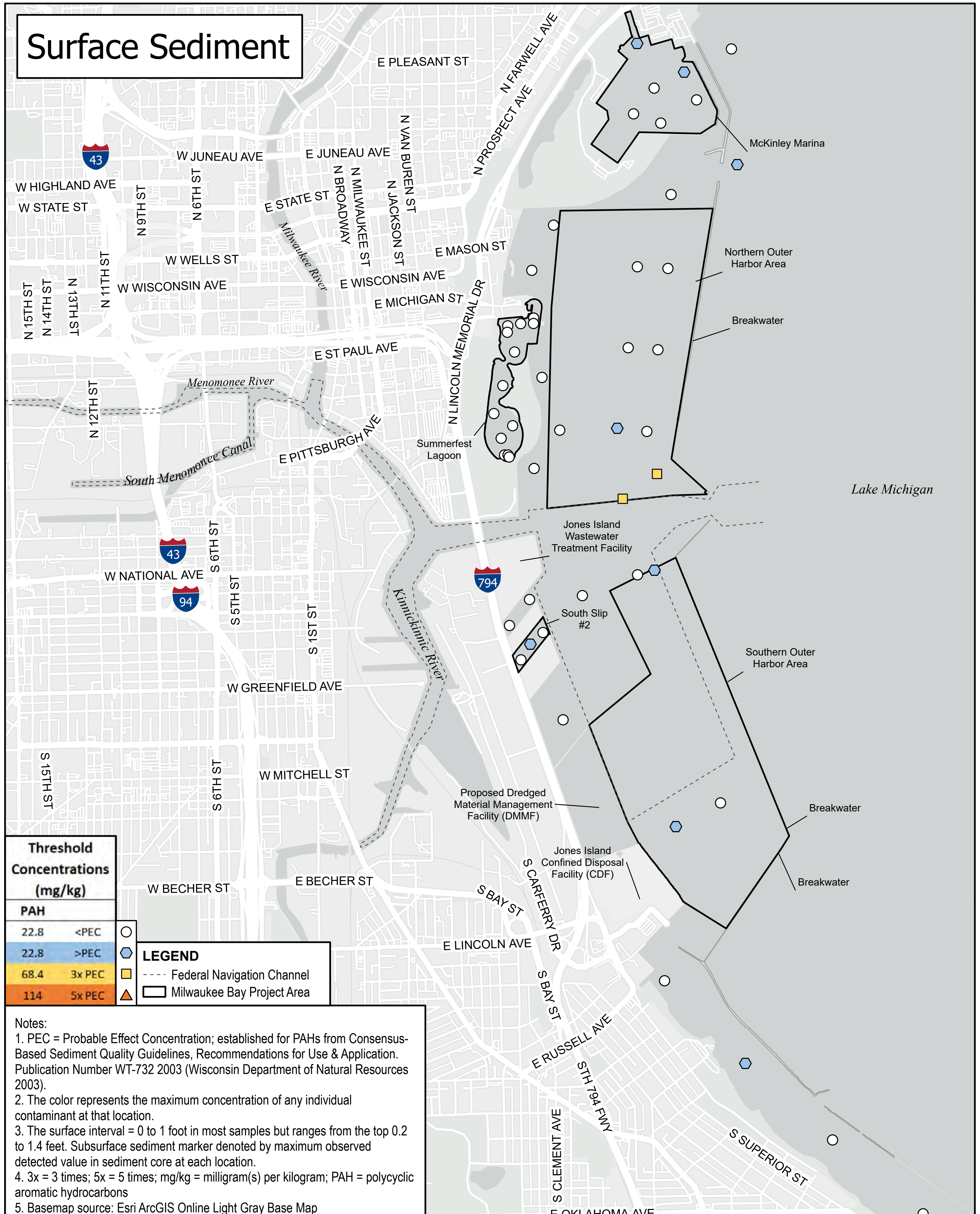
\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2A_MKE_Bay_Summary_Exceedances_508 STOLZRC (9/5/2024)



Notes:
1. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. mg/kg = milligram(s) per kilogram; PCB = polychlorinated biphenyl; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 2-2B
Summary of PCB Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2B_MKE_Bay_Summary of PCB Threshold Level Exceedances_508 STOLZRC (9/5/2024)



Threshold Concentrations (mg/kg)		
PAH		
22.8	<PEC	○
22.8	>PEC	⬡
68.4	3x PEC	□
114	5x PEC	△

LEGEND

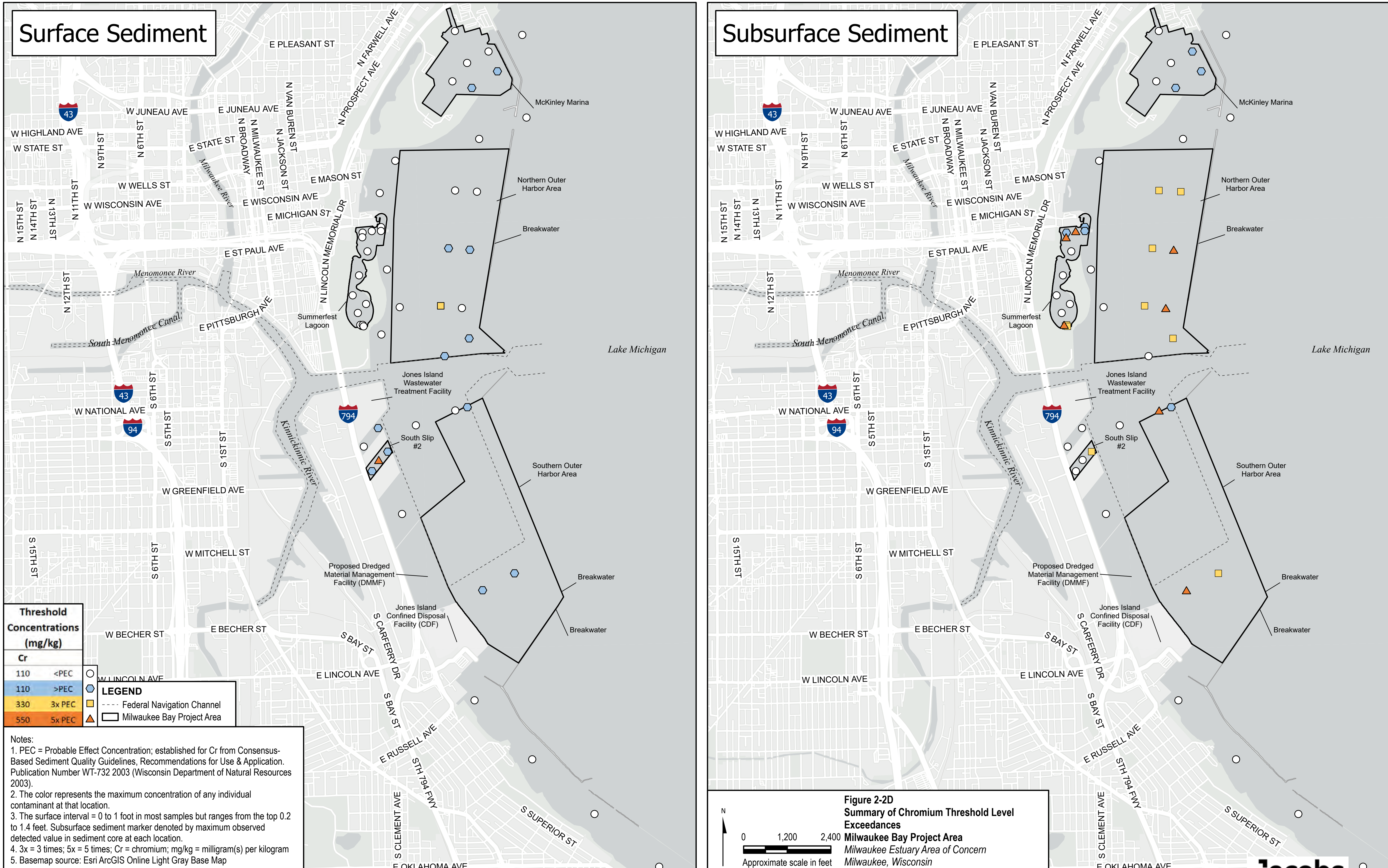
- Federal Navigation Channel
- Milwaukee Bay Project Area

Notes:
1. PEC = Probable Effect Concentration; established for PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbons
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 2-2C
Summary of PAH Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2C_MKE_Bay_Summary of PAH Threshold Level Exceedances_508 STOLZRC (9/5/2024)



Threshold Concentrations (mg/kg)		
Cr		
110	<PEC	○
110	>PEC	⬡
330	3x PEC	□
550	5x PEC	△

LEGEND

- - - - Federal Navigation Channel

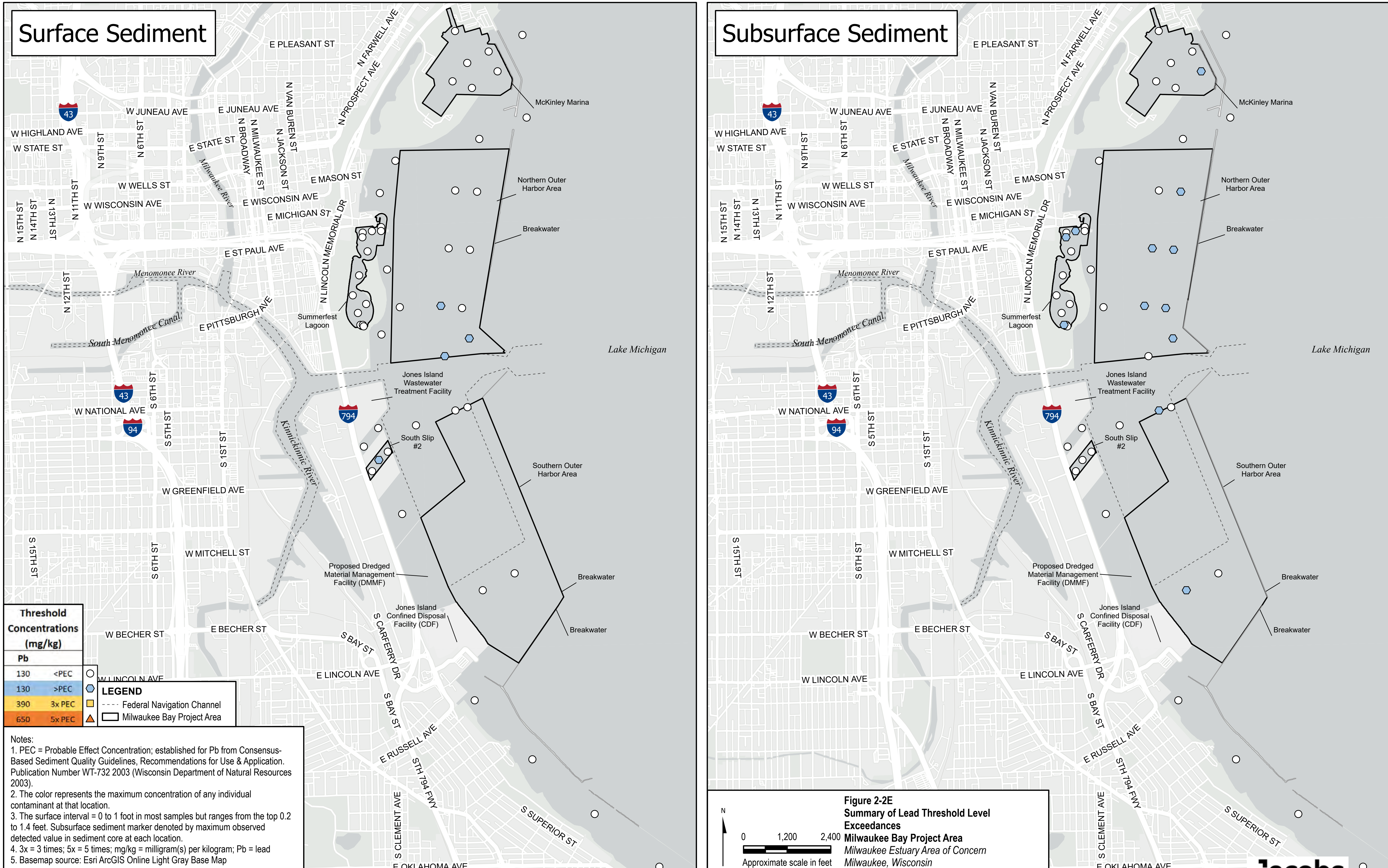
▭ Milwaukee Bay Project Area

Notes:
1. PEC = Probable Effect Concentration; established for Cr from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; mg/kg = milligram(s) per kilogram
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 2-2D
Summary of Chromium Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2D_MKE_Bay_Summary of Cr Threshold Level Exceedances_508 STOLZRC (9/5/2024)



Threshold Concentrations (mg/kg)		
Pb		
130	<PEC	○
130	>PEC	⬡
390	3x PEC	□
650	5x PEC	△

LEGEND

- Federal Navigation Channel
- Milwaukee Bay Project Area

Notes:
1. PEC = Probable Effect Concentration; established for Pb from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; mg/kg = milligram(s) per kilogram; Pb = lead
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

N

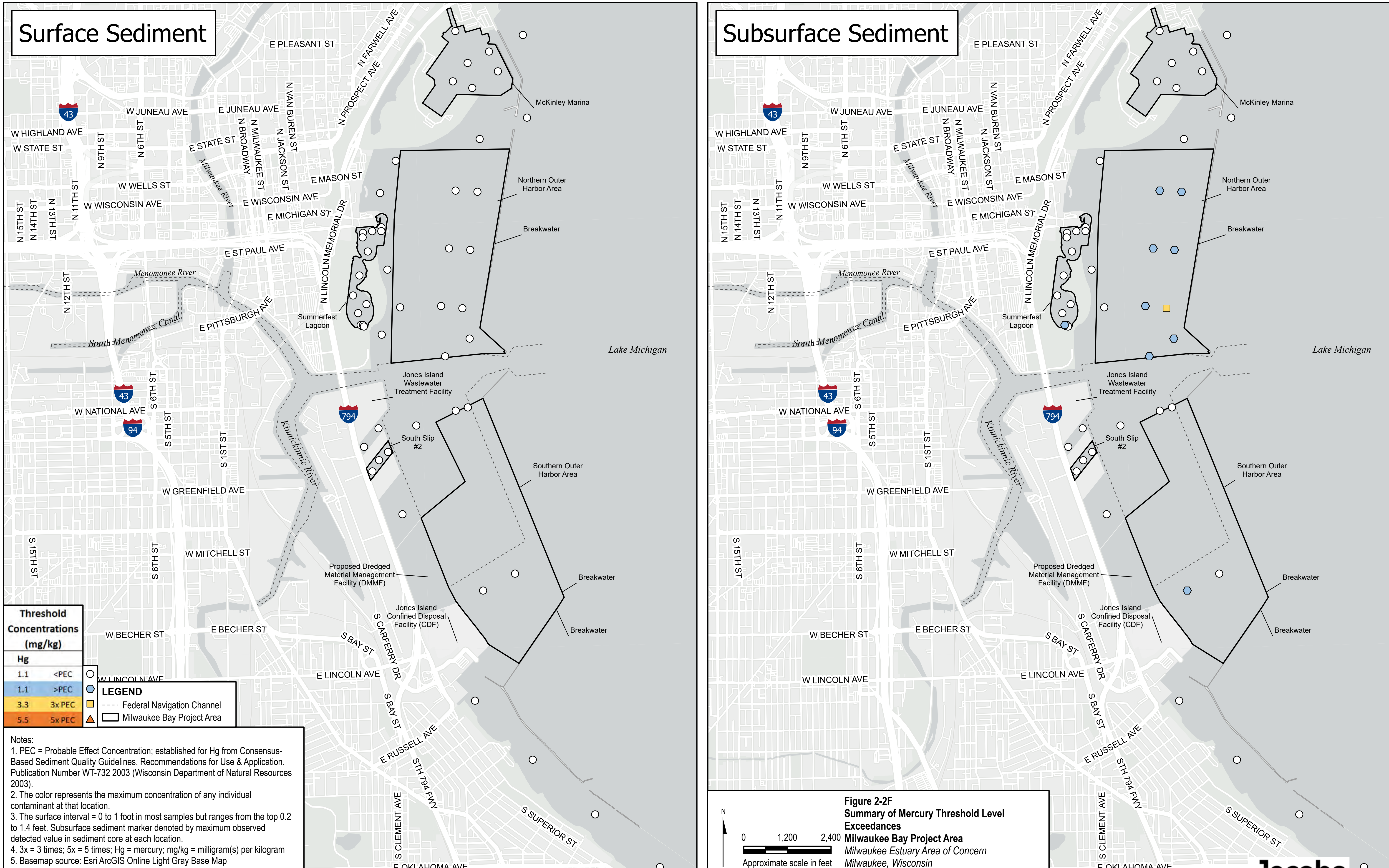
0 1,200 2,400

Approximate scale in feet

Figure 2-2E
Summary of Lead Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2E_MKE_Bay_Summary of Lead Threshold Level Exceedances_508 STOLZRC (9/5/2024)



Threshold Concentrations (mg/kg)		
Hg		
1.1	<PEC	○
1.1	>PEC	⬡
3.3	3x PEC	□
5.5	5x PEC	△

LEGEND

- Federal Navigation Channel
- Milwaukee Bay Project Area

Notes:
1. PEC = Probable Effect Concentration; established for Hg from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. The color represents the maximum concentration of any individual contaminant at that location.
3. The surface interval = 0 to 1 foot in most samples but ranges from the top 0.2 to 1.4 feet. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Hg = mercury; mg/kg = milligram(s) per kilogram
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

N

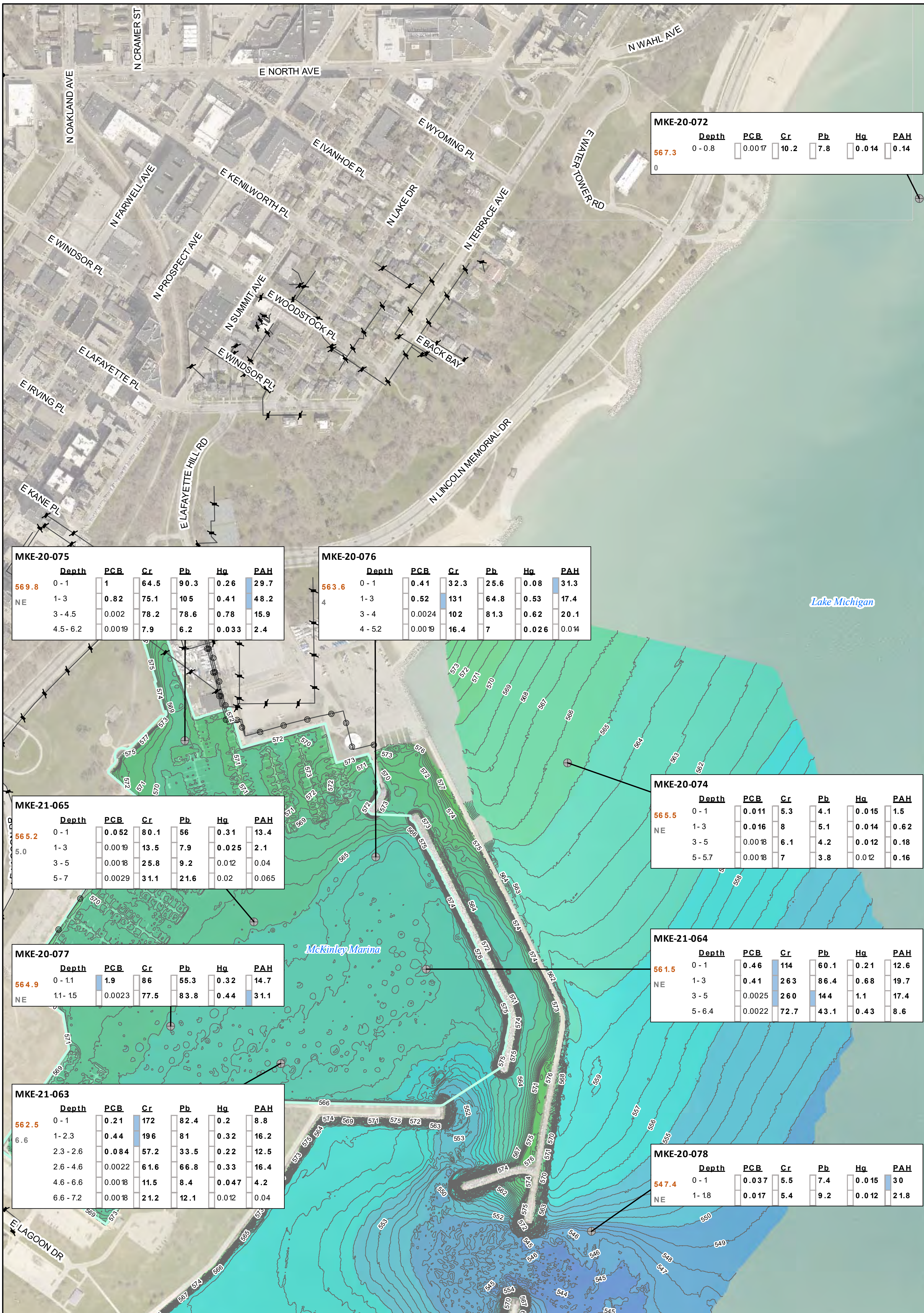
0 1,200 2,400

Approximate scale in feet

Figure 2-2F
Summary of Mercury Threshold Level Exceedances
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_summary_figures_508.aprx-Figure2-2F_MKE_Bay_Summary of Mercury Threshold Level Exceedances_508 STOLZRC (9/5/2024)



MKE-20-072 (Mudline Elevation 567.3; Native Material Depth 0)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 0.8	0.0017	**10.2**	**7.8**	**0.014**	**0.14**

MKE-20-075 (Mudline Elevation 569.8; Native Material Depth NE)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**1**	**64.5**	**90.3**	**0.26**	**29.7**
1 - 3	**0.82**	**75.1**	**105**	**0.41**	**48.2**
3 - 4.5	0.002	**78.2**	**78.6**	**0.78**	**15.9**
4.5 - 6.2	0.0019	**7.9**	**6.2**	**0.033**	**2.4**

MKE-20-076 (Mudline Elevation 563.6; Native Material Depth 4)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.41**	**32.3**	**25.6**	**0.08**	**31.3**
1 - 3	**0.52**	**131**	**64.8**	**0.53**	**17.4**
3 - 4	0.0024	**102**	**81.3**	**0.62**	**20.1**
4 - 5.2	0.0019	**16.4**	**7**	**0.026**	0.014

MKE-20-074 (Mudline Elevation 565.5; Native Material Depth NE)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.011**	**5.3**	**4.1**	**0.015**	**1.5**
1 - 3	**0.016**	**8**	**5.1**	**0.014**	**0.62**
3 - 5	0.0018	**6.1**	**4.2**	**0.012**	**0.18**
5 - 5.7	0.0018	**7**	**3.8**	0.012	**0.16**

MKE-21-065 (Mudline Elevation 565.2; Native Material Depth 5.0)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.052**	**80.1**	**56**	**0.31**	**13.4**
1 - 3	0.0019	**13.5**	**7.9**	**0.025**	**2.1**
3 - 5	0.0018	**25.8**	**9.2**	0.012	0.04
5 - 7	0.0029	**31.1**	**21.6**	0.02	0.065

MKE-21-064 (Mudline Elevation 561.5; Native Material Depth NE)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.46**	**114**	**60.1**	**0.21**	**12.6**
1 - 3	**0.41**	**263**	**86.4**	**0.68**	**19.7**
3 - 5	0.0025	**260**	**144**	**1.1**	**17.4**
5 - 6.4	0.0022	**72.7**	**43.1**	**0.43**	**8.6**

MKE-20-077 (Mudline Elevation 564.9; Native Material Depth NE)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.1	**1.9**	**86**	**55.3**	**0.32**	**14.7**
1.1 - 1.5	0.0023	**77.5**	**83.8**	**0.44**	**31.1**

MKE-21-063 (Mudline Elevation 562.5; Native Material Depth 6.6)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.21**	**172**	**82.4**	**0.2**	**8.8**
1 - 2.3	**0.44**	**196**	**81**	**0.32**	**16.2**
2.3 - 2.6	**0.084**	**57.2**	**33.5**	**0.22**	**12.5**
2.6 - 4.6	0.0022	**61.6**	**66.8**	**0.33**	**16.4**
4.6 - 6.6	0.0018	**11.5**	**8.4**	**0.047**	**4.2**
6.6 - 7.2	0.0018	**21.2**	**12.1**	0.012	0.04

MKE-20-078 (Mudline Elevation 547.4; Native Material Depth NE)

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.037**	**5.5**	**7.4**	**0.015**	**30**
1 - 1.8	**0.017**	**5.4**	**9.2**	**0.012**	**21.8**

LEGEND

- Analytical Sample Location
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Telecom
- Water Line

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

- 580 - 585
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545

0 225 450
Approximate scale in feet

N

Analytical Results Table Format

Location ID

Mudline Elevation

Native Material Depth

	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
Depth	<1	<PEC	<PEC
Sample interval (ft bss)	1 - 3	>PEC	>PEC
	3 - 5	>3xPEC	>3xPEC
	5 - 50	>5xPEC	>5xPEC
	>50		

Bold values represent results above the detection limit

"-" = COC was not sampled/analyzed

NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; WDNR = Wisconsin Department of Natural Resources

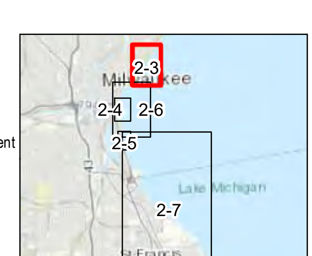
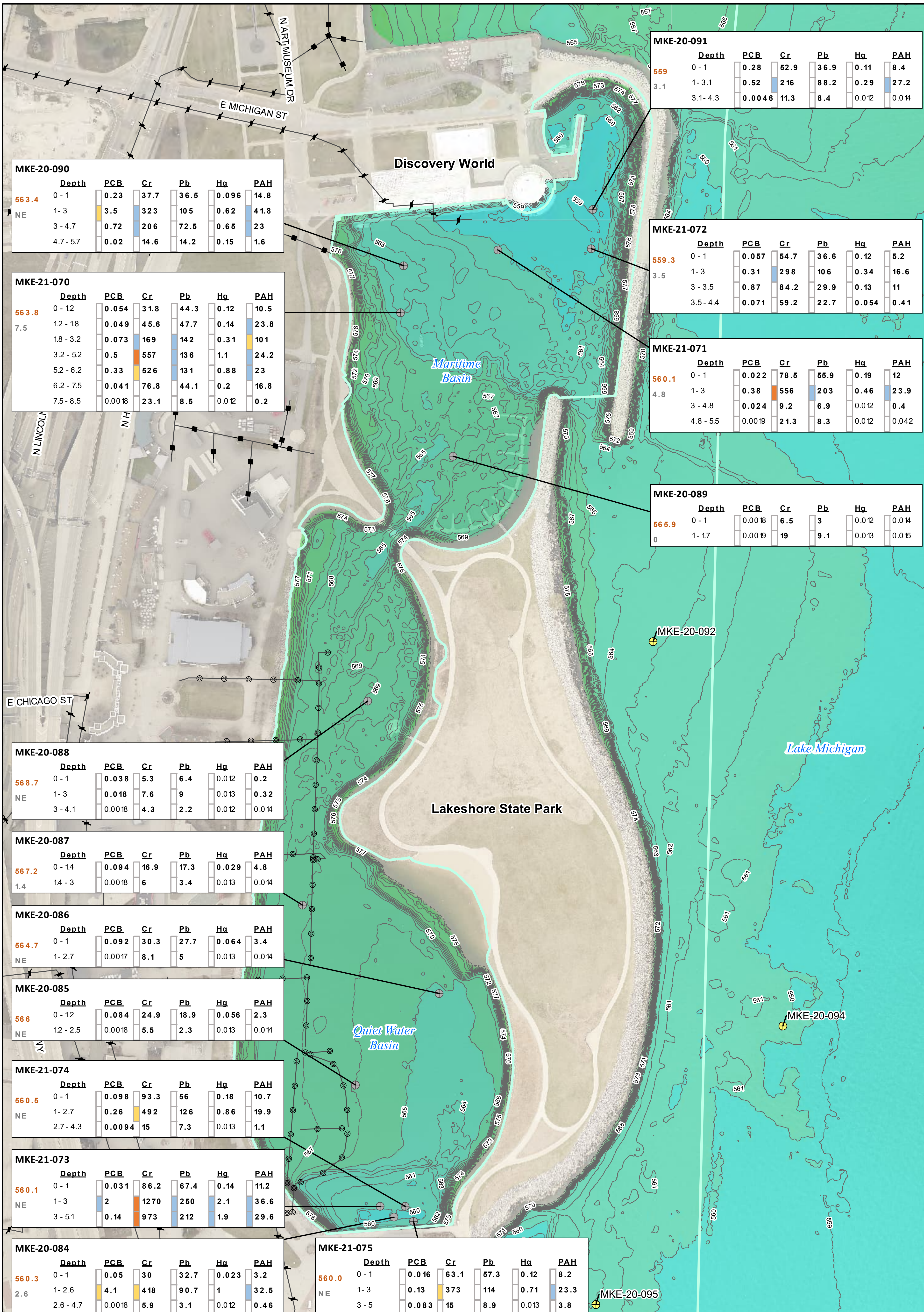


Figure 2-3
Analytical Results Summary
McKinley Marina
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay_Analytical\Figure2-3_MKE_Bay_Analytical_508.mxd AESPEJO (9/9/2024)

Jacobs



MKE-20-090
Mudline Elevation: 563.4 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.23	37.7	36.5	0.096	14.8
1 - 3	3.5	323	105	0.62	41.8
3 - 4.7	0.72	206	72.5	0.65	23
4.7 - 5.7	0.02	14.6	14.2	0.15	1.6

MKE-21-070
Mudline Elevation: 563.8 — Native Material Depth: 7.5

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.2	0.054	31.8	44.3	0.12	10.5
1.2 - 1.8	0.049	45.6	47.7	0.14	23.8
1.8 - 3.2	0.073	169	142	0.31	101
3.2 - 5.2	0.5	557	136	1.1	24.2
5.2 - 6.2	0.33	526	131	0.88	23
6.2 - 7.5	0.041	76.8	44.1	0.2	16.8
7.5 - 8.5	0.0018	23.1	8.5	0.012	0.2

MKE-20-091
Mudline Elevation: 559 — Native Material Depth: 3.1

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.28	52.9	36.9	0.11	8.4
1 - 3.1	0.52	216	88.2	0.29	27.2
3.1 - 4.3	0.0046	11.3	8.4	0.012	0.014

MKE-21-072
Mudline Elevation: 559.3 — Native Material Depth: 3.5

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.057	54.7	36.6	0.12	5.2
1 - 3	0.31	298	106	0.34	16.6
3 - 3.5	0.87	84.2	29.9	0.13	11
3.5 - 4.4	0.071	59.2	22.7	0.054	0.41

MKE-21-071
Mudline Elevation: 560.1 — Native Material Depth: 4.8

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.022	78.5	55.9	0.19	12
1 - 3	0.38	556	203	0.46	23.9
3 - 4.8	0.024	9.2	6.9	0.012	0.4
4.8 - 5.5	0.0019	21.3	8.3	0.012	0.042

MKE-20-089
Mudline Elevation: 565.9 — Native Material Depth: 0

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.0018	6.5	3	0.012	0.014
1 - 1.7	0.0019	19	9.1	0.013	0.015

MKE-20-088
Mudline Elevation: 568.7 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.038	5.3	6.4	0.012	0.2
1 - 3	0.018	7.6	9	0.013	0.32
3 - 4.1	0.0018	4.3	2.2	0.012	0.014

MKE-20-087
Mudline Elevation: 567.2 — Native Material Depth: 1.4

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.4	0.094	16.9	17.3	0.029	4.8
1.4 - 3	0.0018	6	3.4	0.013	0.014

MKE-20-086
Mudline Elevation: 564.7 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.092	30.3	27.7	0.064	3.4
1 - 2.7	0.0017	8.1	5	0.013	0.014

MKE-20-085
Mudline Elevation: 566 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.2	0.084	24.9	18.9	0.056	2.3
1.2 - 2.5	0.0018	5.5	2.3	0.013	0.014

MKE-21-074
Mudline Elevation: 560.5 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.098	93.3	56	0.18	10.7
1 - 2.7	0.26	492	126	0.86	19.9
2.7 - 4.3	0.0094	15	7.3	0.013	1.1

MKE-21-073
Mudline Elevation: 560.1 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.031	86.2	67.4	0.14	11.2
1 - 3	2	1270	250	2.1	36.6
3 - 5.1	0.14	973	212	1.9	29.6

MKE-20-084
Mudline Elevation: 560.3 — Native Material Depth: 2.6

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.05	30	32.7	0.023	3.2
1 - 2.6	4.1	418	90.7	1	32.5
2.6 - 4.7	0.0018	5.9	3.1	0.012	0.46

MKE-21-075
Mudline Elevation: 560.0 — Native Material Depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.016	63.1	57.3	0.12	8.2
1 - 3	0.13	373	114	0.71	23.3
3 - 5	0.083	15	8.9	0.013	3.8

LEGEND

- Analytical Sample Location
- Results included on another results map figure
- Milwaukee Bay FFS Boundary

Utilities
- Fiber Optic
- Storm Sewer
- Telecom

Bathymetry (feet)
- Bathymetric Contour

Elevation (feet)
- 580 - 585
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560

0 125 250
Approximate scale in feet

Analytical Results Table Format

Location ID
Mudline Elevation
Native Material Depth

Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
	<1	<PEC	<PEC
Sample interval (ft bss)	1 - 3	>PEC	>PEC
	3 - 5	>3xPEC	>3xPEC
	5 - 50	>5xPEC	>5xPEC
	>50		

Bold values represent results above the detection limit
"-" = COC was not sampled/analyzed
NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; WDNR = Wisconsin Department of Natural Resources

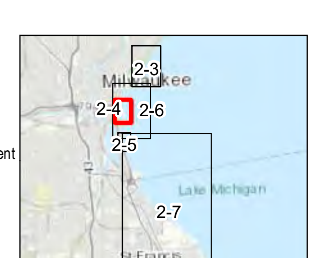


Figure 2-4
Analytical Results Summary
Summerfest Lagoon Basins
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

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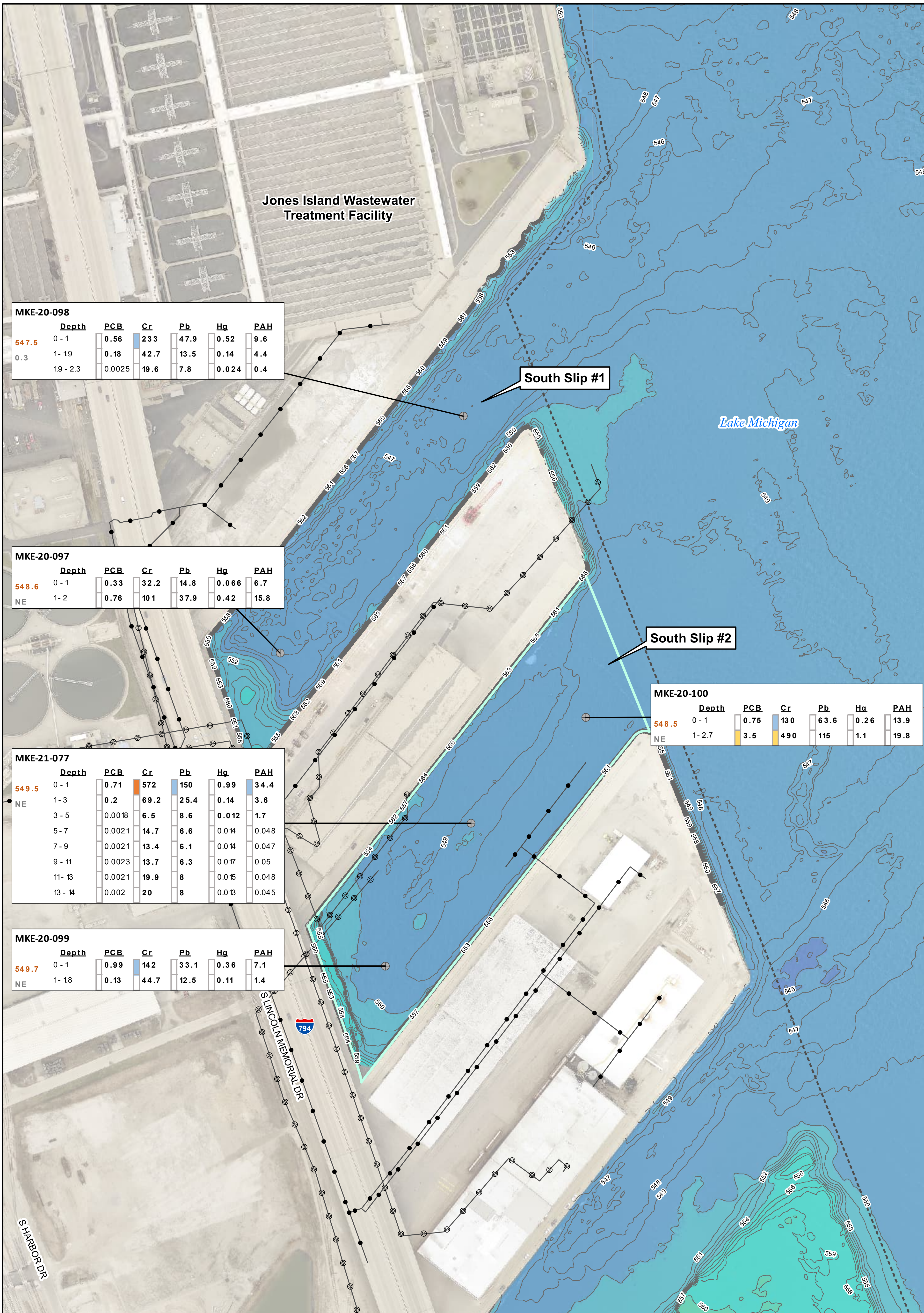


MKE-20-098

	Depth	PCB	Cr	Pb	Hg	PAH
547.5	0 - 1	0.56	233	47.9	0.52	9.6
0.3	1- 1.9	0.18	42.7	13.5	0.14	4.4
	1.9 - 2.3	0.0025	19.6	7.8	0.024	0.4

MKE-20-097

	Depth	PCB	Cr	Pb	Hg	PAH
548.6	0 - 1	0.33	32.2	14.8	0.066	6.7
NE	1 - 2	0.76	101	37.9	0.42	15.8

MKE-20-100

	Depth	PCB	Cr	Pb	Hg	PAH
548.5	0 - 1	0.75	130	63.6	0.26	13.9
NE	1- 2.7	3.5	490	115	1.1	19.8

MKE-21-077

	Depth	PCB	Cr	Pb	Hg	PAH
549.5	0 - 1	0.71	572	150	0.99	34.4
NE	1 - 3	0.2	69.2	25.4	0.14	3.6
	3 - 5	0.0018	6.5	8.6	0.012	1.7
	5 - 7	0.0021	14.7	6.6	0.014	0.048
	7 - 9	0.0021	13.4	6.1	0.014	0.047
	9 - 11	0.0023	13.7	6.3	0.017	0.05
	11- 13	0.0021	19.9	8	0.015	0.048
	13 - 14	0.002	20	8	0.013	0.045

MKE-20-099

	Depth	PCB	Cr	Pb	Hg	PAH
549.7	0 - 1	0.99	142	33.1	0.36	7.1
NE	1- 1.8	0.13	44.7	12.5	0.11	1.4

LEGEND

- Analytical Sample Location
- Federal Navigation Channel
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Water Line

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545

N

0 100 200

Approximate scale in feet

Analytical Results Table Format

Location ID

	Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
Mudline Elevation				
Native Material Depth		<1	<PEC	<PEC
	Sample interval (ft bss)	1 - 3	>PEC	>PEC
		3 - 5	>3xPEC	>3xPEC
		5 - 50	>5xPEC	>5xPEC
		>50		

Bold values represent results above the detection limit

"-" = COC was not sampled/analyzed

NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; ft bss = feet below sediment surface; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; Hg = mercury; mg/kg = milligram(s) per kilogram; ; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; WDNR = Wisconsin Department of Natural Resources

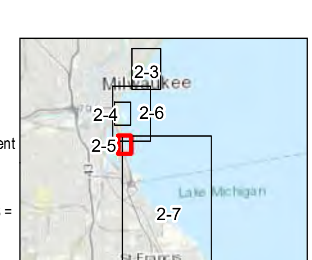
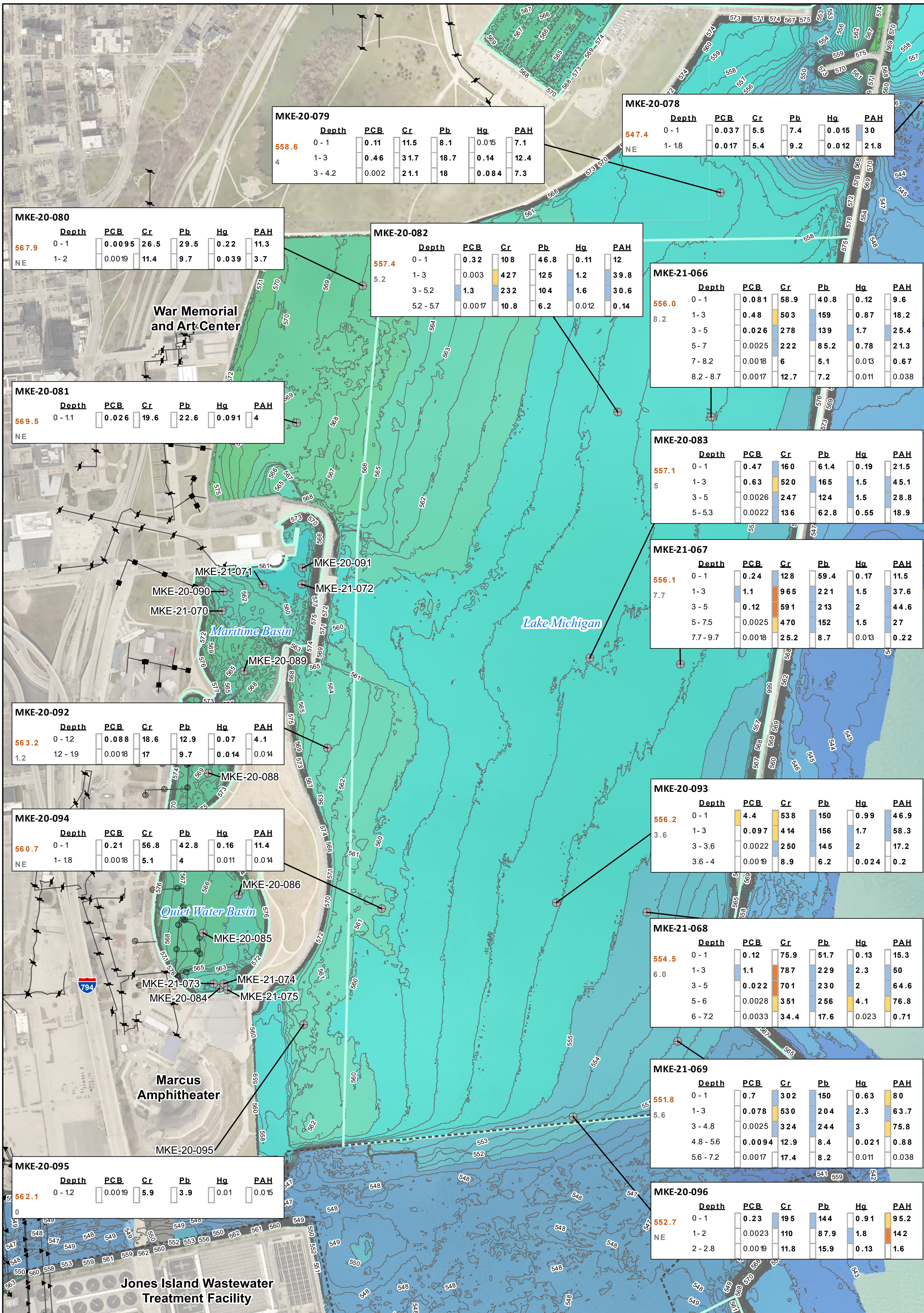


Figure 2-5
Analytical Results Summary
South Slip #1 and #2
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs



LEGEND

- Analytical Sample Location
- Federal Navigation Channel
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Sanitary Sewer
- Storm Sewer
- Telecom
- Water Line

Utility Identified during Menomonee and Milwaukee River FFS

Bathymetry (feet)

Bathymetric Contour

Elevation (feet)

580 - 585
575 - 580
570 - 575
565 - 570
560 - 565
555 - 560
550 - 555
545 - 550
540 - 545
535 - 540

0 300 600
Approximate scale in feet
N

Analytical Results Table Format

Location ID

Mudline Elevation

Native Material Depth

	Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
		<1	<PEC	<PEC
Sample interval (ft bss)		1 - 3	>PEC	>PEC
		3 - 5	>3xPEC	>3xPEC
		5 - 50	>5xPEC	>5xPEC
		>50		

Bold values represent results above the detection limit
"-" = COC was not sampled/analyzed
NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; WDNR = Wisconsin Department of Natural Resources

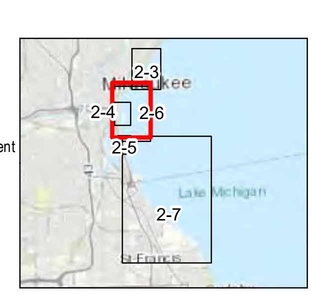


Figure 2-6
Analytical Results Summary
Northern Outer Harbor
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

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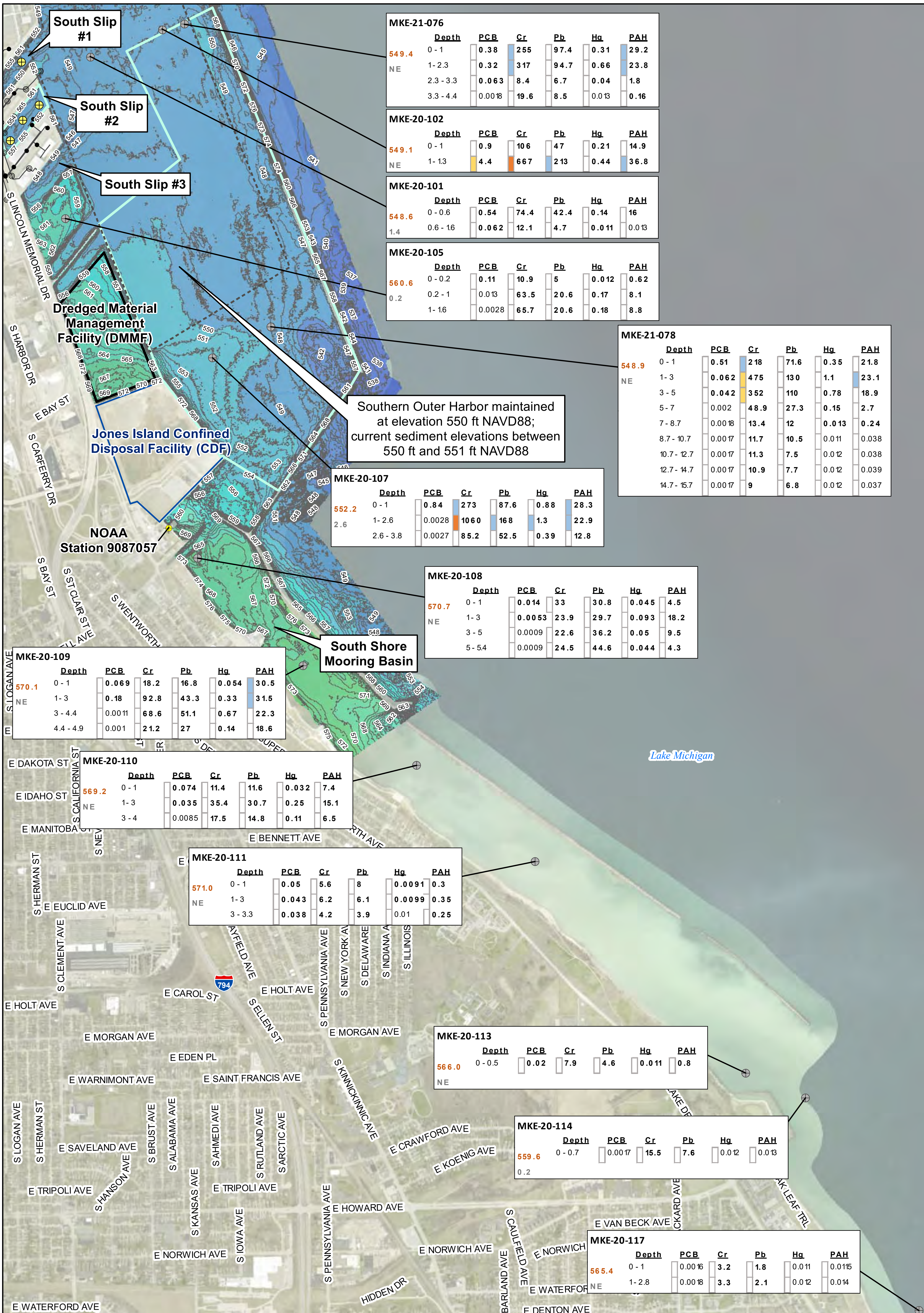
Jacobs



MKE-21-076
Mudline elevation: 549.4; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.38**	**255**	**97.4**	**0.31**	**29.2**
1 - 2.3	**0.32**	**317**	**94.7**	**0.66**	**23.8**
2.3 - 3.3	**0.063**	**8.4**	**6.7**	**0.04**	**1.8**
3.3 - 4.4	0.0018	**19.6**	**8.5**	0.013	**0.16**

MKE-20-102
Mudline elevation: 549.1; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.9**	**106**	**47**	**0.21**	**14.9**
1 - 1.3	**4.4**	**667**	**213**	**0.44**	**36.8**

MKE-20-101
Mudline elevation: 548.6; Native material depth: 1.4

Depth	PCB	Cr	Pb	Hg	PAH
0 - 0.6	**0.54**	**74.4**	**42.4**	**0.14**	**16**
0.6 - 1.6	**0.062**	**12.1**	**4.7**	**0.011**	0.013

MKE-20-105
Mudline elevation: 560.6; Native material depth: 0.2

Depth	PCB	Cr	Pb	Hg	PAH
0 - 0.2	**0.11**	**10.9**	**5**	**0.012**	**0.62**
0.2 - 1	0.013	**63.5**	**20.6**	**0.17**	**8.1**
1 - 1.6	0.0028	**65.7**	**20.6**	**0.18**	**8.8**

MKE-21-078
Mudline elevation: 548.9; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.51**	**218**	**71.6**	**0.35**	**21.8**
1 - 3	**0.062**	**475**	**130**	**1.1**	**23.1**
3 - 5	**0.042**	**352**	**110**	**0.78**	**18.9**
5 - 7	0.002	**48.9**	**27.3**	**0.15**	**2.7**
7 - 8.7	0.0018	**13.4**	**12**	**0.013**	**0.24**
8.7 - 10.7	0.0017	**11.7**	**10.5**	0.011	0.038
10.7 - 12.7	0.0017	**11.3**	**7.5**	0.012	0.038
12.7 - 14.7	0.0017	**10.9**	**7.7**	0.012	0.039
14.7 - 15.7	0.0017	**9**	**6.8**	0.012	0.037

MKE-20-107
Mudline elevation: 552.2; Native material depth: 2.6

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.84**	**273**	**87.6**	**0.88**	**28.3**
1 - 2.6	0.0028	**1060**	**168**	**1.3**	**22.9**
2.6 - 3.8	0.0027	**85.2**	**52.5**	**0.39**	**12.8**

MKE-20-108
Mudline elevation: 570.7; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.014**	**33**	**30.8**	**0.045**	**4.5**
1 - 3	**0.0053**	**23.9**	**29.7**	**0.093**	**18.2**
3 - 5	0.0009	**22.6**	**36.2**	**0.05**	**9.5**
5 - 5.4	0.0009	**24.5**	**44.6**	**0.044**	**4.3**

MKE-20-109
Mudline elevation: 570.1; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.069**	**18.2**	**16.8**	**0.054**	**30.5**
1 - 3	**0.18**	**92.8**	**43.3**	**0.33**	**31.5**
3 - 4.4	0.0011	**68.6**	**51.1**	**0.67**	**22.3**
4.4 - 4.9	0.001	**21.2**	**27**	**0.14**	**18.6**

MKE-20-110
Mudline elevation: 569.2; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.074**	**11.4**	**11.6**	**0.032**	**7.4**
1 - 3	**0.035**	**35.4**	**30.7**	**0.25**	**15.1**
3 - 4	0.0085	**17.5**	**14.8**	**0.11**	**6.5**

MKE-20-111
Mudline elevation: 571.0; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	**0.05**	**5.6**	**8**	**0.0091**	**0.3**
1 - 3	**0.043**	**6.2**	**6.1**	**0.0099**	**0.35**
3 - 3.3	**0.038**	**4.2**	**3.9**	0.01	**0.25**

MKE-20-113
Mudline elevation: 566.0; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 0.5	**0.02**	**7.9**	**4.6**	**0.011**	**0.8**

MKE-20-114
Mudline elevation: 559.6; Native material depth: 0.2

Depth	PCB	Cr	Pb	Hg	PAH
0 - 0.7	0.0017	**15.5**	**7.6**	0.012	0.013

MKE-20-117
Mudline elevation: 565.4; Native material depth: NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.0016	**3.2**	**1.8**	0.011	0.0115
1 - 2.8	0.0018	**3.3**	**2.1**	0.012	0.014

LEGEND

- Analytical Sample Location
- Results included on another results map figure
- Gauging Station
- Federal Navigation Channel
- DMMF Area
- Jones Island CDF
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Water Line

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

575 - 580
570 - 575
565 - 570
560 - 565
555 - 560
550 - 555
545 - 550
540 - 545
535 - 540
534 - 535

N

0 700 1400
Approximate scale in feet

Analytical Results Table Format

Location ID

Mudline Elevation

Native Material Depth

	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
Depth	<1	<PEC	<PEC
Sample interval (ft bss)	1 - 3	>PEC	>PEC
	3 - 5	>3xPEC	>3xPEC
	5 - 50	>5xPEC	>5xPEC
	>50		

Bold values represent results above the detection limit
"-" = COC was not sampled/analyzed
NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; CDF = Confined Disposal Facility; COC = Contaminant of Concern; Cr = chromium; DMMF = Dredged Material Management Facility; FFS = focused feasibility study; ft = feet; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; NOAA = National Oceanic and Atmospheric Administration; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; WDNR = Wisconsin Department of Natural Resources

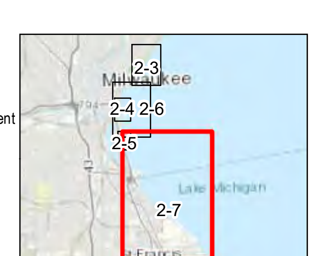


Figure 2-7
Analytical Results Summary
Southern Outer Harbor
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

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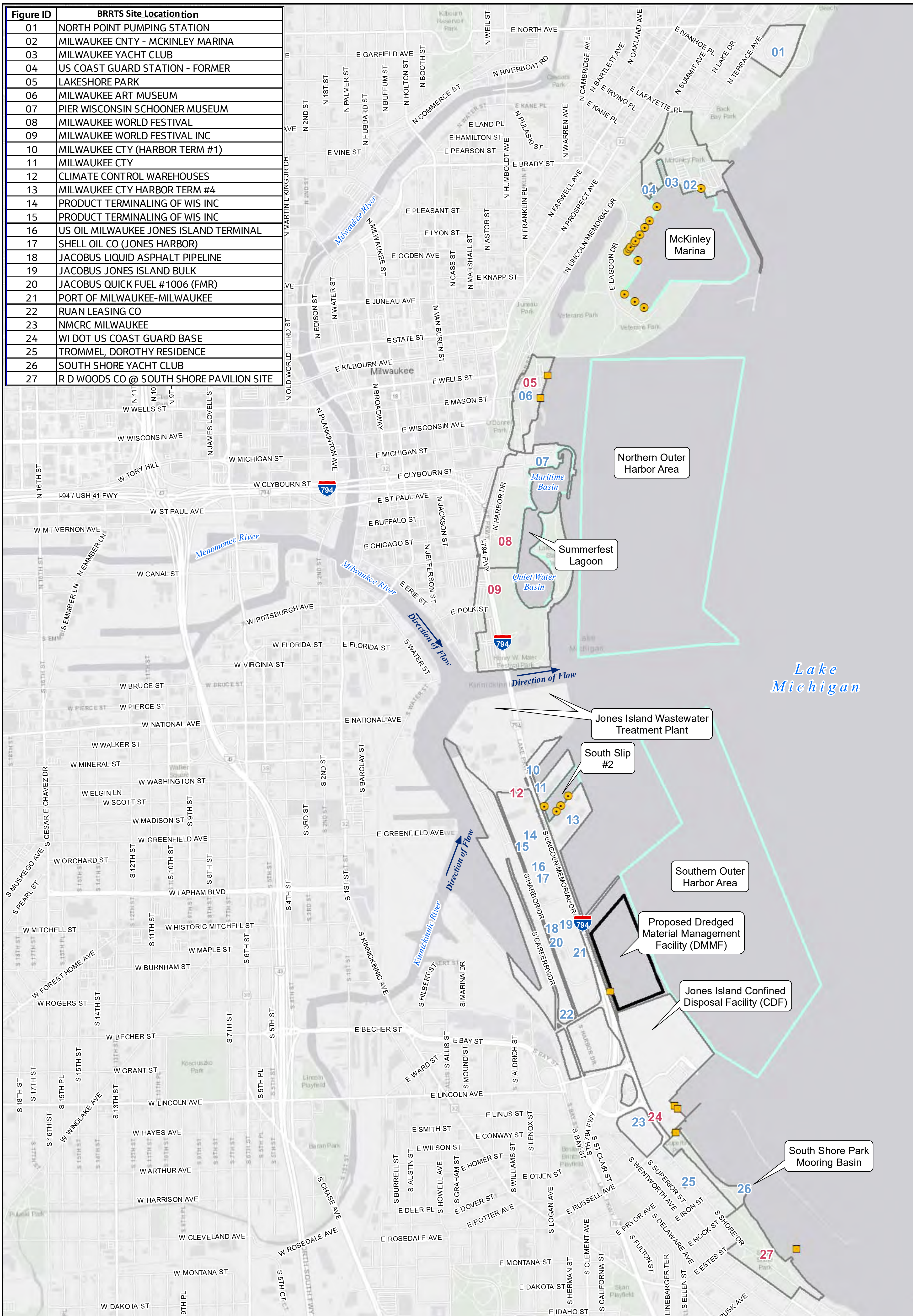


Figure ID	BRRTS Site Location
01	NORTH POINT PUMPING STATION
02	MILWAUKEE CNTY - MCKINLEY MARINA
03	MILWAUKEE YACHT CLUB
04	US COAST GUARD STATION - FORMER
05	LAKESHORE PARK
06	MILWAUKEE ART MUSEUM
07	PIER WISCONSIN SCHOONER MUSEUM
08	MILWAUKEE WORLD FESTIVAL
09	MILWAUKEE WORLD FESTIVAL INC
10	MILWAUKEE CTY (HARBOR TERM #1)
11	MILWAUKEE CTY
12	CLIMATE CONTROL WAREHOUSES
13	MILWAUKEE CTY HARBOR TERM #4
14	PRODUCT TERMINALING OF WIS INC
15	PRODUCT TERMINALING OF WIS INC
16	US OIL MILWAUKEE JONES ISLAND TERMINAL
17	SHELL OIL CO (JONES HARBOR)
18	JACOBUS LIQUID ASPHALT PIPELINE
19	JACOBUS JONES ISLAND BULK
20	JACOBUS QUICK FUEL #1006 (FMR)
21	PORT OF MILWAUKEE-MILWAUKEE
22	RUAN LEASING CO
23	NMCRC MILWAUKEE
24	WI DOT US COAST GUARD BASE
25	TROMMEL, DOROTHY RESIDENCE
26	SOUTH SHORE YACHT CLUB
27	R D WOODS CO @ SOUTH SHORE PAVILION SITE

LEGEND

- Combined Sewer Outfall Noted and Mapped During Jacobs Fall 2021 Shoreline Assessment
- Storm Sewer Outfall Noted and Mapped During Jacobs Fall 2021 Shoreline Assessment
- Milwaukee Bay Project Area
- BRRTS Site Boundary
- Proposed DMMF Area
- 01 Closed BRRTS Site Identification Number
- 05 Open BRRTS Site Identification Number

N

0 900 1800

Approximate scale in feet

Notes:
1. Base map source: Esri ArcGIS Online Gray Base Map
2. Parcel data provided by the Milwaukee County Land Information Office (MCLIO) dated December 21, 2020.
3. BRRTS = WDNR Bureau for Remediation and Redevelopment Tracking System; DMMF = Dredged Material Management Facility; WDNR = Wisconsin Department of Natural Resources

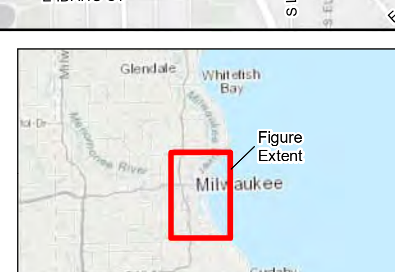
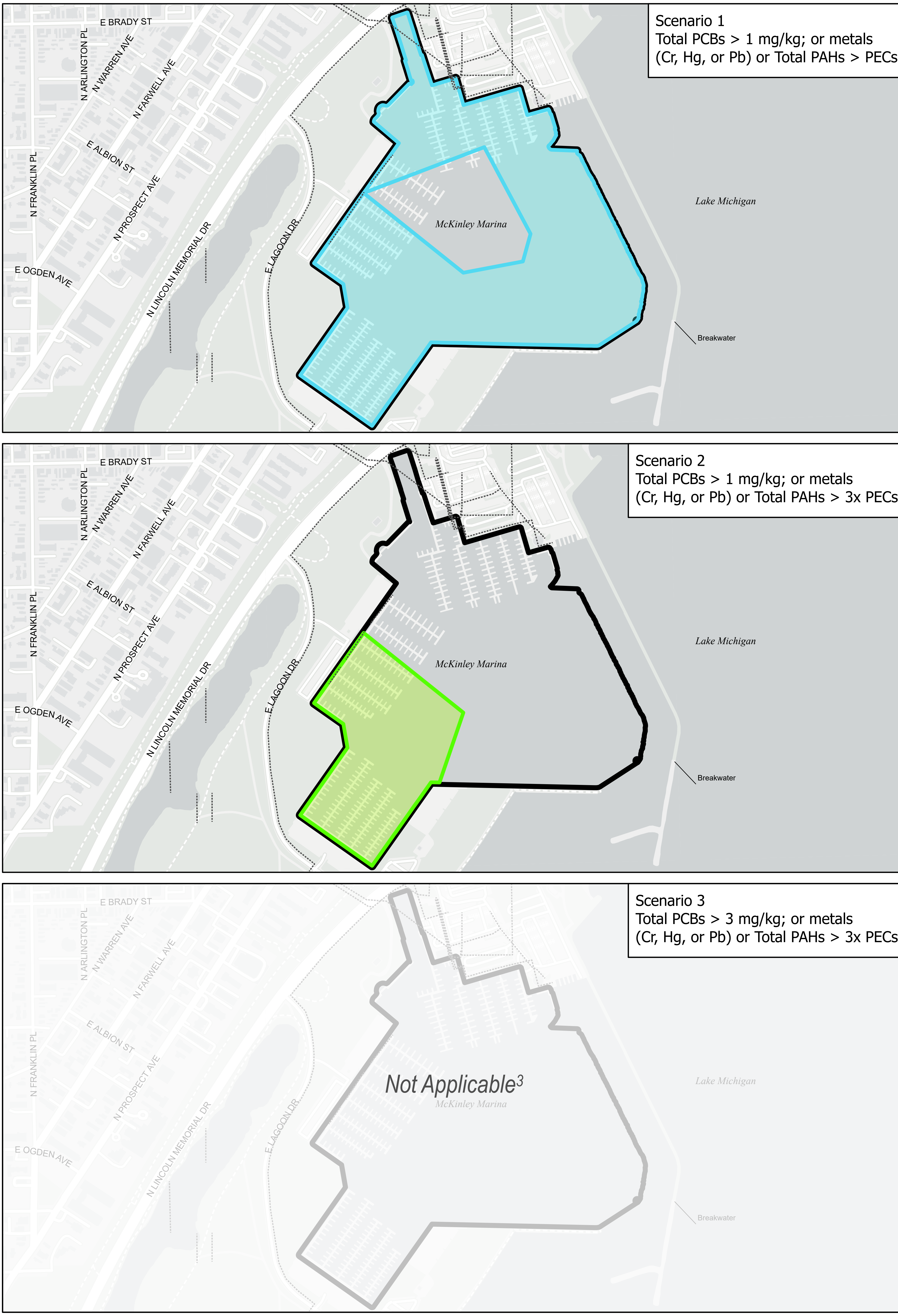


Figure 2-8
Potential Sources
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin



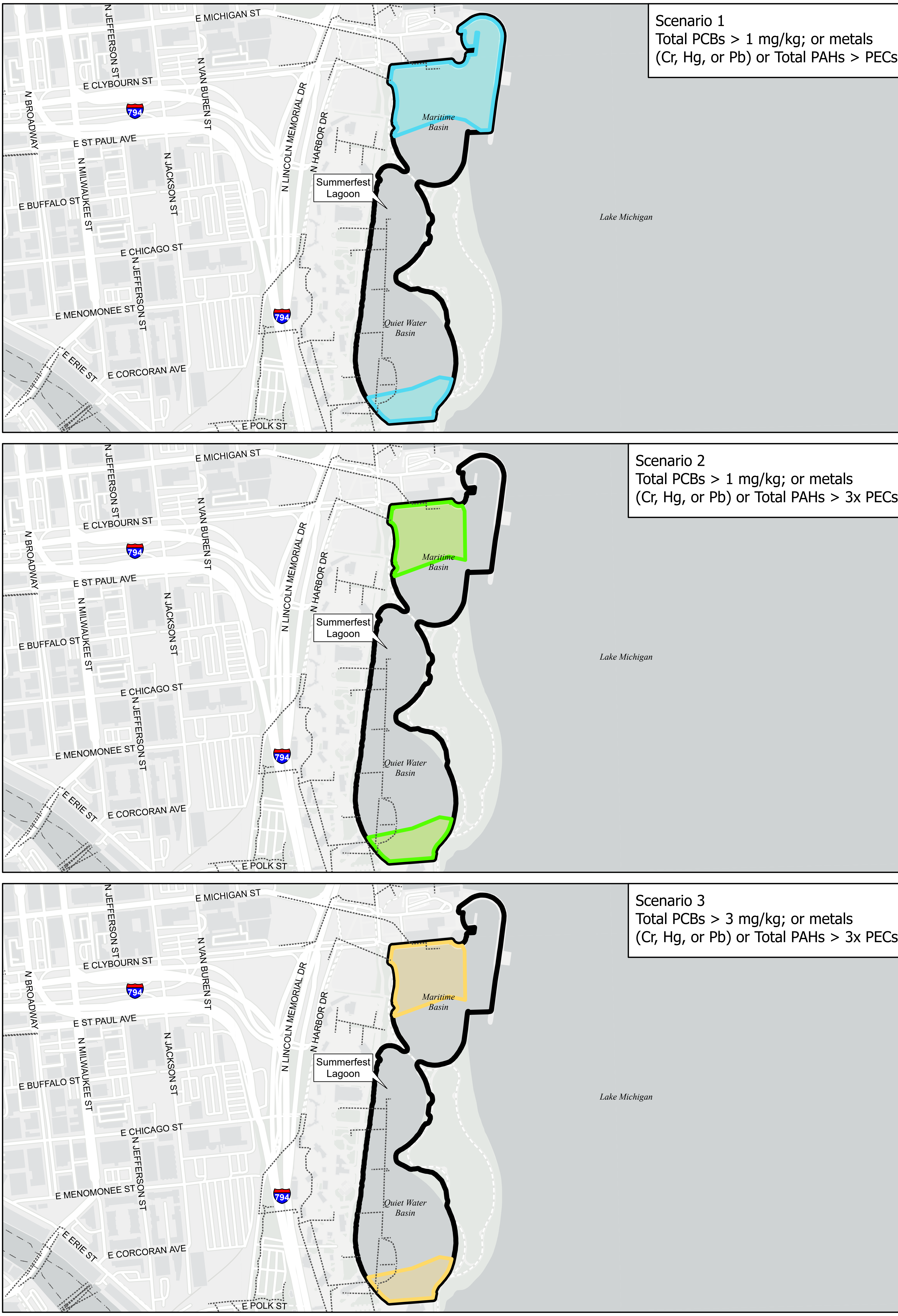
LEGEND

- Remediation Target Area - Scenario 1
- Remediation Target Area - Scenario 2
- Milwaukee Bay Project Area
- Utilities

Notes:
1. Basemap source: Esri ArcGIS Online Light Gray Base Map
2. 3x = 3 times; Cr = chromium; Hg = mercury; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; PECs = Probable Effect Concentrations from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Publication Number WT-732 2003 (WDNR 2003); WDNR = Wisconsin Department of Natural Resources
3 .Scenario 3 is not applicable to the McKinley Marina subarea because there are no sample results here that exceed the screening levels for this alternative.

Figure 3-1
McKinley Marina Remediation Target Areas
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs



LEGEND

- Remediation Target Area - Scenario 1
- Remediation Target Area - Scenario 2
- Remediation Target Area - Scenario 3
- Milwaukee Bay Project Area
- Utilities
- Federal Navigation Channel

N

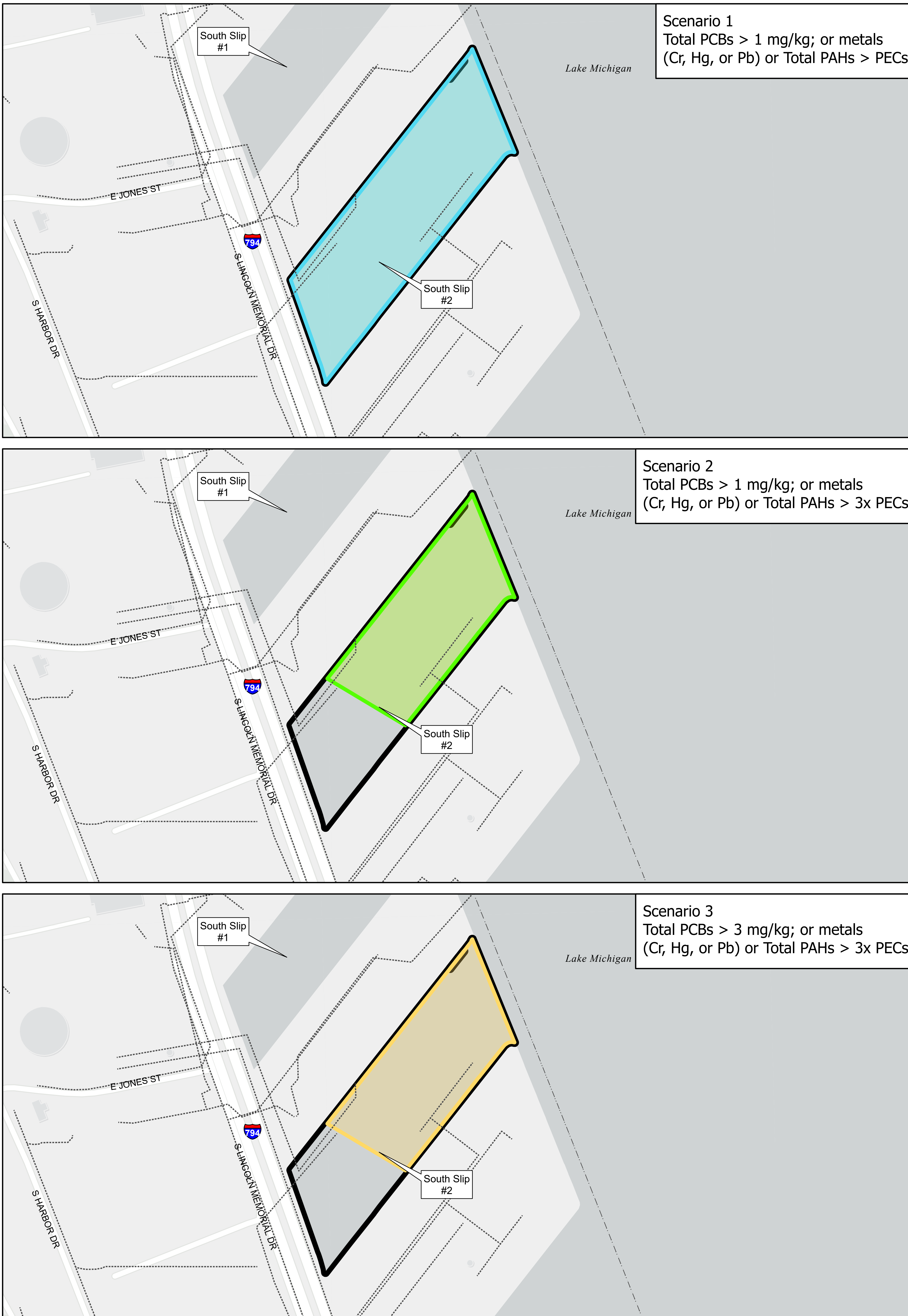
0 350 700

Approximate scale in feet

Notes:
1. Basemap source: Esri ArcGIS Online Light Gray Base Map
2. 3x = 3 times; Cr = chromium; Hg = mercury; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PECs = Probable Effect Concentrations from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Publication Number WT-732 2003 (WDNR 2003); WDNR = Wisconsin Department of 0 350 700 Natural Resources

Figure 3-2
Summerfest Lagoon Remediation Target Areas
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs



N

0 150 300

Approximate scale in feet

LEGEND

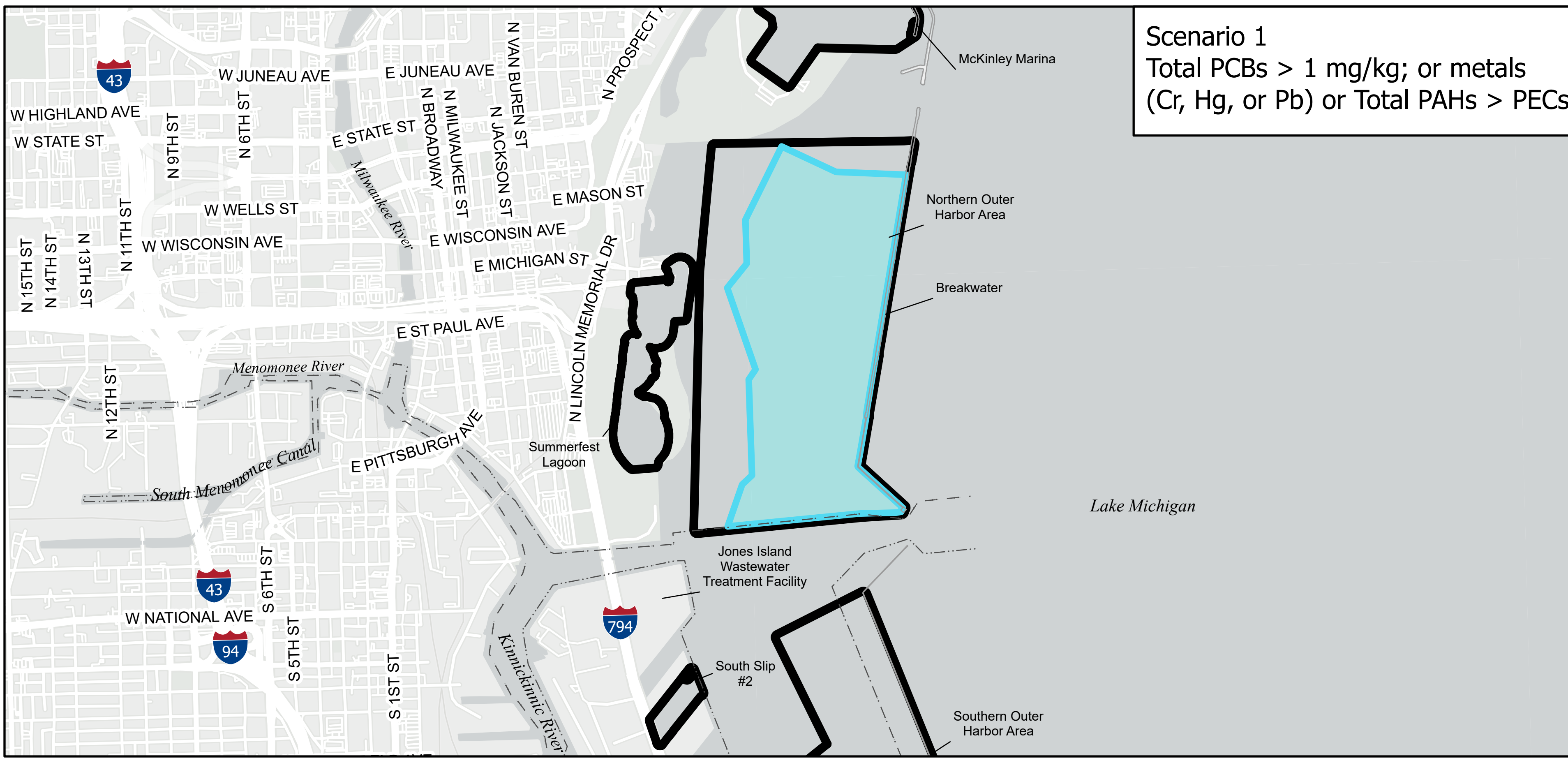
- Remediation Target Area - Scenario 1
- Remediation Target Area - Scenario 2
- Remediation Target Area - Scenario 3
- Milwaukee Bay Project Area
- Utilities
- Federal Navigation Channel

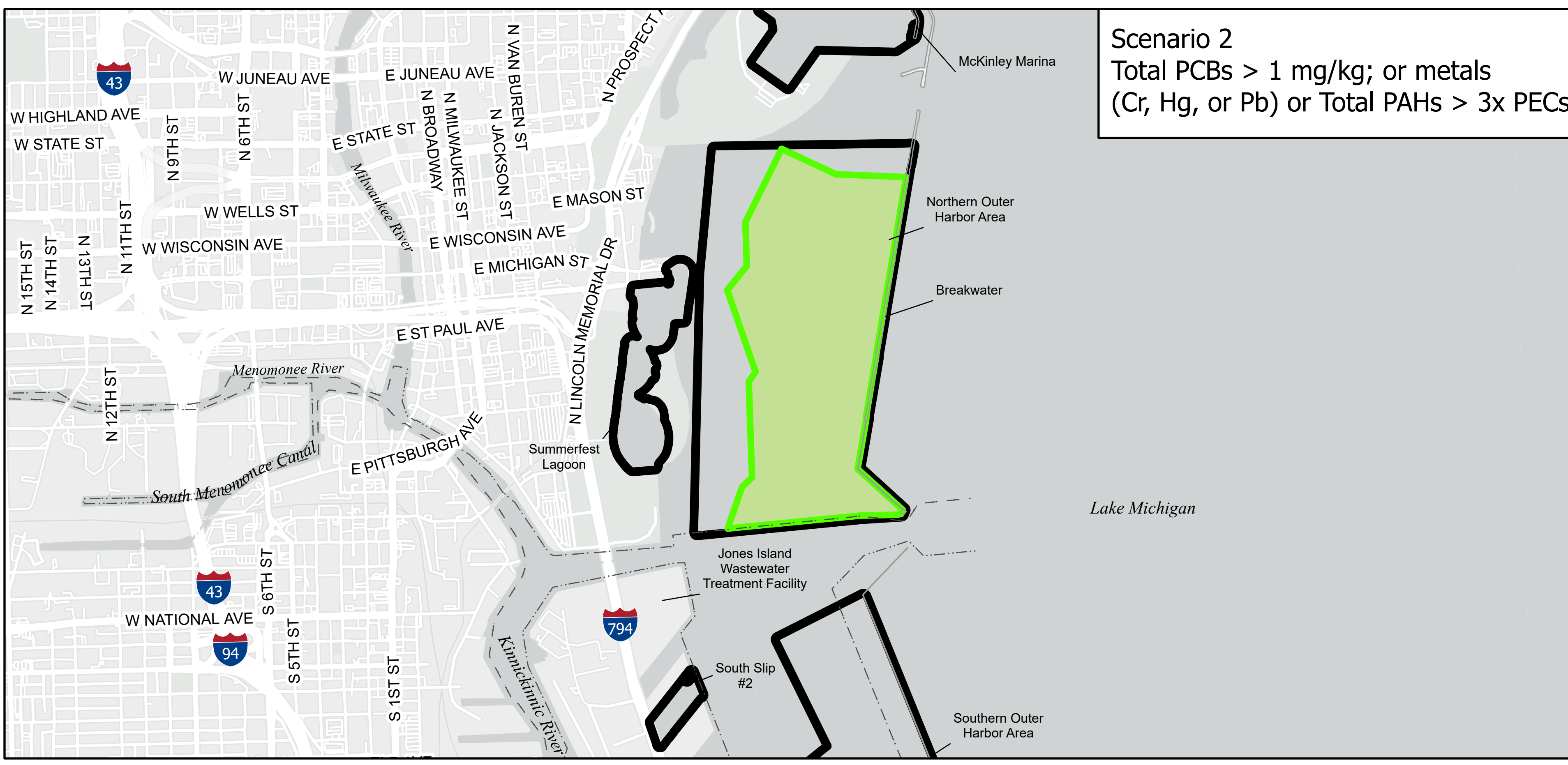
Notes:
1. Basemap source: Esri ArcGIS Online Light Gray Base Map
2. 3x = 3 times; Cr = chromium; Hg = mercury; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable Effect Concentrations from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Publication Number WT-732 2003 (WDNR 2003); WDNR = Wisconsin Department of 0 150 300 Natural Resources

Figure 3-3
South Slip #2 Remediation Target Areas
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_RTA_Figures_508.aprx-Figure3-03_MKE_Bay_SlipNo2_RTAs_508 STOLZRC (9/5/2024)





N

0 1,200 2,400

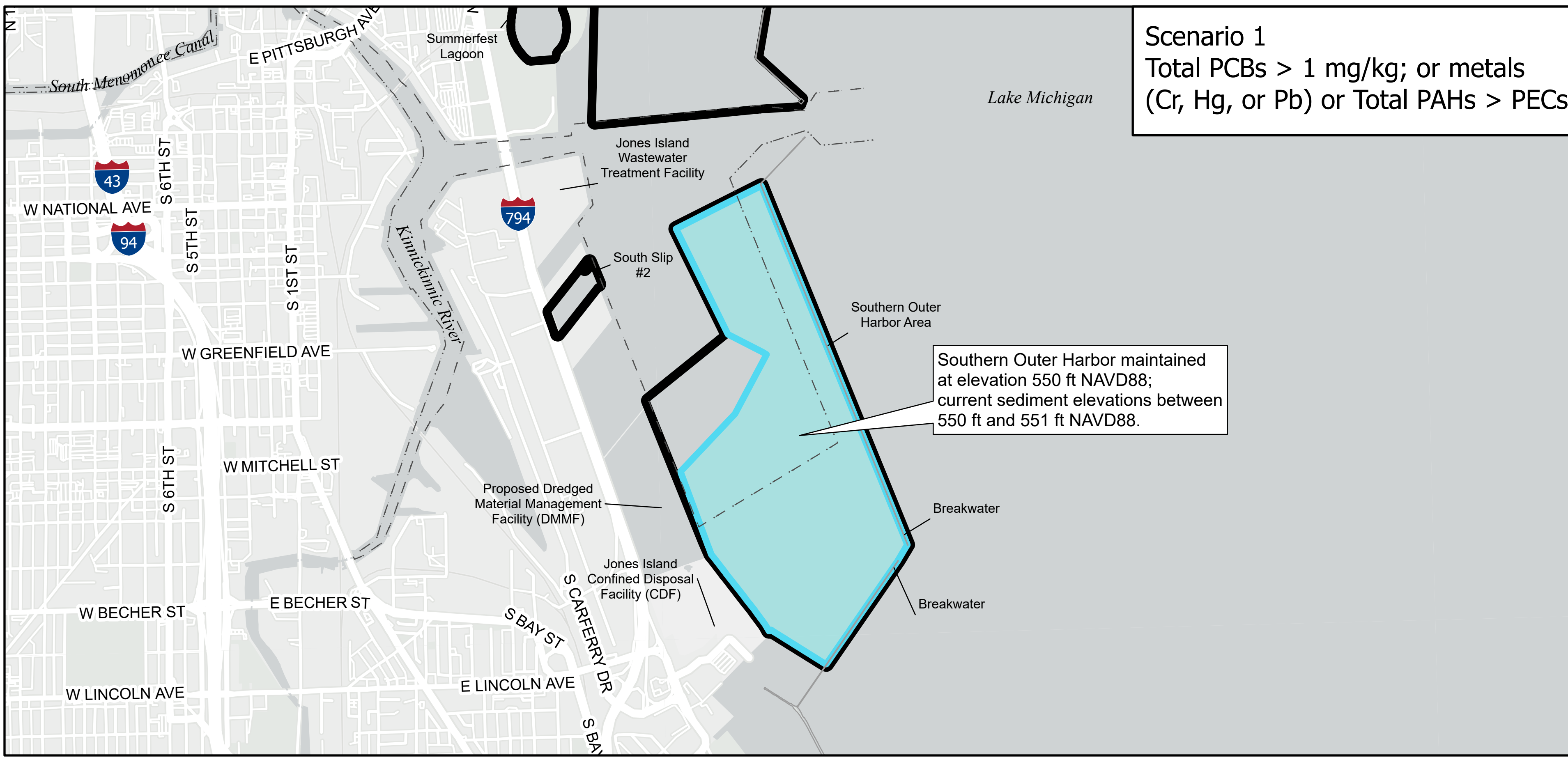
Approximate scale in feet

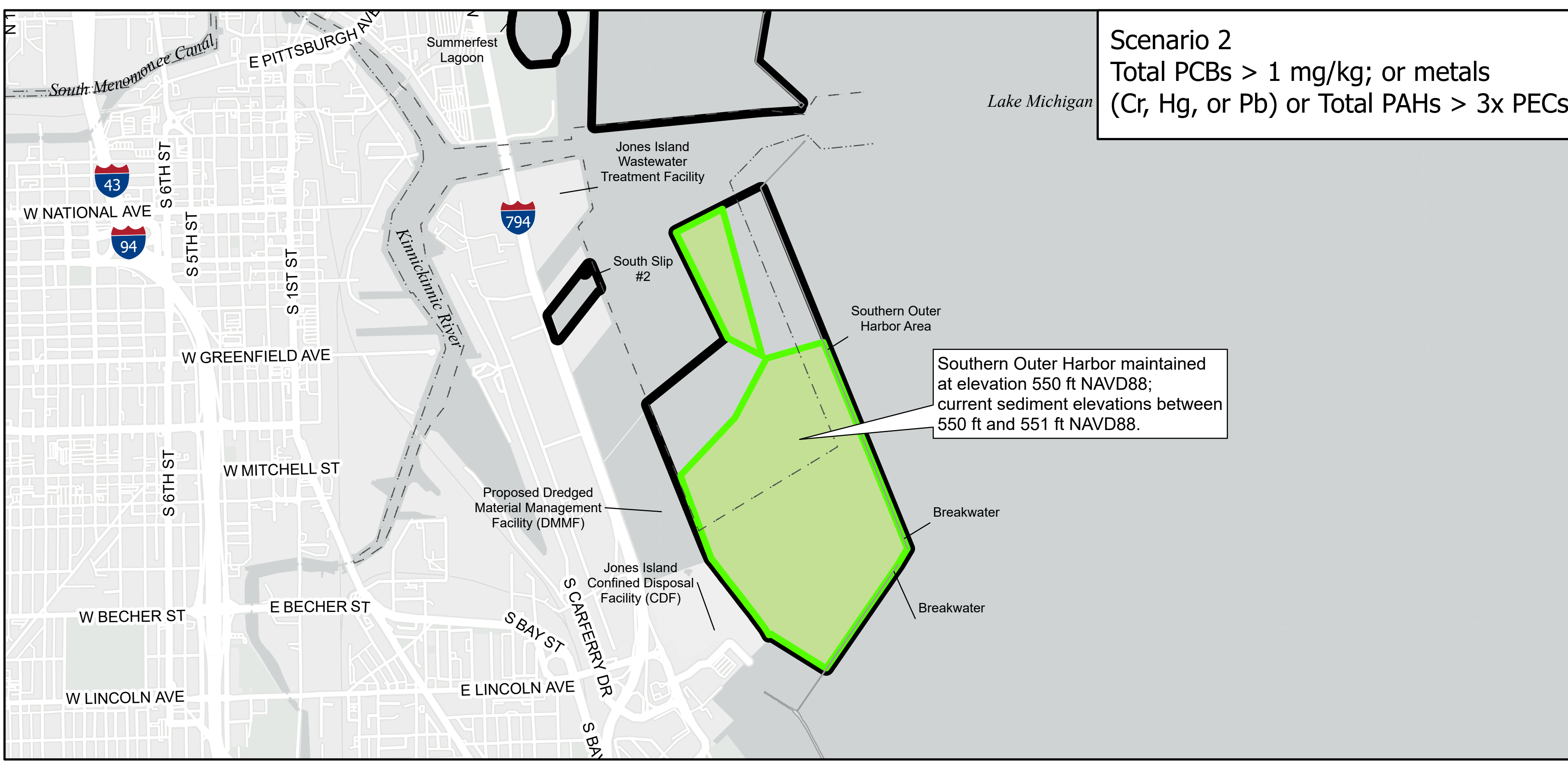
LEGEND

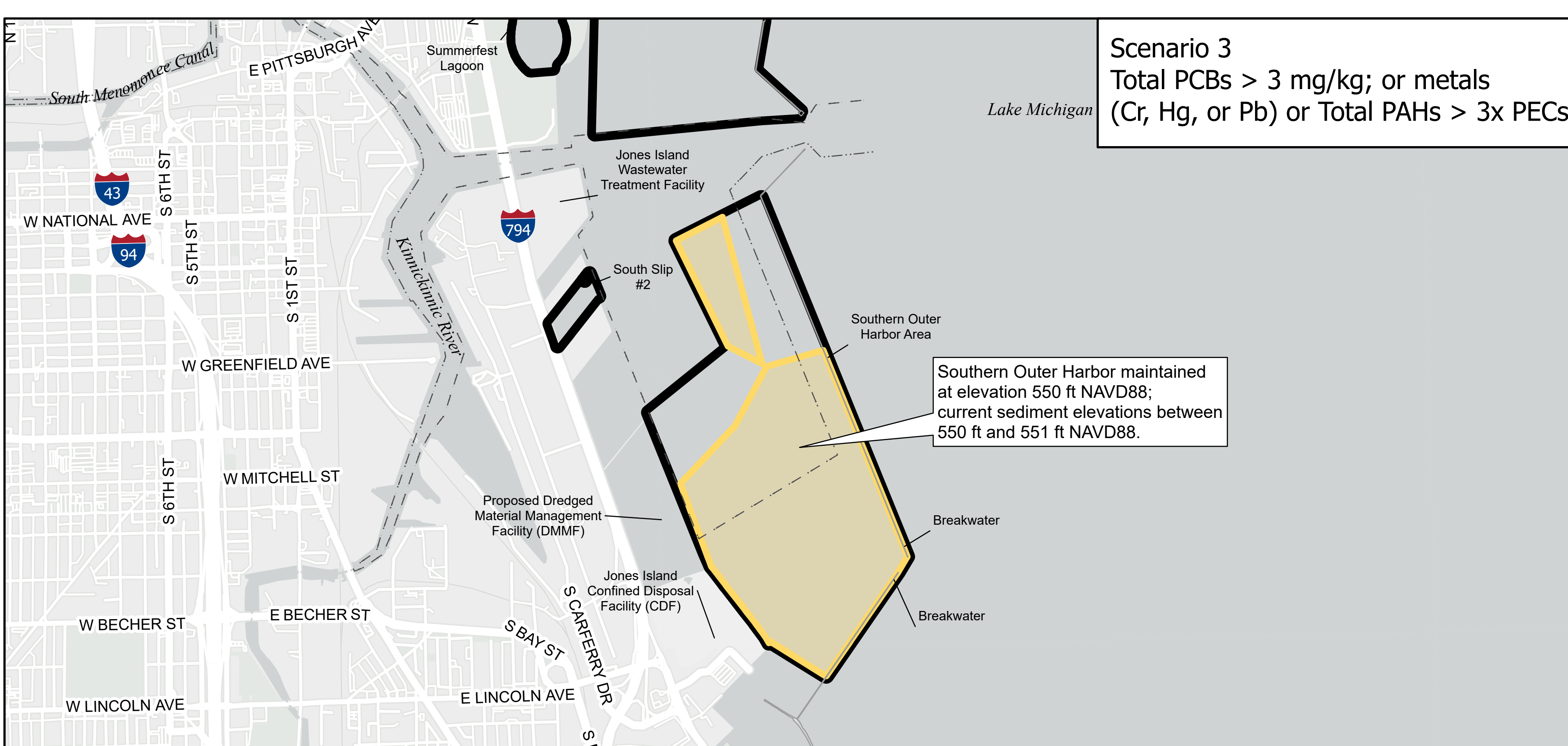
- Remediation Target Area - Scenario 1
- Remediation Target Area - Scenario 2
- Remediation Target Area - Scenario 3
- Milwaukee Bay Project Area
- Federal Navigation Channel

Notes:
1. Basemap source: Esri ArcGIS Online Light Gray Base Map
2. 3x = 3 times; Cr = chromium; Hg = mercury; mg/kg = milligram(s) per kilogram; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; PECs = Probable Effect Concentrations from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Publication Number WT-732 2003 (WDNR 2003); WDNR = Wisconsin Department of Natural Resources

Figure 3-4
Northern Outer Harbor Remediation Target Areas
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin







N

0 1,200 2,400

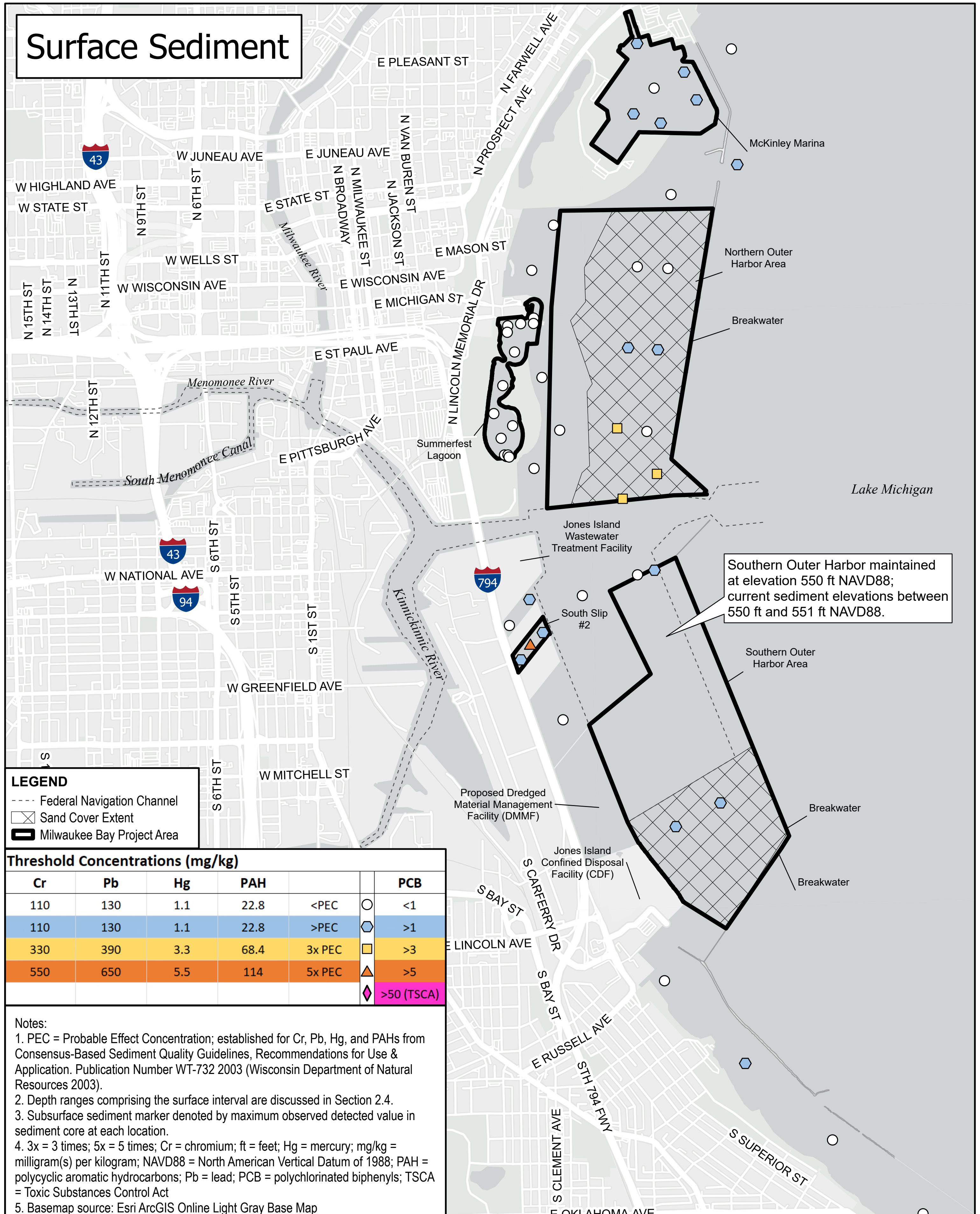
Approximate scale in feet

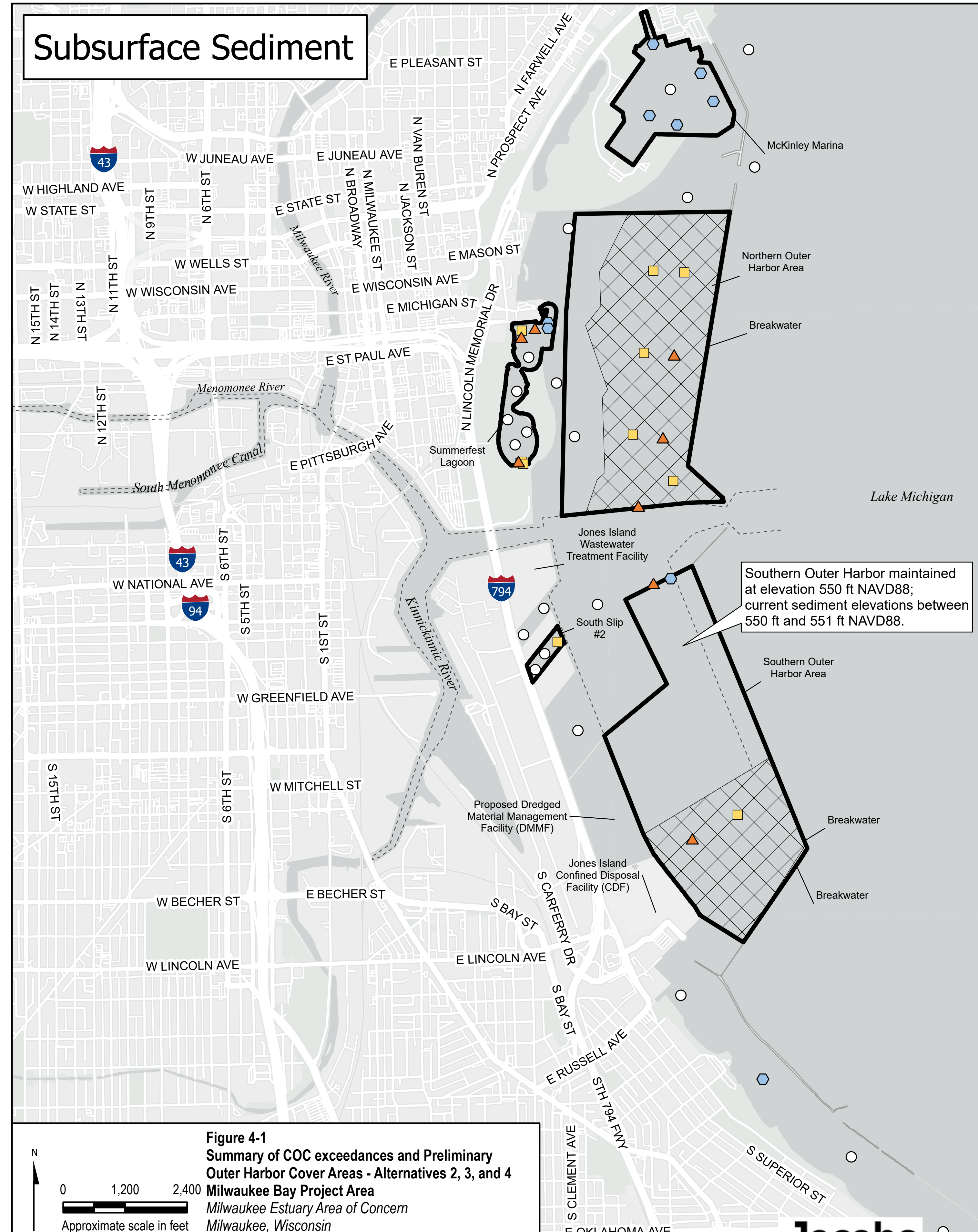
LEGEND

- Remediation Target Area - Scenario 1
- Remediation Target Area - Scenario 2
- Remediation Target Area - Scenario 3
- Milwaukee Bay Project Area
- Federal Navigation Channel

Notes:
1. Basemap source: Esri ArcGIS Online Light Gray Base Map
2. 3x = 3 times; Cr = chromium; ft = feet; Hg = mercury; mg/kg = milligrams per kilogram; NAVD88 = North American Vertical Datum - of 1988; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; PECs = Probable Effect Concentrations from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application, Publication Number WT-732 2003 (WDNR 2003); WDNR = Wisconsin Department of Natural Resources

Figure 3-5
Southern Outer Harbor Remediation Target Areas
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin





LEGEND

- Federal Navigation Channel
- Sand Cover Extent
- Milwaukee Bay Project Area

Threshold Concentrations (mg/kg)

Cr	Pb	Hg	PAH			PCB
110	130	1.1	22.8	<PEC	○	<1
110	130	1.1	22.8	>PEC	⬡	>1
330	390	3.3	68.4	3x PEC	□	>3
550	650	5.5	114	5x PEC	△	>5
					◊	>50 (TSCA)

Notes:
1. PEC = Probable Effect Concentration; established for Cr, Pb, Hg, and PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. Depth ranges comprising the surface interval are discussed in Section 2.4.
3. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; ft = feet; Hg = mercury; mg/kg = milligram(s) per kilogram; NAVD88 = North American Vertical Datum of 1988; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

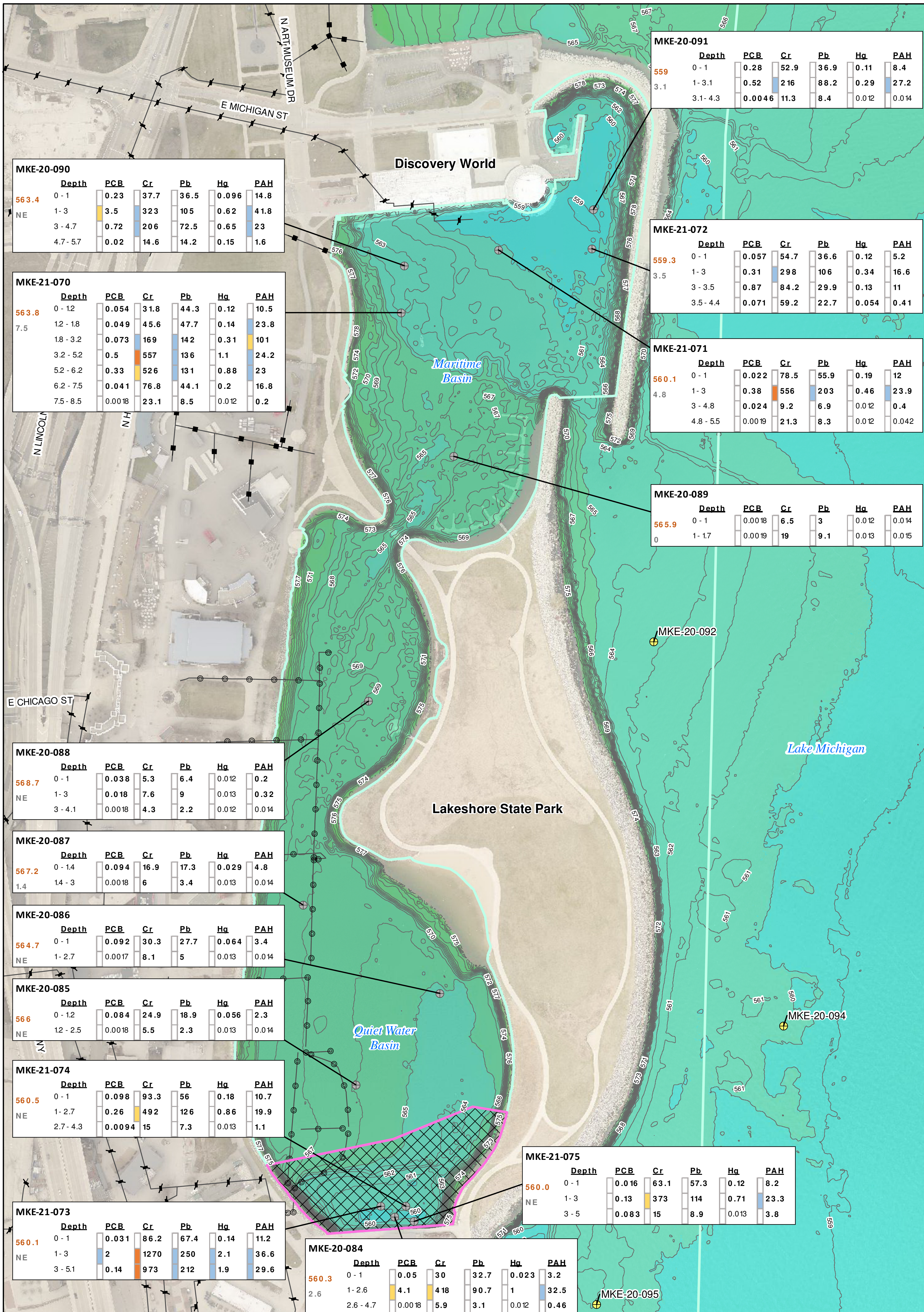
N

0 1,200 2,400
Approximate scale in feet

Figure 4-1
Summary of COC exceedances and Preliminary Outer Harbor Cover Areas - Alternatives 2, 3, and 4
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_Section4_Figures_508.aprx-Figure4-1_COCexceeds_PrelimOHCapAreas_508 STOLZRC (9/10/2024)



MKE-20-091

	Depth	PCB	Cr	Pb	Hg	PAH
559	0 - 1	0.28	52.9	36.9	0.11	8.4
3.1	1 - 3.1	0.52	216	88.2	0.29	27.2
	3.1 - 4.3	**0.0046**	11.3	8.4	0.012	0.014

MKE-20-090

	Depth	PCB	Cr	Pb	Hg	PAH
563.4	0 - 1	0.23	37.7	36.5	0.096	14.8
NE	1 - 3	3.5	323	105	0.62	41.8
	3 - 4.7	0.72	206	72.5	0.65	23
	4.7 - 5.7	0.02	14.6	14.2	0.15	1.6

MKE-21-072

	Depth	PCB	Cr	Pb	Hg	PAH
559.3	0 - 1	0.057	54.7	36.6	0.12	5.2
3.5	1 - 3	0.31	298	106	0.34	16.6
	3 - 3.5	0.87	84.2	29.9	0.13	11
	3.5 - 4.4	0.071	59.2	22.7	0.054	0.41

MKE-21-070

	Depth	PCB	Cr	Pb	Hg	PAH
563.8	0 - 1.2	0.054	31.8	44.3	0.12	10.5
7.5	1.2 - 1.8	0.049	45.6	47.7	0.14	23.8
	1.8 - 3.2	0.073	169	142	0.31	101
	3.2 - 5.2	0.5	557	136	1.1	24.2
	5.2 - 6.2	0.33	526	131	0.88	23
	6.2 - 7.5	0.041	76.8	44.1	0.2	16.8
	7.5 - 8.5	0.0018	23.1	8.5	0.012	0.2

MKE-21-071

	Depth	PCB	Cr	Pb	Hg	PAH
560.1	0 - 1	0.022	78.5	55.9	0.19	12
4.8	1 - 3	0.38	556	203	0.46	23.9
	3 - 4.8	0.024	9.2	6.9	0.012	0.4
	4.8 - 5.5	0.0019	21.3	8.3	0.012	0.042

MKE-20-089

	Depth	PCB	Cr	Pb	Hg	PAH
565.9	0 - 1	0.0018	6.5	3	0.012	0.014
0	1 - 1.7	0.0019	19	9.1	0.013	0.015

MKE-20-088

	Depth	PCB	Cr	Pb	Hg	PAH
568.7	0 - 1	0.038	5.3	6.4	0.012	0.2
NE	1 - 3	0.018	7.6	9	0.013	0.32
	3 - 4.1	0.0018	4.3	2.2	0.012	0.014

MKE-20-087

	Depth	PCB	Cr	Pb	Hg	PAH
567.2	0 - 1.4	0.094	16.9	17.3	0.029	4.8
1.4	1.4 - 3	0.0018	6	3.4	0.013	0.014

MKE-20-086

	Depth	PCB	Cr	Pb	Hg	PAH
564.7	0 - 1	0.092	30.3	27.7	0.064	3.4
NE	1 - 2.7	0.0017	8.1	5	0.013	0.014

MKE-20-085

	Depth	PCB	Cr	Pb	Hg	PAH
566	0 - 1.2	0.084	24.9	18.9	0.056	2.3
NE	1.2 - 2.5	0.0018	5.5	2.3	0.013	0.014

MKE-21-074

	Depth	PCB	Cr	Pb	Hg	PAH
560.5	0 - 1	0.098	93.3	56	0.18	10.7
NE	1 - 2.7	0.26	492	126	0.86	19.9
	2.7 - 4.3	0.0094	15	7.3	0.013	1.1

MKE-21-075

	Depth	PCB	Cr	Pb	Hg	PAH
560.0	0 - 1	0.016	63.1	57.3	0.12	8.2
NE	1 - 3	0.13	373	114	0.71	23.3
	3 - 5	0.083	15	8.9	0.013	3.8

MKE-21-073

	Depth	PCB	Cr	Pb	Hg	PAH
560.1	0 - 1	0.031	86.2	67.4	0.14	11.2
NE	1 - 3	2	1270	250	2.1	36.6
	3 - 5.1	0.14	973	212	1.9	29.6

MKE-20-084

	Depth	PCB	Cr	Pb	Hg	PAH
560.3	0 - 1	0.05	30	32.7	0.023	3.2
2.6	1 - 2.6	4.1	418	90.7	1	32.5
	2.6 - 4.7	0.0018	5.9	3.1	0.012	0.46

LEGEND

- Analytical Sample Location
- Results included on another results map figure
- RTA - Sand Cover
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Storm Sewer
- Telecom

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

- 580 - 585
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560

0 125 250

Approximate scale in feet

N

Analytical Results Table Format

Location ID				
Mudline Elevation	Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
Native Material Depth	Sample interval (ft bss)	<1	<PEC	<PEC
		1 - 3	>PEC	>PEC
		3 - 5	>3xPEC	>3xPEC
		5 - 50	>5xPEC	>5xPEC
		>50		

Bold values represent results above the detection limit

"-" = COC was not sampled/analyzed

NE = Native Material Not Encountered

Notes:
1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; RTA = Remedial Target Area; WDNR = Wisconsin Department of Natural Resources

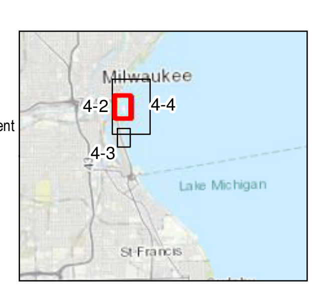
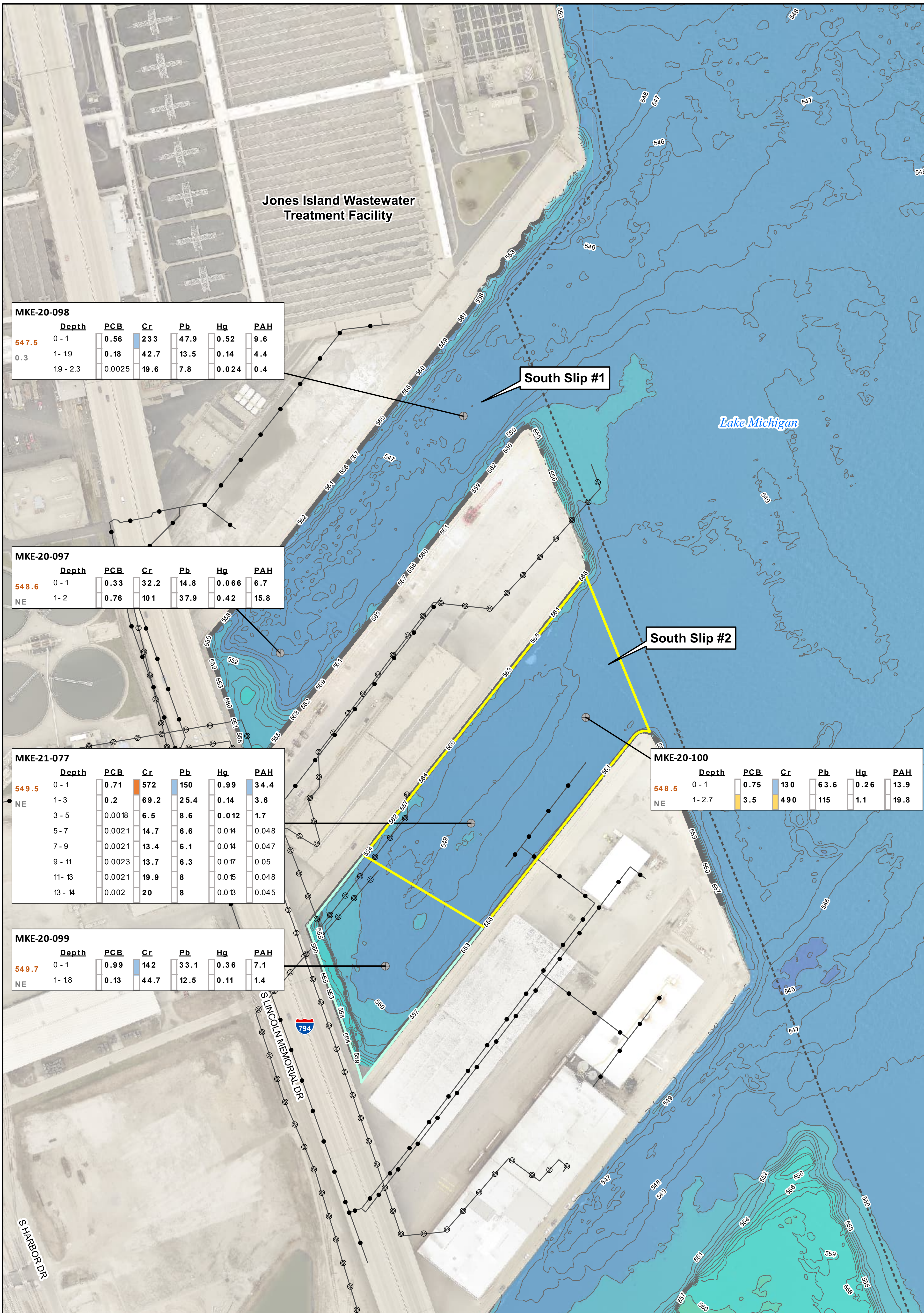


Figure 4-2
Alternative 5 Remedial Target Areas and Analytical Summary
Summerfest Lagoon Basins
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs



MKE-20-098

	Depth	PCB	Cr	Pb	Hg	PAH
547.5	0 - 1	**0.56**	**233**	**47.9**	**0.52**	**9.6**
0.3	1- 1.9	**0.18**	**42.7**	**13.5**	**0.14**	**4.4**
	1.9 - 2.3	0.0025	**19.6**	**7.8**	**0.024**	**0.4**

MKE-20-097

	Depth	PCB	Cr	Pb	Hg	PAH
548.6	0 - 1	**0.33**	**32.2**	**14.8**	**0.066**	**6.7**
NE	1 - 2	**0.76**	**101**	**37.9**	**0.42**	**15.8**

MKE-21-077

	Depth	PCB	Cr	Pb	Hg	PAH
549.5	0 - 1	**0.71**	**572**	**150**	**0.99**	**34.4**
NE	1 - 3	**0.2**	**69.2**	**25.4**	**0.14**	**3.6**
	3 - 5	0.0018	**6.5**	**8.6**	**0.012**	**1.7**
	5 - 7	0.0021	**14.7**	**6.6**	0.014	0.048
	7 - 9	0.0021	**13.4**	**6.1**	0.014	0.047
	9 - 11	0.0023	**13.7**	**6.3**	0.017	0.05
	11- 13	0.0021	**19.9**	**8**	0.015	0.048
	13 - 14	0.002	**20**	**8**	0.013	0.045

MKE-20-099

	Depth	PCB	Cr	Pb	Hg	PAH
549.7	0 - 1	**0.99**	**142**	**33.1**	**0.36**	**7.1**
NE	1- 1.8	**0.13**	**44.7**	**12.5**	**0.11**	**1.4**

MKE-20-100

	Depth	PCB	Cr	Pb	Hg	PAH
548.5	0 - 1	**0.75**	**130**	**63.6**	**0.26**	**13.9**
NE	1- 2.7	**3.5**	**490**	**115**	**1.1**	**19.8**

LEGEND

- Analytical Sample Location
- RTA - Focused Dredging
- Federal Navigation Channel
- Milwaukee Bay FFS Boundary

Utilities

- Fiber Optic
- Water Line

Bathymetry (feet)

- Bathymetric Contour

Elevation (feet)

- 570 - 575
- 565 - 570
- 560 - 565
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545

N

0 100 200

Approximate scale in feet

Analytical Results Table Format

Location ID

	Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
Mudline Elevation				
Native Material Depth		<1	<PEC	<PEC
	Sample interval (ft bss)	1 - 3	>PEC	>PEC
		3 - 5	>3xPEC	>3xPEC
		5 - 50	>5xPEC	>5xPEC
		>50		

Bold values represent results above the detection limit

"-" = COC was not sampled/analyzed

NE = Native Material Not Encountered

Notes:

1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; RTA = Remedial Target Area; WDNR = Wisconsin Department of Natural Resources

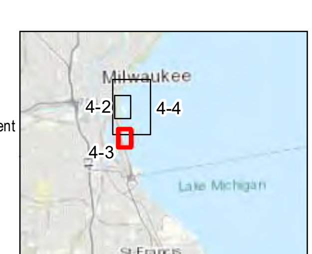
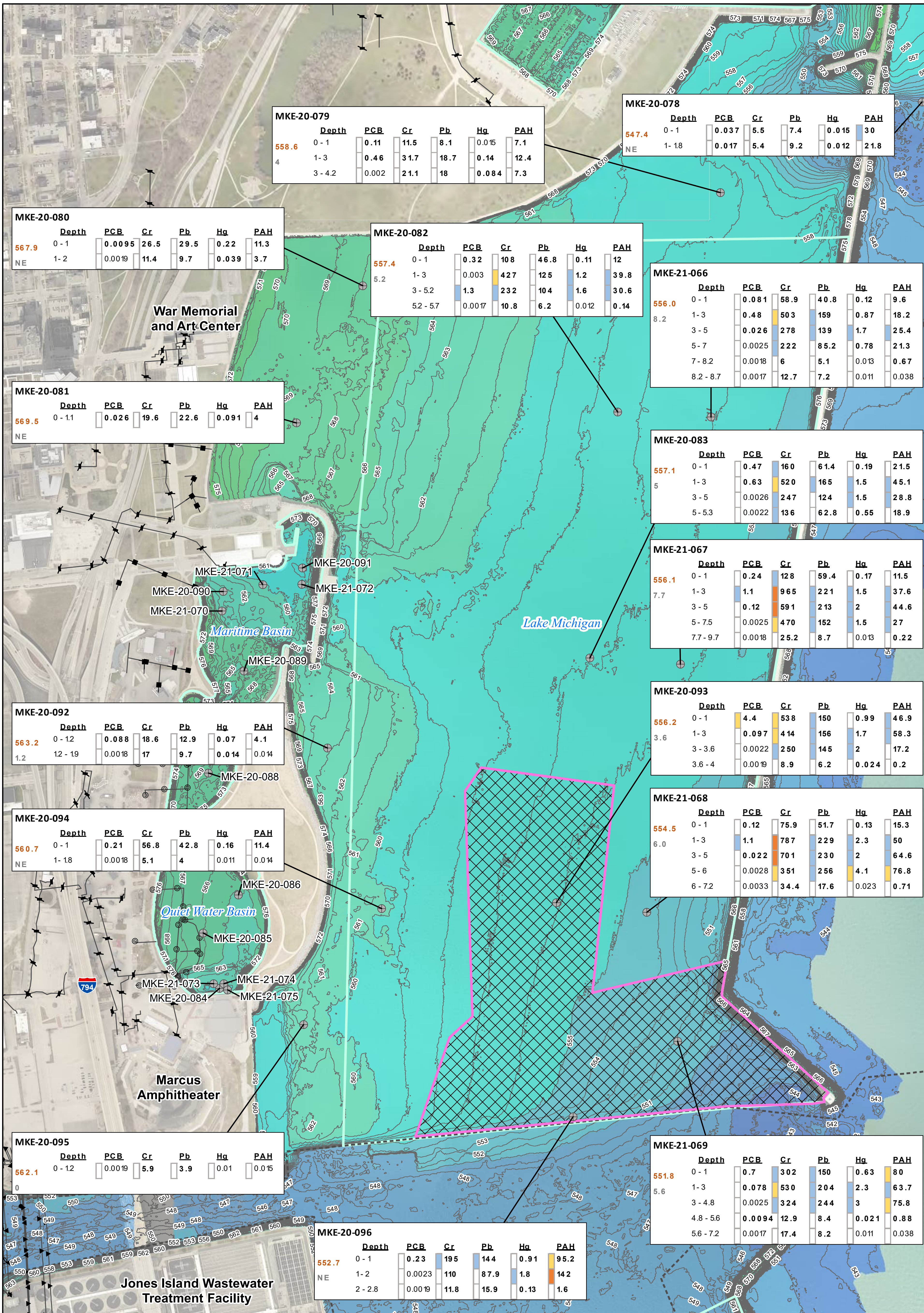


Figure 4-3
Alternative 5 Remedial Target Areas and Analytical Summary
South Slip #2
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay_Analytical\Figure4-3_MKE_Bay_Analytical_RTAs_508.mxd AESPEJO (9/9/2024)



MKE-20-079 — Mudline elevation 558.6; Native material depth 4

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.11	11.5	8.1	0.015	7.1
1 - 3	0.46	31.7	18.7	0.14	12.4
3 - 4.2	0.002	21.1	18	0.084	7.3

MKE-20-078 — Mudline elevation 547.4; Native material depth NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.037	5.5	7.4	0.015	30
1 - 1.8	0.017	5.4	9.2	0.012	21.8

MKE-20-080 — Mudline elevation 567.9; Native material depth NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.0095	26.5	29.5	0.22	11.3
1 - 2	0.0019	11.4	9.7	0.039	3.7

MKE-20-082 — Mudline elevation 557.4; Native material depth 5.2

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.32	108	46.8	0.11	12
1 - 3	0.003	427	125	1.2	39.8
3 - 5.2	1.3	232	104	1.6	30.6
5.2 - 5.7	0.0017	10.8	6.2	0.012	0.14

MKE-21-066 — Mudline elevation 556.0; Native material depth 8.2

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.081	58.9	40.8	0.12	9.6
1 - 3	0.48	503	159	0.87	18.2
3 - 5	0.026	278	139	1.7	25.4
5 - 7	0.0025	222	85.2	0.78	21.3
7 - 8.2	0.0018	6	5.1	0.013	0.67
8.2 - 8.7	0.0017	12.7	7.2	0.011	0.038

MKE-20-081 — Mudline elevation 569.5; Native material depth NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.1	0.026	19.6	22.6	0.091	4

MKE-20-083 — Mudline elevation 557.1; Native material depth 5

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.47	160	61.4	0.19	21.5
1 - 3	0.63	520	165	1.5	45.1
3 - 5	0.0026	247	124	1.5	28.8
5 - 5.3	0.0022	136	62.8	0.55	18.9

MKE-21-067 — Mudline elevation 556.1; Native material depth 7.7

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.24	128	59.4	0.17	11.5
1 - 3	1.1	965	221	1.5	37.6
3 - 5	0.12	591	213	2	44.6
5 - 7.5	0.0025	470	152	1.5	27
7.7 - 9.7	0.0018	25.2	8.7	0.013	0.22

MKE-20-092 — Mudline elevation 563.2; Native material depth 1.2

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.2	0.088	18.6	12.9	0.07	4.1
1.2 - 1.9	0.0018	17	9.7	0.014	0.014

MKE-20-093 — Mudline elevation 556.2; Native material depth 3.6

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	4.4	538	150	0.99	46.9
1 - 3	0.097	414	156	1.7	58.3
3 - 3.6	0.0022	250	145	2	17.2
3.6 - 4	0.0019	8.9	6.2	0.024	0.2

MKE-20-094 — Mudline elevation 560.7; Native material depth NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.21	56.8	42.8	0.16	11.4
1 - 1.8	0.0018	5.1	4	0.011	0.014

MKE-21-068 — Mudline elevation 554.5; Native material depth 6.0

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.12	75.9	51.7	0.13	15.3
1 - 3	1.1	787	229	2.3	50
3 - 5	0.022	701	230	2	64.6
5 - 6	0.0028	351	256	4.1	76.8
6 - 7.2	0.0033	34.4	17.6	0.023	0.71

MKE-20-095 — Mudline elevation 562.1; Native material depth 0

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1.2	0.0019	5.9	3.9	0.01	0.015

MKE-21-069 — Mudline elevation 551.8; Native material depth 5.6

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.7	302	150	0.63	80
1 - 3	0.078	530	204	2.3	63.7
3 - 4.8	0.0025	324	244	3	75.8
4.8 - 5.6	0.0094	12.9	8.4	0.021	0.88
5.6 - 7.2	0.0017	17.4	8.2	0.011	0.038

MKE-20-096 — Mudline elevation 552.7; Native material depth NE

Depth	PCB	Cr	Pb	Hg	PAH
0 - 1	0.23	195	144	0.91	95.2
1 - 2	0.0023	110	87.9	1.8	142
2 - 2.8	0.0019	11.8	15.9	0.13	1.6

LEGEND

- Analytical Sample Location
- RTA - Sand Cover
- Federal Navigation Channel
- Milwaukee Bay FFS Boundary
- Utility Identified during Menomonee and Milwaukee River FFS
- Water Line
- Bathymetry (feet)
- Bathymetric Contour
- 555 - 560
- 550 - 555
- 545 - 550
- 540 - 545
- 535 - 540
- Elevation (feet)
- 580 - 585
- 575 - 580
- 570 - 575
- 565 - 570
- 560 - 565

Utilities

- Fiber Optic
- Sanitary Sewer
- Storm Sewer
- Telecom

0 300 600

Approximate scale in feet

Analytical Results Table Format

Location ID

Mudline Elevation

Native Material Depth

Depth	PCBs (mg/kg)	Metals (mg/kg)	PAHs (mg/kg)
	<1	<PEC	<PEC
Sample interval (ft bss)	1 - 3	>PEC	>PEC
	3 - 5	>3xPEC	>3xPEC
	5 - 50	>5xPEC	>5xPEC
	>50		

Bold values represent results above the detection limit

"-" = COC was not sampled/analyzed

NE = Native Material Not Encountered

Notes:

1. 2020 Aerial Photography provided by The Milwaukee County Land Information Office.
2. Horizontal Datum: North American Datum 1983 (NAD83)
3. Vertical Datum: North American Vertical Datum of 1988 (NAVD88). Bathymetric contour and shading were generated from hydrographic survey data collected by Seaworks (2020).
4. PEC values were obtained from the Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (WDNR 2003).
5. 3x = 3 times; 5x = 5 times; COC = Contaminant of Concern; Cr = chromium; FFS = focused feasibility study; ft bss = feet below sediment surface; Hg = mercury; mg/kg = milligram(s) per kilogram; NE = not encountered; PAH = polyaromatic hydrocarbon; Pb = lead; PCB = polychlorinated biphenyl; PEC = Probable effect concentration; RTA = Remedial Target Area; WDNR = Wisconsin Department of Natural Resources

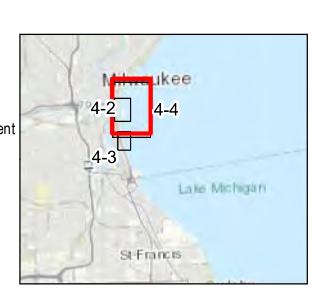
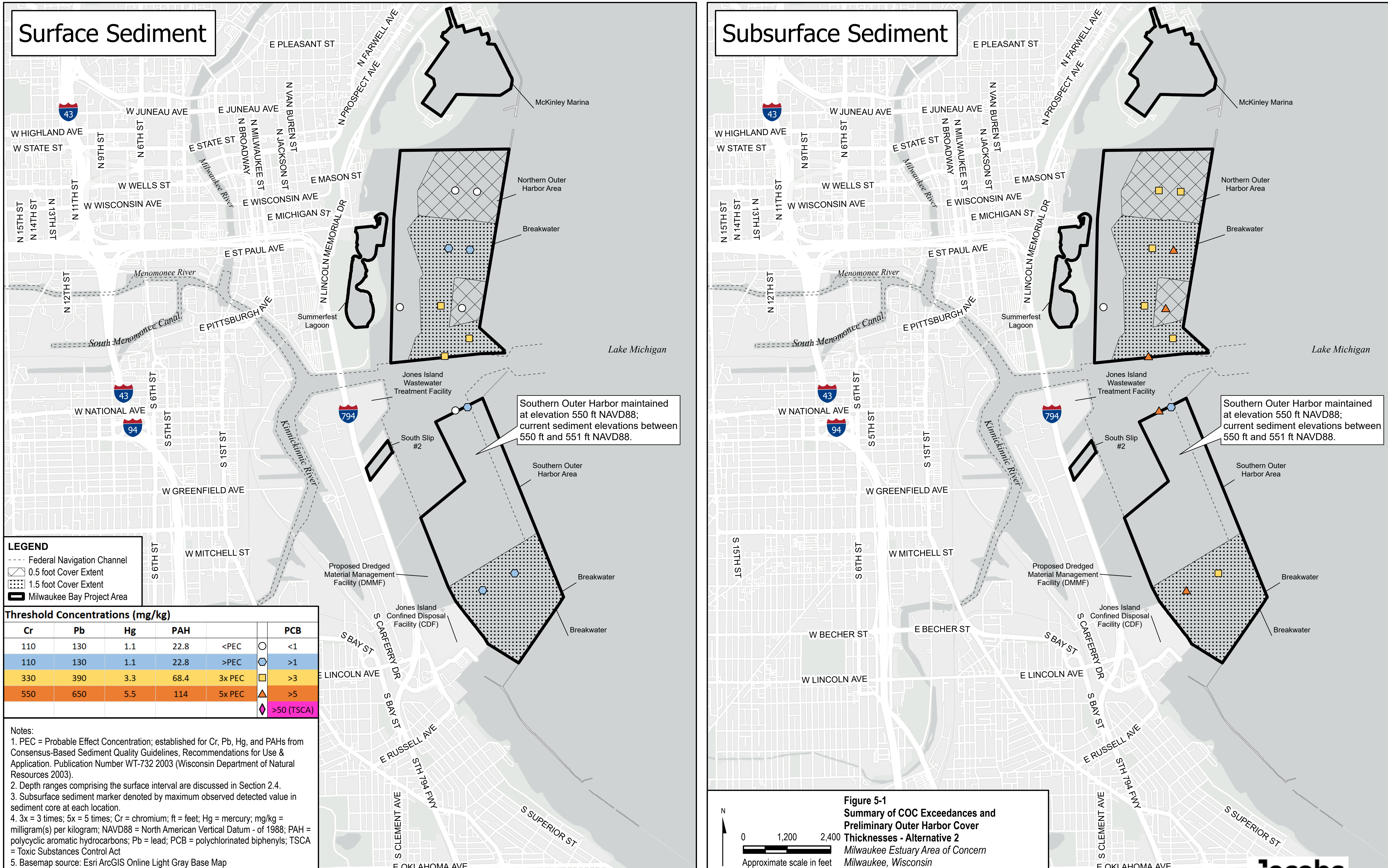


Figure 4-4
Alternative 5 Remedial Target Areas and Analytical Summary
Northern Outer Harbor
Milwaukee Bay Project Area
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\MKE_Bay_Analytical\Figure4-4_MKE_Bay_Analytical_RTAs_508.mxd AESPEJO (9/9/2024)

Jacobs



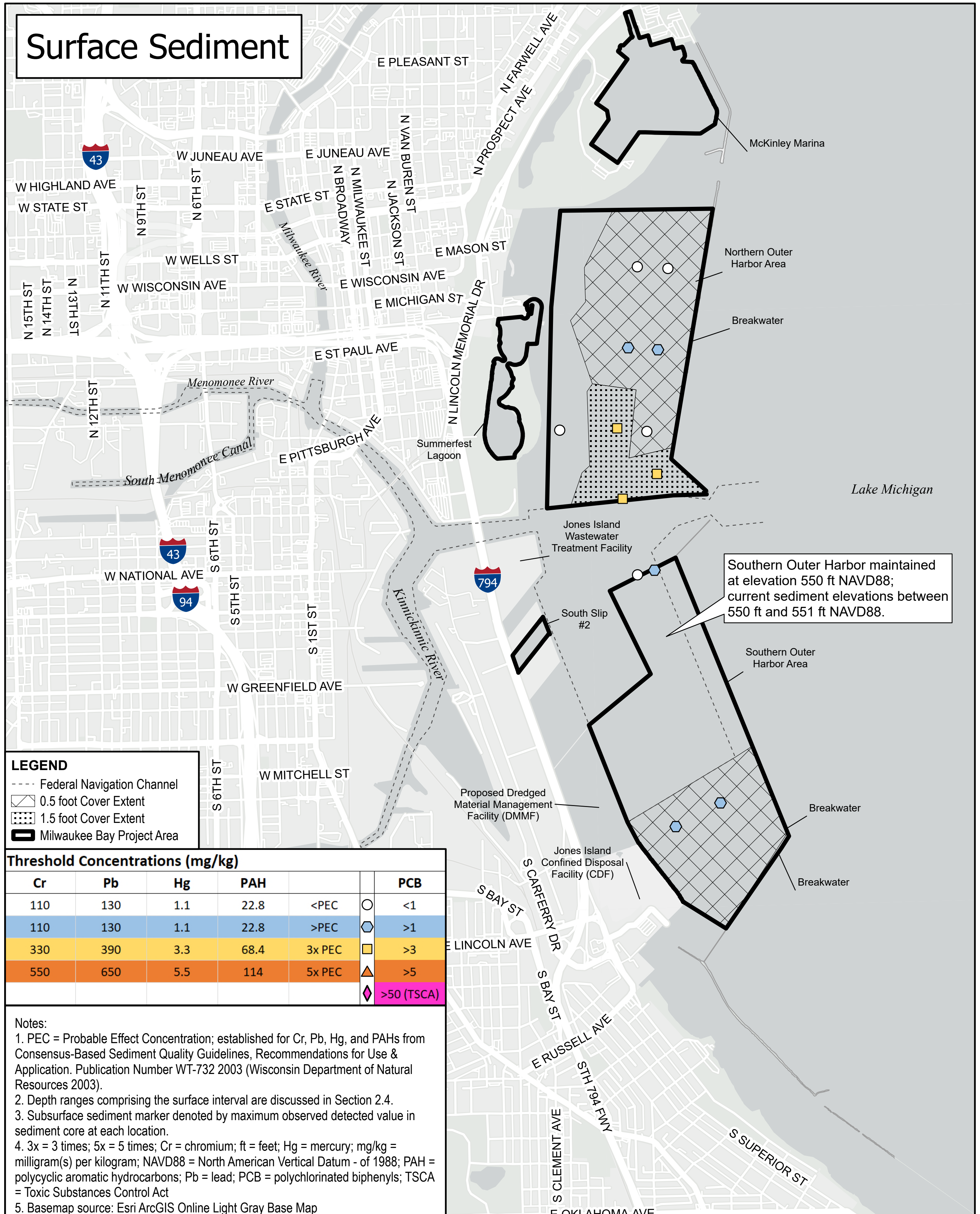
Threshold Concentrations (mg/kg)

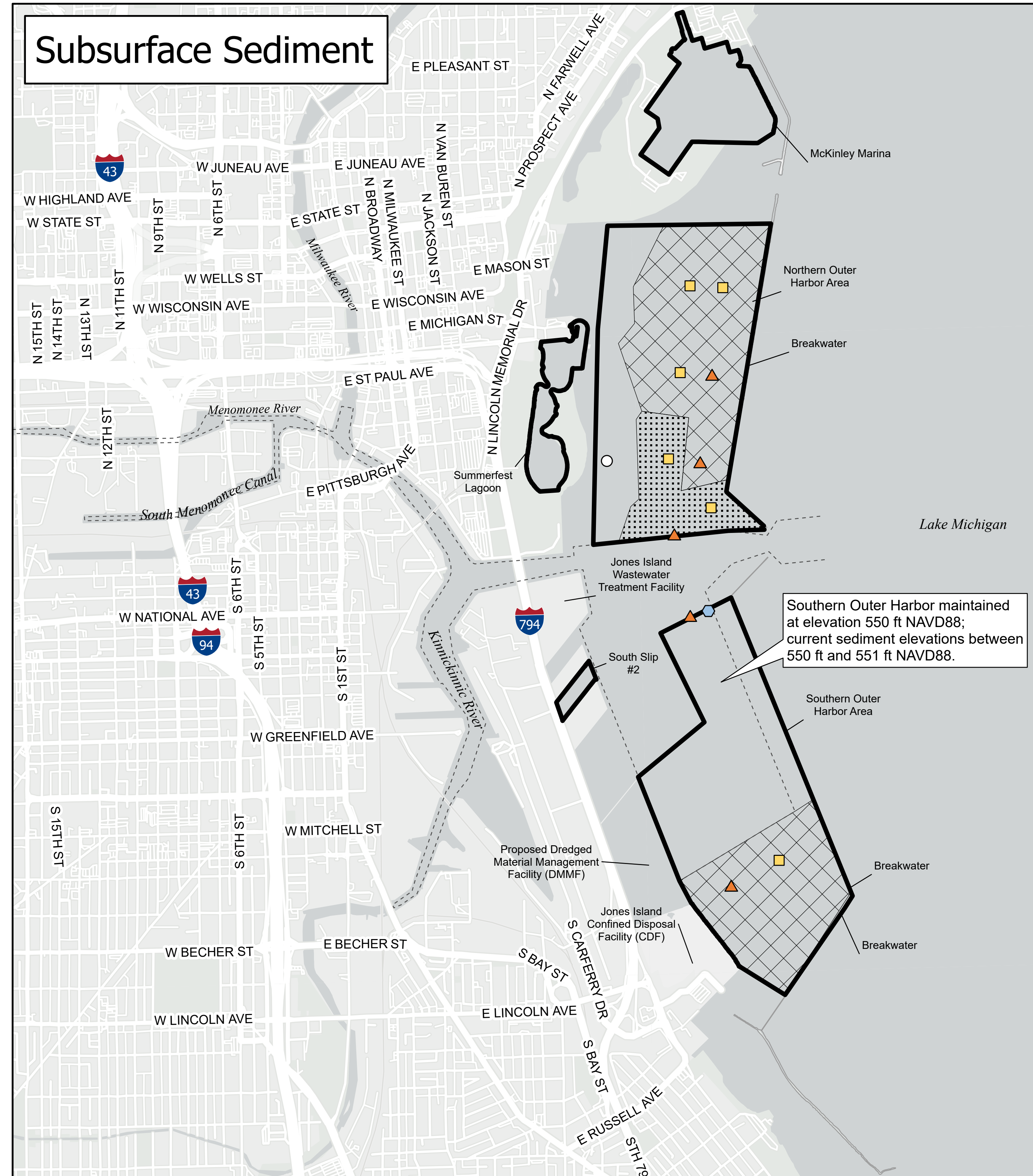
Cr	Pb	Hg	PAH			PCB
110	130	1.1	22.8	<PEC	○	<1
110	130	1.1	22.8	>PEC	⬡	>1
330	390	3.3	68.4	3x PEC	□	>3
550	650	5.5	114	5x PEC	△	>5
					◇	>50 (TSCA)

Notes:
1. PEC = Probable Effect Concentration; established for Cr, Pb, Hg, and PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. Depth ranges comprising the surface interval are discussed in Section 2.4.
3. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; ft = feet; Hg = mercury; mg/kg = milligram(s) per kilogram; NAVD88 = North American Vertical Datum - of 1988; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 5-1
Summary of COC Exceedances and Preliminary Outer Harbor Cover Thicknesses - Alternative 2
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_Section5_Figures_508.aprx-Figure5-1_SumCOCexceeds_PrelimOHCapAreas - Alt 2_508 STOLZRC (9/10/2024)





Threshold Concentrations (mg/kg)

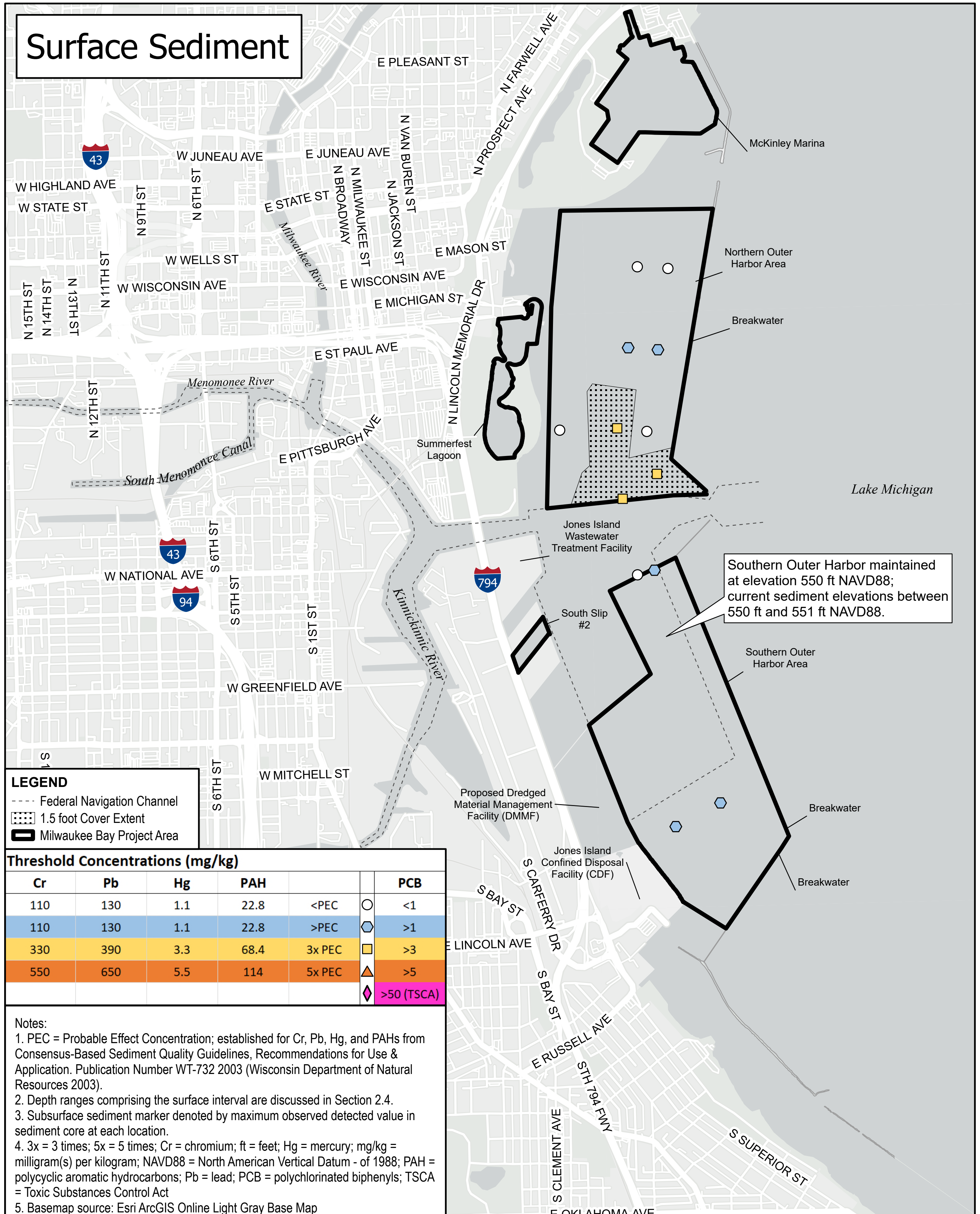
Cr	Pb	Hg	PAH			PCB
110	130	1.1	22.8	<PEC	○	<1
110	130	1.1	22.8	>PEC	⬡	>1
330	390	3.3	68.4	3x PEC	□	>3
550	650	5.5	114	5x PEC	△	>5
					◇	>50 (TSCA)

Notes:
1. PEC = Probable Effect Concentration; established for Cr, Pb, Hg, and PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. Depth ranges comprising the surface interval are discussed in Section 2.4.
3. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; ft = feet; Hg = mercury; mg/kg = milligram(s) per kilogram; NAVD88 = North American Vertical Datum - of 1988; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

Figure 5-2
Summary of COC Exceedances and Preliminary Outer Harbor Cover Thicknesses - Alternatives 3 and 4
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\ProDocs\2022\MKE_Bay_Section5_Figures_508.aprx-Figure5-2_SumCOCexceeds_PrelimOHCapAreas - Alts 3 and 4_508 STOLZRC (9/10/2024)



LEGEND

- Federal Navigation Channel
- 1.5 foot Cover Extent
- Milwaukee Bay Project Area

Threshold Concentrations (mg/kg)

Cr	Pb	Hg	PAH			PCB
110	130	1.1	22.8	<PEC	○	<1
110	130	1.1	22.8	>PEC	⬡	>1
330	390	3.3	68.4	3x PEC	□	>3
550	650	5.5	114	5x PEC	△	>5
					◇	>50 (TSCA)

Notes:
1. PEC = Probable Effect Concentration; established for Cr, Pb, Hg, and PAHs from Consensus-Based Sediment Quality Guidelines, Recommendations for Use & Application. Publication Number WT-732 2003 (Wisconsin Department of Natural Resources 2003).
2. Depth ranges comprising the surface interval are discussed in Section 2.4.
3. Subsurface sediment marker denoted by maximum observed detected value in sediment core at each location.
4. 3x = 3 times; 5x = 5 times; Cr = chromium; ft = feet; Hg = mercury; mg/kg = milligram(s) per kilogram; NAVD88 = North American Vertical Datum - of 1988; PAH = polycyclic aromatic hydrocarbons; Pb = lead; PCB = polychlorinated biphenyls; TSCA = Toxic Substances Control Act
5. Basemap source: Esri ArcGIS Online Light Gray Base Map

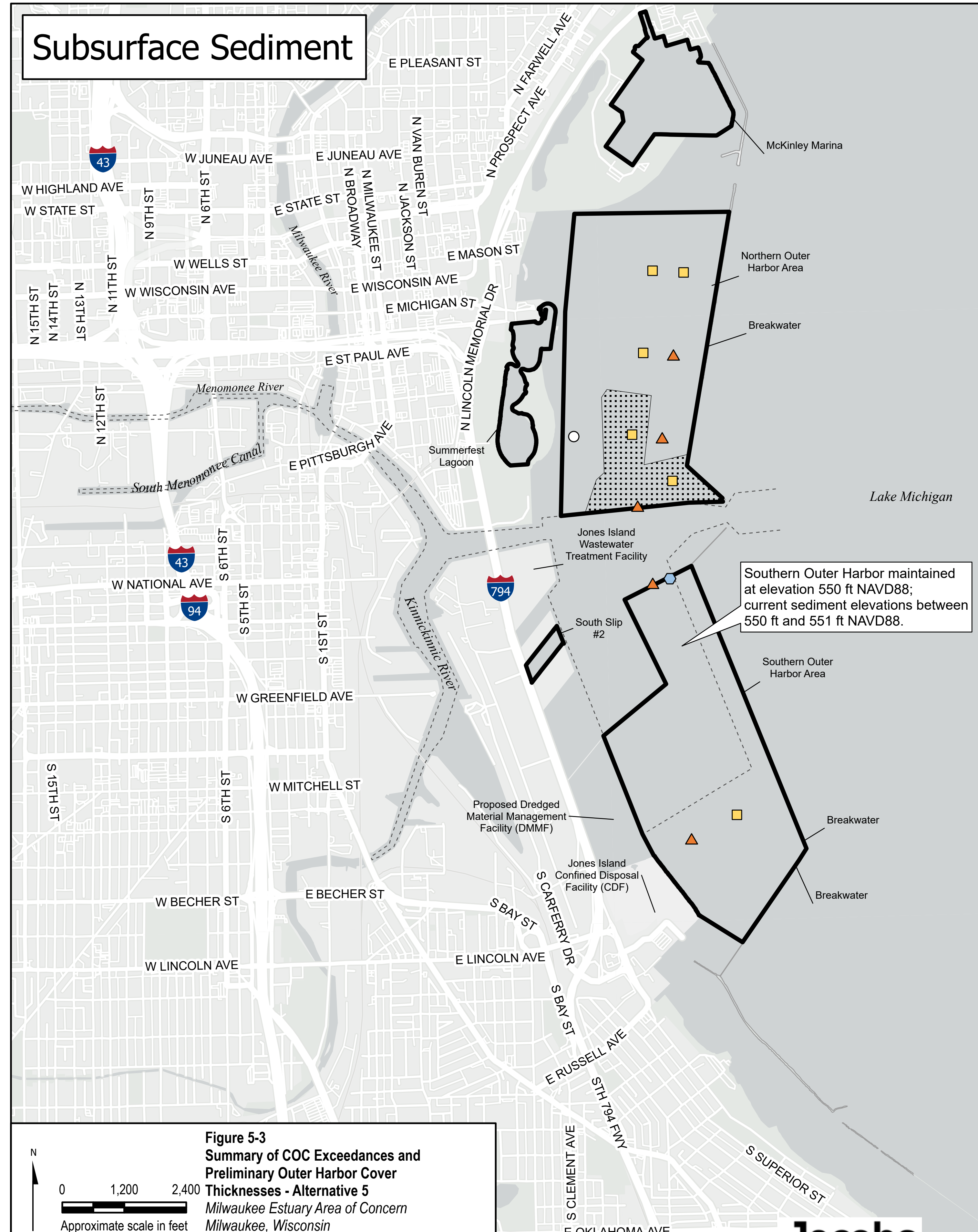


Figure 5-3
Summary of COC Exceedances and Preliminary Outer Harbor Cover Thicknesses - Alternative 5
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

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Appendix A
Milwaukee Bay Project Area – Analytical Results Summary

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibility Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

Analyte Group	Analyte	Unit	WI CBSQG PEC	WI CBSQG PEC 3x	WI CBSQG PEC 5x	TSCA
PCB	Total PCB	mg/kg	1	3	5	50
PCB	Aroclor 1260	mg/kg				
PCB	Aroclor 1254	mg/kg				
PCB	Aroclor 1268	mg/kg				
PCB	Aroclor 1221	mg/kg				
PCB	Aroclor 1232	mg/kg				
PCB	Aroclor 1248	mg/kg				
PCB	Aroclor 1016	mg/kg				
PCB	Aroclor 1262	mg/kg				
PCB	Aroclor 1242	mg/kg				
PAH	Total PAH	mg/kg	22.8	68.4	114	
PAH	2-Methyl naphthalene	mg/kg				
PAH	Acenaphthene	mg/kg				
PAH	Acenaphthylene	mg/kg				
PAH	Anthracene	mg/kg				
PAH	Benzo(a) anthracene	mg/kg				
PAH	Benzo(a) pyrene	mg/kg				
PAH	Benzo(b)-fluoranthene	mg/kg				
PAH	Benzo(e) pyrene	mg/kg				

Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Total PCB mg/kg	Aroclor 1260 mg/kg	Aroclor 1254 mg/kg	Aroclor 1268 mg/kg	Aroclor 1221 mg/kg	Aroclor 1232 mg/kg	Aroclor 1248 mg/kg	Aroclor 1016 mg/kg	Aroclor 1262 mg/kg	Aroclor 1242 mg/kg	Total PAH mg/kg	2-Methyl naphthalene mg/kg	Acenaphthene mg/kg	Acenaphthylene mg/kg	Anthracene mg/kg	Benzo(a) anthracene mg/kg	Benzo(a) pyrene mg/kg	Benzo(b)-fluoranthene mg/kg	Benzo(e) pyrene mg/kg
MKE-20-070	MKE-20-070-C-00-0.9-200925	0	0.9	9/25/2020	0.0017 U	0.0028 U	0.0029 U	0.0013 U	0.0034 U	0.0024 U	0.0023 U	0.0032 U	0.0034 U	0.0014 U	1.1	0.0092 U	0.011 U	0.0084 U	0.012 J	0.089	0.11	0.11	0.066 J
MKE-20-072	MKE-20-072-C-00-0.8-200925	0	0.8	9/25/2020	0.0017 U	0.0027 U	0.0028 U	0.0013 U	0.0033 U	0.0023 U	0.0022 U	0.003 U	0.0033 U	0.0014 U	0.14	0.009 U	0.011 U	0.0082 U	0.0097 U	0.017 U	0.016 U	0.0092 U	0.025 U
MKE-20-074	MKE-20-074-C-00-01-200904	0	1	9/4/2020	0.011	0.0029 U	0.003 U	0.0013 U	0.0036 U	0.0024 U	0.011	0.0033 U	0.0035 U	0.0015 U	1.5	0.0098 U	0.012 J	0.0089 U	0.039 J	0.12	0.12	0.12	0.08 J
MKE-20-074	MKE-20-074-C-01-03-200904	1	3	9/4/2020	0.016	0.0029 U	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.016	0.0033 U	0.0036 U	0.0015 U	0.62	0.0099 U	0.012 U	0.009 U	0.024 J	0.051	0.041	0.056	0.028 U
MKE-20-074	MKE-20-074-C-03-05-200904	3	5	9/4/2020	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	0.18	0.0096 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.0099 U	0.027 U
MKE-20-074	MKE-20-074-C-05-5.7-200904	5	5.7	9/4/2020	0.0018 U	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0025 U	0.0024 U	0.0033 U	0.0036 U	0.0015 U	0.16	0.0096 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.027 U
MKE-20-075	MKE-20-075-C-00-01-200904	0	1	9/4/2020	1	0.22	0.013 UJ	0.006 UJ	0.016 UJ	0.011 UJ	0.78 J	0.015 UJ	0.016 UJ	0.0065 UJ	29.7	0.11 U	0.23 J	0.096 U	0.53	2.2	2.4	3.1	1.7 J
MKE-20-075	MKE-20-075-C-01-03-200904	1	3	9/4/2020	0.82	0.17	0.0079 UJ	0.0035 UJ	0.0093 UJ	0.0064 UJ	0.65 J	0.0085 UJ	0.0092 UJ	0.0038 UJ	48.2	0.11 J	0.61	0.19 J	1.6	3.6	3.3	3.9	2.3
MKE-20-075	MKE-20-075-C-03-4.5-200904	3	4.5	9/4/2020	0.002 U	0.0032 U	0.0033 U	0.0015 U	0.0039 U	0.0027 U	0.0027 U	0.0036 U	0.0039 U	0.0016 U	15.9	0.098	0.22	0.077 J	0.66	1.2	1.1	1.2	0.6
MKE-20-075	MKE-20-075-C-4.5-6.2-200904	4.5	6.2	9/4/2020	0.0019 U	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.0026 U	0.0035 U	0.0037 U	0.0016 U	2.4	0.01 J	0.064	0.026 J	0.14	0.16	0.14	0.13	0.079 J
MKE-20-076	MKE-20-076-C-00-01-200904	0	1	9/4/2020	0.41	0.062 J	0.0079 UJ	0.0035 UJ	0.0093 UJ	0.0064 UJ	0.35 J	0.0085 UJ	0.0092 UJ	0.0038 UJ	31.3	0.063 U	0.35	0.063 J	0.85	2.6	2.7	2.8	1.6
MKE-20-076	MKE-20-076-G-00-01-200904	0	1	9/4/2020																			
MKE-20-076	MKE-20-076-C-01-03-200904	1	3	9/4/2020	0.52	0.12	0.0041 UJ	0.0019 UJ	0.0049 UJ	0.0034 UJ	0.4 J	0.0045 UJ	0.0049 UJ	0.002 UJ	17.4	0.084 J	0.17	0.15	0.44	1.4	1.3	1.6	0.95
MKE-20-076	MKE-20-076-G-01-03-200904	1	3	9/4/2020																			
MKE-20-076	MKE-20-076-C-03-04-200904	3	4	9/4/2020	0.0024 U	0.0037 U	0.004 UJ	0.0018 UJ	0.0047 UJ	0.0032 UJ	0.0032 UJ	0.0043 UJ	0.0046 UJ	0.0019 UJ	20.1	0.19	0.25	0.3	0.61	1.7	1.5	1.7	0.96
MKE-20-076	MKE-20-076-G-03-4.4-200904	3	4.4	9/4/2020																			
MKE-20-076	MKE-20-076-C-04-5.2-200904	4	5.2	9/4/2020	0.0019 U	0.003 U	0.0032 UJ	0.0014 UJ	0.0037 UJ	0.0026 UJ	0.0025 UJ	0.0034 UJ	0.0037 UJ	0.0015 UJ	0.014 U	0.01 U	0.012 U	0.0091 U	0.011 U	0.019 U	0.018 U	0.01 U	0.028 U
MKE-20-076	MKE-20-076-G-4.4-5.3-200904	4.4	5.3	9/4/2020																			
MKE-20-077	MKE-20-077-C-00-1.1-200904	0	1.1	9/4/2020	1.9	0.24 J+	0.0043 UJ	0.0019 UJ	0.0051 UJ	0.0035 UJ	1.7 J+	0.0047 UJ	0.0051 UJ	0.0021 UJ	14.7	0.045 J	0.1 J	0.086 J	0.28	1.1	1.3	1.6	0.83
MKE-20-077	MKE-20-077-C-1.1-1.5-200904	1.1	1.5	9/4/2020	0.0023 U	0.0036 U	0.0038 UJ	0.0017 UJ	0.0045 UJ	0.0031 UJ	0.0031 UJ	0.0042 UJ	0.0045 UJ	0.0019 UJ	31.1	0.24	0.44	0.41	1.1	2.8	2.6	2.2	1.3
MKE-20-078	MKE-20-078-C-00-01-200924	0	1	9/24/2020	0.037	0.0093 J	0.0033 U	0.0015 U	0.0039 U	0.0027 U	0.028	0.0035 U	0.0038 U	0.0016 U	30	0.074 J	0.33	0.18 J	0.87	2.6	2.4	2.6	1.5
MKE-20-078	MKE-20-078-C-01-1.8-200924	1	1.8	9/24/2020	0.017	0.0031 U	0.0033 U	0.0015 U	0.0038 U	0.0026 U	0.017	0.0035 U	0.0038 U	0.0016 U	21.8	0.054 J	0.25	0.069 J	0.69	1.9	1.6	1.9	1
MKE-20-079	MKE-20-079-C-00-01-200902	0	1	9/2/2020	0.11	0.01 J	0.0036 U	0.0016 U	0.0043 U	0.0029 U	0.097	0.0039 U	0.0042 U	0.0018 U	7.1	0.011 U	0.072	0.018 J	0.24	0.58	0.55	0.64	0.34
MKE-20-079	MKE-20-079-C-01-03-200902	1	3	9/2/2020	0.46	0.022	0.0034 U	0.0015 U	0.0041 U	0.0028 U	0.44	0.0037 U	0.004 U	0.0017 U	12.4	0.033 J	0.15	0.055	0.37	0.99	0.98	1.1	0.6
MKE-20-079	MKE-20-079-C-03-4.2-200902	3	4.2	9/2/2020	0.002 U	0.0032 U	0.0034 U	0.0015 U	0.004 U	0.0028 U	0.0027 U	0.0037 U	0.004 U	0.0017 U	7.3	0.043 J	0.12	0.15	0.36	0.58	0.59	0.49	0.31
MKE-20-080	MKE-20-080-C-00-01-200923	0	1	9/23/2020	0.0095	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.0095 J	0.0035 U	0.0038 U	0.0016 U	11.3	0.062 J	0.14	0.18	0.36	0.99	0.98	0.93	0.55 J
MKE-20-080	MKE-20-080-C-01-02-200923	1	2	9/23/2020	0.0019 U	0.003 U	0.0031 U	0.0014 U	0.0037 U	0.0025 U	0.0025 U	0.0034 U	0.0037 U	0.0015 U	3.7	0.016 J	0.074	0.094	0.14	0.34	0.33	0.26	0.17 J
MKE-20-081	MKE-20-081-C-00-1.1-200923	0	1.1	9/23/2020	0.026	0.0056 J	0.0034 U	0.0015 U	0.004 U	0.0027 U	0.02	0.0036 U	0.0039 U	0.0016 U	4	0.013 J	0.06	0.036 J	0.14	0.33	0.29	0.29	0.18 J
MKE-20-082	MKE-20-082-C-00-01-200903	0	1	9/3/2020	0.32	0.049	0.0056 U	0.0025 U	0.0066 U	0.0046 U	0.27	0.0061 U	0.0066 U	0.0027 U	12	0.036 U	0.088 J	0.097 J	0.22	0.84	1	1.3	0.69 J
MKE-20-082	MKE-20-082-C-01-03-200903	1	3	9/3/2020	0.003 U	0.0048 U	0.0051 U	0.0023 U	0.006 U	0.0041 U	0.0041 U	0.0055 U	0.0059 U	0.0025 U	39.8	0.24 J	0.29 J	0.37	0.82	3.1	3.2	4.1	2.4
MKE-20-082	MKE-20-082-C-03-5.2-200903	3	5.2	9/3/2020	1.3	0.13 J-	0.0044 UJ	0.002 UJ	0.0052 UJ	0.0036 UJ	1.2 J-	0.0048 UJ	0.0052 UJ	0.0022 UJ	30.6	0.36	0.44	0.69	0.94	2.6	2.6	2.4	1.5
MKE-20-082	MKE-20-082-C-5.2-5.7-200903	5.2	5.7	9/3/2020	0.0017 U	0.0027 U	0.0028 U	0.0013 U	0.0033 U	0.0023 U	0.0023 U	0.0031 U	0.0033 U	0.0014 U	0.14	0.009 U	0.011 U	0.0082 U	0.0097 U	0.017 U	0.016 U	0.0092 U	0.025 U
MKE-20-083	MKE-20-083-C-00-01-200903	0	1	9/3/2020	0.47	0.059 J-	0.0058 UJ	0.0026 UJ	0.0068 UJ	0.0047 UJ	0.41 J-	0.0063 UJ	0.0068 UJ	0.0028 UJ	21.5	0.058 J	0.14 J	0.14 J	0.47	1.6	1.8	2.3	1.2
MKE-20-083	MKE-20-083-C-01-03-200903	1	3	9/3/2020	0.63	0.1 J-	0.0054 UJ	0.0024 UJ	0.0063 UJ	0.0044 UJ	0.53 J-	0.0058 UJ	0.0063 UJ	0.0026 UJ	45.1	0.33 J	0.29 J	0.46	0.83	3.4	3.5	4.2	2.7
MKE-20-083	MKE-20-083-C-03-05-200903	3	5	9/3/2020	0.0026 U	0.0042 UJ	0.0044 UJ	0.002 UJ	0.0052 UJ	0.0036 UJ	0.0035 UJ	0.0048 UJ	0.0052 UJ	0.0021 UJ	28.8	0.33	0.28	0.68	0.9	2.7	2.5	2.5	1.3
MKE-20-083	MKE-20-083-C-05-5.3-200903	5	5.3	9/3/2020	0.0022 U	0.0034 U	0.0036 U	0.0016 U	0.0043 U	0.0029 U	0.0029 U	0.0039 U	0.0042 U	0.0018 U	18.9	0.19	0.21	0.42	0.72	1.7	1.7	1.3	0.92
MKE-20-084	MKE-20-084-C-00-01-200901	0	1	9/1/2020	0.05	0.0033 U	0.0035 U	0.0016 U	0.0041 U	0.0028 U	0.05	0.0038 U	0.0041 U	0.0017 U	3.2	0.011 U	0.03 J	0.023 J	0.076	0.25	0.24	0.3	0.17 J
MKE-20-084	MKE-20-084-C-01-2.6-200901	1	2.6	9/1/2020	4.1	0.38 J-	0.0042 UJ	0.0019 UJ	0.005 UJ	0.0034 UJ	3.7 J-	0.0046 UJ	0.005 UJ	0.0021 UJ	32.5	0.18	0.28	0.32	0.84	2.5	2.4	2.9	1.8
MKE-20-084	MKE-20-084-C-2.6-4.7-200901	2.6	4.7	9/1/2020	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0015 U	0.46	0.0094 U	0.082	0.0086 U	0.029 J	0.023 J	0.017 U	0.0097 U	0.027 U
MKE-20-085	MKE-20-085-C-00-1.2-200901	0	1.2	9/1/2020	0.084	0.012	0.0034 U	0.0015 U	0.004 U	0.0028 U	0.072	0.0037 U	0.004 U	0.0017 U	2.3	0.011 U	0.019 J	0.019 J	0.041 J	0.16	0.18	0.25	0.15 J
MKE-20-085	MKE-20-085-C-1.2-2.5-200901	1.2	2.5	9/1/2020	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	0.014 U	0.0096 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.027 U
MKE-20-086	MKE-20-086-C-00-01-200902	0	1	9/2/2020	0.092	0.019	0.0046 U	0.0021 U	0.0055 U	0.0038 U	0.073	0.005 U	0.0054 U	0.0023 U	3.4	0.015 U	0.021 J	0.053 J	0.063	0.25	0.28	0.4	0.23 J
MKE-20-086	MKE-20-086-C-01-2.7-200902	1	2.7	9/2/2020	0.0017 U	0.0028 U	0.0029 U	0.0013 U	0.0034 U	0.0024 U	0.0023 U	0.0032 U	0.0034 U	0.0014 U	0.014 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0097 U	0.027 U
MKE-20-087	MKE-20-087-C-00-1.4-200902	0	1.4	9/2/2020	0.094	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.094	0.0035 U	0.0037 U	0.0016 U	4.8	0.01 J	0.078	0.027 J	0.19	0.42	0.32	0.35	0.21
MKE-20-087	MKE-20-087-C-1.4-03-200902	1.4	3	9/2/2020	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0015 U	0.014 U	0.0096 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.027 U
MKE-20-088	MKE-20-088-C-00-01-200902	0	1	9/2/2020	0.038	0.016	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.022	0.0032 U	0.0035 U	0.0015 U	0.2	0.0097 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.015 J	0.027 U
MKE-20-088	MKE-20-088-G-00-01-200902	0	1	9/2/2020																			
MKE-20-088	MKE-20-088-C-01-03-200902	1	3	9/2/2020	0.018	0.003 U	0.0031 U	0.0014 U	0.0037 U	0.0026 U	0.018	0.0034 U	0.0037 U	0.0015 U	0.32	0.01 U	0.012 U	0.0093 U	0.011 U	0.026 J	0.024 J	0.029 J	0.029 U
MKE-20-088	MKE-20-088-G-01-03-200902	1	3	9/2/2020																			
MKE-20-088	MKE-20-088-C-03-4.1-200902	3	4.1	9/2/2020	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	0.014 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.027 U
MKE-20-089	MKE-20-089-C-00-01-200902	0	1	9/2/2020	0.0018 U	0.0029 U	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.0025 U	0.0033 U	0.0036 U	0.0015 U	0.014 U	0.0097 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.0099 U	0.027 U
MKE-20-089	MKE-20-089-C-01-1.7-200902	1	1.7	9/2/2020	0.0019 U	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.0026 U	0.0035 U	0.0038 U	0.0016 U	0.015 U	0.01 U	0.012 U	0.0092 U	0.011 U	0.019 U	0.018 U	0.01 U	0.029 U
MKE-20-090	MKE-20-090-C-00-01-200902	0	1	9/2/2020	0.23	0.028	0.0036 U	0.0016 U	0.0042 U	0.0029 U	0.2	0.0039 U	0.0042 U	0.0017 U	14.8	0.041 J	0.14	0.091 J	0.34	1.1	1.1	1.4	0.75
MKE-20-090	MKE-20-090-C-01-03-200902	1	3	9/2/2020	3.5	0.28	0.041 U	0.019 U	0.049 U	0.034 U	3.2	0.045 U	0.049 U	0.02 U	41.8	0.12 J	0.42	0.26 J	1	3.1	3.1	4.1	2.1
MKE-20-090	MKE-20-090-C-03-4.7-200902	3	4.7	9/2/2020	0.72	0.076	0.0036 U	0.0016 U	0.0043 U	0.0029 U	0.64	0.0039 U	0.0042 U	0.0018 U	23	0.15	0.29	0.21	0.81	1.8	1.6	1.8	1.1
MKE-20-090	MKE-20-090-C-4.7-5.7-200902	4.7	5.7	9/2/2020	0.02	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0025 U	0.02	0.0033 U	0.0036 U	0.0015 U	1.6	0.0096 U	0.035 J	0.0087 U	0.074	0.12	0.1	0.12	0.067 J
MKE-20-091	MKE-20-091-C-00-01-200903	0	1	9/3/2020	0.28	0.03 J-	0.0039 UJ	0.0018 UJ	0.0046 UJ	0.0032 UJ	0.25 J-	0.0043 UJ	0.0046 UJ	0.0019 UJ	8.4	0.036 J	0.079 J	0.073 J	0.19	0.61	0.65	0.79	0.47 J
MKE-20-091	MKE-20-091-C-01-3.1-200903	1	3.1	9/3/2020	0.52	0.052 J-	0.0045 UJ	0.002 UJ	0.0053 UJ	0.0037 UJ	0.47 J-	0.0049 UJ	0.0053 UJ	0.0022 UJ	27.2	0.095 J	0.31	0.23 J	0.76	2.1	2.1	2.4	1.3 J
MKE-20-091	MKE-20-091-C-3.1-4.3-200903	3.1	4.3	9/3/2020	0.0046	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0046 J	0.0032 U	0.0035 U	0.0015 U	0.014 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0097 U	0.027 U
MKE-20-092	MKE-20-092-C-00-1.2-200923	0	1.2	9/23/2020	0.088	0.026 J	0.0035 U	0.0016 U	0.0041 U	0.0029 U	0.062	0.0038 U	0.0041 U	0.0017 U	4.1	0.018 J	0.044 J	0.063	0.1	0.32	0.35	0.37	0.23
MKE-20-092	MKE-20-092-C-1.2-1.9-200923	1.2	1.9	9/23/2020	0.0018 U	0.0029 UJ	0.003 UJ	0.0014 UJ	0.0036 UJ	0.0025 UJ	0.0024 UJ	0.0033 UJ	0.0036 UJ	0.0015 UJ	0.014 U	0.0097 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.0099 U	0.027 U

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PAH										Metals								
				Analyte	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC											110	1.1	130	49	33	5	150	460	
				WI CBSQG PEC 3x											330	3.3	390	147	99	15	450	1380	
				WI CBSQG PEC 5x											550	5.5	650	245	165	25	750	2300	
				TSCA																			
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MKE-20-070	MKE-20-070-C-00-0.9-200925	0	0.9	9/25/2020	0.079	0.036 J	0.11	0.049	0.12	0.0075 U	0.067	0.0074 U	0.053	0.14	4.5	0.011 U	2.9	4.8	1.3	0.11	10.6	35.4 J	
MKE-20-072	MKE-20-072-C-00-0.8-200925	0	0.8	9/25/2020	0.0081 U	0.011 U	0.021 U	0.024 U	0.0099 U	0.0074 U	0.019 U	0.0073 U	0.025 J	0.0089 U	10.2	0.014 J	7.8	18.1	4.7	0.079	14.8	31.7 J	
MKE-20-074	MKE-20-074-C-00-01-200904	0	1	9/4/2020	0.087	0.059	0.13	0.029 J	0.25	0.02 J	0.08	0.008 U	0.15	0.2	5.3	0.015 J	4.1	3.5 J	1.6 J	0.1 UJ	2.9 J	38.4	
MKE-20-074	MKE-20-074-C-01-03-200904	1	3	9/4/2020	0.03 J	0.012 J	0.041	0.026 U	0.11	0.0087 J	0.024 J	0.008 U	0.082	0.092	8	0.014 J	5.1	4.7 J	1.6 J	0.19 J	2.6 J	43.7	
MKE-20-074	MKE-20-074-C-03-05-200904	3	5	9/4/2020	0.0087 U	0.012 U	0.022 U	0.026 U	0.029 J	0.0079 U	0.02 U	0.0078 U	0.02 J	0.022 J	6.1	0.012 J	4.2	3.7 J	1.6 J	0.1 UJ	2.8 J	25.4	
MKE-20-074	MKE-20-074-C-05-5.7-200904	5	5.7	9/4/2020	0.0086 U	0.012 U	0.022 U	0.026 U	0.022 J	0.0079 U	0.02 U	0.0078 U	0.012 J	0.016 J	7	0.012 U	3.8	4.6 J	1.3 J	0.1 UJ	2.7 J	36.7	
MKE-20-075	MKE-20-075-C-00-01-200904	0	1	9/4/2020	2.2	1	2.7	0.58	5.1	0.26 J	1.8	0.086 U	2	3.8	64.5	0.26	90.3	14.9 J-	4.6	1.9	44.7 J-	189 J-	
MKE-20-075	MKE-20-075-C-01-03-200904	1	3	9/4/2020	2.6	1.4	3.8	0.76	8.6	0.73	2.2	0.23 J	5.7	6.6	75.1	0.41	105	12.5 J-	6	2.2	23.5 J-	131 J-	
MKE-20-075	MKE-20-075-C-03-4.5-200904	3	4.5	9/4/2020	0.72	0.44	1.2	0.19	2.7	0.28	0.59	0.15	2.2	2.3	78.2	0.78	78.6	9.2 J	5.2 J	0.38 J	30.7 J	111	
MKE-20-075	MKE-20-075-C-4.5-6.2-200904	4.5	6.2	9/4/2020	0.095	0.051	0.15	0.027 U	0.4	0.046	0.072	0.028 J	0.43	0.36	7.9	0.033	6.2	6.7 J	1.9 J	0.11 UJ	4.9 J	20.9	
MKE-20-076	MKE-20-076-C-00-01-200904	0	1	9/4/2020	1.9	1.2	2.8	0.48	5.1	0.35	1.5	0.059 J	2.6	4.3	32.3	0.08	25.6	8 J-	3.2	0.92	11.9 J-	65.6 J-	
MKE-20-076	MKE-20-076-G-00-01-200904	0	1	9/4/2020																			
MKE-20-076	MKE-20-076-C-01-03-200904	1	3	9/4/2020	1.1	0.53	1.5	0.32	2.8	0.25	0.88	0.11	1.5	2.3	131	0.53	64.8	15.9 J-	7.9	4.2	27.3 J-	179 J-	
MKE-20-076	MKE-20-076-G-01-03-200904	1	3	9/4/2020																			
MKE-20-076	MKE-20-076-C-03-04-200904	3	4	9/4/2020	1.3	0.52	1.8	0.25	3	0.27	0.98	0.32	1.8	2.6	102	0.62	81.3	12.4 J-	8.4	1.9	30.9 J-	180 J-	
MKE-20-076	MKE-20-076-G-03-4.4-200904	3	4.4	9/4/2020																			
MKE-20-076	MKE-20-076-C-04-5.2-200904	4	5.2	9/4/2020	0.009 U	0.012 U	0.023 U	0.027 U	0.011 U	0.0082 U	0.021 U	0.0081 U	0.011 U	0.0099 U	16.4	0.026	7	14.2 J-	2.7	0.079	12.2 J-	29.5 J-	
MKE-20-076	MKE-20-076-G-4.4-5.3-200904	4.4	5.3	9/4/2020																			
MKE-20-077	MKE-20-077-C-00-1.1-200904	0	1.1	9/4/2020	1.2	0.52	1.2	0.28	2.4	0.077 J	0.95	0.062 J	0.79	1.9	86	0.32	55.3	14 J-	4.4	2.4	24.1 J-	129 J-	
MKE-20-077	MKE-20-077-C-1.1-1.5-200904	1.1	1.5	9/4/2020	1.9	1	2.4	0.51	4.5	0.34	1.5	0.66	2.8	4.4	77.5	0.44	83.8	7.3 J-	7.7	0.46	22.3 J-	90 J-	
MKE-20-078	MKE-20-078-C-00-01-200924	0	1	9/24/2020	1.5	1.1	2.5	0.59	4.5	0.4	1.3	0.15 J	2.9	4.5	5.5 J	0.015 J	7.4	5	2.4	0.11	4.5	21.9 J	
MKE-20-078	MKE-20-078-C-01-1.8-200924	1	1.8	9/24/2020	1	0.69	1.8	0.43	3.5	0.3	0.91	0.077 J	2.4	3.2	5.4 J	0.012 J	9.2	4.2	2	0.12	4.4	21.4 J	
MKE-20-079	MKE-20-079-C-00-01-200902	0	1	9/2/2020	0.46	0.21	0.58	0.14	1.2	0.1	0.38	0.0093 U	0.7	0.88	11.5	0.015 U	8.1	5.9	2	0.27	7.7	42.2 J	
MKE-20-079	MKE-20-079-C-01-03-200902	1	3	9/2/2020	0.82	0.38	0.99	0.24	2	0.16	0.67	0.063	1.3	1.5	31.7	0.14	18.7	7	3	0.54	9	57.7 J	
MKE-20-079	MKE-20-079-C-03-4.2-200902	3	4.2	9/2/2020	0.43	0.16	0.51	0.12	0.98	0.13	0.32	0.12	0.72	1.2	21.1	0.084	18 J	7.9	2.7	0.2	14.9	40.6 J	
MKE-20-080	MKE-20-080-C-00-01-200923	0	1	9/23/2020	0.55	0.37	0.93	0.2	1.5	0.12 J	0.47	0.18	0.92	1.9	26.5	0.22 J-	29.5	5.6	3.6	0.45	10	66.8	
MKE-20-080	MKE-20-080-C-01-02-200923	1	2	9/23/2020	0.2	0.12	0.31	0.083	0.49	0.051	0.16	0.04 J	0.27	0.59	11.4	0.039 J-	9.7	4.1	2.1	0.14	4.9	45.1	
MKE-20-081	MKE-20-081-C-00-1.1-200923	0	1.1	9/23/2020	0.18	0.13	0.3	0.081	0.62	0.045	0.15	0.033 J	0.4	0.69	19.6	0.091 J-	22.6	5.5	2.9	0.66	7.7	94	
MKE-20-082	MKE-20-082-C-00-01-200903	0	1	9/3/2020	0.93	0.56	1	0.23	1.9	0.12 J	0.72	0.075 J	0.64	1.6	108	0.11	46.8	15.9	4.7	1.7	33.9	137	
MKE-20-082	MKE-20-082-C-01-03-200903	1	3	9/3/2020	2.6	1.4	3.8	0.64	6.2	0.39	2.2	0.34 J	2.7	5	427	1.2	125	29	13	12	72.2	398	
MKE-20-082	MKE-20-082-C-03-5.2-200903	3	5.2	9/3/2020	1.7	0.98	2.7	0.5	4.2	0.5	1.4	0.82	2.1	4.2	232	1.6	104	14.1	10.6	0.65	47.3	174	
MKE-20-082	MKE-20-082-C-5.2-5.7-200903	5.2	5.7	9/3/2020	0.0081 U	0.011 U	0.021 U	0.024 U	0.01 J	0.0073 U	0.019 U	0.0073 U	0.017 J	0.014 J	10.8	0.012 U	6.2	13	3.3	0.12	12.1	38.7	
MKE-20-083	MKE-20-083-C-00-01-200903	0	1	9/3/2020	1.6	0.72	1.8	0.39	3.5	0.15	1.3	0.15	1.4	2.8	160	0.19	61.4	17	4.9	2.2	41.6	175	
MKE-20-083	MKE-20-083-C-01-03-200903	1	3	9/3/2020	3.1	1.9	4.7	0.73	6.9	0.43	2.4	0.4	3	5.8	520	1.5	165	33.4	16.1	13.5	87	493	
MKE-20-083	MKE-20-083-C-03-05-200903	3	5	9/3/2020	1.7	0.78	2.7	0.41	3.9	0.39	1.3	0.66	2	3.8	247	1.5	124	15.4	10.9	0.86	53.5	197	
MKE-20-083	MKE-20-083-C-05-5.3-200903	5	5.3	9/3/2020	1.1	0.62	1.6	0.29	2.5	0.24	0.84	0.5	1.6	2.4	136	0.55	62.8	12.3	6.6	0.38	33	99	
MKE-20-084	MKE-20-084-C-00-01-200901	0	1	9/1/2020	0.2	0.12	0.27	0.085	0.51	0.038 J	0.18	0.0091 U	0.26	0.45	30	0.023	32.7 J	14.5	4.2	0.48	19.4	67.4 J	
MKE-20-084	MKE-20-084-C-01-2.6-200901	1	2.6	9/1/2020	1.9	1.2	2.9	0.52	5.4	0.4	1.7	0.22	2.7	4.3	418	1	90.7 J	17.6	7.5	9.4	54	332 J	
MKE-20-084	MKE-20-084-C-2.6-4.7-200901	2.6	4.7	9/1/2020	0.0085 U	0.012 U	0.022 J	0.025 U	0.067	0.0081 J	0.02 U	0.0077 U	0.093	0.059	5.9	0.012 U	3.1 J	7.2	1.5	0.055 J	6.2	18 J	
MKE-20-085	MKE-20-085-C-00-1.2-200901	0	1.2	9/1/2020	0.18	0.095	0.19	0.073	0.34	0.015 J	0.15	0.012 J	0.13	0.32	24.9	0.056	18.9 J	6.2	1.9	0.6	12.8	80.8 J	
MKE-20-085	MKE-20-085-C-1.2-2.5-200901	1.2	2.5	9/1/2020	0.0086 U	0.012 U	0.022 U	0.025 U	0.011 U	0.0078 U	0.02 U	0.0078 U	0.011 U	0.0094 U	5.5	0.013 U	2.3 J	6.4	0.91	0.028 J	5.1	13.3 J	
MKE-20-086	MKE-20-086-C-00-01-200902	0	1	9/2/2020	0.26	0.13	0.32	0.11	0.44	0.021 J	0.24	0.014 J	0.14	0.44	30.3	0.064	27.7 J	8.8	2.2	0.79	18	84.3 J	
MKE-20-086	MKE-20-086-C-01-2.7-200902	1	2.7	9/2/2020	0.0085 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0077 U	0.011 U	0.0094 U	8.1	0.013 U	5	9.6	2.2	0.071	9.5	23.7 J	
MKE-20-087	MKE-20-087-C-00-1.4-200902	0	1.4	9/2/2020	0.24	0.16	0.37	0.093	0.77	0.081	0.21	0.017 J	0.54	0.68	16.9	0.029	17.3	5.3	2.2	0.5	7.5	66.8 J	
MKE-20-087	MKE-20-087-C-1.4-03-200902	1.4	3	9/2/2020	0.0086 U	0.012 U	0.022 U	0.026 U	0.011 U	0.0078 U	0.02 U	0.0078 U	0.011 U	0.0094 U	6	0.013 U	3.4	7.3	2	0.058 J	6.6	17.7 J	
MKE-20-088	MKE-20-088-C-00-01-200902	0	1	9/2/2020	0.0087 U	0.012 U	0.022 U	0.026 U	0.032 J	0.0079 U	0.02 U	0.0079 U	0.021 J	0.032 J	5.3	0.012 U	6.4	4.6	2.5	0.12	5.3	39.8 J	
MKE-20-088	MKE-20-088-G-00-01-200902	0	1	9/2/2020																			
MKE-20-088	MKE-20-088-C-01-03-200902	1	3	9/2/2020	0.013 J	0.013 U	0.028 J	0.027 U	0.048	0.0083 U	0.021 U	0.0083 U	0.031 J	0.047	7.6	0.013 U	9	4.9	1.7	0.19	7.4	53.1 J	
MKE-20-088	MKE-20-088-G-01-03-200902	1	3	9/2/2020																			
MKE-20-088	MKE-20-088-C-03-4.1-200902	3	4.1	9/2/2020	0.0086 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0078 U	0.011 U	0.0094 U	4.3	0.012 U	2.2	3.6	2.1	0.097	3.6	32.5 J	
MKE-20-089	MKE-20-089-C-00-01-200902	0	1	9/2/2020	0.0087 U	0.012 U	0.022 U	0.026 U	0.011 U	0.0079 U	0.02 U	0.0078 U	0.011 U	0.0095 U	6.5 J	0.012 U	3 J	7.5 J	1.3 J	0.04 J	6.3 J	15.9 J	
MKE-20-089	MKE-20-089-C-01-1.7-200902	1	1.7	9/2/2020	0.0091 U	0.013 U	0.023 U	0.027 U	0.011 U	0.0083 U	0.021 U	0.0082 U	0.011 U	0.01 U	19	0.013 U	9.1	25.8	4.6	0.14	20.9	52.3 J	
MKE-20-090	MKE-20-090-C-00-01-200902	0	1	9/2/2020	0.7	0.47	1.2	0.23	2.5	0.15	0.65	0.12	1.3	2.5	37.7	0.096	36.5	8.9	3.1	0.79	18.6	93.9 J	
MKE-20-090	MKE-20-090-C-01-03-200902	1	3	9/2/2020	2	1.2	3.5	0.65	7.3	0.53	1.9	0.2 J	3.8	6.5	323	0.62	105 J	26.1	7.8	10.2	61.2	340	
MKE-20-090	MKE-20-090-C-03-4.7-200902	3	4.7	9/2/2020	1.4	0.8	2	0.44	3.6	0.43	1.1	0.2	2.4	2.9	206	0.65	72.5 J	17	8.2	5.7	37.6	248	
MKE-20-090	MKE-20-090-C-4.7-5.7-200902	4.7	5.7	9/2/2020	0.059	0.056	0.13	0.026 U	0.28	0.029 J	0.051	0.0078 U	0.25	0.25	14.6	0.15	14.2 J	5.6	2.7	0.47	7.7	58.9	
MKE-20-091	MKE-20-091-C-00-01-200903	0	1	9/3/2020	0.63	0.34	0.7	0.14	1.3	0.087 J	0.47	0.077 J	0.63	1.1	52.9	0.11	36.9	10.8	3.3	1.2	23.5	99.2	
MKE-20-091	MKE-20-091-C-01-3.1-200903	1	3.1	9/3/2020	1.7	0.9	2.3	0.49	4.7	0.3	1.5	0.13 J	2.4	3.5	216	0.29	88.2	19.1	6.1	3.2	45	205	
MKE-20-091	MKE-20-091-C-3.1-4.3-200903	3.1	4.3	9/3/2020	0.0086 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0077 U	0.011 U	0.0094 U	11.3	0.012 U	8.4	13.3	4.4	0.18	14.3	50.3	
MKE-20-092	MKE-20-092-C-00-1.2-200923	0	1.2	9/23/2020	0.22	0.15	0.35	0.094	0.56	0.049	0.19	0.044 J	0.3	0.62	18.6	0.07 J-	12.9	9.9	2.4	0.36	12.3	56.1	
MKE-20-092	MKE-20-092-C-1.2-1.9-200923	1.2	1.9	9/23/2020	0.0087 U	0.012 U	0.022 U	0.026 U	0.011 U	0.0079 U	0.02 U	0.0079 U	0.011 U	0.0096 U	17	0.014 J-	9.7	20.8	4	0.17	18.3	45.5	

Appendix A

Milwaukee Bay Sediment Analytical Results Summary

Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	Metals																Physical Parameters							
				Analyte	Barium	Selenium	Aluminum	Iron	Manganese	Potassium	Sodium	Thallium	Antimony	Beryllium	Cobalt	Calcium	Cyanide	Magnesium	Vanadium	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
				WI CBSQG PEC				40000	1100				25															
				WI CBSQG PEC 3x				120000	3300				75															
				WI CBSQG PEC 5x				200000	5500				125															
				TSCA																								
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Barium mg/kg	Selenium mg/kg	Aluminum mg/kg	Iron mg/kg	Manganese mg/kg	Potassium mg/kg	Sodium mg/kg	Thallium mg/kg	Antimony mg/kg	Beryllium mg/kg	Cobalt mg/kg	Calcium mg/kg	Cyanide mg/kg	Magnesium mg/kg	Vanadium mg/kg	TOC mg/kg	Gravel %	Sand %	Coarse Sand %	Medium Sand %	Fine Sand %	Silt %	Clay %	Fines %
MKE-20-070	MKE-20-070-C-00-0.9-200925	0	0.9	9/25/2020																								
MKE-20-072	MKE-20-072-C-00-0.8-200925	0	0.8	9/25/2020																								
MKE-20-074	MKE-20-074-C-00-01-200904	0	1	9/4/2020																27900								
MKE-20-074	MKE-20-074-C-01-03-200904	1	3	9/4/2020																28800								
MKE-20-074	MKE-20-074-C-03-05-200904	3	5	9/4/2020																36400								
MKE-20-074	MKE-20-074-C-05-5.7-200904	5	5.7	9/4/2020																33900								
MKE-20-075	MKE-20-075-C-00-01-200904	0	1	9/4/2020																64100								
MKE-20-075	MKE-20-075-C-01-03-200904	1	3	9/4/2020																66700								
MKE-20-075	MKE-20-075-C-03-4.5-200904	3	4.5	9/4/2020																48300								
MKE-20-075	MKE-20-075-C-4.5-6.2-200904	4.5	6.2	9/4/2020																18200								
MKE-20-076	MKE-20-076-C-00-01-200904	0	1	9/4/2020																51400								
MKE-20-076	MKE-20-076-G-00-01-200904	0	1	9/4/2020																	0 U	41.6	0.2	3.1	38.3	48.9	9.5	58.4
MKE-20-076	MKE-20-076-C-01-03-200904	1	3	9/4/2020																51100								
MKE-20-076	MKE-20-076-G-01-03-200904	1	3	9/4/2020																	0 U	30	0 U	2.2	27.8	49.3	20.7	70
MKE-20-076	MKE-20-076-C-03-04-200904	3	4	9/4/2020																21200								
MKE-20-076	MKE-20-076-G-03-4.4-200904	3	4.4	9/4/2020																	0.5	33.9	0.3	2.8	30.8	45.4	20.2	65.6
MKE-20-076	MKE-20-076-C-04-5.2-200904	4	5.2	9/4/2020																12300								
MKE-20-076	MKE-20-076-G-4.4-5.3-200904	4.4	5.3	9/4/2020																	0 U	15.3	0 U	3	12.3	50.8	33.9	84.7
MKE-20-077	MKE-20-077-C-00-1.1-200904	0	1.1	9/4/2020																33000								
MKE-20-077	MKE-20-077-C-1.1-1.5-200904	1.1	1.5	9/4/2020																42400								
MKE-20-078	MKE-20-078-C-00-01-200924	0	1	9/24/2020																								
MKE-20-078	MKE-20-078-C-01-1.8-200924	1	1.8	9/24/2020																								
MKE-20-079	MKE-20-079-C-00-01-200902	0	1	9/2/2020																38300 J								
MKE-20-079	MKE-20-079-C-01-03-200902	1	3	9/2/2020																36400 J								
MKE-20-079	MKE-20-079-C-03-4.2-200902	3	4.2	9/2/2020																46300 J								
MKE-20-080	MKE-20-080-C-00-01-200923	0	1	9/23/2020													0.079 UJ											
MKE-20-080	MKE-20-080-C-01-02-200923	1	2	9/23/2020													0.076 UJ											
MKE-20-081	MKE-20-081-C-00-1.1-200923	0	1.1	9/23/2020													0.52 J-											
MKE-20-082	MKE-20-082-C-00-01-200903	0	1	9/3/2020																43100								
MKE-20-082	MKE-20-082-C-01-03-200903	1	3	9/3/2020																46400								
MKE-20-082	MKE-20-082-C-03-5.2-200903	3	5.2	9/3/2020																51900								
MKE-20-082	MKE-20-082-C-5.2-5.7-200903	5.2	5.7	9/3/2020																32400								
MKE-20-083	MKE-20-083-C-00-01-200903	0	1	9/3/2020																48400								
MKE-20-083	MKE-20-083-C-01-03-200903	1	3	9/3/2020																51600								
MKE-20-083	MKE-20-083-C-03-05-200903	3	5	9/3/2020																57500								
MKE-20-083	MKE-20-083-C-05-5.3-200903	5	5.3	9/3/2020																49200								
MKE-20-084	MKE-20-084-C-00-01-200901	0	1	9/1/2020													0.23 J			30300								
MKE-20-084	MKE-20-084-C-01-2.6-200901	1	2.6	9/1/2020													2.1			59000								
MKE-20-084	MKE-20-084-C-2.6-4.7-200901	2.6	4.7	9/1/2020													0.074 U			31600								
MKE-20-085	MKE-20-085-C-00-1.2-200901	0	1.2	9/1/2020													0.13 J			50300								
MKE-20-085	MKE-20-085-C-1.2-2.5-200901	1.2	2.5	9/1/2020													0.072 U			31300								
MKE-20-086	MKE-20-086-C-00-01-200902	0	1	9/2/2020													0.18 J			67800 J								
MKE-20-086	MKE-20-086-C-01-2.7-200902	1	2.7	9/2/2020													0.068 U			32000 J								
MKE-20-087	MKE-20-087-C-00-1.4-200902	0	1.4	9/2/2020													0.074 U			48600 J								
MKE-20-087	MKE-20-087-C-1.4-03-200902	1.4	3	9/2/2020													0.074 UJ			27000 J								
MKE-20-088	MKE-20-088-C-00-01-200902	0	1	9/2/2020													0.069 UJ			23600 J								
MKE-20-088	MKE-20-088-G-00-01-200902	0	1	9/2/2020																	10.4	57.7	2	2.8	52.9	25.6	6.3	31.9
MKE-20-088	MKE-20-088-C-01-03-200902	1	3	9/2/2020													0.074 UJ			35200 J								
MKE-20-088	MKE-20-088-G-01-03-200902	1	3	9/2/2020																	0 U	81.5	0 U	2	79.5	16.6	1.9	18.5
MKE-20-088	MKE-20-088-C-03-4.1-200902	3	4.1	9/2/2020													0.069 UJ			33200 J								
MKE-20-089	MKE-20-089-C-00-01-200902	0	1	9/2/2020													0.073 UJ			27500 J								
MKE-20-089	MKE-20-089-C-01-1.7-200902	1	1.7	9/2/2020													0.073 UJ			19900 J								
MKE-20-090	MKE-20-090-C-00-01-200902	0	1	9/2/2020													0.18 J-			44700 J								
MKE-20-090	MKE-20-090-C-01-03-200902	1	3	9/2/2020													1.6 J-			36600 J								
MKE-20-090	MKE-20-090-C-03-4.7-200902	3	4.7	9/2/2020													1.2 J-			46700 J								
MKE-20-090	MKE-20-090-C-4.7-5.7-200902	4.7	5.7	9/2/2020													0.074 UJ			37900								
MKE-20-091	MKE-20-091-C-00-01-200903	0	1	9/3/2020													0.17 J			54900								
MKE-20-091	MKE-20-091-C-01-3.1-200903	1	3.1	9/3/2020													1.2			52600								
MKE-20-091	MKE-20-091-C-3.1-4.3-200903	3.1	4.3	9/3/2020													0.071 U			34600								
MKE-20-092	MKE-20-092-C-00-1.2-200923	0	1.2	9/23/2020													0.087 UJ											
MKE-20-092	MKE-20-092-C-1.2-1.9-200923	1.2	1.9	9/23/2020													0.075 UJ											

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PCB										PAH								
				Analyte	Total PCB	Aroclor 1260	Aroclor 1254	Aroclor 1268	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1016	Aroclor 1262	Aroclor 1242	Total PAH	2-Methyl naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b)-fluoranthene	Benzo(e) pyrene
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC	1										22.8								
				WI CBSQG PEC 3x	3										68.4								
				WI CBSQG PEC 5x	5										114								
				TSCA	50																		
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Total PCB mg/kg	Aroclor 1260 mg/kg	Aroclor 1254 mg/kg	Aroclor 1268 mg/kg	Aroclor 1221 mg/kg	Aroclor 1232 mg/kg	Aroclor 1248 mg/kg	Aroclor 1016 mg/kg	Aroclor 1262 mg/kg	Aroclor 1242 mg/kg	Total PAH mg/kg	2-Methyl naphthalene mg/kg	Acenaphthene mg/kg	Acenaphthylene mg/kg	Anthracene mg/kg	Benzo(a) anthracene mg/kg	Benzo(a) pyrene mg/kg	Benzo(b)-fluoranthene mg/kg	Benzo(e) pyrene mg/kg
MKE-20-093	MKE-20-093-C-00-01-200903	0	1	9/3/2020	4.4	0.0049 U	2 J	0.0023 U	0.0062 U	0.0042 U	0.0042 U	0.0056 U	0.0061 U	2.4 J	46.9	0.21 J	0.42	0.42	0.92	3.9	3.6	4.6	2.7
MKE-20-093	MKE-20-093-C-01-03-200903	1	3	9/3/2020	0.097	0.0049 U	0.097	0.0023 U	0.0061 U	0.0042 U	0.0042 U	0.0056 U	0.0061 U	0.0025 U	58.3	0.68	0.42	0.99	1.5	5.5	4.9	4.8	3.1
MKE-20-093	MKE-20-093-C-03-3.6-200903	3	3.6	9/3/2020	0.0022 U	0.0035 U	0.0037 U	0.0016 U	0.0043 U	0.003 U	0.0029 U	0.004 U	0.0043 U	0.0018 U	17.2	0.35	0.23	0.28	0.59	1.4	1.3	1.5	0.77
MKE-20-093	MKE-20-093-C-3.6-04-200903	3.6	4	9/3/2020	0.0019 U	0.0029 U	0.0031 U	0.0014 U	0.0037 U	0.0025 U	0.0025 U	0.0034 U	0.0036 U	0.0015 U	0.2	0.01 U	0.012 U	0.0091 U	0.011 U	0.019 U	0.018 U	0.01 U	0.028 U
MKE-20-094	MKE-20-094-C-00-01-200923	0	1	9/23/2020	0.21	0.08 J-	0.006 UJ	0.0027 UJ	0.0071 UJ	0.0049 UJ	0.13 J-	0.0065 UJ	0.007 UJ	0.0029 UJ	11.4	0.094 U	0.11 U	0.12 J	0.17 J	0.73	0.9	1.4	0.7 J
MKE-20-094	MKE-20-094-C-01-1.8-200923	1	1.8	9/23/2020	0.0018 U	0.0029 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0033 U	0.0035 U	0.0015 U	0.014 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.027 U
MKE-20-095	MKE-20-095-C-00-1.2-200923	0	1.2	9/23/2020	0.0019 U	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.0025 U	0.0035 U	0.0037 U	0.0016 U	0.015 U	0.01 U	0.012 U	0.0092 U	0.011 U	0.019 U	0.018 U	0.01 U	0.029 U
MKE-20-096	MKE-20-096-C-00-01-200903	0	1	9/3/2020	0.23	0.052	0.0044 U	0.002 U	0.0052 U	0.0036 U	0.18	0.0048 U	0.0052 U	0.0022 U	95.2	1.3	1.5	1.8	5.1	8.7	7.1	5.9	4
MKE-20-096	MKE-20-096-C-01-02-200903	1	2	9/3/2020	0.0023 U	0.0036 U	0.0038 U	0.0017 U	0.0045 U	0.0031 U	0.0031 U	0.0041 U	0.0045 U	0.0019 U	142	6.7	4.8	2.5	9.4	9.9	8	6.7	4.4
MKE-20-096	MKE-20-096-C-02-2.8-200903	2	2.8	9/3/2020	0.0019 U	0.0031 U	0.0032 U	0.0015 U	0.0038 U	0.0026 U	0.0026 U	0.0035 U	0.0038 U	0.0016 U	1.6	0.035 J	0.077	0.02 J	0.099	0.1	0.063	0.075	0.045 J
MKE-20-097	MKE-20-097-C-00-01-200924	0	1	9/24/2020	0.33	0.12	0.0036 U	0.0016 U	0.0042 U	0.0029 U	0.21	0.0039 U	0.0042 U	0.0017 U	6.7	0.057 U	0.069 J	0.052 U	0.17 J	0.51	0.46	0.59	0.35 J
MKE-20-097	MKE-20-097-C-01-02-200924	1	2	9/24/2020	0.76	0.16	0.0038 U	0.0017 U	0.0045 U	0.0031 U	0.6	0.0041 U	0.0045 U	0.0019 U	15.8	0.12 U	0.14 J	0.11 J	0.3 J	1.2	1.3	1.6	0.91 J
MKE-20-098	MKE-20-098-C-00-01-200924	0	1	9/24/2020	0.56	0.12	0.0043 U	0.0019 U	0.005 U	0.0035 U	0.44	0.0046 U	0.005 U	0.0021 U	9.6	0.092 J	0.087 J	0.12 J	0.21 J	0.72	0.74	0.91	0.61 J
MKE-20-098	MKE-20-098-C-01-1.9-200924	1	1.9	9/24/2020	0.18	0.037	0.0039 U	0.0017 U	0.0046 U	0.0032 U	0.14	0.0042 U	0.0046 U	0.0019 U	4.4	0.029 J	0.069 J	0.056 J	0.15	0.34	0.3	0.36	0.19 J
MKE-20-098	MKE-20-098-C-1.9-2.3-200924	1.9	2.3	9/24/2020	0.0025 U	0.004 U	0.0043 U	0.0019 U	0.005 U	0.0035 U	0.0034 U	0.0046 U	0.005 U	0.0021 U	0.4	0.026 U	0.031 U	0.024 U	0.028 U	0.049 U	0.047 U	0.027 U	0.074 U
MKE-20-099	MKE-20-099-C-00-01-200924	0	1	9/24/2020	0.99	0.21	0.0037 U	0.0017 U	0.0044 U	0.003 U	0.78	0.004 U	0.0043 U	0.0018 U	7.1	0.066 J	0.07 U	0.091 J	0.14 J	0.52	0.54	0.65	0.5 J
MKE-20-099	MKE-20-099-C-01-1.8-200924	1	1.8	9/24/2020	0.13	0.031	0.0034 U	0.0015 U	0.004 U	0.0027 U	0.1	0.0037 U	0.0039 U	0.0016 U	1.4	0.013 J	0.017 J	0.022 J	0.031 J	0.11	0.1	0.12	0.088 J
MKE-20-100	MKE-20-100-C-00-01-200924	0	1	9/24/2020	0.75	0.16	0.0051 U	0.0023 U	0.006 U	0.0041 U	0.59	0.0055 U	0.006 U	0.0025 U	13.9	0.08 U	0.097 U	0.13 J	0.24 J	1	1.1	1.6	0.86 J
MKE-20-100	MKE-20-100-C-01-2.7-200924	1	2.7	9/24/2020	3.5	0.39 J+	0.0039 U	0.0017 U	0.0046 U	0.0032 U	3.1 J+	0.0042 U	0.0046 U	0.0019 U	19.8	0.12 J	0.18 J	0.22 J	0.42	1.6	1.5	1.9	1.1 J
MKE-20-101	MKE-20-101-C-00-0.6-200924	0	0.6	9/24/2020	0.54	0.066	0.0035 U	0.0016 U	0.0042 U	0.0029 U	0.47	0.0038 U	0.0042 U	0.0017 U	16	0.05 J	0.12	0.11	0.3	1.2	1.2	1.5	0.82
MKE-20-101	MKE-20-101-G-00-0.6-200924	0	0.6	9/24/2020																			
MKE-20-101	MKE-20-101-C-0.6-1.6-200924	0.6	1.6	9/24/2020	0.062	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0025 U	0.062	0.0033 U	0.0036 U	0.0015 U	0.013 U	0.0093 U	0.011 U	0.0085 U	0.01 U	0.018 U	0.017 U	0.0096 U	0.026 U
MKE-20-101	MKE-20-101-G-0.6-1.6-200924	0.6	1.6	9/24/2020																			
MKE-20-102	MKE-20-102-C-00-01-200928	0	1	9/28/2020	0.9	0.14 J	0.0036 U	0.0016 U	0.0042 U	0.0029 U	0.76	0.0039 U	0.0042 U	0.0018 U	14.9	0.04 J	0.12	0.1	0.32	1.1	1.2	1.5	0.77
MKE-20-102	MKE-20-102-C-01-1.3-200928	1	1.3	9/28/2020	4.4	0.58	0.0044 U	0.002 U	0.0052 U	0.0036 U	3.8	0.0048 U	0.0052 U	0.0022 U	36.8	0.076	0.26	0.24	0.61	2.6	2.8	3.6	1.9
MKE-20-105	MKE-20-105-C-00-0.2-200922	0	0.2	9/22/2020	0.11	0.01	0.003 U	0.0013 UJ	0.0035 UJ	0.0024 UJ	0.1 J	0.0032 UJ	0.0035 UJ	0.0015 UJ	0.62	0.0096 U	0.012 U	0.0088 U	0.014 J	0.049	0.045	0.053	0.032 J
MKE-20-105	MKE-20-105-C-0.2-01-200922	0.2	1	9/22/2020	0.013 U	0.02 U	0.021 UJ	0.0094 UJ	0.025 UJ	0.017 UJ	0.017 UJ	0.023 UJ	0.025 UJ	0.01 UJ	8.1	0.068 J	0.11 J	0.16 J	0.25	0.72	0.57	0.67	0.34 J
MKE-20-105	MKE-20-105-C-01-1.6-200922	1	1.6	9/22/2020	0.0028 U	0.0044 U	0.0047 U	0.0021 U	0.0055 U	0.0038 U	0.0037 U	0.005 U	0.0055 U	0.0023 U	8.8	0.079 J	0.14	0.18	0.25	0.74	0.6	0.64	0.36 J
MKE-20-107	MKE-20-107-C-00-01-200925	0	1	9/25/2020	0.84	0.16 J+	0.0043 U	0.0019 U	0.0051 U	0.0035 U	0.68 J+	0.0047 U	0.005 U	0.0021 U	28.3	0.19	0.35	0.37	0.85	2.2	2	2.3	1.3
MKE-20-107	MKE-20-107-G-00-01-200925	0	1	9/25/2020																			
MKE-20-107	MKE-20-107-C-01-2.6-200925	1	2.6	9/25/2020	0.0028 U	0.0045 U	0.0048 U	0.0021 U	0.0056 U	0.0039 U	0.0038 U	0.0052 U	0.0056 U	0.0023 U	22.9	0.44	0.35	0.17 J	0.62	1.5	1.2	1.6	0.79 J
MKE-20-107	MKE-20-107-G-01-2.6-200925	1	2.6	9/25/2020																			
MKE-20-107	MKE-20-107-C-2.6-3.8-200925	2.6	3.8	9/25/2020	0.0027 U	0.0044 U	0.0046 U	0.0021 U	0.0054 U	0.0037 U	0.0037 U	0.005 U	0.0054 U	0.0022 U	12.8	0.16	0.17	0.24	0.41	1	0.91	0.86	0.56 J
MKE-20-107	MKE-20-107-G-3.6-3.8-200925	3.6	3.8	9/25/2020																			
MKE-20-108	MKE-20-108-C-00-01-200922	0	1	9/22/2020	0.014	0.004 J	0.0027 UJ	0.0012 UJ	0.0032 UJ	0.0022 UJ	0.01 J	0.0029 UJ	0.0032 UJ	0.0013 UJ	4.5	0.074	0.059 J	0.053 J	0.15	0.33	0.27	0.33	0.19 J
MKE-20-108	MKE-20-108-C-01-03-200922	1	3	9/22/2020	0.0053	0.0013 U	0.0014 U	0.00063 U	0.0017 U	0.0011 U	0.0053	0.0015 U	0.0016 U	0.00069 U	18.2	0.37	0.35	0.23	0.87	1.3	1	1.1 J	0.57 J
MKE-20-108	MKE-20-108-C-03-05-200922	3	5	9/22/2020	0.0009 U	0.0015 UJ	0.0015 UJ	0.00069 UJ	0.0018 UJ	0.0013 UJ	0.0012 UJ	0.0017 UJ	0.0018 UJ	0.00075 UJ	9.5	0.19	0.14	0.095	0.47	0.64	0.5	0.49	0.28
MKE-20-108	MKE-20-108-C-05-5.4-200922	5	5.4	9/22/2020	0.0009 U	0.0015 UJ	0.0015 UJ	0.00069 UJ	0.0018 UJ	0.0013 UJ	0.0012 UJ	0.0017 UJ	0.0018 UJ	0.00075 UJ	4.3	0.14	0.11	0.051	0.17	0.27	0.23	0.22	0.13 J
MKE-20-109	MKE-20-109-C-00-01-200922	0	1	9/22/2020	0.069	0.011 J-	0.0019 UJ	0.00084 UJ	0.0022 UJ	0.0015 UJ	0.058 J-	0.002 UJ	0.0022 UJ	0.00091 UJ	30.5	0.24 J	0.45	0.25 J	1.1	2.3	2.2	2.4	1.3
MKE-20-109	MKE-20-109-C-01-03-200922	1	3	9/22/2020	0.18	0.03	0.0019 U	0.00086 U	0.0023 U	0.0016 U	0.15	0.0021 U	0.0022 U	0.00093 U	31.5	0.15 J	0.47	0.28	1.1	2.5	2.2	2.5	1.4
MKE-20-109	MKE-20-109-C-03-4.4-200922	3	4.4	9/22/2020	0.0011 U	0.0017 U	0.0018 U	0.0008 U	0.0021 U	0.0014 U	0.0014 U	0.0019 U	0.0021 U	0.00087 U	22.3	0.3	0.32	0.51	0.71	1.7	1.6	1.7	1
MKE-20-109	MKE-20-109-C-4.4-4.9-200922	4.4	4.9	9/22/2020	0.001 U	0.0016 U	0.0017 U	0.00074 U	0.002 U	0.0013 U	0.0013 U	0.0018 U	0.0019 U	0.00081 U	18.6	0.19	0.34	0.25	0.75	1.4	1.3	1.2	0.71
MKE-20-110	MKE-20-110-C-00-01-200922	0	1	9/22/2020	0.074	0.013	0.0016 UJ	0.00071 UJ	0.0019 UJ	0.0013 UJ	0.061 J	0.0017 UJ	0.0019 UJ	0.00078 UJ	7.4	0.072 J	0.13	0.066 J	0.28	0.56	0.5	0.53	0.29 J
MKE-20-110	MKE-20-110-G-00-01-200922	0	1	9/22/2020																			
MKE-20-110	MKE-20-110-C-01-03-200922	1	3	9/22/2020	0.035	0.0016 U	0.0017 UJ	0.00075 UJ	0.002 UJ	0.0014 UJ	0.035 J	0.0018 UJ	0.0019 UJ	0.00081 UJ	15.1	0.16 J	0.24	0.23	0.54	1.2	1.1	1	0.64 J
MKE-20-110	MKE-20-110-G-01-03-200922	1	3	9/22/2020																			
MKE-20-110	MKE-20-110-C-03-04-200922	3	4	9/22/2020	0.0085 U	0.014 U	0.015 U	0.0066 U	0.017 U	0.012 U	0.012 U	0.016 U	0.017 U	0.0072 U	6.5	0.071 J	0.11 J	0.14	0.27	0.49	0.42	0.42	0.25 J
MKE-20-110	MKE-20-110-G-03-3.3-200922	3	3.3	9/22/2020																			
MKE-20-111	MKE-20-111-C-00-01-200922	0	1	9/22/2020	0.05	0.012 U	0.013 U	0.0058 U	0.015 U	0.01 U	0.05	0.014 U	0.015 U	0.0063 U	0.3	0.0083 U	0.011 J	0.0075 U	0.013 J	0.016 J	0.015 U	0.017 J	0.023 U
MKE-20-111	MKE-20-111-C-01-03-200922	1	3	9/22/2020	0.043	0.0013 U	0.0014 UJ	0.00061 UJ	0.0016 UJ	0.0011 UJ	0.043 J	0.0015 UJ	0.0016 UJ	0.00066 UJ	0.35	0.0088 U	0.013 J	0.008 U	0.015 J	0.021 J	0.016 U	0.02 J	0.025 U
MKE-20-111	MKE-20-111-C-03-3.3-200922	3	3.3	9/22/2020	0.038	0.0016 J	0.0014 UJ	0.00061 UJ	0.0016 UJ	0.0011 UJ	0.036 J	0.0015 UJ	0.0016 UJ	0.00067 UJ	0.25	0.0089 U	0.011 U	0.0081 U	0.01 J	0.017 U	0.016 U	0.012 J	0.025 U
MKE-20-113	MKE-20-113-C-00-0.45-200928	0	0.5	9/28/2020	0.02	0.006 J	0.0028 U	0.0013 U	0.0033 U	0.0023 U	0.014	0.0031 U	0.0033 U	0.0014 U	0.8	0.0089 U	0.011 U	0.0083 J	0.022 J	0.058	0.06	0.068	0.042 J
MKE-20-114	MKE-20-114-C-00-0.7-200928	0	0.7	9/28/2020	0.0017 U	0.0027 U	0.0029 U	0.0013 U	0.0034 U	0.0023 U	0.0023 U	0.0031 U	0.0034 U	0.0014 U	0.013 U	0.0091 U	0.011 U	0.0083 U	0.0099 U	0.017 U	0.017 U	0.0094 U	0.026 U
MKE-20-117	MKE-20-117-C-00-01-200928	0	1	9/28/2020	0.0016 U	0.0025 U	0.0026 U	0.0012 U	0.0031 U	0.0021 U	0.0021 U	0.0028 U	0.003 U	0.0013 U	0.0115 U	0.0082 U	0.0098 U	0.0075 U	0.0088 U	0.015 U	0.015 U	0.0084 U	0.023 U
MKE-20-117	MKE-20-117-C-01-2.8-200928	1	2.8	9/28/2020	0.0018 U	0.0029 U	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.0025 U	0.0033 U	0.0036 U	0.0015 U	0.014 U	0.0096 U	0.012 U	0.0088 U	0.01 U	0.018 U	0.017 U	0.0099 U	0.027 U
MKE-21-063	MKE-21-063-00-01-210818	0	1	8/18/2021	0.21	0.05	0.0059 U	0.0027 U	0.007 U	0.0048 U	0.16	0.0064 U	0.0069 U	0.0029 U	8.8	0.019 U	0.057 J	0.064 J	0.17	0.67	0.72	0.97	0.54
MKE-21-063	MKE-21-063-01-2.3-210818	1	2.3	8/18/2021	0.44	0.061	0.005 U	0.0022 U	0.0059 U	0.004 U	0.38	0.0054 U	0.0058 U	0.0024 U	16.2	0.048 U	0.12 J	0.11 J	0.31	1.2	1.3	1.8	1
MKE-21-063	MKE-21-063-2.3-2.6-210818	2.3	2.6	8/18/2021	0.084	0.018	0.0035 U	0.0016 U	0.0041 U	0.0028 U	0.066	0.0038 U	0.0041 U	0.0017 U	12.5	0.026 J	0.13	0.057	0.41	1	0.87	1.1	0.61
MKE-21-063	MKE-21-063-2.6-4.6-210818	2.6	4.6	8/18/2021	0.0022 U	0.0034 U	0.0036 U	0.0016 U	0.0043 U	0.0029 U	0.0029 U	0.0039 U	0.0042 U	0.0018 U	16.4	0.068 J	0.2	0.26	0.66	1.4	1.3	1.4	0.83
MKE-21-063	MKE-21-063-4.6-6.6-210818	4.6	6.6	8/18/2021	0.0018 U	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0025 U	0.0024 U	0.0033 U	0.0036 U	0.0015 U	4.2	0.015 J	0.059	0.061	0.22	0.32	0.32	0.31	0.19 J
MKE-21-063	MKE-21-063-6.6-7.2-210818	6.6	7.2	8/18/2021	0.0018 U	0.0028 U	0.0029 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	0.04 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.08 U

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PAH										Metals								
				Analyte	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC											110	1.1	130	49	33	5	150	460	
				WI CBSQG PEC 3x											330	3.3	390	147	99	15	450	1380	
				WI CBSQG PEC 5x											550	5.5	650	245	165	25	750	2300	
				TSCA																			
Location code	**Sample ID**	**Start Depth (ft)**	**End Depth (ft)**	**Date**	**Benzo(g,h,i) perylene mg/kg**	**Benzo(k) fluoranthene mg/kg**	**Chrysene mg/kg**	**Dibenzo(a,h) anthracene mg/kg**	**Fluoranthene mg/kg**	**Fluorene mg/kg**	**Indeno(1,2,3-Cd)Pyrene mg/kg**	**Naphthalene mg/kg**	**Phenanthrene mg/kg**	**Pyrene mg/kg**	**Chromium mg/kg**	**Mercury mg/kg**	**Lead mg/kg**	**Nickel mg/kg**	**Arsenic** mg/kg	**Cadmium** mg/kg	**Copper** mg/kg	**Zinc** mg/kg	**Silver** mg/kg
MKE-20-093	MKE-20-093-C-00-01-200903	0	1	9/3/2020	3.1	1.7	4.7	0.9	7.2	0.49	2.4	0.26 J	3.4	6	538	0.99	150	27.9	9.4	14.1	76.4	417	
MKE-20-093	MKE-20-093-C-01-03-200903	1	3	9/3/2020	3.4	2.3	5.9	1.1	8.2	0.64	2.8	0.65	3.8	7.6	414	1.7	156	25.7	17.9	10.8	78.3	367	
MKE-20-093	MKE-20-093-C-03-3.6-200903	3	3.6	9/3/2020	0.94	0.38	1.5	0.22	2.4	0.26	0.74	0.56	1.7	2.1	250	2	145	12.8	9.8	0.67	51.2	173	
MKE-20-093	MKE-20-093-C-3.6-04-200903	3.6	4	9/3/2020	0.009 U	0.013 U	0.023 U	0.027 U	0.028 J	0.0082 U	0.021 U	0.0081 U	0.027 J	0.033 J	8.9	0.024	6.2	11.9	3.4	0.1	10.2	26.3	
MKE-20-094	MKE-20-094-C-00-01-200923	0	1	9/23/2020	0.94	0.36 J	1	0.45	1.5	0.097 J	0.72	0.093 J	0.61	1.5	56.8	0.16 J-	42.8	15.3	4.1	1	36.9	130	
MKE-20-094	MKE-20-094-C-01-1.8-200923	1	1.8	9/23/2020	0.0086 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0077 U	0.011 U	0.0094 U	5.1	0.011 R	4	6.5	1.6	0.071	6.4	19.9	
MKE-20-095	MKE-20-095-C-00-1.2-200923	0	1.2	9/23/2020	0.0091 U	0.013 U	0.023 U	0.027 U	0.011 U	0.0082 U	0.021 U	0.0082 U	0.011 U	0.0099 U	5.9	0.01 R	3.9	7.3	1.9	0.054 J	7.2	16.1	
MKE-20-096	MKE-20-096-C-00-01-200903	0	1	9/3/2020	4.2	2.2	9	0.99	12	1.7	3.1	1.6	11	14	195	0.91	144	18.3	12.5	4.1	55.3	249	
MKE-20-096	MKE-20-096-C-01-02-200903	1	2	9/3/2020	4.4	2.5	9.8	1.1	17	4.7	3.3	3.1	24	20	110	1.8	87.9	8.9	6.6	1.7	39.4	172	
MKE-20-096	MKE-20-096-C-02-2.8-200903	2	2.8	9/3/2020	0.043	0.02 J	0.099	0.028 U	0.23	0.064	0.036 J	0.053	0.3	0.21	11.8	0.13	15.9	5	2.5	0.11	6.8	34.5	
MKE-20-097	MKE-20-097-C-00-01-200924	0	1	9/24/2020	0.34	0.25	0.59	0.25	1	0.087 J	0.3	0.065 J	0.58	1	32.2 J	0.066	14.8	8.6	1.8	0.61	13.4	57.6 J	
MKE-20-097	MKE-20-097-C-01-02-200924	1	2	9/24/2020	0.81	0.59	1.4	0.64	2.2	0.15 J	0.81	0.18 J	1.1	2.3	101	0.42	37.9	11.6	3.9	1.9	38.3	148	
MKE-20-098	MKE-20-098-C-00-01-200924	0	1	9/24/2020	0.5	0.35	0.9	0.38	1.3	0.12 J	0.43	0.084 J	0.66	1.4	233	0.52	47.9	21.1	6.5	5.4	37.9	216	
MKE-20-098	MKE-20-098-C-01-1.9-200924	1	1.9	9/24/2020	0.19	0.11	0.33	0.12	0.65	0.081 J	0.16	0.059 J	0.52	0.7	42.7	0.14	13.5	13.6	3	1.1	15.4	73.2	
MKE-20-098	MKE-20-098-C-1.9-2.3-200924	1.9	2.3	9/24/2020	0.024 U	0.033 U	0.061 U	0.07 U	0.031 J	0.021 U	0.054 U	0.021 U	0.032 J	0.038 J	19.6	0.024	7.8	16.8	2.3	0.33	14.3	55.9	
MKE-20-099	MKE-20-099-C-00-01-200924	0	1	9/24/2020	0.48	0.23 J	0.75	0.32	0.86	0.078 J	0.35	0.095 J	0.48	0.92	142	0.36	33.1	14.4	5.5	3.8	25.1	155	
MKE-20-099	MKE-20-099-C-01-1.8-200924	1	1.8	9/24/2020	0.071	0.045	0.14	0.05	0.19	0.02 J	0.062	0.025 J	0.11	0.22	44.7	0.11	12.5	7.6	2.7	1.3	10.7	59.5	
MKE-20-100	MKE-20-100-C-00-01-200924	0	1	9/24/2020	0.87	0.52	1.3	0.43	2	0.099 J	0.78	0.072 J	0.8	2	130	0.26	63.6	18	5.2	2.6	49.4	199	
MKE-20-100	MKE-20-100-C-01-2.7-200924	1	2.7	9/24/2020	1	0.72	1.9	0.47	2.9	0.22 J	0.96	0.16 J	1.5	2.9	490	1.1	115	27.6	11.2	12.8	67.8	389	
MKE-20-101	MKE-20-101-C-00-0.6-200924	0	0.6	9/24/2020	0.84	0.57	1.3	0.27	2.7	0.13	0.77	0.085 J	1.2	2.8	74.4	0.14	42.4	11.7	3.4	1.3	28.2	108	
MKE-20-101	MKE-20-101-G-00-0.6-200924	0	0.6	9/24/2020																			
MKE-20-101	MKE-20-101-C-0.6-1.6-200924	0.6	1.6	9/24/2020	0.0084 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0076 U	0.019 U	0.0076 U	0.01 U	0.0092 U	12.1	0.011 J	4.7	10.4	1.9	0.14	10.1	27.4	
MKE-20-101	MKE-20-101-G-0.6-1.6-200924	0.6	1.6	9/24/2020																			
MKE-20-102	MKE-20-102-C-00-01-200928	0	1	9/28/2020	0.78	0.47	1.2	0.22	2.6	0.14	0.74	0.075	1.2	2.3	106	0.21 J	47	11.4	3.2	1.6	24	104 J	
MKE-20-102	MKE-20-102-C-01-1.3-200928	1	1.3	9/28/2020	2	1.4	3	0.48	7.5	0.32	1.8	0.12	2.9	5.2	667	0.44 J	213	29.9	7.3	11.1	71.7	348 J	
MKE-20-105	MKE-20-105-C-00-0.2-200922	0	0.2	9/22/2020	0.029 J	0.021 J	0.053	0.04	0.096	0.0079 U	0.028 J	0.011 J	0.036 J	0.092	10.9 J	0.012 J-	5	4.1	1.1	0.16	3.4	24.1	
MKE-20-105	MKE-20-105-C-0.2-01-200922	0.2	1	9/22/2020	0.35	0.24	0.65	0.23	1.2	0.087 J	0.31	0.33	0.64	1.2	63.5	0.17 J-	20.6	15.6	3.2	0.37	19.8	70.5	
MKE-20-105	MKE-20-105-C-01-1.6-200922	1	1.6	9/22/2020	0.41	0.3	0.71	0.19	1.3	0.094 J	0.38	0.4	0.76	1.3	65.7 J	0.18 J-	20.6	14.5	3.5	0.29	19.8	64.9	
MKE-20-107	MKE-20-107-C-00-01-200925	0	1	9/25/2020	1.3	0.9	2.4	0.43	4.3	0.39	1.1	0.56	2.5	4.9	273	0.88	87.6	24.7	11	7.1	47.6	253 J	
MKE-20-107	MKE-20-107-G-00-01-200925	0	1	9/25/2020																			
MKE-20-107	MKE-20-107-C-01-2.6-200925	1	2.6	9/25/2020	0.79	0.35	1.5	0.49	3.2	0.42	0.66	2.4	2.7	3.7	1060	1.3	168	27.9	49.9	1.4	73.6	369 J	
MKE-20-107	MKE-20-107-G-01-2.6-200925	1	2.6	9/25/2020																			
MKE-20-107	MKE-20-107-C-2.6-3.8-200925	2.6	3.8	9/25/2020	0.56	0.45	1.1	0.24	1.7	0.2	0.5	0.52	1.1	2.1	85.2	0.39	52.5	19.6	7.8	1.4	32.6	156 J	
MKE-20-107	MKE-20-107-G-3.6-3.8-200925	3.6	3.8	9/25/2020																			
MKE-20-108	MKE-20-108-C-00-01-200922	0	1	9/22/2020	0.18	0.13	0.33	0.11	0.65	0.075	0.16	0.32	0.44	0.68	33 J	0.045 J-	30.8	52.5	10	0.34	86.5	123	
MKE-20-108	MKE-20-108-C-01-03-200922	1	3	9/22/2020	0.57	0.4	1.1	0.28	2.5	0.41	0.54	1.6	2.5	2.5 J	23.9 J	0.093 J-	29.7	30.9	8.1	0.23	29.8	99.1	
MKE-20-108	MKE-20-108-C-03-05-200922	3	5	9/22/2020	0.28	0.19	0.63	0.099	1.4	0.22	0.25	0.69	1.5	1.4	22.6 J	0.05 J	36.2	33.3	7.5	0.18	24.7	149	
MKE-20-108	MKE-20-108-C-05-5.4-200922	5	5.4	9/22/2020	0.14	0.088	0.26	0.063	0.55	0.12	0.12	0.47	0.62	0.57	24.5 J	0.044 J	44.6	40.5	9.3	0.25	33.2	103	
MKE-20-109	MKE-20-109-C-00-01-200922	0	1	9/22/2020	1.3	0.79	2.3	0.52	4.9	0.42	1.2	0.98	3.3	4.5	18.2 J	0.054 J	16.8	8.4	2.8	0.44	14.2	60.5	
MKE-20-109	MKE-20-109-C-01-03-200922	1	3	9/22/2020	1.3	0.86	2.5	0.57	5.4	0.47	1.3	0.44	3.4	4.7	92.8 J	0.33 J	43.3	18.8	6.7	2.8	27.9	135	
MKE-20-109	MKE-20-109-C-03-4.4-200922	3	4.4	9/22/2020	1	0.56	1.7	0.35	3.2	0.37	0.84	1	2.1	3.3	68.6 J	0.67 J	51.1	14.9	6.9	0.9	29.4	112	
MKE-20-109	MKE-20-109-C-4.4-4.9-200922	4.4	4.9	9/22/2020	0.77	0.49	1.3	0.25	2.7	0.36	0.68	0.76	2.3	2.8	21.2 J	0.14 J	27	8.3	4.1	0.21	14.6	77.6	
MKE-20-110	MKE-20-110-C-00-01-200922	0	1	9/22/2020	0.3	0.22	0.53	0.16	1.1	0.14	0.27	0.3	0.9	1.1	11.4 J	0.032 J	11.6	7	2.4	0.28	10.3	47.8	
MKE-20-110	MKE-20-110-G-00-01-200922	0	1	9/22/2020																			
MKE-20-110	MKE-20-110-C-01-03-200922	1	3	9/22/2020	0.63	0.45	1.1	0.34	2.1	0.25	0.56	0.86	1.5	2.2	35.4 J	0.25 J	30.7	11.1	4.6	0.48	18.3	79.4	
MKE-20-110	MKE-20-110-G-01-03-200922	1	3	9/22/2020																			
MKE-20-110	MKE-20-110-C-03-04-200922	3	4	9/22/2020	0.28	0.16	0.47	0.15	0.9	0.14	0.25	0.3	0.72	0.95	17.5 J	0.11 J	14.8	6.9	3.4	0.17	9.9	44.9	
MKE-20-110	MKE-20-110-G-03-3.3-200922	3	3.3	9/22/2020																			
MKE-20-111	MKE-20-111-C-00-01-200922	0	1	9/22/2020	0.0074 U	0.01 U	0.033 J	0.022 U	0.046	0.012 J	0.017 U	0.0067 U	0.044	0.054	5.6 J	0.0091 J	8	5.9	3.2	0.27	9.5	61.5	
MKE-20-111	MKE-20-111-C-01-03-200922	1	3	9/22/2020	0.013 J	0.011 U	0.031 J	0.024 U	0.058	0.014 J	0.018 U	0.0088 J	0.047	0.058	6.2 J	0.0099 J	6.1	5.9	2.8	0.39	8.2	93.8	
MKE-20-111	MKE-20-111-C-03-3.3-200922	3	3.3	9/22/2020	0.01 J	0.011 U	0.025 J	0.024 U	0.035 J	0.0093 J	0.018 U	0.0072 U	0.033 J	0.043	4.2 J	0.01 U	3.9	3.9	2.1	0.16	5.6	36.3	
MKE-20-113	MKE-20-113-C-00-0.45-200928	0	0.5	9/28/2020	0.041	0.03 J	0.072	0.024 U	0.13	0.013 J	0.041	0.0072 U	0.066	0.12	7.9	0.011 J	4.6	7.7	5.3	0.12	6.9	32.7 J	
MKE-20-114	MKE-20-114-C-00-0.7-200928	0	0.7	9/28/2020	0.0082 U	0.011 U	0.021 U	0.024 U	0.01 U	0.0075 U	0.019 U	0.0074 U	0.01 U	0.009 U	15.5	0.012 UJ	7.6	18.7	4.8	0.074	15.9	33.1 J	
MKE-20-117	MKE-20-117-C-00-01-200928	0	1	9/28/2020	0.0074 U	0.01 U	0.019 U	0.022 U	0.009 U	0.0067 U	0.017 U	0.0066 U	0.0092 U	0.0081 U	3.2	0.011 UJ	1.8	3.7	1.4	0.033 J	7.5	12 J	
MKE-20-117	MKE-20-117-C-01-2.8-200928	1	2.8	9/28/2020	0.0087 U	0.012 U	0.022 U	0.026 U	0.011 U	0.0079 U	0.02 U	0.0078 U	0.011 U	0.0095 U	3.3	0.012 UJ	2.1	3.4	1.5	0.092	5.3	18.9 J	
MKE-21-063	MKE-21-063-00-01-210818	0	1	8/18/2021	0.56	0.36	0.75	0.15	1.4	0.055 J	0.54	0.029 J	0.48	1.3	172 J	0.2	82.4	20.2	6.4	2.6	40.9	188 J	
MKE-21-063	MKE-21-063-01-2.3-210818	1	2.3	8/18/2021	0.97	0.7	1.4	0.3	2.6	0.14 J	0.95	0.058 J	1.1	2.1	196 J	0.32	81	24.3	7	4.9	40.9	219 J	
MKE-21-063	MKE-21-063-2.3-2.6-210818	2.3	2.6	8/18/2021	0.55	0.41	1	0.16	2.3	0.16	0.54	0.052	1.3	1.8	57.2 J	0.22	33.5	11.4	4	1.7	16.1	115 J	
MKE-21-063	MKE-21-063-2.6-4.6-210818	2.6	4.6	8/18/2021	0.85	0.47	1.3	0.23	2.5	0.23	0.75	0.14	1.5	2.3	61.6 J	0.33	66.8	9.3	4.4	0.74	19.3	101 J	
MKE-21-063	MKE-21-063-4.6-6.6-210818	4.6	6.6	8/18/2021	0.23	0.099	0.27	0.042	0.64	0.057	0.19	0.035 J	0.44	0.71	11.5 J	0.047	8.4	8.8	2.5	0.16	11.7	37.1 J	
MKE-21-063	MKE-21-063-6.6-7.2-210818	6.6	7.2	8/18/2021	0.0086 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0077 U	0.011 U	0.0094 U	21.2 J	0.012 U	12.1	22.4	5.8	0.093	19.1	49.9 J	

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	Metals															Physical Parameters								
				Analyte	Barium	Selenium	Aluminum	Iron	Manganese	Potassium	Sodium	Thallium	Antimony	Beryllium	Cobalt	Calcium	Cyanide	Magnesium	Vanadium	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
				WI CBSQG PEC				40000	1100				25															
				WI CBSQG PEC 3x				120000	3300				75															
				WI CBSQG PEC 5x				200000	5500				125															
				TSCA																								
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Barium	Selenium	Aluminum	Iron	Manganese	Potassium	Sodium	Thallium	Antimony	Beryllium	Cobalt	Calcium	Cyanide	Magnesium	Vanadium	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
MKE-20-093	MKE-20-093-C-00-01-200903	0	1	9/3/2020																54400								
MKE-20-093	MKE-20-093-C-01-03-200903	1	3	9/3/2020																60100								
MKE-20-093	MKE-20-093-C-03-3.6-200903	3	3.6	9/3/2020																52100								
MKE-20-093	MKE-20-093-C-3.6-04-200903	3.6	4	9/3/2020																33200								
MKE-20-094	MKE-20-094-C-00-01-200923	0	1	9/23/2020													0.24 J											
MKE-20-094	MKE-20-094-C-01-1.8-200923	1	1.8	9/23/2020													0.072 UJ											
MKE-20-095	MKE-20-095-C-00-1.2-200923	0	1.2	9/23/2020													0.66 J-											
MKE-20-096	MKE-20-096-C-00-01-200903	0	1	9/3/2020																76300								
MKE-20-096	MKE-20-096-C-01-02-200903	1	2	9/3/2020																51300								
MKE-20-096	MKE-20-096-C-02-2.8-200903	2	2.8	9/3/2020																32200								
MKE-20-097	MKE-20-097-C-00-01-200924	0	1	9/24/2020																								
MKE-20-097	MKE-20-097-C-01-02-200924	1	2	9/24/2020																								
MKE-20-098	MKE-20-098-C-00-01-200924	0	1	9/24/2020																								
MKE-20-098	MKE-20-098-C-01-1.9-200924	1	1.9	9/24/2020																								
MKE-20-098	MKE-20-098-C-1.9-2.3-200924	1.9	2.3	9/24/2020																								
MKE-20-099	MKE-20-099-C-00-01-200924	0	1	9/24/2020																								
MKE-20-099	MKE-20-099-C-01-1.8-200924	1	1.8	9/24/2020																								
MKE-20-100	MKE-20-100-C-00-01-200924	0	1	9/24/2020																								
MKE-20-100	MKE-20-100-C-01-2.7-200924	1	2.7	9/24/2020																								
MKE-20-101	MKE-20-101-C-00-0.6-200924	0	0.6	9/24/2020																42100								
MKE-20-101	MKE-20-101-G-00-0.6-200924	0	0.6	9/24/2020																	0 U	42.8	0.7	3.1	39	48.3	8.9	57.2
MKE-20-101	MKE-20-101-C-0.6-1.6-200924	0.6	1.6	9/24/2020																20600								
MKE-20-101	MKE-20-101-G-0.6-1.6-200924	0.6	1.6	9/24/2020																	0 U	42.8	0 U	0.8	42	38.5	18.7	57.2
MKE-20-102	MKE-20-102-C-00-01-200928	0	1	9/28/2020																								
MKE-20-102	MKE-20-102-C-01-1.3-200928	1	1.3	9/28/2020																								
MKE-20-105	MKE-20-105-C-00-0.2-200922	0	0.2	9/22/2020																								
MKE-20-105	MKE-20-105-C-0.2-01-200922	0.2	1	9/22/2020																								
MKE-20-105	MKE-20-105-C-01-1.6-200922	1	1.6	9/22/2020																								
MKE-20-107	MKE-20-107-C-00-01-200925	0	1	9/25/2020																58600								
MKE-20-107	MKE-20-107-G-00-01-200925	0	1	9/25/2020																	0 U	31	0.5	2.7	27.8	43.7	25.3	69
MKE-20-107	MKE-20-107-C-01-2.6-200925	1	2.6	9/25/2020																49500								
MKE-20-107	MKE-20-107-G-01-2.6-200925	1	2.6	9/25/2020																	0 U	18.1	1.4	3.5	13.2	61.6	20.3	81.9
MKE-20-107	MKE-20-107-C-2.6-3.8-200925	2.6	3.8	9/25/2020																58200								
MKE-20-107	MKE-20-107-G-3.6-3.8-200925	3.6	3.8	9/25/2020																	0 U	12.3	0 U	3.1	9.2	35.9	51.8	87.7
MKE-20-108	MKE-20-108-C-00-01-200922	0	1	9/22/2020																								
MKE-20-108	MKE-20-108-C-01-03-200922	1	3	9/22/2020																								
MKE-20-108	MKE-20-108-C-03-05-200922	3	5	9/22/2020																								
MKE-20-108	MKE-20-108-C-05-5.4-200922	5	5.4	9/22/2020																								
MKE-20-109	MKE-20-109-C-00-01-200922	0	1	9/22/2020																								
MKE-20-109	MKE-20-109-C-01-03-200922	1	3	9/22/2020																								
MKE-20-109	MKE-20-109-C-03-4.4-200922	3	4.4	9/22/2020																								
MKE-20-109	MKE-20-109-C-4.4-4.9-200922	4.4	4.9	9/22/2020																								
MKE-20-110	MKE-20-110-C-00-01-200922	0	1	9/22/2020																41600 J-								
MKE-20-110	MKE-20-110-G-00-01-200922	0	1	9/22/2020																	0 U	86.9	1.2	6.3	79.4	9.6	3.5	13.1
MKE-20-110	MKE-20-110-C-01-03-200922	1	3	9/22/2020																72300 J-								
MKE-20-110	MKE-20-110-G-01-03-200922	1	3	9/22/2020																	0 U	52.5	0 U	1.9	50.6	39.5	8	47.5
MKE-20-110	MKE-20-110-C-03-04-200922	3	4	9/22/2020																48600 J-								
MKE-20-110	MKE-20-110-G-03-3.3-200922	3	3.3	9/22/2020																	1.5	67	6.5	18.8	41.7	25.3	6.2	31.5
MKE-20-111	MKE-20-111-C-00-01-200922	0	1	9/22/2020																								
MKE-20-111	MKE-20-111-C-01-03-200922	1	3	9/22/2020																								
MKE-20-111	MKE-20-111-C-03-3.3-200922	3	3.3	9/22/2020																								
MKE-20-113	MKE-20-113-C-00-0.45-200928	0	0.5	9/28/2020																								
MKE-20-114	MKE-20-114-C-00-0.7-200928	0	0.7	9/28/2020																								
MKE-20-117	MKE-20-117-C-00-01-200928	0	1	9/28/2020																								
MKE-20-117	MKE-20-117-C-01-2.8-200928	1	2.8	9/28/2020																								
MKE-21-063	MKE-21-063-00-01-210818	0	1	8/18/2021																27800								
MKE-21-063	MKE-21-063-01-2.3-210818	1	2.3	8/18/2021																28700								
MKE-21-063	MKE-21-063-2.3-2.6-210818	2.3	2.6	8/18/2021																18900 J-								
MKE-21-063	MKE-21-063-2.6-4.6-210818	2.6	4.6	8/18/2021																41800								
MKE-21-063	MKE-21-063-4.6-6.6-210818	4.6	6.6	8/18/2021																29600 J								
MKE-21-063	MKE-21-063-6.6-7.2-210818	6.6	7.2	8/18/2021																27700								

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PCB										PAH								
				Analyte	Total PCB	Aroclor 1260	Aroclor 1254	Aroclor 1268	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1016	Aroclor 1262	Aroclor 1242	Total PAH	2-Methyl naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b)-fluoranthene	Benzo(e) pyrene
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC	1										22.8								
				WI CBSQG PEC 3x	3										68.4								
				WI CBSQG PEC 5x	5										114								
				TSCA	50																		
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Total PCB mg/kg	Aroclor 1260 mg/kg	Aroclor 1254 mg/kg	Aroclor 1268 mg/kg	Aroclor 1221 mg/kg	Aroclor 1232 mg/kg	Aroclor 1248 mg/kg	Aroclor 1016 mg/kg	Aroclor 1262 mg/kg	Aroclor 1242 mg/kg	Total PAH mg/kg	2-Methyl naphthalene mg/kg	Acenaphthene mg/kg	Acenaphthylene mg/kg	Anthracene mg/kg	Benzo(a) anthracene mg/kg	Benzo(a) pyrene mg/kg	Benzo(b)-fluoranthene mg/kg	Benzo(e) pyrene mg/kg
MKE-21-064	MKE-21-064-00-01-210818	0	1	8/18/2021	0.46	0.056	0.11	0.0022 U	0.0057 U	0.0039 U	0.29	0.0052 U	0.0056 U	0.0023 U	12.6	0.031 U	0.099 J	0.06 J	0.26	1	1	1.4	0.77
MKE-21-064	MKE-21-064-01-03-210818	1	3	8/18/2021	0.41	0.053	0.12	0.0021 U	0.0056 U	0.0039 U	0.24	0.0052 U	0.0056 U	0.0023 U	19.7	0.073 J	0.15	0.14	0.4	1.4	1.5	2.2	1.2
MKE-21-064	MKE-21-064-03-05-210818	3	5	8/18/2021	0.0025 U	0.004 U	0.0043 U	0.0019 U	0.005 U	0.0035 U	0.0034 U	0.0046 U	0.005 U	0.0021 U	17.4	0.12	0.19	0.31	0.52	1.4	1.3	1.7	0.94
MKE-21-064	MKE-21-064-05-6.4-210818	5	6.4	8/18/2021	0.0022 U	0.0035 U	0.0037 U	0.0017 U	0.0044 U	0.003 U	0.003 U	0.004 U	0.0043 U	0.0018 U	8.6	0.053	0.12	0.19	0.32	0.69	0.65	0.69	0.42
MKE-21-065	MKE-21-065-00-01-210818	0	1	8/18/2021	0.052	0.0068 J	0.0037 U	0.0016 U	0.0043 U	0.003 U	0.045	0.004 U	0.0043 U	0.0018 U	13.4	0.067	0.16	0.24	0.41	1.1	1.1	1.3	0.72
MKE-21-065	MKE-21-065-G-00-01-210818	0	1	8/18/2021																			
MKE-21-065	MKE-21-065-01-03-210818	1	3	8/18/2021	0.0019 U	0.003 U	0.0032 U	0.0014 U	0.0038 U	0.0026 U	0.0025 U	0.0034 U	0.0037 U	0.0016 U	2.1	0.01 U	0.031 J	0.039 J	0.095	0.18	0.17	0.16	0.094 J
MKE-21-065	MKE-21-065-G-01-03-210818	1	3	8/18/2021																			
MKE-21-065	MKE-21-065-03-05-210818	3	5	8/18/2021	0.0018 U	0.0028 U	0.0029 U	0.0013 U	0.0035 U	0.0024 U	0.0023 U	0.0032 U	0.0034 U	0.0014 U	0.04 U	0.0095 U	0.011 U	0.0087 U	0.01 U	0.018 U	0.017 U	0.0098 U	0.08 U
MKE-21-065	MKE-21-065-G-03-05-210818	3	5	8/18/2021																			
MKE-21-065	MKE-21-065-05-07-210818	5	7	8/18/2021	0.0029 U	0.0047 U	0.0049 U	0.0022 U	0.0058 U	0.004 U	0.0039 U	0.0053 U	0.0058 U	0.0024 U	0.065 U	0.016 U	0.019 U	0.014 U	0.017 U	0.03 U	0.028 U	0.016 U	0.13 U
MKE-21-065	MKE-21-065-G-05-07-210818	5	7	8/18/2021																			
MKE-21-066	MKE-21-066-00-01-210819	0	1	8/19/2021	0.081	0.022	0.0054 U	0.0024 U	0.0064 U	0.0044 U	0.059	0.0059 U	0.0063 U	0.0026 U	9.6	0.035 U	0.052 J	0.058 J	0.22	0.8	0.68	1	0.61 J
MKE-21-066	MKE-21-066-01-03-210819	1	3	8/19/2021	0.48	0.093	0.0052 U	0.0023 U	0.0061 U	0.0042 U	0.39	0.0056 U	0.0061 U	0.0025 U	18.2	0.08 J	0.13 J	0.15	0.33	1.4	1.3	2.1	1.2
MKE-21-066	MKE-21-066-03-05-210819	3	5	8/19/2021	0.026	0.01 J	0.0043 U	0.0019 U	0.0051 U	0.0035 U	0.016	0.0047 U	0.0051 U	0.0021 U	25.4	0.18	0.19	0.56	0.65	2.3	2	2.5	1.5
MKE-21-066	MKE-21-066-05-07-210819	5	7	8/19/2021	0.0025 U	0.004 U	0.0042 U	0.0019 U	0.005 U	0.0034 U	0.0034 U	0.0046 U	0.0049 U	0.0021 U	21.3	0.2	0.26	0.36	0.69	2	1.7	1.8	1.1
MKE-21-066	MKE-21-066-07-8.2-210819	7	8.2	8/19/2021	0.0018 U	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0025 U	0.0024 U	0.0033 U	0.0035 U	0.0015 U	0.67	0.0097 U	0.017 J	0.0089 U	0.039 J	0.046	0.041	0.039 J	0.081 U
MKE-21-066	MKE-21-066-8.2-8.7-210819	8.2	8.7	8/19/2021	0.0017 U	0.0027 U	0.0028 U	0.0013 U	0.0033 U	0.0023 U	0.0023 U	0.0031 U	0.0033 U	0.0014 U	0.038 U	0.009 U	0.011 U	0.0082 U	0.0098 U	0.017 U	0.016 U	0.0093 U	0.075 U
MKE-21-067	MKE-21-067-00-01-210818	0	1	8/18/2021	0.24	0.068	0.0061 U	0.0027 U	0.0072 U	0.005 U	0.17	0.0067 U	0.0072 U	0.003 U	11.5	0.039 U	0.066 J	0.055 J	0.21	0.79	0.91	1.3	0.74 J
MKE-21-067	MKE-21-067-01-03-210818	1	3	8/18/2021	1.1	0.19	0.0062 U	0.0028 U	0.0073 U	0.005 U	0.95	0.0067 U	0.0073 U	0.003 U	37.6	0.14 J	0.21	0.29	0.65	2.7	2.8	4.1	2.4
MKE-21-067	MKE-21-067-03-05-210818	3	5	8/18/2021	0.12	0.043	0.0061 U	0.0027 U	0.0072 U	0.005 U	0.079	0.0066 U	0.0072 U	0.003 U	44.6	0.36 J	0.32 J	0.75	1	3.8	3.3	4.6	2.8
MKE-21-067	MKE-21-067-05-7.5-210818	5	7.5	8/18/2021	0.0025 U	0.004 U	0.0042 U	0.0019 U	0.0049 U	0.0034 U	0.0033 U	0.0045 U	0.0049 U	0.002 U	27	0.34	0.29	0.7	0.84	2.4	2.1	2.4	1.4
MKE-21-067	MKE-21-067-7.7-9.7-210818	7.7	9.7	8/18/2021	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	0.22	0.0094 U	0.011 U	0.0086 U	0.01 U	0.018 U	0.017 U	0.011 J	0.079 U
MKE-21-068	MKE-21-068-00-01-210818	0	1	8/18/2021	0.12	0.038	0.0043 U	0.0019 U	0.0051 U	0.0035 U	0.085	0.0047 U	0.0051 U	0.0021 U	15.3	0.069 U	0.13 J	0.12 J	0.31	1.1	1.2	1.8	0.93 J
MKE-21-068	MKE-21-068-01-03-210818	1	3	8/18/2021	1.1	0.16	0.0052 U	0.0023 U	0.0062 U	0.0043 U	0.94 J	0.0057 U	0.0061 U	0.0026 U	50	0.22 J	0.32 J	0.37	1	3.8	3.4	5.4	3
MKE-21-068	MKE-21-068-03-05-210818	3	5	8/18/2021	0.022	0.0046 U	0.0048 U	0.0022 U	0.0057 U	0.0039 U	0.022	0.0052 U	0.0057 U	0.0024 U	64.6	0.94	0.82	0.8	2.2	5.1	4.3	5.4	3.4
MKE-21-068	MKE-21-068-05-06-210818	5	6	8/18/2021	0.0028 U	0.0045 U	0.0047 U	0.0021 U	0.0056 U	0.0038 U	0.0038 U	0.0051 U	0.0055 U	0.0023 U	76.8	0.85	0.66	2.5	2.4	6.8	5.5	6.2	3.8
MKE-21-068	MKE-21-068-06-7.2-210818	6	7.2	8/18/2021	0.0033 U	0.0052 U	0.0055 U	0.0025 U	0.0065 U	0.0045 U	0.0044 U	0.006 U	0.0065 U	0.0027 U	0.71	0.018 U	0.021 U	0.016 U	0.039 J	0.063 J	0.038 J	0.043 J	0.15 U
MKE-21-069	MKE-21-069-00-01-210817	0	1	8/17/2021	0.7	0.09	0.0047 U	0.0021 U	0.0055 U	0.0038 U	0.61	0.0051 U	0.0055 U	0.0023 U	80	0.17	0.51	0.42	1.7	6.2	5.6	7.9	4.4
MKE-21-069	MKE-21-069-01-03-210817	1	3	8/17/2021	0.078	0.016 J	0.005 U	0.0022 U	0.0059 U	0.0041 U	0.062	0.0054 U	0.0059 U	0.0024 U	63.7	0.79	0.8	0.64	1.9	5.1	4.3	5.9	3.4
MKE-21-069	MKE-21-069-03-4.8-210817	3	4.8	8/17/2021	0.0025 U	0.0041 U	0.0043 U	0.0019 U	0.005 U	0.0035 U	0.0034 U	0.0046 U	0.005 U	0.0021 U	75.8	1.5	1.2	1.7	3.2	6.5	5.2	5.8	3.4
MKE-21-069	MKE-21-069-4.8-5.6-210817	4.8	5.6	8/17/2021	0.0094	0.0027 U	0.0028 U	0.0013 U	0.0034 U	0.0023 U	0.0094 J	0.0031 U	0.0033 U	0.0014 U	0.88	0.059	0.071	0.015 J	0.039	0.053	0.037 J	0.044	0.076 U
MKE-21-069	MKE-21-069-5.6-7.2-210817	5.6	7.2	8/17/2021	0.0017 U	0.0027 U	0.0028 U	0.0013 U	0.0033 U	0.0023 U	0.0023 U	0.0031 U	0.0033 U	0.0014 U	0.038 U	0.009 U	0.011 U	0.0082 U	0.0097 U	0.017 U	0.016 U	0.0092 U	0.075 U
MKE-21-070	MKE-21-070-00-1.2-210819	0	1.2	8/19/2021	0.054	0.0088 J	0.0034 U	0.0015 U	0.004 U	0.0027 U	0.045	0.0037 U	0.004 U	0.0017 U	10.5	0.032 J	0.12	0.1	0.35	0.89	0.74	0.93	0.53
MKE-21-070	MKE-21-070-G-00-1.2-210819	0	1.2	8/19/2021																			
MKE-21-070	MKE-21-070-1.2-1.8-210819	1.2	1.8	8/19/2021	0.049	0.0088 J	0.0031 U	0.0014 U	0.0037 U	0.0025 U	0.04	0.0034 U	0.0036 U	0.0015 U	23.8	0.046 J	0.21	0.095	0.61	1.8	1.7	2.6	1.3
MKE-21-070	MKE-21-070-1.8-3.2-210819	1.8	3.2	8/19/2021	0.073	0.0098 J	0.0041 U	0.0019 U	0.0049 U	0.0034 U	0.063	0.0045 U	0.0048 U	0.002 U	101	0.16 J	1.2	0.34	3.7	8.2	6.8	7.9	4.6
MKE-21-070	MKE-21-070-G-1.8-3.2-210819	1.8	3.2	8/19/2021																			
MKE-21-070	MKE-21-070-3.2-5.2-210819	3.2	5.2	8/19/2021	0.5	0.081	0.0043 U	0.0019 U	0.005 U	0.0035 U	0.42	0.0046 U	0.005 U	0.0021 U	24.2	0.11	0.24	0.19	0.63	2	1.7	2.4	1.5
MKE-21-070	MKE-21-070-G-3.2-5.2-210819	3.2	5.2	8/19/2021																			
MKE-21-070	MKE-21-070-5.2-6.2-210819	5.2	6.2	8/19/2021	0.33	0.076	0.0041 U	0.0019 U	0.0049 U	0.0034 U	0.25	0.0045 U	0.0049 U	0.002 U	23	0.17	0.24	0.2	0.79	1.7	1.6	2	1.3
MKE-21-070	MKE-21-070-G-5.2-6.2-210819	5.2	6.2	8/19/2021																			
MKE-21-070	MKE-21-070-6.2-7.5-210819	6.2	7.5	8/19/2021	0.041	0.01 J	0.0033 U	0.0015 U	0.0039 U	0.0027 U	0.031	0.0036 U	0.0039 U	0.0016 U	16.8	0.059 J	0.22	0.11	0.63	1.4	1.1	1.3	0.81
MKE-21-070	MKE-21-070-G-6.2-7.5-210819	6.2	7.5	8/19/2021																			
MKE-21-070	MKE-21-070-7.5-8.5-210819	7.5	8.5	8/19/2021	0.0018 U	0.0029 U	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.0024 U	0.0033 U	0.0036 U	0.0015 U	0.2	0.0097 U	0.012 U	0.0089 U	0.01 U	0.018 U	0.018 U	0.0099 U	0.081 U
MKE-21-070	MKE-21-070-G-7.5-8.5-210819	7.5	8.5	8/19/2021																			
MKE-21-071	MKE-21-071-00-01-210819	0	1	8/19/2021	0.022	0.004 U	0.0042 U	0.0019 U	0.005 U	0.0035 U	0.022	0.0046 U	0.005 U	0.0021 U	12	0.022 J	0.067	0.051 J	0.16	0.83	0.94	1.4	0.81
MKE-21-071	MKE-21-071-01-03-210819	1	3	8/19/2021	0.38	0.066	0.005 U	0.0022 U	0.0059 U	0.0041 U	0.31	0.0054 U	0.0059 U	0.0024 U	23.9	0.047 J	0.18	0.11	0.48	1.9	1.8	2.6	1.4
MKE-21-071	MKE-21-071-03-4.8-210819	3	4.8	8/19/2021	0.024	0.0026 U	0.0028 U	0.0012 U	0.0033 U	0.0023 U	0.024	0.003 U	0.0033 U	0.0014 U	0.4	0.0089 U	0.011 U	0.0081 U	0.011 J	0.026 J	0.03 J	0.028 J	0.074 U
MKE-21-071	MKE-21-071-4.8-5.5-210819	4.8	5.5	8/19/2021	0.0019 U	0.003 U	0.0031 U	0.0014 U	0.0037 U	0.0026 U	0.0025 U	0.0034 U	0.0037 U	0.0015 U	0.042 U	0.01 U	0.012 U	0.0091 U	0.011 U	0.019 U	0.018 U	0.01 U	0.083 U
MKE-21-072	MKE-21-072-00-01-210819	0	1	8/19/2021	0.057	0.011 J	0.0036 U	0.0016 U	0.0043 U	0.0029 U	0.046	0.0039 U	0.0043 U	0.0018 U	5.2	0.017 J	0.058	0.041 J	0.13	0.41	0.41	0.48	0.31
MKE-21-072	MKE-21-072-01-03-210819	1	3	8/19/2021	0.31	0.056	0.0047 U	0.0021 U	0.0056 U	0.0039 U	0.25	0.0051 U	0.0056 U	0.0023 U	16.6	0.035 J	0.13	0.081 J	0.32	1.3	1.3	2.1	1.1
MKE-21-072	MKE-21-072-03-3.5-210819	3	3.5	8/19/2021	0.87	0.1	0.0031 U	0.0014 U	0.0037 U	0.0025 U	0.77	0.0034 U	0.0037 U	0.0015 U	11	0.047	0.19	0.065	0.29	0.86	0.75	1	0.57
MKE-21-072	MKE-21-072-3.5-4.4-210819	3.5	4.4	8/19/2021	0.071	0.0095 J	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.061	0.0033 U	0.0036 U	0.0015 U	0.41	0.0097 U	0.012 J	0.0088 U	0.01 U	0.027 J	0.029 J	0.037 J	0.081 U
MKE-21-073	MKE-21-073-00-01-210809	0	1	8/9/2021	0.031	0.0054 U	0.0057 U	0.0026 U	0.0067 U	0.0046 U	0.031	0.0062 U	0.0067 U	0.0028 U	11.2	0.054 U	0.065 U	0.066 J	0.12 J	0.67	0.8	1.4	0.74 J
MKE-21-073	MKE-21-073-01-03-210809	1	3	8/9/2021	2	0.16	0.0056 U	0.0025 U	0.0066 U	0.0045 U	1.8	0.0061 U	0.0065 U	0.0027 U	36.6	0.24	0.25	0.35	0.75	3	2.7	4	2.3
MKE-21-073	MKE-21-073-03-5.1-210809	3	5.1	8/9/2021	0.14	0.018	0.0049 U	0.0022 U	0.0058 U	0.004 U	0.12	0.0053 U	0.0058 U	0.0024 U	29.6	0.25	0.24	0.25	0.66	2.2	2.1	2.8	1.9
MKE-21-074	MKE-21-074-00-01-210809	0	1	8/9/2021	0.098	0.0046 U	0.0049 U	0.0022 U	0.0058 U	0.004 U	0.098	0.0053 U	0.0057 U	0.0024 U	10.7	0.031 U	0.046 J	0.061 J	0.12 J	0.61	0.82	1.2	0.73
MKE-21-074	MKE-21-074-01-2.7-210809	1	2.7	8/9/2021	0.26	0.034	0.0045 U	0.002 U	0.0053 U	0.0037 U	0.23	0.0049 U	0.0053 U	0.0022 U	19.9	0.12	0.15	0.17	0.46	1.5	1.4	2.2	1.3
MKE-21-074	MKE-21-074-2.7-4.3-210809	2.7	4.3	8/9/2021	0.0094	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0094 J	0.0032 U	0.0035 U	0.0015 U	1.1	0.0096 U	0.026 J	0.0087 U	0.064	0.093	0.067	0.081	0.08 U
MKE-21-075	MKE-21-075-00-01-210809	0	1	8/9/2021	0.016	0.0056 U	0.0059 U	0.0026 U	0.0069 U	0.0048 U	0.016 J	0.0064 U	0.0069 U	0.0029 U	8.2	0.038 U	0.06 J	0.057 J	0.12 J	0.49	0.6	1	0.55 J

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PAH										Metals								
				Analyte	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC											110	1.1	130	49	33	5	150	460	
				WI CBSQG PEC 3x											330	3.3	390	147	99	15	450	1380	
				WI CBSQG PEC 5x											550	5.5	650	245	165	25	750	2300	
				TSCA																			
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MKE-21-064	MKE-21-064-00-01-210818	0	1	8/18/2021	0.78	0.5	1.1	0.22	2.1	0.11 J	0.74	0.033 J	0.74	1.7	114 J	0.21	60.1	17.7	5.1	2.6	31.6	156 J	
MKE-21-064	MKE-21-064-01-03-210818	1	3	8/18/2021	1.2	0.78	1.7	0.32	3.2	0.2	1.1	0.1 J	1.5	2.5	263 J	0.68	86.4	27.1	10.7	8.2	47.7	295 J	
MKE-21-064	MKE-21-064-03-05-210818	3	5	8/18/2021	0.97	0.45	1.4	0.27	2.6	0.26	0.89	0.32	1.4	2.4	260	1.1	144	18.9	12.3	1.4	60.1	220	
MKE-21-064	MKE-21-064-05-6.4-210818	5	6.4	8/18/2021	0.47	0.24	0.65	0.13	1.2	0.13	0.4	0.25	0.72	1.3	72.7	0.43	43.1	14.5	5.7	0.3	26.6	82.8	
MKE-21-065	MKE-21-065-00-01-210818	0	1	8/18/2021	0.82	0.4	1.1	0.22	1.9	0.13	0.73	0.19	0.92	1.9	80.1	0.31	56	11.3	5.8	0.86	23.3	102	
MKE-21-065	MKE-21-065-G-00-01-210818	0	1	8/18/2021																			
MKE-21-065	MKE-21-065-01-03-210818	1	3	8/18/2021	0.12	0.062	0.14	0.027 J	0.32	0.032 J	0.1	0.023 J	0.17	0.32	13.5	0.025	7.9	9.1	2.6	0.17	8.8	46	
MKE-21-065	MKE-21-065-G-01-03-210818	1	3	8/18/2021																			
MKE-21-065	MKE-21-065-03-05-210818	3	5	8/18/2021	0.0086 U	0.012 U	0.022 U	0.025 U	0.01 U	0.0078 U	0.02 U	0.0077 U	0.011 U	0.0094 U	25.8	0.012 U	9.2	23.4	4.1	0.11	18.4	61.9	
MKE-21-065	MKE-21-065-G-03-05-210818	3	5	8/18/2021																			
MKE-21-065	MKE-21-065-05-07-210818	5	7	8/18/2021	0.014 U	0.02 U	0.036 U	0.042 U	0.017 U	0.013 U	0.033 U	0.013 U	0.018 U	0.016 U	31.1	0.02 U	21.6	41	12.6	0.43	35.8	135	
MKE-21-065	MKE-21-065-G-05-07-210818	5	7	8/18/2021																			
MKE-21-066	MKE-21-066-00-01-210819	0	1	8/19/2021	0.7	0.36	0.84	0.17	1.4	0.093 J	0.6	0.028 U	0.68	1.3	58.9	0.12	40.8 J	16	4.8	1.1	31.3	133	
MKE-21-066	MKE-21-066-01-03-210819	1	3	8/19/2021	1.3	0.71	1.7	0.31	2.6	0.18	1.1	0.089 J	1.2	2.3	503	0.87 J	159 J	31.4	12	13.5	71.6	432	
MKE-21-066	MKE-21-066-03-05-210819	3	5	8/19/2021	1.5	0.88	2.5	0.47	3.4	0.23	1.3	0.35	1.5	3.4	278	1.7	139 J	23.4	14.4	4.5	67.3	321	
MKE-21-066	MKE-21-066-05-07-210819	5	7	8/19/2021	1.1	0.72	1.9	0.31	2.4	0.27	0.99	0.58	1.7	3.2	222	0.78	85.2 J	15.6	9.1	0.58	41.4	136	
MKE-21-066	MKE-21-066-07-8.2-210819	7	8.2	8/19/2021	0.045	0.022 J	0.037 J	0.026 U	0.084	0.012 J	0.039 J	0.0088 J	0.086	0.096	6	0.013 U	5.1 J	4.3	1.5	0.12	3.9	38.2	
MKE-21-066	MKE-21-066-8.2-8.7-210819	8.2	8.7	8/19/2021	0.0081 U	0.011 U	0.021 U	0.024 U	0.0099 U	0.0074 U	0.019 U	0.0073 U	0.01 U	0.0089 U	12.7	0.011 U	7.2 J	14.7	3.4	0.18	14.3	45.1	
MKE-21-067	MKE-21-067-00-01-210818	0	1	8/18/2021	0.76	0.54	1	0.2	1.8	0.1 J	0.7	0.037 J	0.67	1.6	128	0.17	59.4	19.2	5.8	1.9	44.4	180	
MKE-21-067	MKE-21-067-01-03-210818	1	3	8/18/2021	2.4	1.7	3.6	0.61	6	0.35	2.1	0.17	2.4	5	965	1.5	221	42.2	14.1	21.7	113	657	
MKE-21-067	MKE-21-067-03-05-210818	3	5	8/18/2021	2.5	1.5	4.3	0.78	6.5	0.5	2.4	0.43	2.7	6.1	591	2	213	38.3	30	12.8	105	558	
MKE-21-067	MKE-21-067-05-7.5-210818	5	7.5	8/18/2021	1.4	0.79	2.4	0.42	3.6	0.38	1.3	0.61	1.8	3.8	470	1.5	152	20.4	14.9	0.92	62.6	229	
MKE-21-067	MKE-21-067-7.7-9.7-210818	7.7	9.7	8/18/2021	0.014 J	0.012 U	0.022 J	0.025 U	0.019 J	0.0077 U	0.02 U	0.0077 U	0.017 J	0.023 J	25.2	0.013 U	8.7	24.6	3.7	0.087	14.9	45.7	
MKE-21-068	MKE-21-068-00-01-210818	0	1	8/18/2021	1	0.55	1.3	0.28 J	2.4	0.15 J	0.98	0.056 U	0.96	2	75.9	0.13	51.7	12.5	3.7	1.2	30.2	134	
MKE-21-068	MKE-21-068-01-03-210818	1	3	8/18/2021	2.9	1.7	4.5	0.82	8.5	0.49	2.7	0.23 J	3.9	6.7	787	2.3	229	45.3	19.5	23.7	117	666	
MKE-21-068	MKE-21-068-03-05-210818	3	5	8/18/2021	3.1	2	5.9	0.8	9.2	1	2.4	0.63	6.7	9.9	701	2	230	40	25.3	15.8	116	563	
MKE-21-068	MKE-21-068-05-06-210818	5	6	8/18/2021	3.5	2.4	7.7	0.87	10	1.1	3	1.1	6.4	12	351	4.1	256	22	18.1	1.6	99.3	419	
MKE-21-068	MKE-21-068-06-7.2-210818	6	7.2	8/18/2021	0.039 J	0.022 U	0.065 J	0.047 U	0.088	0.014 U	0.037 U	0.014 U	0.07 J	0.096	34.4	0.023 U	17.6	33.6	8.7	0.5	30.7	150	
MKE-21-069	MKE-21-069-00-01-210817	0	1	8/17/2021	4.3	2.8	7.6	1.1	14	0.79	4	0.23	7.3	11	302	0.63	150 J	24.8	8	7.6	56.2	294	
MKE-21-069	MKE-21-069-01-03-210817	1	3	8/17/2021	3.1	1.9	6.4	0.77	9	0.93	2.8	0.43	6.5	9	530	2.3	204 J	39.4	20.4	18	103	534	
MKE-21-069	MKE-21-069-03-4.8-210817	3	4.8	8/17/2021	3.2	1.8	6.5	0.86	9.9	1.4	2.6	1.3	8.7	11	324	3	244 J	21.3	18.2	3	95.6	433	
MKE-21-069	MKE-21-069-4.8-5.6-210817	4.8	5.6	8/17/2021	0.023 J	0.015 J	0.05	0.024 U	0.1	0.041	0.022 J	0.023 J	0.14	0.1	12.9	0.021	8.4 J	12.1	4	0.099	14.6	39.5	
MKE-21-069	MKE-21-069-5.6-7.2-210817	5.6	7.2	8/17/2021	0.0081 U	0.011 U	0.021 U	0.024 U	0.0099 U	0.0074 U	0.019 U	0.0073 U	0.01 U	0.0089 U	17.4	0.011 U	8.2	16.2	3.2	0.2	14.8	54.5	
MKE-21-070	MKE-21-070-00-1.2-210819	0	1.2	8/19/2021	0.58	0.33	0.9	0.14	1.6	0.16	0.49	0.079	1.1	1.4	31.8	0.12	44.3 J	8.2	3.1	0.71	16	84.9	
MKE-21-070	MKE-21-070-G-00-1.2-210819	0	1.2	8/19/2021																			
MKE-21-070	MKE-21-070-1.2-1.8-210819	1.2	1.8	8/19/2021	1.5	0.62	2.1	0.33	3.8	0.29	1.2	0.078 J	2.2	3.3	45.6	0.14	47.7 J	9.5	3.4	0.98	23.9	114	
MKE-21-070	MKE-21-070-1.8-3.2-210819	1.8	3.2	8/19/2021	5	3.5	7.9	1.3	18	1.5	4.5	0.33	12	14	169	0.31	142 J	17.6	5.9	3.5	44.5	219	
MKE-21-070	MKE-21-070-G-1.8-3.2-210819	1.8	3.2	8/19/2021																			
MKE-21-070	MKE-21-070-3.2-5.2-210819	3.2	5.2	8/19/2021	1.4	0.9	2.2	0.39	3.4	0.34	1.2	0.15	2.2	3.2	557	1.1	136 J	32.1	11.3	15.7	78.5	499	
MKE-21-070	MKE-21-070-G-3.2-5.2-210819	3.2	5.2	8/19/2021																			
MKE-21-070	MKE-21-070-5.2-6.2-210819	5.2	6.2	8/19/2021	1.4	0.9	2.2	0.37	3.2	0.36	1.1	0.15	2.3	3	526	0.88	131 J	25.6	11.7	10.8	69.9	453	
MKE-21-070	MKE-21-070-G-5.2-6.2-210819	5.2	6.2	8/19/2021																			
MKE-21-070	MKE-21-070-6.2-7.5-210819	6.2	7.5	8/19/2021	0.89	0.59	1.4	0.18	2.6	0.24	0.75	0.1	2	2.4	76.8	0.2	44.1 J	12.3	5	2.2	21.4	132	
MKE-21-070	MKE-21-070-G-6.2-7.5-210819	6.2	7.5	8/19/2021																			
MKE-21-070	MKE-21-070-7.5-8.5-210819	7.5	8.5	8/19/2021	0.0087 U	0.012 U	0.022 U	0.026 U	0.021 J	0.0079 U	0.02 U	0.0079 U	0.024 J	0.023 J	23.1	0.012 U	8.5 J	22.7	3	0.12	20.4	41.3	
MKE-21-070	MKE-21-070-G-7.5-8.5-210819	7.5	8.5	8/19/2021																			
MKE-21-071	MKE-21-071-00-01-210819	0	1	8/19/2021	0.88	0.55	1.1	0.19	1.7	0.088	0.86	0.04 J	0.73	1.6	78.5	0.19	55.9 J	13.4	4.4	1.7	32.6	138	
MKE-21-071	MKE-21-071-01-03-210819	1	3	8/19/2021	1.5	0.89	2.1	0.36	3.7	0.2	1.5	0.069	1.8	3.3	556	0.46	203 J	33	9.5	10.8	76.2	371	
MKE-21-071	MKE-21-071-03-4.8-210819	3	4.8	8/19/2021	0.026 J	0.028 J	0.036 J	0.024 U	0.039	0.0073 U	0.019 U	0.0072 U	0.051	0.042	9.2 J	0.012 U	6.9	11.3	3.7	0.12	10.4	27.2	
MKE-21-071	MKE-21-071-4.8-5.5-210819	4.8	5.5	8/19/2021	0.009 U	0.012 U	0.023 U	0.027 U	0.011 U	0.0082 U	0.021 U	0.0081 U	0.011 U	0.0099 U	21.3 J	0.012 U	8.3	22.5	3	0.077	19.1	36.5	
MKE-21-072	MKE-21-072-00-01-210819	0	1	8/19/2021	0.34	0.23	0.48	0.069	0.67	0.054	0.29	0.04 J	0.45	0.73	54.7 J	0.12	36.6	9.8	3	1.3	20.9	94.4	
MKE-21-072	MKE-21-072-01-03-210819	1	3	8/19/2021	0.92	0.49	1.5	0.24	2.4	0.15	0.91	0.06 J	1.2	2.4	298 J	0.34	106	21.5	6.8	5	52	253	
MKE-21-072	MKE-21-072-03-3.5-210819	3	3.5	8/19/2021	0.53	0.32	0.98	0.15	1.7	0.2	0.48	0.056	1.2	1.6	84.2 J	0.13	29.9	25.5	6.1	2.5	24.4	105	
MKE-21-072	MKE-21-072-3.5-4.4-210819	3.5	4.4	8/19/2021	0.0087 U	0.018 J	0.044	0.026 U	0.047	0.0079 U	0.02 U	0.0079 U	0.043	0.061	59.2 J	0.054	22.7	16.8	4.3	1.7	19	86.2	
MKE-21-073	MKE-21-073-00-01-210809	0	1	8/9/2021	0.92	0.53	1.1	0.24	1.7	0.082 J	0.78	0.044 U	0.59	1.4	86.2	0.14	67.4	14.8	4.5	1.7	38.4	187	
MKE-21-073	MKE-21-073-01-03-210809	1	3	8/9/2021	2.2	1.2	3.7	0.72	5.3	0.34	1.9	0.23	2.5	4.9	1270	2.1	250	54.2	20.2	39.8	163	998	
MKE-21-073	MKE-21-073-03-5.1-210809	3	5.1	8/9/2021	1.8	1.3	3	0.48	4.4	0.38	1.4	0.21	2.3	3.9	973	1.9	212	37.2	21.3	24	116	810	
MKE-21-074	MKE-21-074-00-01-210809	0	1	8/9/2021	0.82	0.56	0.99	0.23	1.7	0.078 J	0.78	0.035 J	0.6	1.3	93.3	0.18	56	13	3.8	2	33.7	155	
MKE-21-074	MKE-21-074-01-2.7-210809	1	2.7	8/9/2021	1.1	0.7	1.9	0.31	3.2	0.25	0.96	0.12	1.5	2.6	492	0.86	126	25.2	10.9	11.5	67.8	398	
MKE-21-074	MKE-21-074-2.7-4.3-210809	2.7	4.3	8/9/2021	0.052	0.029 J	0.095	0.026 U	0.17	0.01 J	0.042	0.0078 U	0.17	0.17	15	0.013 U	7.3	10	2.7	0.29	9.1	40.4	
MKE-21-075	MKE-21-075-00-01-210809	0	1	8/9/2021	0.72	0.32	0.77	0.14 J	1.1	0.072 J	0.6	0.032 J	0.51	1	63.1	0.12	57.3	14.9	4.4	1.2	33.5	171	

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibility Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	Metals																Physical Parameters							
				Analyte	Barium	Selenium	Aluminum	Iron	Manganese	Potassium	Sodium	Thallium	Antimony	Beryllium	Cobalt	Calcium	Cyanide	Magnesium	Vanadium	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
				WI CBSQG PEC				40000	1100				25															
				WI CBSQG PEC 3x				120000	3300				75															
				WI CBSQG PEC 5x				200000	5500				125															
				TSCA																								
Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Barium mg/kg	Selenium mg/kg	Aluminum mg/kg	Iron mg/kg	Manganese mg/kg	Potassium mg/kg	Sodium mg/kg	Thallium mg/kg	Antimony mg/kg	Beryllium mg/kg	Cobalt mg/kg	Calcium mg/kg	Cyanide mg/kg	Magnesium mg/kg	Vanadium mg/kg	TOC mg/kg	Gravel %	Sand %	Coarse Sand %	Medium Sand %	Fine Sand %	Silt %	Clay %	Fines %
MKE-21-064	MKE-21-064-00-01-210818	0	1	8/18/2021																28500								
MKE-21-064	MKE-21-064-01-03-210818	1	3	8/18/2021																39000								
MKE-21-064	MKE-21-064-03-05-210818	3	5	8/18/2021																51100								
MKE-21-064	MKE-21-064-05-6.4-210818	5	6.4	8/18/2021																41600 J								
MKE-21-065	MKE-21-065-00-01-210818	0	1	8/18/2021																48900								
MKE-21-065	MKE-21-065-G-00-01-210818	0	1	8/18/2021																	0 U	38.1	0 U	1.8	36.3	51	10.9	61.9
MKE-21-065	MKE-21-065-01-03-210818	1	3	8/18/2021																25900								
MKE-21-065	MKE-21-065-G-01-03-210818	1	3	8/18/2021																	0 U	29.8	0 U	0.5	29.3	55	15.2	70.2
MKE-21-065	MKE-21-065-03-05-210818	3	5	8/18/2021																22100 J								
MKE-21-065	MKE-21-065-G-03-05-210818	3	5	8/18/2021																	1.8	23.7	2.2	7.6	13.9	35.4	39.1	74.5
MKE-21-065	MKE-21-065-05-07-210818	5	7	8/18/2021																50400 J								
MKE-21-065	MKE-21-065-G-05-07-210818	5	7	8/18/2021																	0 U	19.2	2.3	6.1	10.8	42.1	38.7	80.8
MKE-21-066	MKE-21-066-00-01-210819	0	1	8/19/2021																31900								
MKE-21-066	MKE-21-066-01-03-210819	1	3	8/19/2021																32400								
MKE-21-066	MKE-21-066-03-05-210819	3	5	8/19/2021																35500								
MKE-21-066	MKE-21-066-05-07-210819	5	7	8/19/2021																40500								
MKE-21-066	MKE-21-066-07-8.2-210819	7	8.2	8/19/2021																18600 J								
MKE-21-066	MKE-21-066-8.2-8.7-210819	8.2	8.7	8/19/2021																22900								
MKE-21-067	MKE-21-067-00-01-210818	0	1	8/18/2021																50200 J								
MKE-21-067	MKE-21-067-01-03-210818	1	3	8/18/2021																44900 J								
MKE-21-067	MKE-21-067-03-05-210818	3	5	8/18/2021																57800 J								
MKE-21-067	MKE-21-067-05-7.5-210818	5	7.5	8/18/2021																55100 J								
MKE-21-067	MKE-21-067-7.7-9.7-210818	7.7	9.7	8/18/2021																26600 J-								
MKE-21-068	MKE-21-068-00-01-210818	0	1	8/18/2021																36900								
MKE-21-068	MKE-21-068-01-03-210818	1	3	8/18/2021																44400 J								
MKE-21-068	MKE-21-068-03-05-210818	3	5	8/18/2021																54400 J								
MKE-21-068	MKE-21-068-05-06-210818	5	6	8/18/2021																63200 J								
MKE-21-068	MKE-21-068-06-7.2-210818	6	7.2	8/18/2021																36800 J								
MKE-21-069	MKE-21-069-00-01-210817	0	1	8/17/2021																55500 J-								
MKE-21-069	MKE-21-069-01-03-210817	1	3	8/17/2021																60600 J-								
MKE-21-069	MKE-21-069-03-4.8-210817	3	4.8	8/17/2021																66000 J-								
MKE-21-069	MKE-21-069-4.8-5.6-210817	4.8	5.6	8/17/2021																34400 J-								
MKE-21-069	MKE-21-069-5.6-7.2-210817	5.6	7.2	8/17/2021																31000 J-								
MKE-21-070	MKE-21-070-00-1.2-210819	0	1.2	8/19/2021																31500								
MKE-21-070	MKE-21-070-G-00-1.2-210819	0	1.2	8/19/2021																	4	67.2	2	3.3	61.9	19.3	9.5	28.8
MKE-21-070	MKE-21-070-1.2-1.8-210819	1.2	1.8	8/19/2021																37100								
MKE-21-070	MKE-21-070-1.8-3.2-210819	1.8	3.2	8/19/2021																62500								
MKE-21-070	MKE-21-070-G-1.8-3.2-210819	1.8	3.2	8/19/2021																	0.7	46.3	1.2	2.9	42.2	41.6	11.4	53
MKE-21-070	MKE-21-070-3.2-5.2-210819	3.2	5.2	8/19/2021																37300								
MKE-21-070	MKE-21-070-G-3.2-5.2-210819	3.2	5.2	8/19/2021																	0 U	30.6	0 U	2.3	28.3	46.9	22.5	69.4
MKE-21-070	MKE-21-070-5.2-6.2-210819	5.2	6.2	8/19/2021																46400								
MKE-21-070	MKE-21-070-G-5.2-6.2-210819	5.2	6.2	8/19/2021																	1.2	26.3	0.4	1.6	24.3	48.7	23.8	72.5
MKE-21-070	MKE-21-070-6.2-7.5-210819	6.2	7.5	8/19/2021																30200								
MKE-21-070	MKE-21-070-G-6.2-7.5-210819	6.2	7.5	8/19/2021																	0.1	61	0.2	1.7	59.1	29.5	9.4	38.9
MKE-21-070	MKE-21-070-7.5-8.5-210819	7.5	8.5	8/19/2021																21900								
MKE-21-070	MKE-21-070-G-7.5-8.5-210819	7.5	8.5	8/19/2021																	0 U	6.6	0 U	0.5	6.1	50.4	43	93.4
MKE-21-071	MKE-21-071-00-01-210819	0	1	8/19/2021																37600								
MKE-21-071	MKE-21-071-01-03-210819	1	3	8/19/2021																34900								
MKE-21-071	MKE-21-071-03-4.8-210819	3	4.8	8/19/2021																17200								
MKE-21-071	MKE-21-071-4.8-5.5-210819	4.8	5.5	8/19/2021																31300								
MKE-21-072	MKE-21-072-00-01-210819	0	1	8/19/2021																57500								
MKE-21-072	MKE-21-072-01-03-210819	1	3	8/19/2021																34000								
MKE-21-072	MKE-21-072-03-3.5-210819	3	3.5	8/19/2021																19600								
MKE-21-072	MKE-21-072-3.5-4.4-210819	3.5	4.4	8/19/2021																23800								
MKE-21-073	MKE-21-073-00-01-210809	0	1	8/9/2021																91800								
MKE-21-073	MKE-21-073-01-03-210809	1	3	8/9/2021																49200								
MKE-21-073	MKE-21-073-03-5.1-210809	3	5.1	8/9/2021																56000								
MKE-21-074	MKE-21-074-00-01-210809	0	1	8/9/2021																49700								
MKE-21-074	MKE-21-074-01-2.7-210809	1	2.7	8/9/2021																44100								
MKE-21-074	MKE-21-074-2.7-4.3-210809	2.7	4.3	8/9/2021																42100								
MKE-21-075	MKE-21-075-00-01-210809	0	1	8/9/2021																43300								

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	PCB										PAH								
				Analyte	Total PCB	Aroclor 1260	Aroclor 1254	Aroclor 1268	Aroclor 1221	Aroclor 1232	Aroclor 1248	Aroclor 1016	Aroclor 1262	Aroclor 1242	Total PAH	2-Methyl naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b)-fluoranthene	Benzo(e) pyrene
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC	1										22.8								
				WI CBSQG PEC 3x	3										68.4								
				WI CBSQG PEC 5x	5										114								
				TSCA	50																		
Location code	**Sample ID**	**Start Depth (ft)**	**End Depth (ft)**	**Date**	**Total PCB mg/kg**	**Aroclor 1260 mg/kg**	**Aroclor 1254 mg/kg**	**Aroclor 1268 mg/kg**	**Aroclor 1221 mg/kg**	**Aroclor 1232 mg/kg**	**Aroclor 1248 mg/kg**	**Aroclor 1016 mg/kg**	**Aroclor 1262 mg/kg**	**Aroclor 1242 mg/kg**	**Total PAH mg/kg**	**2-Methyl naphthalene mg/kg**	**Acenaphthene mg/kg**	**Acenaphthylene mg/kg**	**Anthracene mg/kg**	**Benzo(a) anthracene mg/kg**	**Benzo(a) pyrene mg/kg**	**Benzo(b)-fluoranthene mg/kg**	**Benzo(e) pyrene mg/kg**
MKE-21-075	MKE-21-075-01-03-210809	1	3	8/9/2021	**0.13**	0.0041 U	0.0043 U	0.0019 U	0.0051 U	0.0035 U	**0.13**	0.0047 U	0.0051 U	0.0021 U	**23.3**	**0.076 J**	**0.19**	**0.086 J**	**0.43**	**1.6**	**1.7**	**2.5**	**1.3**
MKE-21-075	MKE-21-075-03-05-210809	3	5	8/9/2021	**0.083**	0.0029 U	0.003 U	0.0014 U	0.0036 U	0.0024 U	**0.083**	0.0033 U	0.0035 U	0.0015 U	**3.8**	0.0096 U	**0.12**	0.0087 U	**0.29**	**0.28**	**0.19**	**0.21**	**0.11 J**
MKE-21-076	MKE-21-076-00-01-210817	0	1	8/17/2021	**0.38**	**0.052**	0.0046 U	0.0021 U	0.0055 U	0.0038 U	**0.33**	0.005 U	0.0054 U	0.0023 U	**29.2**	**0.058 J**	**0.22**	**0.17**	**0.57**	**2.2**	**2.2**	**3.2**	**1.7**
MKE-21-076	MKE-21-076-G-00-01-210817	0	1	8/17/2021																			
MKE-21-076	MKE-21-076-01-2.3-210817	1	2.3	8/17/2021	**0.32**	**0.039**	0.0039 U	0.0018 U	0.0047 U	0.0032 U	0.0032 U	0.0043 U	0.0046 U	**0.28**	**23.8**	**0.099**	**0.21**	**0.15**	**0.54**	**2.1**	**1.8**	**2.6**	**1.4**
MKE-21-076	MKE-21-076-G-01-2.3-210817	1	2.3	8/17/2021																			
MKE-21-076	MKE-21-076-2.3-3.3-210817	2.3	3.3	8/17/2021	**0.063**	**0.012**	0.0029 U	0.0013 U	0.0034 U	0.0024 U	**0.051**	0.0031 U	0.0034 U	0.0014 U	**1.8**	0.0092 U	**0.084**	**0.02 J**	**0.094**	**0.12**	**0.1**	**0.12**	**0.077 J**
MKE-21-076	MKE-21-076-G-2.3-3.3-210817	2.3	3.3	8/17/2021																			
MKE-21-076	MKE-21-076-3.3-4.4-210817	3.3	4.4	8/17/2021	0.0018 U	0.0029 U	0.0031 U	0.0014 U	0.0036 U	0.0025 U	0.0025 U	0.0033 U	0.0036 U	0.0015 U	**0.16**	0.0099 U	0.012 U	0.0091 U	0.011 U	0.019 U	0.018 U	0.01 U	0.083 U
MKE-21-076	MKE-21-076-G-3.3-4.4-210817	3.3	4.4	8/17/2021																			
MKE-21-077	MKE-21-077-00-01-210817	0	1	8/17/2021	**0.71**	**0.12**	0.0049 U	0.0022 U	0.0058 U	0.004 U	**0.59**	0.0053 U	0.0057 U	0.0024 U	**34.4**	**0.18**	**0.28**	**0.3**	**0.68**	**2.9**	**2.6**	**3.5**	**2**
MKE-21-077	MKE-21-077-01-03-210817	1	3	8/17/2021	**0.2**	**0.031**	0.0032 U	0.0014 U	0.0038 U	0.0026 U	**0.17**	0.0035 U	0.0038 U	0.0016 U	**3.6**	**0.027 J**	**0.052**	**0.031 J**	**0.12**	**0.3**	**0.25**	**0.3**	**0.19 J**
MKE-21-077	MKE-21-077-03-05-210817	3	5	8/17/2021	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	**1.7**	**0.016 J**	**0.06**	**0.017 J**	**0.085**	**0.14**	**0.096**	**0.11**	0.08 U
MKE-21-077	MKE-21-077-05-07-210817	5	7	8/17/2021	0.0021 U	0.0034 U	0.0036 U	0.0016 U	0.0042 U	0.0029 U	0.0029 U	0.0039 U	0.0042 U	0.0018 U	0.048 U	0.011 U	0.014 U	0.01 U	0.012 U	0.021 U	0.021 U	0.012 U	0.095 U
MKE-21-077	MKE-21-077-07-09-210817	7	9	8/17/2021	0.0021 U	0.0033 U	0.0035 U	0.0016 U	0.0041 U	0.0028 U	0.0028 U	0.0038 U	0.0041 U	0.0017 U	0.047 U	0.011 U	0.013 U	0.01 U	0.012 U	0.021 U	0.02 U	0.011 U	0.093 U
MKE-21-077	MKE-21-077-09-11-210817	9	11	8/17/2021	0.0023 U	0.0037 U	0.0039 U	0.0017 U	0.0046 U	0.0032 U	0.0031 U	0.0042 U	0.0046 U	0.0019 U	0.05 U	0.013 U	0.015 U	0.011 U	0.014 U	0.024 U	0.023 U	0.013 U	0.1 U
MKE-21-077	MKE-21-077-11-13-210817	11	13	8/17/2021	0.0021 U	0.0034 U	0.0036 U	0.0016 U	0.0042 U	0.0029 U	0.0029 U	0.0039 U	0.0042 U	0.0017 U	0.048 U	0.011 U	0.014 U	0.01 U	0.012 U	0.022 U	0.021 U	0.012 U	0.096 U
MKE-21-077	MKE-21-077-13-14.2-210817	13	14	8/17/2021	0.002 U	0.0032 U	0.0034 U	0.0015 U	0.004 U	0.0027 U	0.0027 U	0.0037 U	0.004 U	0.0016 U	0.045 U	0.011 U	0.013 U	0.0099 U	0.012 U	0.02 U	0.02 U	0.011 U	0.09 U
MKE-21-078	MKE-21-078-00-01-210817	0	1	8/17/2021	**0.51**	**0.07**	0.0045 U	0.002 U	0.0053 U	0.0037 U	**0.44**	0.0049 U	0.0053 U	0.0022 U	**21.8**	**0.055 J**	**0.2**	**0.11**	**0.46**	**1.8**	**1.6**	**2.2**	**1.2**
MKE-21-078	MKE-21-078-01-03-210817	1	3	8/17/2021	**0.062**	**0.012 J**	0.005 U	0.0022 U	0.0059 U	0.004 U	**0.05**	0.0054 U	0.0058 U	0.0024 U	**23.1**	**0.13**	**0.18**	**0.16**	**0.52**	**1.9**	**1.7**	**2.3**	**1.4**
MKE-21-078	MKE-21-078-03-05-210817	3	5	8/17/2021	**0.042**	**0.0088 J**	0.0049 U	0.0022 U	0.0058 U	0.004 U	**0.033**	0.0053 U	0.0057 U	0.0024 U	**18.9**	**0.11 J**	**0.15**	**0.24**	**0.38**	**1.4**	**1.4**	**1.9**	**1.2**
MKE-21-078	MKE-21-078-05-07-210817	5	7	8/17/2021	0.002 U	0.0032 U	0.0034 U	0.0015 U	0.004 U	0.0027 U	0.0027 U	0.0036 U	0.0039 U	0.0016 U	**2.7**	**0.032 J**	**0.032 J**	**0.044 J**	**0.082**	**0.22**	**0.17**	**0.23**	**0.14 J**
MKE-21-078	MKE-21-078-07-8.7-210817	7	8.7	8/17/2021	0.0018 U	0.0028 U	0.003 U	0.0013 U	0.0035 U	0.0024 U	0.0024 U	0.0032 U	0.0035 U	0.0014 U	**0.24**	0.0094 U	0.011 U	0.0086 U	0.01 U	0.018 U	0.017 U	**0.018 J**	0.078 U
MKE-21-078	MKE-21-078-8.7-10.7-210817	8.7	10.7	8/17/2021	0.0017 U	0.0027 U	0.0029 U	0.0013 U	0.0034 U	0.0023 U	0.0023 U	0.0031 U	0.0034 U	0.0014 U	0.038 U	0.0091 U	0.011 U	0.0083 U	0.0099 U	0.017 U	0.016 U	0.0093 U	0.076 U
MKE-21-078	MKE-21-078-10.7-12.7-210817	10.7	12.7	8/17/2021	0.0017 U	0.0027 U	0.0029 U	0.0013 U	0.0034 U	0.0023 U	0.0023 U	0.0031 U	0.0034 U	0.0014 U	0.038 U	0.0091 U	0.011 U	0.0083 U	0.0099 U	0.017 U	0.017 U	0.0094 U	0.076 U
MKE-21-078	MKE-21-078-12.7-14.7-210817	12.7	14.7	8/17/2021	0.0017 U	0.0028 U	0.0029 U	0.0013 U	0.0034 U	0.0024 U	0.0023 U	0.0032 U	0.0034 U	0.0014 U	0.039 U	0.0092 U	0.011 U	0.0084 U	0.01 U	0.017 U	0.017 U	0.0095 U	0.077 U
MKE-21-078	MKE-21-078-14.7-15.7-210817	14.7	15.7	8/17/2021	0.0017 U	0.0026 U	0.0028 U	0.0012 U	0.0033 U	0.0022 U	0.0022 U	0.003 U	0.0032 U	0.0014 U	0.037 U	0.0089 U	0.011 U	0.0081 U	0.0096 U	0.017 U	0.016 U	0.0091 U	0.074 U
MKEBAY21-GT4	MKEBAY21-GT4-5.0/8.7	5	9	11/3/2021																			

Appendix A

Milwaukee Bay Sediment Analytical Results Summary

Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

Location code	Sample ID	Start Depth (ft)	End Depth (ft)	Date	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene
				Analyte Group	PAH									
				Analyte	Benzo(g,h,i) perylene	Benzo(k) fluoranthene	Chrysene	Dibenzo(a,h) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-Cd)Pyrene	Naphthalene	Phenanthrene	Pyrene
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
				WI CBSQG PEC										
				WI CBSQG PEC 3x										
				WI CBSQG PEC 5x										
				TSCA										
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MKE-21-075	MKE-21-075-01-03-210809	1	3	8/9/2021	1.3	1	2.3	0.21	3.8	0.26	1.1	0.094 J	2.3	3.1
MKE-21-075	MKE-21-075-03-05-210809	3	5	8/9/2021	0.093	0.1	0.26	0.032 J	0.6	0.034 J	0.095	0.0078 U	0.86	0.56
MKE-21-076	MKE-21-076-00-01-210817	0	1	8/17/2021	1.8	0.85	2.7	0.4	4.8	0.28	1.6	0.13	2.3	4
MKE-21-076	MKE-21-076-G-00-01-210817	0	1	8/17/2021										
MKE-21-076	MKE-21-076-01-2.3-210817	1	2.3	8/17/2021	1.4	0.88	2.3	0.36	3.3	0.25	1.2	0.2	1.9	3.1
MKE-21-076	MKE-21-076-G-01-2.3-210817	1	2.3	8/17/2021										
MKE-21-076	MKE-21-076-2.3-3.3-210817	2.3	3.3	8/17/2021	0.075	0.044	0.13	0.025 U	0.24	0.056	0.064	0.013 J	0.3	0.23
MKE-21-076	MKE-21-076-G-2.3-3.3-210817	2.3	3.3	8/17/2021										
MKE-21-076	MKE-21-076-3.3-4.4-210817	3.3	4.4	8/17/2021	0.0089 U	0.012 U	0.023 U	0.027 U	0.011 U	0.0081 U	0.021 U	0.0081 U	0.013 J	0.0098 U
MKE-21-076	MKE-21-076-G-3.3-4.4-210817	3.3	4.4	8/17/2021										
MKE-21-077	MKE-21-077-00-01-210817	0	1	8/17/2021	2.1	1.4	3.4	0.55	5.1	0.35	1.7	0.35	2.5	4.5
MKE-21-077	MKE-21-077-01-03-210817	1	3	8/17/2021	0.23	0.16	0.34	0.064	0.45	0.048	0.18	0.063	0.31	0.47
MKE-21-077	MKE-21-077-03-05-210817	3	5	8/17/2021	0.07	0.046	0.12	0.026 U	0.22	0.047	0.059	0.053	0.29	0.26
MKE-21-077	MKE-21-077-05-07-210817	5	7	8/17/2021	0.01 U	0.014 U	0.026 U	0.03 U	0.013 U	0.0094 U	0.024 U	0.0093 U	0.013 U	0.011 U
MKE-21-077	MKE-21-077-07-09-210817	7	9	8/17/2021	0.01 U	0.014 U	0.026 U	0.03 U	0.012 U	0.0091 U	0.023 U	0.009 U	0.012 U	0.011 U
MKE-21-077	MKE-21-077-09-11-210817	9	11	8/17/2021	0.011 U	0.016 U	0.029 U	0.034 U	0.014 U	0.01 U	0.026 U	0.01 U	0.014 U	0.012 U
MKE-21-077	MKE-21-077-11-13-210817	11	13	8/17/2021	0.01 U	0.014 U	0.026 U	0.031 U	0.013 U	0.0094 U	0.024 U	0.0093 U	0.013 U	0.011 U
MKE-21-077	MKE-21-077-13-14.2-210817	13	14	8/17/2021	0.0097 U	0.014 U	0.025 U	0.029 U	0.012 U	0.0089 U	0.022 U	0.0088 U	0.012 U	0.011 U
MKE-21-078	MKE-21-078-00-01-210817	0	1	8/17/2021	1.3	0.81	2	0.35	3.2	0.22	1.2	0.14	1.9	3.1
MKE-21-078	MKE-21-078-01-03-210817	1	3	8/17/2021	1.4	0.83	2.3	0.38	3.3	0.22	1.3	0.22	1.9	3
MKE-21-078	MKE-21-078-03-05-210817	3	5	8/17/2021	1.1	0.66	1.8	0.28	3	0.2	0.95	0.25	1.3	2.6
MKE-21-078	MKE-21-078-05-07-210817	5	7	8/17/2021	0.14	0.087	0.25	0.035 J	0.44	0.046	0.1	0.075	0.22	0.4
MKE-21-078	MKE-21-078-07-8.7-210817	7	8.7	8/17/2021	0.011 J	0.012 U	0.023 J	0.025 U	0.027 J	0.0077 U	0.019 U	0.0076 U	0.017 J	0.03 J
MKE-21-078	MKE-21-078-8.7-10.7-210817	8.7	10.7	8/17/2021	0.0082 U	0.011 U	0.021 U	0.024 U	0.01 U	0.0075 U	0.019 U	0.0074 U	0.01 U	0.009 U
MKE-21-078	MKE-21-078-10.7-12.7-210817	10.7	12.7	8/17/2021	0.0082 U	0.011 U	0.021 U	0.024 U	0.01 U	0.0075 U	0.019 U	0.0074 U	0.01 U	0.009 U
MKE-21-078	MKE-21-078-12.7-14.7-210817	12.7	14.7	8/17/2021	0.0083 U	0.012 U	0.021 U	0.025 U	0.01 U	0.0076 U	0.019 U	0.0075 U	0.01 U	0.0091 U
MKE-21-078	MKE-21-078-14.7-15.7-210817	14.7	15.7	8/17/2021	0.008 U	0.011 U	0.02 U	0.024 U	0.0097 U	0.0073 U	0.018 U	0.0072 U	0.0099 U	0.0088 U
MKEBAY21-GT4	MKEBAY21-GT4-5.0/8.7	5	9	11/3/2021										

Location code	Sample ID	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
	Analyte Group	Metals								
	Analyte	Chromium	Mercury	Lead	Nickel	Arsenic	Cadmium	Copper	Zinc	Silver
	Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	WI CBSQG PEC	110	1.1	130	49	33	5	150	460	
	WI CBSQG PEC 3x	330	3.3	390	147	99	15	450	1380	
	WI CBSQG PEC 5x	550	5.5	650	245	165	25	750	2300	
	TSCA									
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
MKE-21-075	MKE-21-075-01-03-210809	373	0.71	114	22.1	8.9	9.8	163	339	
MKE-21-075	MKE-21-075-03-05-210809	15	0.013 U	8.9	8.5	2.6	1	17	42.1	
MKE-21-076	MKE-21-076-00-01-210817	255	0.31	97.4 J	20.3	5.2	5.3	47.5	224	
MKE-21-076	MKE-21-076-G-00-01-210817									
MKE-21-076	MKE-21-076-01-2.3-210817	317	0.66	94.7 J	22.3	8.5	8.8	50.4	273	
MKE-21-076	MKE-21-076-G-01-2.3-210817									
MKE-21-076	MKE-21-076-2.3-3.3-210817	8.4	0.04	6.7 J	4.3	1.6	0.16	4.8	33.9	
MKE-21-076	MKE-21-076-G-2.3-3.3-210817									
MKE-21-076	MKE-21-076-3.3-4.4-210817	19.6	0.013 U	8.5 J	21.3	4 J	0.12	17.3	42.1	
MKE-21-076	MKE-21-076-G-3.3-4.4-210817									
MKE-21-077	MKE-21-077-00-01-210817	572	0.99	150 J	34	10	13.1	81	422	
MKE-21-077	MKE-21-077-01-03-210817	69.2	0.14	25.4 J	9.7	3.1	1.5	19.6	68.4	
MKE-21-077	MKE-21-077-03-05-210817	6.5	0.012 J	8.6 J	5.3	1.7	0.091	6.2	27.9	
MKE-21-077	MKE-21-077-05-07-210817	14.7	0.014 U	6.6 J	15.3	2.1	0.14	12.9	38.6	
MKE-21-077	MKE-21-077-07-09-210817	13.4	0.014 U	6.1 J	14	1.8	0.16	12	41.8	
MKE-21-077	MKE-21-077-09-11-210817	13.7	0.017 U	6.3 J	14.3	1.8	0.19	12	45	
MKE-21-077	MKE-21-077-11-13-210817	19.9	0.015 U	8 J	19.3	2.2	0.15	15.1	44.9	
MKE-21-077	MKE-21-077-13-14.2-210817	20	0.013 U	8 J	19.7	2.7	0.11	15.8	41.8	
MKE-21-078	MKE-21-078-00-01-210817	218	0.35 J	71.6	20.2	6.3	4.7	34.8	191	
MKE-21-078	MKE-21-078-01-03-210817	475	1.1 J	130	33.2	13.1	11.9	68.3	413	
MKE-21-078	MKE-21-078-03-05-210817	352	0.78 J	110	32.7	14.7	7.9	64.5	329	
MKE-21-078	MKE-21-078-05-07-210817	48.9	0.15 J	27.3	15.2	7.9	0.95	25.9	135	
MKE-21-078	MKE-21-078-07-8.7-210817	13.4	0.013 J	12	13	4.8	0.25	21.3	61	
MKE-21-078	MKE-21-078-8.7-10.7-210817	11.7	0.011 U	10.5	13.6	5	0.16	15.5	55.3	
MKE-21-078	MKE-21-078-10.7-12.7-210817	11.3	0.012 U	7.5	12.8	3.8	0.17	12.4	56.5	
MKE-21-078	MKE-21-078-12.7-14.7-210817	10.9	0.012 U	7.7	12.3	3.8	0.13	12.3	44.6	
MKE-21-078	MKE-21-078-14.7-15.7-210817	9	0.012 U	6.8	10.3	3.7	0.22	11.5	103	
MKEBAY21-GT4	MKEBAY21-GT4-5.0/8.7									

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

				Analyte Group	Metals															Physical Parameters								
				Analyte	**Barium**	**Selenium**	**Aluminum**	**Iron**	**Manganese**	**Potassium**	**Sodium**	**Thallium**	**Antimony**	**Beryllium**	**Cobalt**	**Calcium**	**Cyanide**	**Magnesium**	**Vanadium**	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
				Unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
				WI CBSQG PEC				40000	1100				25															
				WI CBSQG PEC 3x				120000	3300				75															
				WI CBSQG PEC 5x				200000	5500				125															
				TSCA																								
Location code	**Sample ID**	**Start Depth (ft)**	**End Depth (ft)**	**Date**	**Barium**	**Selenium**	**Aluminum**	**Iron**	**Manganese**	**Potassium**	**Sodium**	**Thallium**	**Antimony**	**Beryllium**	**Cobalt**	**Calcium**	**Cyanide**	**Magnesium**	**Vanadium**	TOC	Gravel	Sand	Coarse Sand	Medium Sand	Fine Sand	Silt	Clay	Fines
					mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	%	%	%	%	%	%	%	%
MKE-21-075	MKE-21-075-01-03-210809	1	3	8/9/2021																**49700**								
MKE-21-075	MKE-21-075-03-05-210809	3	5	8/9/2021																**27100**								
MKE-21-076	MKE-21-076-00-01-210817	0	1	8/17/2021																**51400 J-**								
MKE-21-076	MKE-21-076-G-00-01-210817	0	1	8/17/2021																	0 U	**30.5**	**0.3**	**1.1**	**29.1**	**53.5**	**16**	**69.5**
MKE-21-076	MKE-21-076-01-2.3-210817	1	2.3	8/17/2021																**44400 J-**								
MKE-21-076	MKE-21-076-G-01-2.3-210817	1	2.3	8/17/2021																	0 U	**29.2**	**0.1 J**	**1.1**	**28**	**54**	**16.8**	**70.8**
MKE-21-076	MKE-21-076-2.3-3.3-210817	2.3	3.3	8/17/2021																**17400 J-**								
MKE-21-076	MKE-21-076-G-2.3-3.3-210817	2.3	3.3	8/17/2021																	**9.5**	**75.3**	**8**	**19.2**	**48.1**	**12.8**	**2.4**	**15.2**
MKE-21-076	MKE-21-076-3.3-4.4-210817	3.3	4.4	8/17/2021																**39100 J-**								
MKE-21-076	MKE-21-076-G-3.3-4.4-210817	3.3	4.4	8/17/2021																	0 U	**0.5**	0 U	**0.2**	**0.3**	**76.1**	**23.4**	**99.5**
MKE-21-077	MKE-21-077-00-01-210817	0	1	8/17/2021																**58400 J-**								
MKE-21-077	MKE-21-077-01-03-210817	1	3	8/17/2021																**31500 J-**								
MKE-21-077	MKE-21-077-03-05-210817	3	5	8/17/2021																**22600 J-**								
MKE-21-077	MKE-21-077-05-07-210817	5	7	8/17/2021																**44200 J-**								
MKE-21-077	MKE-21-077-07-09-210817	7	9	8/17/2021																**41600 J-**								
MKE-21-077	MKE-21-077-09-11-210817	9	11	8/17/2021																**51800 J-**								
MKE-21-077	MKE-21-077-11-13-210817	11	13	8/17/2021																**31300 J-**								
MKE-21-077	MKE-21-077-13-14.2-210817	13	14	8/17/2021																**32600 J-**								
MKE-21-078	MKE-21-078-00-01-210817	0	1	8/17/2021																**50100 J-**								
MKE-21-078	MKE-21-078-01-03-210817	1	3	8/17/2021																**56200 J-**								
MKE-21-078	MKE-21-078-03-05-210817	3	5	8/17/2021																**45200 J-**								
MKE-21-078	MKE-21-078-05-07-210817	5	7	8/17/2021																**29600 J-**								
MKE-21-078	MKE-21-078-07-8.7-210817	7	8.7	8/17/2021																**37100 J-**								
MKE-21-078	MKE-21-078-8.7-10.7-210817	8.7	10.7	8/17/2021																**19000**								
MKE-21-078	MKE-21-078-10.7-12.7-210817	10.7	12.7	8/17/2021																**26500 J-**								
MKE-21-078	MKE-21-078-12.7-14.7-210817	12.7	14.7	8/17/2021																**31900 J-**								
MKE-21-078	MKE-21-078-14.7-15.7-210817	14.7	15.7	8/17/2021																**29700 J-**								
MKEBAY21-GT4	MKEBAY21-GT4-5.0/8.7	5	9	11/3/2021																	**1.8**	**58.9**						

Appendix A
Milwaukee Bay Sediment Analytical Results Summary
Focused Feasibity Study, Milwaukee Estuary AOC, Milwaukee, Wisconsin

Notes:

Wisconsin Consensus-based Sediment Quality Guidelines (WI CBSQG) Probable Effects Concentrations (PECs) or PCB threshold levels are used for comparative purposes to evaluate the data.
Blue shading = results greater than 1 mg/kg PCB threshold level or greater than PEC
Gold shading = results greater than 3 mg/kg PCB threshold level or 3x PEC
Orange shading = results greater than 5 mg/kg PCB threshold level or 5x PEC
Pink shading = results greater than TSCA concentration (50 mg/kg)
a blank cell for a given sample location for a given analyte or test means that the analysis or test has not been completed at the indicated sample location
ft = foot or feet
ID = identification
J = Estimated (the "-" symbol after a J qualifier indicates a potential low bias)
mg/kg = milligram(s) per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
R = rejected
TOC = total organic carbon
TSCA = Toxic Substances Control Act
U = Nondetect

Appendix B
Technical Memorandum: Focused List of Metals to Delineate the Nature and Extent of Sediment Contamination

Appendix B
Technical Memorandum

Subject	**Focused List of Metals to Delineate the Nature and Extent of Sediment Contamination**
Project Name	Milwaukee Estuary Area of Concern, City of Milwaukee, Milwaukee County, Wisconsin Task Order 68HE0520F0069, Contract No. 68HE0519D00007
From	Jacobs
Date	October 20, 2022

1. Introduction

This technical memorandum presents the rationale for using a focused list of metals (chromium, lead, and mercury) along with total polychlorinated biphenyls (PCBs) and total polycyclic aromatic hydrocarbons (PAHs) to delineate the nature and extent of contamination and establish remedial target areas (RTAs) in the focused feasibility studies (FFSs) for the Milwaukee Estuary Area of Concern (AOC). The work herein was completed for the U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office by Jacobs[1], in accordance with Task Order 68HE0520F0069 under Contract No. 68HE0519D00007. Jacobs is preparing FFS documents for in-channel sediment for the Milwaukee River Downtown Reach and for portions of three additional project areas including the South Menomonee Canal, the Kinnickinnic (KK) River, and the Milwaukee Bay (MKE Bay). The data from these project areas and two additional project areas (Menomonee River and Milwaukee River Third Ward) were evaluated (Figure 1). Data from the Floodplains Reach Project Area are not included in this memorandum because a different approach was used to describe the nature and extent of contamination and delineate RTAs.

2. Data Evaluation Methods and Results

Previous documents prepared for the Milwaukee Estuary AOC reported that a subset of metals tended to exhibit more exceedances relative to screening values. For example, the *Focused Feasibility Study Report, Menomonee and Milwaukee Rivers* (CH2M 2019a) reported that in the Menomonee River and in the downstream end of the Milwaukee River (currently referred to as the Downtown Reach Project Area), cadmium, chromium, lead and mercury frequently exceeded their respective Probable Effect Concentration (PEC)[2] values, and lead and chromium exhibited the greatest frequency and magnitude of exceedance. The *Site Characterization Report, Milwaukee River Downstream Sediments* documented that in the Milwaukee River Downtown Reach, chromium, lead, and mercury most frequently exceeded their respective PEC values (CH2M 2019b). The *100% Final Site Investigation Report, Characterization of Sediments in South Menomonee Canal* (Anchor QEA 2021) concluded that lead, chromium, and copper were the metals with the greatest number of PEC exceedances.

[1] On December 15, 2017, CH2M HILL Companies Ltd. and its subsidiaries including CH2M HILL, Inc. became part of Jacobs.

[2] PECs from the Wisconsin Consensus-based Sediment Quality Guidelines or PCB screening levels are used for comparative purposes to evaluate the data.

This evaluation considers the AOC-wide sediment FFS data set that covers six project areas. Metals with corresponding PECs included in the data set are chromium, mercury, lead, nickel, arsenic, cadmium, copper, zinc, iron, manganese, and antimony.

Iron, manganese, and antimony were not included in this analysis. Antimony was not widely analyzed, and where the data are available, the concentrations do not exceed the antimony PEC. Iron and manganese were not analyzed in all investigations; where analyzed, PEC exceedances were limited to seven samples in the KK River (Table 1). Five of the iron or manganese PEC exceedances were in surface sediment samples collected along the KK River shoreline during the Solvay Coke Remedial Investigation (Arcadis 2016); PAH concentrations also exceeded the PEC in four of these samples. The remaining two samples were collected by the U.S. Army Corps of Engineers as part of the 2020 investigation of the KK federal navigation channel and the exceedances occur at 5 to 7 feet and 9 to 11.4 feet below the sediment surface (bss).

The co-occurrence of what is termed herein as the five primary chemicals of concern (COCs) (total PCBs, total PAHs, chromium, mercury, and lead) and the other nonprimary metals (arsenic, cadmium, copper, nickel, and zinc) was evaluated using the following stepwise process:

1. An exceedance factor was calculated for each COC in each sample by dividing the COC concentration by the corresponding PEC or the 1 milligram per kilogram (mg/kg) threshold level for PCBs.
2. The maximum exceedance factor was selected for each sample for the nonprimary metals (arsenic, cadmium, copper, nickel, and zinc).
3. The maximum exceedance factor was selected for each sample for the primary metals (chromium, lead, and mercury).
4. The maximum exceedance factor for the nonprimary metals was plotted against the maximum exceedance factor for the primary metals for each sample (Figure 2).

The plot shown on Figure 2 is divided into four quadrants where gridlines representing exceedance factors of 1 for primary and nonprimary metals intersect:

- Upper left quadrant: Samples plotting in this quadrant have a PEC exceedance for a nonprimary metal, but not for a primary metal.
- Upper right quadrant: Samples plotting in this quadrant have co-located PEC exceedances for primary and nonprimary metals.
- Lower left quadrant: Samples plotting in this quadrant have no PEC exceedances for primary or nonprimary metals.
- Lower right quadrant: Samples plotting in this quadrant have a PEC exceedance for a primary metal but not for a nonprimary metal.

Information on Figure 2 illustrates that a relatively small number of samples fall into the upper left quadrant (approximately 40 samples out of nearly 2,500 samples included in this evaluation). These are samples where PEC exceedances of a nonprimary metal are not co-located with an exceedance of a primary metal.

The analysis was then expanded to also include total PAHs and total PCBs as follows:

1. The maximum exceedance factor was determined for the five primary COCs for each sample (chromium, lead, mercury, total PCBs, and total PAHs).
2. The maximum exceedance factor for the nonprimary metals was plotted against the maximum exceedance factor for the five primary COCs for each sample (Figure 3).

As shown on Figure 3, the addition of total PAHs and total PCBs to the analysis reduces the number of samples plotting in the upper left quadrant to six. These samples are summarized in Table 2. Nickel, cadmium, copper, or zinc nominally exceed the PEC in these samples, with exceedance factors ranging from approximately 1.1 to 1.3.

3. Conclusion

The evaluation presented in this memorandum demonstrates that designation of chromium, lead, and mercury as primary COCs (along with total PAHs and total PCBs) is an appropriate and protective means of delineating RTAs for each of the five sediment project areas within the Milwaukee Estuary AOC. PEC exceedances of nonprimary metals are either not significant within the AOC (iron and manganese) or are predominantly co-located with chromium, lead, or mercury PEC exceedances (arsenic, cadmium, copper, nickel, and zinc). When co-occurrence with total PCBs and total PAHs is also considered, there are only six samples with nonprimary metal PEC exceedances that are not co-located with a primary COC PEC or PCB threshold level exceedance, and the PEC exceedance factors in these cases are all less than two.

4. References

Anchor QEA. 2021. *100% Final Site Investigation Report, Characterization of Sediments in South Menomonee Canal, Milwaukee, Wisconsin.* Prepared for Wisconsin Department of Natural Resources and U.S. Environmental Protection Agency Great Lakes National Program Office; EPA GLRI Grant No. GL-00E02392. August.

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CH2M HILL, Inc. (CH2M). 2019b. *Final Site Characterization Report, Milwaukee River Downstream Sediments, Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin.* Prepared for U.S. Environmental Protection Agency Great Lakes National Program Office. Task Order No. 0029/Contract No. EP-R5-11-09. December.

Tables

Table 1. Summary of Iron and Manganese Results Exceeding PECs
Milwaukee Estuary AOC, Milwaukee, Wisconsin

Reach	Investigation	Location Code	Sample ID	Start Depth (feet)	End Depth (feet)	Date	Total PCB mg/kg	Total PAH mg/kg	Metals: Chromium mg/kg	Metals: Mercury mg/kg	Metals: Lead mg/kg	Metals: Nickel mg/kg	Metals: Arsenic mg/kg	Metals: Cadmium mg/kg	Metals: Copper mg/kg	Metals: Zinc mg/kg	Metals: Iron mg/kg	Metals: Manganese mg/kg	Metals: Antimony mg/kg
						WI CBSQG PEC	1	22.8	110	1.1	130	49	33	5	150	460	40000	1100	25
						WI CBSQG PEC 3x	3	68.4	330	3.3	390	147	99	15	450	1380	120000	3300	75
						WI CBSQG PEC 5x	5	114	550	5.5	650	245	165	25	750	2300	200000	5500	125
						TSCA	50												
Kinnickinnic River	Solvay Coke RI Report	P-3	P-3-0.0/0.0	0	0	11/7/2013		**72.8**	**24**	**0.14** J	**160**			**2.1**		**650**	**52000** J		
Kinnickinnic River	Solvay Coke RI Report	P-4	P-4-0.0/0.0	0	0	11/7/2013		**37.7**	**23**	**0.42** J	**51**			**2.6**		**410**	**100000** J		
Kinnickinnic River	Solvay Coke RI Report	P-1	P-1-0.0/0.0	0	0	11/7/2013		**26.2**	**48**	**0.14** J	**110**			**0.65**		**120**	**470000** J		
Kinnickinnic River	Solvay Coke RI Report	P-2	P-2-0.0/0.0	0	0	11/7/2013		**32**	**250**	**1.1** J	**1200**			**3.8**		**1000**	**450000** J		
Kinnickinnic River	Solvay Coke RI Report	P-4A	P-4A-0.0/0.0	0	0	11/7/2013		**1.3**	**78**	**0.0062** J	**3.5**			**0.043** J		**13**	**400000** J		
Kinnickinnic River	2020 USACE KK River Navigation Channel	MKE-FNC09	MKE-NAV20-09-5-7	5	7	10/6/2020	**0.25**	**2.3**	**120**	**0.49**	**260**	**24**	**9.1**	**4.1**	**58**	**310**	**98000**	**590**	
Kinnickinnic River	2020 USACE KK River Navigation Channel	MKE-FNC45	MKE-NAV20-45-9-11.4	9	11.4	10/15/2020	0.005 U	**0.0077**	**23**	**0.026** J	**10**	**21**	**2.1**	**0.2**	**14**	**53**	**29000**	**1600**	

Notes:
Wisconsin Consensus-based Sediment Quality Guidelines (WI CBSQG) Probable Effects Concentrations (PECs) or PCB threshold levels are used for comparative purposes to evaluate the data.
Aroclors and total PCBs from Solvay Coke RI Report not included due to discrepancies in source data
Blue shading = results greater than 1 mg/kg PCB screening level value or greater than PEC
Gold shading = results greater than 3 mg/kg PCB screening level value or 3x PEC
Orange shading = results greater than 5 mg/kg PCB screening level value or 5x PEC
Pink shading = results greater than TSCA concentration (50 mg/kg)
3x = 3 times
5x = 5 times
ID = identification
J = Estimated
KK = Kinnickinnic
mg/kg = milligram(s) per kilogram
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
R = rejected
RI = Remedial Investigation
TOC = total organic carbon
TSCA = Toxic Substances Control Act
U = Nondetect
USACE = United States Army Corps of Engineers

Table 2. Summary of Samples with Non-Co-Located Exceedances of Non-Primary Metals

Milwaukee Estuary AOC, Milwaukee, Wisconsin

Reach	Investigation	Location Code	Sample ID	Start Depth (feet)	End Depth (feet)	Date	Total PCB mg/kg		Total PAH mg/kg		Metals: Chromium mg/kg		Metals: Mercury mg/kg		Metals: Lead mg/kg		Metals: Nickel mg/kg		Metals: Arsenic mg/kg		Metals: Cadmium mg/kg		Metals: Copper mg/kg		Metals: Zinc mg/kg	
						WI CBSQG PEC	1		22.8		110		1.1		130		49		33		5		150		460	
						WI CBSQG PEC 3x	3		68.4		330		3.3		390		147		99		15		450		1380	
						WI CBSQG PEC 5x	5		114		550		5.5		650		245		165		25		750		2300	
						TSCA	50																			
Kinnickinnic River	2021 WDNR FFS Data Gap	KKR-21-060	KKR-21-060-07-09-210820	7	9	8/20/2021	0.0025	U	**5.6**		**14.8**	J	**0.2**		**54.8**		**11**		**3.5**		**0.34**		**170**		**170**	
Kinnickinnic River	2020 WDNR Kinnickinnic Sediment Characterization	KKR-20-002	KKR-20-002-C-01-03-200916	1	3	9/16/2020	**0.062**		**20.8**		**20**	J-	**0.054**		**37**		**11**	J	**4.2**		**5.2**		**27**	J	**240**	
Kinnickinnic River	2020 USACE KK River Navigation Channel	MKE-FNC16	MKE-NAV20-16-00-01	0	1	10/5/2020	0.0065	U	**0.1**		**77**		0.027	U	**16**		**59**		**6.9**		**0.33**		**170**		**200**	
Menomonee River	2015 GLNPO Menomonee River Site Characterization	R5-11	MR-SD-R5-11-0.0/0.5	0	0.5	11/3/2015	**0.33**		**12.2**		**61.4**		**0.245**	J	**117**		**31.2**		**6.92**	J	2.69	U	**120**		**499**	
Milwaukee Bay	2020 WDNR Milwaukee Bay Sediment Characterization	MKE-20-108	MKE-20-108-C-00-01-200922	0	1	9/22/2020	**0.014**		**4.5**		**33**	J	**0.045**	J-	**30.8**		**52.5**		**10**		**0.34**		**86.5**		**123**	
South Menomonee Canal	2021 WDNR FFS Data Gap	SMC-21-007	SMC-21-007-00-01-210821	0	1	8/21/2021	0.0027	U	**0.23**		**11.9**		**0.033**		**10.8**		**74.5**		**2.9**		**0.3**		**18.6**		**64.2**	J

Notes:

Wisconsin Consensus-based Sediment Quality Guidelines (WI CBSQG) Probable Effects Concentrations (PECs) or PCB screening levels are used for comparative purposes to evaluate the data.

Blue shading = results greater than 1 mg/kg PCB screening level value or greater than PEC

Gold shading = results greater than 3 mg/kg PCB screening level value or 3x PEC

Orange shading = results greater than 5 mg/kg PCB screening level value or 5x PEC

Pink shading = results greater than TSCA concentration (50 mg/kg)

3x = 3 times

5x = 5 times

FFS = Focus Feasibility Study

GLNPO = Great Lakes National Program Office

ID = identification

J = Estimated

KK = Kinnickinnic

mg/kg = milligram(s) per kilogram

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

R = rejected

TOC = total organic carbon

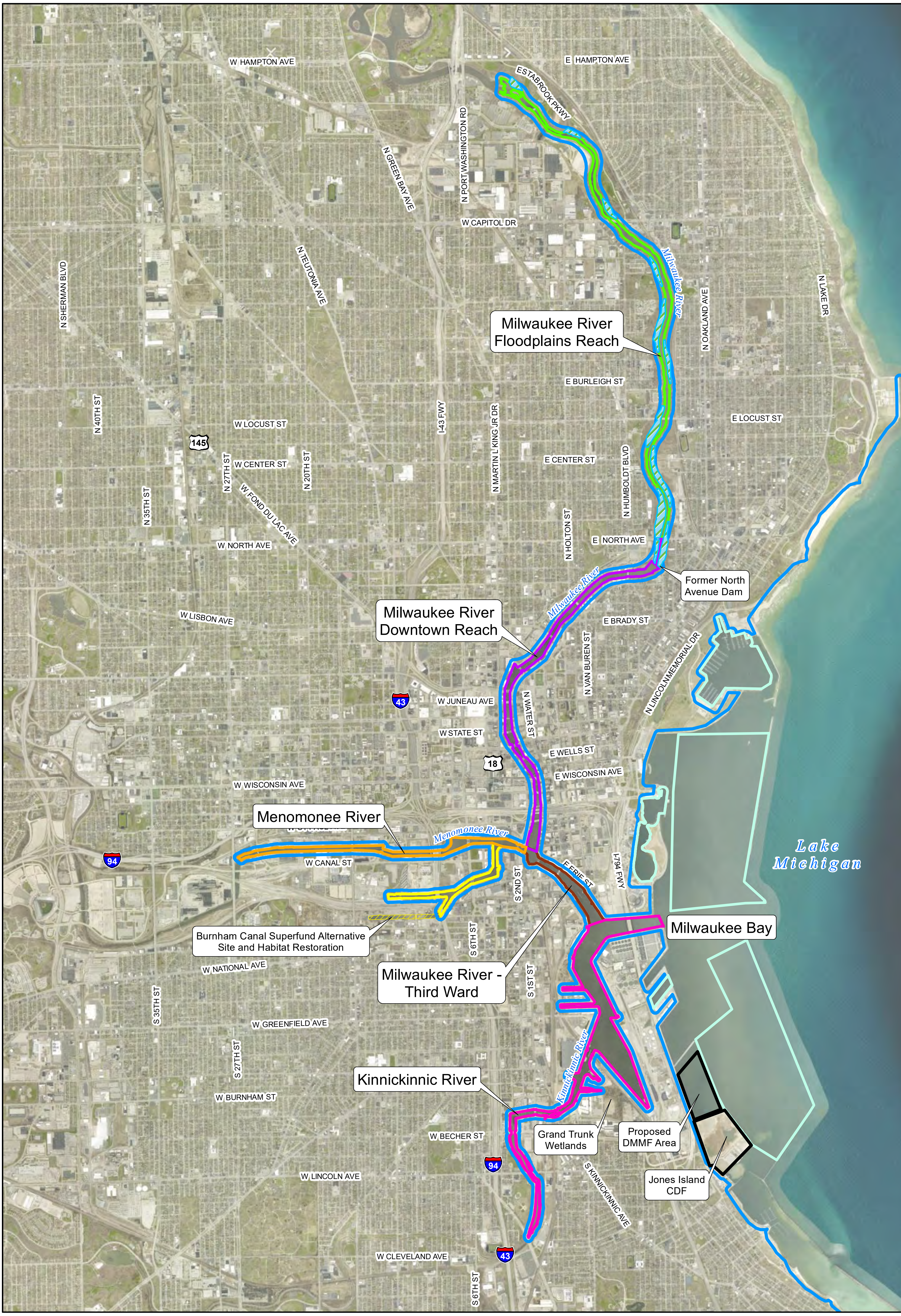
TSCA = Toxic Substances Control Act

U = Nondetect

USACE = United States Army Corps of Engineers

WDNR = Wisconsin Department of Natural Resources

Figures



LEGEND

- Floodplain Area Boundary
- Milwaukee Bay
- Menomonee River
- Kinnickinnic River
- Milwaukee River Downtown
- Milwaukee River Floodplain
- Milwaukee River - Third Ward
- South Menomonee Canal
- Greater Milwaukee GLLA Project Agreement boundary

N

0 1500 3000
Feet

Notes:
1. CDF = confined disposal facility; DMMF = dredged materials management facility; GLLA = Great Lakes Legacy Act
2. 2022 Aerial Photography provided by Esri ArcGIS Online World Imagery.

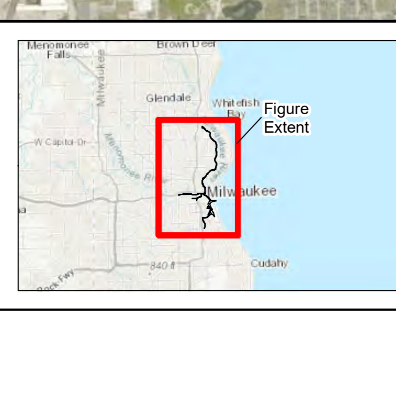
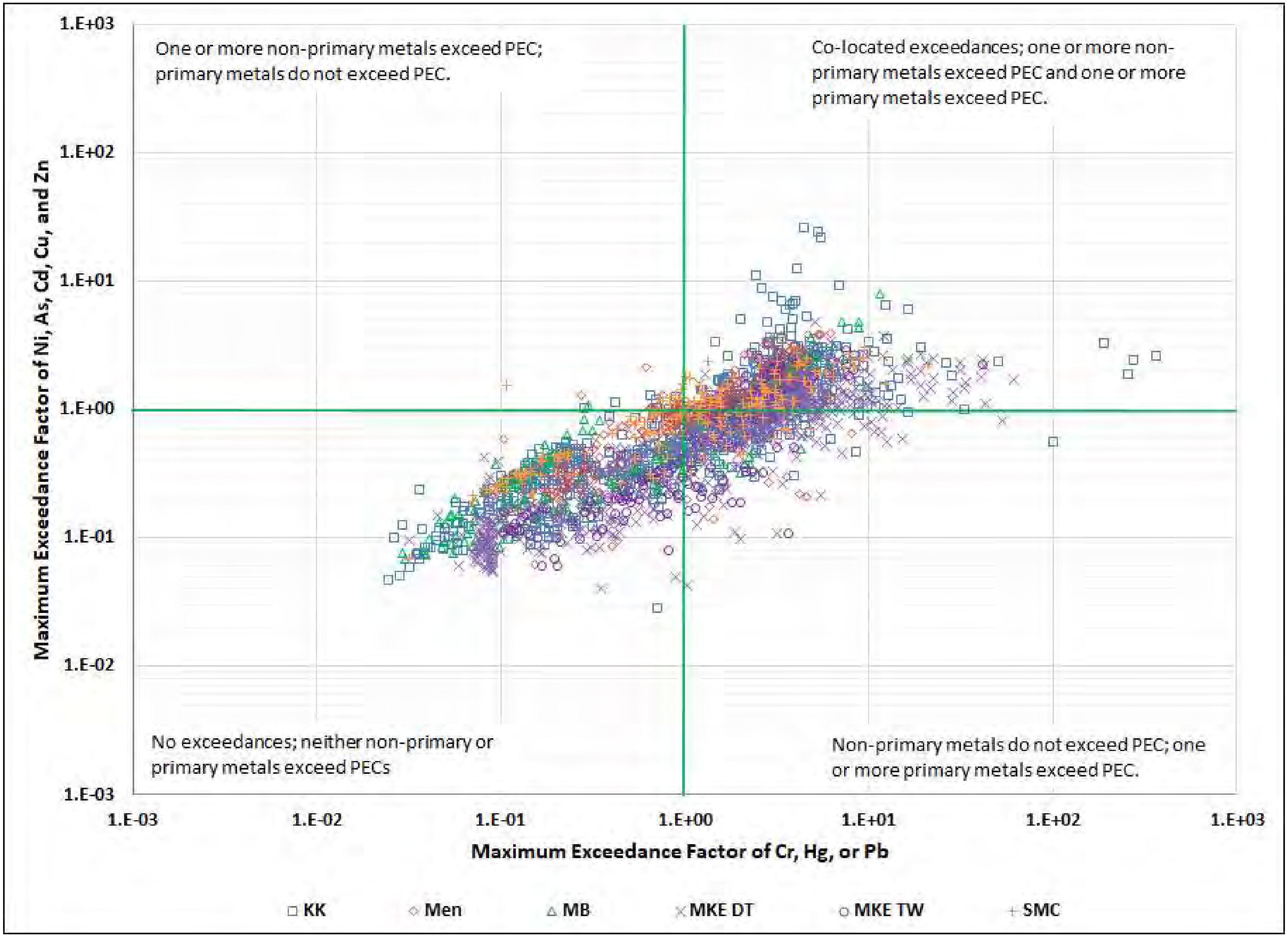


Figure 1
Regional Features
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

\\dc1vs01\GISProj\E\EPA\681867_MKERiverDownstream\MapFiles\2022\Floodplain\Figure1-1_Milwaukee_Estuary_AOC_Regional_Features.mxd jhansen1 (9/11/2023)

Jacobs



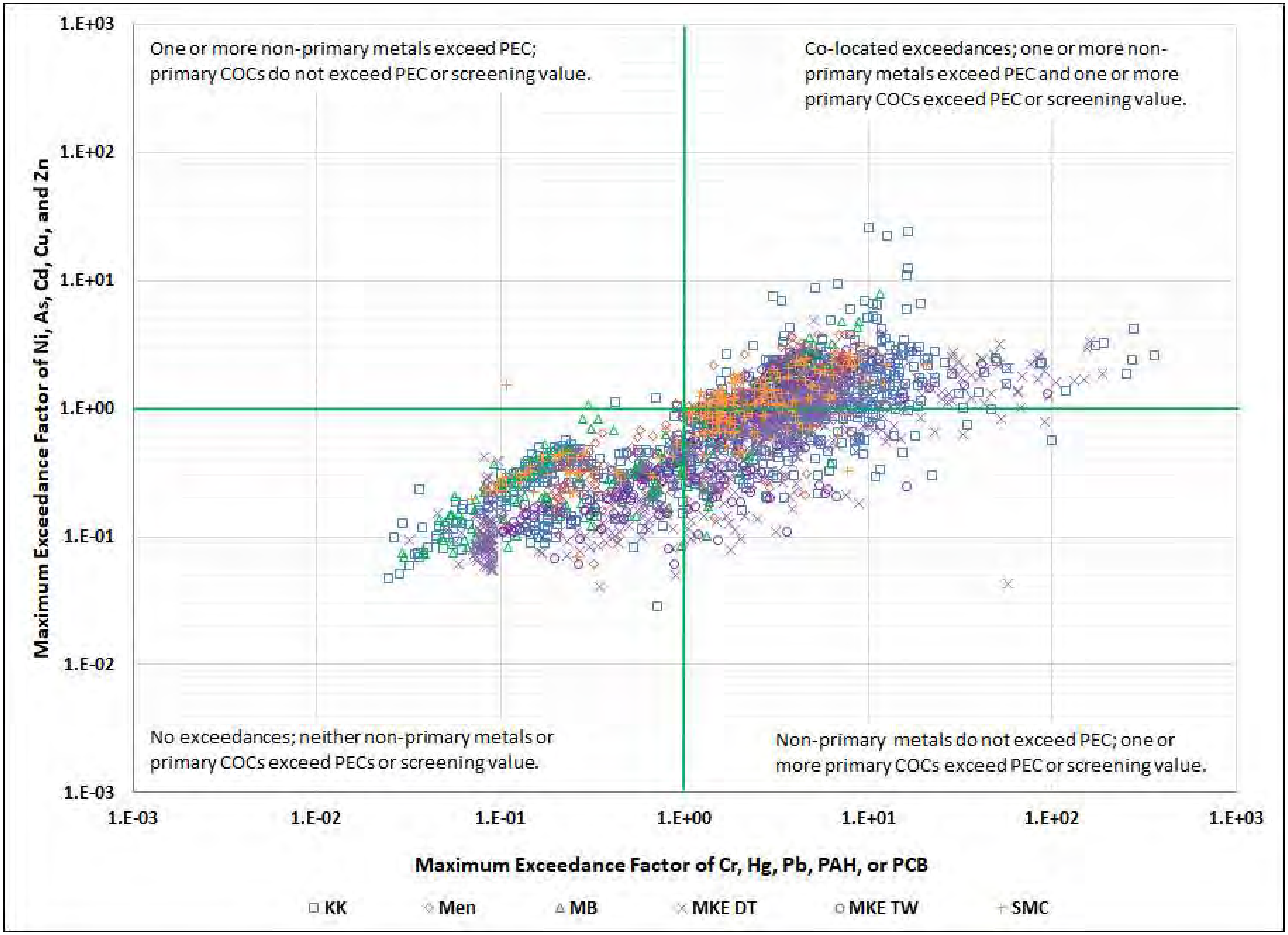
Notes:

KK – Kinnickinnic River
Men – Menomonee River
MB – Milwaukee Bay
MKE DT – Milwaukee River – Downtown
MKE TW – Milwaukee River – Third Ward
PEC – Probable Effect Concentration
SMC – South Menomonee Canal

As – arsenic
Cd – cadmium
Cr – chromium
Cu – copper
Hg – mercury
Ni – nickel
Pb – lead
Zn - zinc

Figure 2
Exceedance Factors: Non-Primary Metals vs. Primary Metals
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs



Notes:
COC – chemical of concern
KK – Kinnickinnic River
Men – Menomonee River
MB – Milwaukee Bay
MKE DT – Milwaukee River – Downtown
MKE TW – Milwaukee River – Third Ward
PEC – Probable Effect Concentration
SMC – South Menomonee Canal

As – arsenic
Cd – cadmium
Cr – chromium
Cu – copper
Hg – mercury
Ni – nickel
PAH – polycyclic aromatic hydrocarbon
Pb – lead
PCB – polychlorinated biphenyl
Zn - zinc

Figure 3
Exceedance Factors: Non-Primary Metals vs. Primary COCs
Milwaukee Estuary Area of Concern
Milwaukee, Wisconsin

Jacobs

Appendix C
Overview of Applicable Federal, State, and Local Permitting Requirements

Appendix C. Overview of Applicable Federal, State, and Local Permitting Requirements – Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Permit/Approval	Requirement/Purpose	Applicability to Project
Clean Water Act (CWA) Section 404 33 U.S. Code (USC) 1344 33 Code of Federal Regulations (CFR) 320 Rivers and Harbors Act of 1899 Section 10	Requires a permit from U.S. Army Corps of Engineers (USACE) for discharge of dredged or fill material into waters of the United States.	A CWA permit is anticipated to be required. Nationwide Permit (NWP) 38 – Cleanup of Hazardous and Toxic Waste (covers "specific activities required to effect the containment stabilization, or removal of hazardous or toxic waste materials that are performed, ordered or sponsored by a government agency with established legal or regulatory authority (USACE 2021). It is anticipated that project activities will be covered under NWP 38 as they are intended to contain or remove hazardous materials and the activities are sponsored by the U.S. Environmental Protection Agency (EPA). A preconstruction notification (PCN) will be required to gain coverage under NWP 38. If USACE determines that project activities are not able to be covered under NWP 38, an individual permit would be required.
CWA Section 401 Wisconsin Department of Natural Resources (WDNR's) NR 299 – Water Quality Certification (WQC)	Provides states with the authority to issue water quality certifications (WQCs) to ensure that federal agencies will not issue permits or licenses that violate the water quality standards of the state.	WQC is anticipated to be required. It is anticipated that the project will be covered under NWP 38. WDNR has conditionally issued WQC for projects authorized by NWP 38. It is anticipated that the project will meet the applicable state 401 WQC conditions.
Endangered Species Act of 1973, Section 7 Consultation 16 USC 1531 50 CFR 200	Requires that Federal agencies ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Informal consultation with U.S. Fish and Wildlife Service is anticipated to be required as part of the CWA 404 permit authorization.
Fish and Wildlife Coordination Act 16 USC 661 et seq. Wisconsin Endangered Resources Review NR 27 – Endangered and Threatened Species	Requires consultation when a modification of a stream or other water body is proposed or authorized and requires protection of fish and wildlife from adverse effects of site action.	Consultation with the WDNR is anticipated to be required as part of the CWA 404 permit authorization.
Section 106 Concurrence National Historical Preservation Act of 1966 36 CFR Part 65 36 CFR 800	No activity is authorized under any NWP, which may have the potential to cause effects to properties listed, or eligible for listing, in the National Register of Historic Places until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.	Consultation with the Wisconsin State Historic Preservation Office is anticipated be required as part of the CWA 404 permit authorization.
Section 408 Authorization to Alter USACE Civil Works Projects 33 USC 408	Requires that alterations to any USACE federally authorized Civil Works project be reviewed and approved before being undertaken.	A Section 408 permit is anticipated to be required. Construction and operation of a temporary water treatment plant for the Great Lakes Legacy Act sediment remediation project is anticipated to occur within a portion of the existing USACE dredged materials disposal facility (DMDF) because of the proximity to the future dredged materials management facility (DMMF), where dredged sediment will be disposed.

Appendix C. Overview of Applicable Federal, State, and Local Permitting Requirements – Milwaukee Bay Project Area

Milwaukee Estuary Area of Concern, Milwaukee, Wisconsin

Permit/Approval	Requirement/Purpose	Applicability to Project
Wisconsin Statutes Chapter 30 - Navigable Waters, Harbors, and Navigation NR 345 – Dredging in Navigable Waterways	Establish procedures and limitations for exempt activities, general permits, and individual permits for removal of material from the beds of navigable waterways within Wisconsin.	A Lake or Stream Dredging Individual Permit is anticipated to be required. Applicable for activities including dredging and placement of structures (such as fill material, sheet pilings, coffer dams) on the bed of a river or lake and placement of residual sand cover. Dredged material will contain contaminants at concentrations equal to or greater than the PEC concentration as published in WDNR (2003); if so, the discharge from the dredging activities would not qualify for exemptions or coverage under a general permit.
40 CFR 761.77 NR 700 – Investigation and Remediation of Environmental Contamination	TSCA sediment removal and disposal would be implemented under the WDNR One Cleanup Program Memorandum of Agreement (RR-786) dated November 2014.	The process allows for the approval of the remediation under WDNR lead and oversight, in coordination with the EPA, under state authority for the pathways addressed under the NR 700 rules series. Remediation performed under the requirements of NR 700 would be seen as equivalent to a TSCA cleanup for the environmental pathways addressed under the NR 700 rules series.
NR 216 – Storm Water Discharge Permit Construction Site Storm Water Runoff General Permit (Permit Number WI-S067831-6)	Wisconsin Pollutant Discharge Elimination System (WPDES) stormwater general permit authorizing stormwater discharge(s) from construction sites of one acre or more of land disturbance.	Coverage under the Wisconsin Construction Site Storm Water Runoff General Permit (WPDES Permit Number WI-S067831-6 is anticipated be required. Applicable to stormwater runoff or other discharged water during construction activities that will disturb ≥1 acre.
WPDES Individual Discharge Permit	Individual (site-specific) permit authorizing discharge from dredging operations where carriage water or interstitial water from sediment dredging projects will be discharged to surface water.	An individual WPDES discharge permit is anticipated to be required. This permit applies for point source discharge of carriage and/or interstitial water to waters of the state from mechanical or hydraulic dredging operations that target sediment contaminants greater than the probable effect concentration (PEC) for sediment toxicity listed in the Consensus Based Sediment Quality Guidelines (WDNR 2003).
Federal Coastal Zone Management Act of 1972 16 USC 1451 et seq. Wisconsin Coastal Management Program (WCMP)	An applicant for a federal permit affecting any land, water use, or natural resource in the coastal zone must provide a consistency certification. The project proponent must certify that activities will comply with the approved policies of the WCMP and be conducted in a manner consistent with the policies.	A federal consistency determination is anticipated to be required. The Milwaukee Estuary AOC project area boundary is within the Wisconsin coastal zone (WCMP 2022).
Local Notice to Mariners 33 CFR 165 - Notification	Establishes procedures for controlled access areas and regulated navigation areas.	The notification is anticipated to be required. Applicable to in-water work being performed in waterways with commercial and/or recreational usage while project activities occur. Project is within the jurisdiction of U.S. Coast Guard District 9.

Sources:

U.S. Army Corps of Engineers (USACE). 2021. Nationwide Permits. 38 – Cleanup of Hazardous and Toxic Waste. Accessed October 18, 2022. https://www.mvp.usace.army.mil/Portals/57/docs/regulatory/NWPs/2021/NWP%2038%20terms%20and%20conditions%202021.pdf?ver=QtThnf6ZPFepxqlnjVbESQ%3d%3d

Wisconsin Coastal Management Program (WCMP). 2022. About Us. Accessed October 18, 2022. https://doa.wi.gov/Pages/LocalGovtsGrants/CoastalManagement.aspx

Wisconsin Department of Natural Resources (WDNR). 2003. *Wisconsin Consensus-based Sediment Quality Guidelines. Recommendations for Use and Application,* Interim Guidance RR-088. December.

Note:

The overview of permitting requirements included in this appendix is preliminary and may change during detailed design. Additional permits that are not listed here may be identified during detailed design.

≥ = greater or equal to

CFR = Code of Federal Regulations

CWA = Clean Water Act

DMDF = USACE's dredged materials disposal facility

DMMF = proposed dredged materials management facility to support the Milwaukee Estuary Area of Concern project

NHPA = National Historic Preservation Act

NWP = Nationwide Permit

PCN = pre-construction notification

PEC = Probable Effects Concentration per WDNR 2003

USC = U.S. Code

USACE = U.S. Army Corps of Engineers

WCMP = Wisconsin Coastal Management Program

WDNR = Wisconsin Department of Natural Resources

WPDES = Wisconsin Pollutant Discharge Elimination System

WQC = Water Quality Certification

Appendix D
Estimated Costs
(Removed)

Appendix E
Frequently Asked Questions

Milwaukee Estuary Contaminated Sediment Cleanup Public Outreach Meetings: Frequently Asked Questions (FAQ)

This document summarizes questions and comments received in association with the public meetings held on November 2, 2023; February 15, 2024; April 25, 2024; and June 13, 2024. Additional information such as posters and technical details describing the contaminated sediment cleanup project are included in the Focused Feasibility Study Report. Please visit the Waterway Restoration Partnership website.

FAQ1: Will the sediment churned up during dredging be a problem downstream /elsewhere in the water?

Construction best management practices (BMPs) will be used during dredging to minimize the impacts from disturbing the sediment. Turbidity curtains will be used around the dredge areas to contain resuspended sediment, and monitoring will be conducted to confirm effectiveness and make modifications to the curtain if needed.

FAQ2: What are the general features of the Dredged Materials Management Facility construction, how is leakage of contamination into the lake prevented once material has been placed inside, and how long will the sediment be in the containment facility?

The Dredged Materials Management Facility (DMMF) has a design life of 100 years and will be a steel structure with an inner and outer wall. The walls will be tied together with steel tie rods and the space between the walls will be filled with aggregate (rock). In addition to the steel walls, there will also be another wall in the middle of the structure which will be 2.5 to 3-feet thick. That center wall, called a soil-mix wall, will be impermeable and will not allow water or contaminants to pass through. Sediment placed in the DMMF will permanently remain there. Sediment will not be filtered or amended in the facility. There will be a temporary water treatment facility during this cleanup project that will treat water that is currently inside the DMMF and precipitation that falls onto the DMMF.

FAQ3: Have fish consumption advisory posters been installed at public fishing locations along the river and Lake Michigan?

Fish consumption signage has been installed at various locations along the Milwaukee River from Lincoln Park to the former North Avenue Dam. Partners are working to identify the best locations for installing additional signs throughout the project areas. The signs provide information that was developed in collaboration with Wisconsin Department of Natural Services (WDNR) and the Wisconsin Department of Health Services (DHS).

For additional information on fish consumption advisories, please visit the Wisconsin Department of Natural Resources.

WATERWAY RESTORATION PARTNERSHIP
MILWAUKEE ESTUARY AREA OF CONCERN

FAQ4: During the actual "dredging" will there be foul odors in the air? Is there an airborne risk for workers and residential neighbors?

None of the contaminants found in the project areas are expected to produce odors during dredging or excavation. Some of the dredged sediment may contain decaying organic matter that has a distinctive odor. Best management practices (BMPs) will be used during construction to mitigate odors and dust.

FAQ5: Will the Milwaukee River be restored to conditions making the waters safe for swimming as a recreation?

The river and floodplains remedial actions are intended to address the Milwaukee Estuary Area of Concern (AOC) beneficial use impairments (BUIs) that are specific to legacy contaminants such as heavy metals, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). The remedial actions are not designed to address other water quality issues such as bacterial or viral contaminants that could affect safe swimming.

FAQ6: How will the funding of this project, including the habitat projects, be impacted by this being an election year?

Funding has already been appropriated and approved by congress for this project. Currently no impact on federal funding is anticipated.

FAQ7: Regarding the resuspension of sediment from propeller wash, how deep does dredging need to occur to not allow propeller wash?

The depth of influence of propeller wash is vessel-specific and will be evaluated as part of the design. Areas that are dredged and susceptible to propeller wash will be designed to be protective through adequate depths and placement of a cover material to minimize the risk of resuspension.

FAQ8: Has the amount of water displaced by the dredging been evaluated against the flow rate of the river?

A stream gauge located at Jones Island in Milwaukee, Wisconsin measures the flow of water in the Milwaukee River as it enters Lake Michigan. The main source of water to the river is precipitation, including snowmelt and storms. There are several tributaries that feed into the Milwaukee River, including the Menomonee River and the Kinnickinnic River. Seasonal trends show that flow is typically highest in the spring and lowest in the winter. The year over year average measured at the Jones Island gauge is approximately 3,000 cubic feet per second (cfs) with the maximum measured peak flow of 22,000 cfs. The anticipated flow rate for the dredging activities is 20 to 30 cfs, so only a small fraction of the total flow.

FAQ9: What happens to the water after entering into the Dredged Materials Management Facility?

The solids settle within the Dredged Materials Management Facility and the water is removed and treated through a temporary water treatment plant to meet the State of Wisconsin discharge criteria. Treated water is then likely discharged to Lake Michigan. Testing is performed to confirm discharge criteria is being met.

FAQ10: How far will the hydraulic dredges be from the Dredged Materials Management Facility?

The farthest dredge from the Dredged Materials Management Facility (DMMF) will be 3.9 miles. Booster pumps will be used along the pipeline route to facilitate pumping the sediment to the DMMF. Much of the pipeline route will be submerged to avoid conflict with vessel traffic.

FAQ11: What is comprised of the sand layer? Can it survive turbulent storms?

The specific composition of the sand layer will be determined during remedial design. The sand layer is not intended to be an immobile engineered cap, and some movement may occur during large storms. However, engineered caps will be used where contaminated sediment is left in place.

FAQ12: What are the dredging depths?

The dredge depths are designed to remove contaminants which vary in depth across the project area and will be finalized during remedial design.

FAQ13: Are there plans to monitor the ecosystem afterwards?

The Milwaukee River Area of Concern (AOC) has 11 beneficial use impairments (BUIs), 7 of which are related to contaminated sediment. The Remedial Action Plan for the AOC includes a range of actions and monitoring processes for tracking the effectiveness of remedial measures and confirming the restoration of beneficial uses. The sediment remediation projects will contribute to the overall efforts to remove the BUIs and de-list the AOC.

FAQ14: What are the potential wildlife impacts that could be caused by the Dredged Materials Management Facility construction?

A waterfowl study was completed for the existing CDF facility. The area contains mostly migratory species that do not reside in the area permanently, which decreases the potential impact.

FAQ15: Will there be opportunities for hands-on activities and models for the community?

There is a potential to include hands-on activities in forthcoming public engagement activities.

FAQ16: There is a historic wall on the Pleasant Valley Park side of the river. Will this feature be preserved during the construction?

The historic wall located within Gordon Park, associated with the former bath house, has been noted as a structure of cultural significance. Currently the area of remediation is not anticipated to interfere with the structure.

FAQ17: Have we engineered the Dredged Materials Management Facility to capture natural and unnatural surges?

The DMMF was designed for a range of water levels, wind and wave events, ice, rainfall, and climate change.

Have a question? Looking for a general project overview?

Check out this [Fact Sheet] for more information including project partner contact information.