Site Investigation Report
Characterization of Sediments in the North End District and Clough Island
St. Louis River and Bay Area of Concern, Superior, Wisconsin

Prepared for

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
µg/kg	Microgram(s) per kilogram
%	Percent
AOC	Area of Concern
ASE	American Surveying & Engineering, P.C.
BTV	Background threshold value
BUI	Beneficial use impairment
CHS	Cenex Harvest State Cooperatives
CLP	Contract Laboratory Program
DEM	Digital elevation model
DNR	Department of Natural Resources
DUAR	Data Usability Assessment Report
EA	EA Engineering, Science, and Technology, Inc., PBC
EPA	U.S. Environmental Protection Agency
Eurofins TestAmerica	Eurofins TestAmerica Laboratories, Inc.
FD	Field duplicate
FS	Field split
FSP	Field Sampling Plan
ft	Foot (feet)
GC	Gas chromatography
GIS	Geographic information system
GLNPO	Great Lakes National Program Office
GNSS	Global Navigation Satellite System
GPS	Global positioning system
IGLD85	International Great Lakes Datum of 1985
in.	Inch(es)
LWD	Low water datum
M/V	Motor vessel
MDL	Method detection limit
MEC	Midpoint effect concentration
mg	Milligram(s)
mg/kg	Milligram(s) per kilogram
MS	Mass spectrometry

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

ND	Non-detect
NELAC	National Environmental Laboratory Accreditation Conference
OSI	Ocean Surveys, Inc.
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PEC	Probable effect concentration
QAPP	Quality Assurance Project Plan
R/V	Research vessel
RAP	Remedial Action Plan
RCL	Residual contaminant level
RL	Reporting limit
ROV	Remotely operated vehicle
SIM	Selected ion monitoring
SIR	Site Investigation Report
SQG	Sediment Quality Guideline
SVOC	Semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TEC	Threshold effect concentration
TEQ	Toxicity equivalency quotient
TOC	Total organic carbon
UV	Ultraviolet
VOC	Volatile organic compound
WHO	World Health Organization
WISCORS	Wisconsin Continuous Observing Reference Station

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1. INTRODUCTION

EA Engineering, Science, and Technology, Inc., PBC (EA), on behalf of the State of Wisconsin Department of Natural Resources (DNR), has prepared this Site Investigation Report (SIR) to describe the Characterization of Sediments in the North End District and Clough Island 2020. This work was funded through the Great Lakes Restoration Initiative via a cooperative agreement between U.S. Environmental Protection Agency (EPA) Great Lakes National Program Office (GLNPO) and DNR. The study area is located in Superior, Wisconsin (Figure 1-1). The site characterization field effort involved sediment sampling in six assessment areas located within the North End District and Clough Island area: the Hallet Dock 8 Slip, the Oil Barge Dock Slip, the General Mills Slip, the Tower Avenue Slip, the Estuary Flats, and Clough Island (Figure 1-2). This SIR provides: an overview of the sampling event, including geophysical survey activities conducted prior to sampling; the number and location of samples; results of physical and chemical testing; results of toxicity and bioaccumulation testing; data tables and maps, data interpretation, and findings of the investigation.

1.1 SITE DESCRIPTION AND BACKGROUND

The St. Louis River, the largest U.S. tributary to Lake Superior, drains 3,634 square miles and enters the southwest corner of the lake at the twin-port cities of Duluth, Minnesota, and Superior, Wisconsin. The river flows 179 miles through three distinct areas: coarse soils, glacial till, and outwash deposits at its headwaters; a deep, narrow gorge at Jay Cooke State Park; and red clay deposits in its lower reaches. As it approaches Duluth and Superior, the river takes on the characteristics of a 12,000-acre freshwater estuary. The upper estuary has some wilderness-like areas while the lower estuary contains urban development, an industrial harbor, and a major port. The St. Louis River and Bay Area of Concern (AOC) is located on the western arm of Lake Superior and includes the twin-port cities of Duluth, Minnesota, and Superior, Wisconsin. The AOC includes the lower 39 miles of the St. Louis River and the lower estuary containing multiple bays and Duluth-Superior Harbor, the Nemadji River, and the western end of Lake Superior.

Under the Great Lakes Water Quality Agreement, a St. Louis River Stage 1 Remedial Action Plan (RAP) was completed in 1992 through the collaborative efforts of DNR, the Minnesota Pollution Control Agency, and local stakeholders. Updates to the RAP have been made periodically with the most recent update in 2019. The RAP identifies the project subareas as requiring additional sediment characterization to determine if remedial action is necessary to address beneficial use impairments (BUIs). Originally, the RAP identified the following BUIs for the St. Louis River and Bay AOC:

- Restrictions on fish and wildlife consumption
- Excessive loading of sediment and nutrients
- Degradation of fish and wildlife populations
- Beach closings
- Fish tumors or other deformities
- Degradation of aesthetics
- Degradation of benthos

- Restriction on dredging activities
- Loss of fish and wildlife habitat.

Management actions have been completed for three of the original nine listed BUIs (fish tumors/other deformities, excessive loading of sediments and nutrients, and degradation of aesthetics) and these BUIs have been formally removed for this AOC. Historical discharges resulted in sediments contaminated with various pollutants, including lead, mercury, dioxins, polychlorinated biphenyls (PCBs), tributyltin, and polycyclic aromatic hydrocarbons (PAHs). The remaining BUIs are linked to contaminated sediment.

The 2019 RAP update outlines the upcoming steps that will lead to the removal of the remaining BUIs and ultimately, the delisting of the St. Louis River and Bay AOC. Identifying locations with contaminated sediments and completing remedial actions in those areas will play a large role in addressing and removing BUIs. RAP management action included the completion of sediment characterization projects to determine if there are other contaminated sediment sites that require remedial action to address BUIs.

1.1.1 Assessment Areas of the Site Characterization

This sediment characterization is focused on the lower estuary of the AOC, specifically portions of the North End of the City of Superior's waterfront district located in St. Louis Bay and Howards Bay as well as a sheltered bay at Clough Island below Spirit Lake. There are six assessment areas located within the North End District and Clough Island area: the Hallet Dock 8 Slip, the Oil Barge Dock Slip, the General Mills Slip, the Tower Avenue Slip, the Estuary Flats, and Clough Island (Figure 1-2).

The project area has been subjected to significant modification over time to streamline and maximize commerce, as well as accommodate changes in industry and site usage since the late 1800s. Based on information provided in a historical records review and related analysis of shoreline changes, the pier or dock features that bound each slip are primarily comprised of fill material (Sigma Group 2019a-c). Considered submerged lands of the state, rights to utilize the beds of lakes were leased to individual riparian owners and municipalities under Section 24.39(4) of the Wisconsin Statutes. Furthermore, these rights included the ability to fill in beds of lakes or navigable streams, when the purpose of the lease is for the improvement of navigation or for the improvement or construction of harbor facilities as defined in Section 30.01. As a result, the docks are primarily constructed of fill material placed over freshwater marsh sediments, while the bedded material within each slip is representative of the native St. Louis Bay and Howards Bay sediments. The sediments comprising these areas of lakebed have been further modified by dredging and impacted by activities associated with the adjacent industries. Each of the areas are described in the subsections below.

<u>Hallet Dock 8 Slip</u>

The Hallet Dock 8 Slip encompasses a 12-acre area and is adjacent to the Oil Barge Dock Slip. This slip is located within the 40-acre West Waterfront area in St. Louis Bay. Historically the slip was predominately used for coal and petroleum-related shipments and industries. Nearby manufacturers included a foundry, coal briquet maker, and coke ovens. In the 1930s and 1940s, there were approximately 112 acres of coal storage adjacent to the slip. Industrial uses of the slip continue to this day, with terminals for coal and road salt shipments, and accompanying large stockpiles of each along the shoreline.

Oil Barge Dock Slip

The Oil Barge Dock Slip encompasses a 6-acre area to the east of the Hallet Dock 8 Slip. The Oil Barge Dock Slip is located within the 40-acre West Waterfront area in St. Louis Bay. Historical uses of the Oil Barge Dock slip included coal and petroleum-related shipments and industries. Nearby manufacturers included a foundry, coal briquet maker, and coke ovens. In the 1930s and 1940s, there were approximately 112 acres of coal storage adjacent to the slip. Petroleum products (i.e., gasoline, diesel, jet fuel, and crude oil) were transferred at the Barge Dock for 103 years (1890 to 1993) and discontinued when the former Amoco Terminal on Winter Street was abandoned (following petroleum pipeline construction). The east shoreline of the slip continues to be used to stockpile coal at the Midwest Energy Resources Company.

Previous sediment investigations indicate impacts from coal and petroleum, as well as sediment toxicity at this slip. There are several active and closed Bureau for Remediation and Redevelopment Tracking System case sites on lands adjacent to the West Waterfront area with extensive plumes of petroleum contaminated groundwater and at least 60,000 gallons of free product remaining to be recovered. The groundwater/sediment/surface water pathway may be of interest for future source characterization and remedial evaluation in the Oil Barge Dock Slip.

General Mills Slip

The General Mills Slip is a 7-acre inlet off of St. Louis Bay that is immediately east of Midwest Energy Resources Company’s large coal stockpile at the West Waterfront. The slip was formally used as a freight warehouse, coal dock, and grain elevator. It is currently used by General Mills for loading grain into ships for transport.

Tower Avenue Slip

The Tower Avenue Slip is a 13-acre area in Howards Bay, with a number of different surrounding industries, both historical and current, including coke ovens, petroleum tank farms, a foundry, lumber production facilities, chemical warehousing, and bulk transportation warehouses. The slip has six municipal storm sewer outfalls that drain into its waters, transporting historical and current discharges from industrial and residential properties in the Superior area. The slip also received discharges from a former electric power generation plant. The slip is currently used for loading of ships at the Cenex Harvest States Cooperative (CHS) grain terminal and long-term layup of ships.

The Sigma Report for Tower Avenue (The Sigma Group 2019b) cited historical documents that indicate that, prior to the 1880s, the northern section of the Tower Avenue area was marshland surrounding Tower Bay. Significant development within the project area began around 1887.

The inland section of the project area is currently developed with a mix of light manufacturing, auto repair, recovery facilities, and commercial properties.

Based on a review of the available information, Sigma identified 12 sites within the project area, which are potential sources of contamination, including:

- Site No. 1: Globe Elevator Dock Site
- Site No. 2: Barko Hydraulics Dock Site
- Site No. 3: Speakes Company Site
- Site No. 4: Harvest States Cooperative Site
- Site No. 5: Northwestern Oil Site
- Site No. 6: Streetcar Powerhouse Site
- Site No. 7: Northern Engineering Site
- Site No. 8: Evered Foundry Site
- Site No. 9: Power Plant and Waste Oil Site
- Site No. 10: Railyard Site
- Site No. 11: Northwestern Boiler Works Site
- Site No. 12: Railcar Barn Site.

Estuary Flats

The Estuary Flats is an approximately 290-acre area that is bounded by St. Louis Bay to the north and the St. Louis River to the west. This area is presently undeveloped land, and historically, development and shoreline changes within this area were minimal. This area contained an iron ore dock from 1917 to 1931 and dredged material was disposed of in the shallow waters of the Estuary Flats. Sigma did not identify any potential source sites within Estuary Flats, though the area has been a documented historical disposal site for dock fill materials and dredge materials, which may have contaminated sediments (The Sigma Group 2019a).

Clough Island

Clough Island is the largest island in the St. Louis River estuary and was the site of former farming activities. Clough Island has been preserved as a DNR-managed property and studies indicate relatively unimpacted conditions around the island, except in one sheltered bay where elevated levels of dioxin have consistently been found in surficial sediments. This bay is included within the study area, it is approximately 20 acres in size, and is located at the southwest corner of the island, immediately downstream of Spirit Lake and the U.S. Steel Superfund site. This bay is located behind a bar, which separates it from the main channel of the St. Louis River.

1.2 PURPOSE AND OBJECTIVES

1.2.1 Project Objectives

The primary objective of the North End District and Clough Island Sediment Characterization is to obtain the data necessary to evaluate the degree and extent of sediment contamination and, where feasible, identify potential sources of contamination in the assessment areas. The results will be used to help identify areas, if any, that may require further investigation or remedial action. Moreover, where action is warranted, a secondary objective is to collect enough information to facilitate the planning and/or completion of remedial action options report(s) under Wisconsin Admin Code Chapter NR 722, and accelerate the development of design plans under Wisconsin Administrative Code Chapter NR 724.

1.2.2 Objectives of the Site Investigation Report

The purpose of the SIR is to summarize the findings from the field investigation, including data tables and maps, data interpretation, and conclusions of the investigation with respect to the overall goals of the sediment assessment including identification and mapping of sediment benchmark exceedances and estimating sediment volumes and evaluating toxicity and bioaccumulation data with respect to reference locations to identify site-specific effects/impacts to benthic organisms.

1.3 REPORT ORGANIZATION

This SIR describes the 2020 field efforts to characterize sediments in the North End District and Clough Island 2020, which involved sediment sampling in six assessment areas located within the North End District and Clough Island area: the Hallet Dock 8 Slip, the Oil Barge Dock Slip, the General Mills Slip, the Tower Avenue Slip, the Estuary Flats, and Clough Island.

This document is organized as follows:

- Chapter 1 presents the site description, background, purpose, and objectives of the investigation.

- Chapter 2 presents the narratives of the investigation efforts, deviations from the Quality Assurance Project Plan (QAPP), and introduces supplemental data used to characterize the site.

- Chapter 3 presents the geophysical results from each of the assessment areas.

- Chapter 4 presents the analytical results from each of the assessment areas as well as gas chromatography results.

- Chapter 5 presents the toxicity and bioaccumulation testing methodology and results.

- Chapter 6 presents the summary of findings.

- Chapter 7 presents references used in the SIR.

2. SEDIMENT CHARACTERIZATION SITE INVESTIGATION

The North End District and Clough Island Sediment Characterization was conducted in coordination with DNR and the EPA. The investigations, including sampling activities and analytical testing methods, were carried out in accordance with procedures coordinated and approved by DNR and EPA GLNPO as documented in the Survey and Sampling QAPPs with Field Sampling Plan (FSP) attachments (EA 2019 and 2020), respectively. The Survey and Sampling QAPPs with FSP are included in Appendix K.

The first phase of the field effort included a geophysical survey of each slip area, as well as an acoustic dock wall survey within the Oil Barge and Tower Avenue Slips. These activities were conducted from 27 April through 3 May 2020. Survey activities were completed by EA's subcontractor American Surveying & Engineering, P.C. (ASE) with oversight and manual probing activities completed by EA. The remote sensing work was performed aboard ASE's Research Vessel (R/V) *Abraham Lincoln*, a 23-foot (ft)-long aluminum Scully survey platform. Sediment probing and field photography were completed concurrent with the remote sensing work aboard a 20-ft aluminum EA workboat to facilitate COVID-19 (novel coronavirus disease of 2019)-related social distancing requirements.

Sediment sampling was conducted during the second phase of the field effort, from 22 June through 4 July 2020. Samples were collected from the Ocean Surveys, Inc. (OSI) R/V *Candu*, a 35-ft-long aluminum pontoon-type vessel with a 25-ft-tall derrick-mounted pneumatic vibracore, as well as EA's 26-ft motor vessel (M/V) *Chinook*. An EA field team member was present onboard the R/V *Candu* during sampling. DNR was present onsite periodically to observe coring and processing activities and was involved in daily field decision-making throughout the sampling effort. Sample locations and depths below the sediment-water interface were determined prior to the second phase of the field effort based on bathymetry and sub-bottom profiling results and were adjusted in the field to collect samples spatially and to depths capturing the extent of observable impacts at the target locations to meet the sampling objectives defined by DNR. Cores were processed at the Sea Service warehouse in Superior, Wisconsin. All field operations, including sample planning, collection, and processing, were performed in coordination with DNR. The analytical testing methods were carried out in accordance with procedures outlined in the QAPP and FSP (EA 2020). Field modifications from the QAPP/FSP sampling procedures were approved by DNR.

2.1 GEOPHYSICAL SURVEYING EFFORT

Geophysical surveying efforts, including precision multibeam bathymetric, sub-bottom profiling, and an acoustic dock wall survey, were conducted prior to sediment sampling (27 April through 3 May 2020) to establish a current basemap of the project area. In addition, the completion of these efforts provided the water depths, bottom elevations, and sediment thickness data necessary for future evaluations of the volumes of sediment that could be removed as part of future remediation efforts. The multibeam bathymetric and sub-bottom profiling surveys were completed in the Hallet Dock 8 Slip, Oil Barge Dock Slip, General Mills Slip, and Tower Avenue Slip. However, the dock wall acoustic surveys were only completed within the Oil

Barge Dock and Tower Avenue Slips due to funding limitations and prioritization of slip walls with known or suspected failures (Figure 1-2, 2-1 through 2-3). Additional information on the methodology of the bathymetric survey, sub-bottom profiling, and acoustic survey including documentation during the survey effort is provided in Appendix A. Appendix A Attachment 1 includes copies of the daily logbook and field notes; ASE's report is provided in Appendix A Attachment 2; acoustic imagery produced by the wall surveys is provided in Appendix A Attachment 3.

Prior to the geophysical survey efforts, EA coordinated with Central Marine Logistics to move the M/V *Ryerson* from the Tower Avenue Slip (Figure 1-2) in Superior to the Fraser Shipyard in Superior. The movement of the vessel in early November 2019 provided the opportunity to collect bathymetric soundings, evaluate the condition of the dock wall, and complete sediment sampling activities in a significant portion of the Tower Avenue Slip.

2.2 SAMPLE COLLECTION

Mobilization for the sediment sampling field effort commenced on 19 June 2020. Vibracore sampling began aboard the M/V *Candu* provided by subcontractor OSI on 22 June 2020 and continued through 4 July 2020. Surface grab sampling (via ponar grab) began aboard EA's M/V *Chinook* on 24 June 2020 and continued through 4 July 2020.

Coordinates of proposed sediment sample locations were provided to EA by DNR. Prior to the field effort, but after the finalization of the QAPP, proposed target locations were adjusted and sampling intervals were added based on review of historical data, multibeam bathymetry and sub-bottom profiling results, and discussion with DNR. During the field effort, actual sampling locations were adjusted in certain areas based on field observations, field conditions, and coordination with DNR. Actual sample locations are depicted in Figures 2-4 through 2-10. The coordinates for each location sampled and details of sample collection, including penetration and recovery, are included in Tables 2-2 and 2-3 for surface grab samples and core samples, respectively.

Staging for the field effort was conducted at Sea Service's warehouse in Superior, Wisconsin. A temporary core processing area was set up at the warehouse and included a designated area for core logging and sample processing, decontamination of sampling equipment, a refrigeration truck for core and sample storage, and a support area for oversight and data management activities, including electronic sample management and tracking with Scribe software.

The sample naming convention included, as the first field, the general project area and year collected (ND20 includes ND as "North End District" and "20" for the year 2020). The second field in each sample name indicates the assessment area and sample location number. Assessment area designations are as follows:

- Hallet Dock Slip – HD
- Oil Barge Dock – BP
- General Mills Slip – GM

- Tower Avenue Slip – TB
- Estuary Flats – EF
- Clough Island – CL
- Reference location – REF
  - KB – Kimballs Bay
  - LF – Loonsfoot Landing
  - SB – Superior Bay
  - SLB – St. Louis Bay.

The third field, "0320," indicates the bottom of the sample interval measured in feet below sediment surface. For the 0 to 0.3 ft interval, the third field was designated as "SURF" to indicate a surficial sample. As an example, the analytical sample ND20-HD01-SURF is the surface (ponar grab) sample (0.0 to 0.3 ft) collected from location 01 in the Hallet Dock, and ND20-BP03-2040 is the sediment sample collected from location 03 in the Oil Barge Dock from the 2.0 to 4.0 ft interval.

Logs of sample collection activities, sampling locations, water depths, and core recoveries were recorded in permanently bound logbooks with indelible ink. Personnel names, local weather conditions, and other information that impacted the field sampling program were also recorded. Each page of the logbook was numbered and dated by the personnel entering information. Lithologic logs were completed for each final sampling location describing the full length of the sediment core. Logs were also completed for each surface sample. Copies of the field logbooks and lithologic logs for the cores provided in Appendixes B and C, respectively. A photographic record containing photos of the ponar grabs and cores is presented in Appendix D.

2.2.1 Surface Samples

A total of 89 of the planned 91 surface sediment samples were successfully collected using a ponar grab sampler. Due to heavy woody debris and detritus at the head of the Oil Barge Dock, a surface sample could not be collected using the ponar grab sampler at locations BP01 and BP02. Sampling procedures for those locations are discussed in Section 2.5.

The ponar grab sampler was mechanically deployed and retrieved from the M/V *Chinook* as described in the FSP and EA Standard Operating Procedure 021 (EA 2020). A Trimble SPS461 global positioning system (GPS) paired with a laptop computer running HYPACK marine positioning software was used to navigate to the sampling locations. To enhance the positional accuracy of the Trimble SPS461 GPS receiver, corrections for the satellite positioning data were received in real time through a subscription to the Wisconsin Continuous Observing Reference Station (WISCORS) network. A wireless hotspot allows the Trimble SPS461 GPS receiver to interface directly with the WISCORS network and derive corrections to the satellite positioning information in real time. Following the application of the WISCORS corrections, the positional information generated by the roving Trimble R8 Global Navigation Satellite System (GNSS) receiver unit yielded position fixes with a geodetic accuracy of 5 centimeters in the horizontal plane and 5 centimeters in the vertical plane. Surface sample locations for the North End District and Clough Island Sediment Characterization are depicted in Figures 2-4 through 2-10. Sample location details are provided in Table 2-2.

The procedure for collecting surface samples via ponar included deploying the sampler off of the edge of the boat, retrieving the sampler to the boat deck, decanting water at the top of the sampler, and transferring the sediment into an appropriate pan. A decontaminated stainless-steel tray was used to capture the sediment as it was transferred from the ponar. A digital photograph of the sediments was captured, and volatile organic compound (VOC) samples were collected (if appropriate). Once the VOC samples were collected (if appropriate), the sediments were homogenized, and transferred to laboratory-approved containers, labeled, and stored on ice in coolers.

2.2.2 Sediment Cores

A total of 66 out of the planned 67 locations were successfully sampled (refusal was encountered at GM13 as described in Section 2.5.3) using the vibracoring system onboard the M/V *Candu.* Coordinates and core recovery details are provided in Table 2-3.

The pneumatic vibratory coring system utilized by OSI consisted of a 4-inch (in.)-diameter steel core barrel, fitted with an internal dedicated cellulose acetate butyrate liner (3.75-in. inner diameter) that was driven into the seabed by a top-mounted, air-powered hammer device. An air compressor mounted on the deck of the M/V *Candu* was connected to the vibratory head via supply and exhaust hoses that provide the power necessary to drive the vibratory core barrel into the lakebed. The core barrel was penetrated to the prescribed depth or refusal, and then retrieved using an onboard hydraulic winch and 24-ft-tall derrick. Following core collection, the core liner was removed from the coring unit and excess liner was cut just above the sediment-water interface with a saw.

Following collection, each core was capped at both ends, sealed, and measured. Each core was labeled with the location number and orientation (top and bottom) of core. Sediment cores were stored upright in a cooler onboard the M/V *Candu*, and then transferred to a refrigeration truck (cooled to 4 degrees Celsius [°C]) at the onshore staging area. The cores were stored in a vertical position in a secured refrigeration truck until they were processed.

2.3 SAMPLE PROCESSING

Sediment sample processing was performed onboard the M/V *Chinook* and onshore at a temporary staging location at Sea Service’s warehouse in Superior, Wisconsin. Ponar grab samples were processed on the M/V *Chinook* at the time of collection. At the processing facility, cores were split, photographed, lithologically logged, and the target depth intervals sampled in accordance with the QAPP and field-based decisions agreed upon by DNR and EA. Summaries of sample quantities submitted for laboratory analysis in each area are provided in Tables 2-4 through 2-10; a total summary of project sample quantities is provided in Table 2-11.

Additional samples were taken from deeper intervals than listed in the QAPP if the sample showed evidence of contamination or when the location was of particular interest to DNR. These deviations from the QAPP are noted in Section 2.5.

Samples were homogenized by removing material collected from the designated depth interval and placing into a dedicated disposable aluminum pan, and then mixing with decontaminated stainless-steel tools until consistency was uniform. Sediment samples were packaged and shipped in accordance with EA standard operating procedures as listed in the QAPP (EA 2020). Lithologic and photographic logs of sediment cores are included in Appendix B and C, respectively. Sampling tools that came in contact with the sediment were decontaminated as described in the FSP (EA 2020). Excess sediments from core processing were be containerized and disposed of appropriately (Appendix J).

2.4 ANALYTICAL PROGRAM

Analytical samples were submitted to Eurofins TestAmerica Laboratories, Inc. (Eurofins TestAmerica) in Burlington, Vermont and Pittsburgh, Pennsylvania.

Each sediment sample was analyzed for the following: Target Analyte List (TAL) metals including mercury, Target Compound List (TCL) semivolatile organic compounds (SVOCs) (including 18 PAHs), total organic carbon (TOC), grain size, and moisture content. Selected samples were also analyzed for additional analyte groups, including alkylated PAHs, TCL VOCs, dioxins/furans, organotins, aliphatic hydrocarbons, and microscopic analysis of coal particles. Select sediment samples were identified for toxicity testing based on limited historical data and following consultation with DNR. Acute toxicity bioassays, chronic toxicity bioassays, and bioaccumulation exposures were conducted for these samples, using the 10-day *Chironomus riparius* test, the 28-day + 4-hour ultraviolet (UV) light *Hyalella azteca* test, and the 28-day *Lumbriculus variegates* test, respectively. The analyses performed at each location are summarized in Tables 2-4 through 2-10; Table 2-11 includes a summary of samples collected across all areas.

Samples were shipped in ice-filled coolers via FedEx or UPS with a separate chain-of-custody form and airbill. Field splits (FSs), field duplicates (FDs) and matrix spike/matrix spike duplicate samples were submitted by individual analyte based on the total submitted number of samples for each analyte across the entire project, as indicated in the QAPP (EA 2020).

2.5 DEVIATIONS FROM THE QUALITY ASSURANCE PROJECT PLAN

2.5.1 Sample Vessel

Due to the Covid-19 Pandemic, the EPA R/V *Mudpuppy* was not available for the sampling effort as described in the QAPP (EA 2020). Surface sample collection was completed by EA aboard the M/V *Chinook* as described in Section 2.2.1. Vibracore samples at all locations were completed by OSI using the M/V *Candu* was described in Section 2.2.2.

2.5.2 Surface Grab Sample Collection

As discussed in Section 2.2, at the head of the Oil Barge Dock Slip there was a substantial number of woody debris, sticks, branches, and other detritus that prevented the successful collection of a surface grab sample using a ponar at locations BP01 and BP02. At location BP01, a surficial sample interval (0.0 to 0.3 ft) was collected from the core that was collected by OSI at that location. As the core did not have enough volume for the full planned analytical suite for the surface sample, priority analyses (alkylated PAHs, SVOCs, metals, VOCs, and TOC) were submitted per discussions with DNR. A decontaminated stainless-steel shovel was used to collect surficial sediments from BP02. Using waders, EA personnel cleared an area of woody debris and detritus from the BP-02 area. The sediments were then scooped from the bottom, and slowly raised through the water column as to prevent the loss of fine-grained material from the sample. Once above the surface of the water, the sample was deposited into a decontaminated stainless-steel pot for homogenization. VOC samples were collected from a single scoop prior to the homogenization of the sediments.

2.5.3 Core Collection

With the exception of GM13, a core was successfully collected at each planned location in accordance with the QAPP (EA 2020). At location GM13, the vibracore hit refusal after 1.1 ft of penetration. The sediments remained in the core cutter and catcher; however, there was not enough penetration that any sediments entered the core liner, making the collection and preservation of an intact core sample unattainable. Per conversations with DNR, additional attempts to achieve greater penetrations and obtain a core sample at location GM-13 were not executed.

Additional samples were taken from deeper intervals than listed in the QAPP if the sample showed evidence of contamination or when the location was of particular interest to DNR.

2.5.4 Sample Processing and Analysis

Sample processing and analysis proceeded in general as planned in the QAPP (EA 2020). Consultation with DNR prior to and during the field sampling effort led to modification in sample core depths and sample intervals. Based on observations in the field (including observations of odor, sheen, staining, elevated PID reading or other indicators of potential impacts), analytes were added to select sample locations and depth intervals. Tables 2-4 through 2-11 provide detail on the actual samples submitted for testing. Modifications from the QAPP were discussed and approved by DNR. The QAPP identified that aliphatic hydrocarbon analysis would be performed by Pace Analytical Services. Prior to execution of the field effort, however, Pace Energy Services changed in name to Microbial Insights due to Pace's divestment of the Knoxville lab that performed the analysis under subcontract to Eurofins TestAmerica. Analyses performed by Microbial Insights were completed consistent with the methods and reporting requirements specified in the QAPP (EA 2020).

2.6 SUPPLEMENTAL DATA

Supplemental sediment and tissue data collected previous to the 2020 field investigation are available and have been included in the report. The supplemental data are described by media in the sections below.

2.6.1 Sediment

Analytical data from recent sediment site characterization efforts conducted in the Superior Waterfront and Upper St Louis River (EA 2016 and EA 2017) and completed in coordination with EPA are available through the GLSED database. These data were used during the work planning stage to inform sample location and interval selection for the 2020 effort, and the results from these recent studies are considered relevant and useful as supplemental data for the 2020 data evaluation effort. The supplemental data were incorporated into the North End database and evaluated with the 2020 sample data. Reports from the 2016 and 2017 investigations include the following sample locations in each investigation areas:

Superior Waterfront (EA 2016)
Estuary Flats: SW15-SLB01
Hallet Dock 8 Slip: SW15-SLB02
Oil Barge Dock Slip: SW15-SLB03
General Mills Slip: SW15-SLB05, SW15-06, SW15-07
Tower Avenue Slip: SW15-SLB11 through SW15-SLB18

Upper St. Louis River (EA 2017)
Clough Island: SLR16-UR29, SLR16-31, SLR16-34, SLR16-35.

Sample locations for the supplemental data are provided on the figures included in Chapters 4 and 6.

2.6.2 Tissue

Laboratory bioaccumulation data for *Lumbriculus variegatus* are available from samples collected at four other sites in the SLRAOC: 40th Avenue West, Munger Landing, Mud Lake West, and Reservoirs. The data were collected by the Minnesota Pollution Control Agency, EPA, U.S. Army Corps of Engineers, or U.S. Fish and Wildlife Service (Great Lakes Environmental Center, Inc. 2015; Lake Superior Research Institute 2016; Bay West LLC 2017; Advanced Environmental Management Group 2016). The regional bioaccumulation data will be used to compare to bioaccumulation data collected from the North End District and Clough Island. The available data from each site are summarized below.

Site	Area Description	Year	Coordinates Available?	Sediment Samples for Bioaccumulation Testing	Tissue Replicates	Tissue Bioaccumulation Analyses
40th Avenue West	Between the North End District and Clough Island on Minnesota shore	2014	No	• 19 samples • 2 reference samples • 3 pre-test samples	5 replicates per sample	• lipids, • moisture, • PAHs, • metals, • PCB Aroclors, • dioxins and furans.
Munger Landing	West of Clough Island	2016	No	• 4 samples • 1 pre-test sample	5 replicates per sample analyzed for metals. Replicates composited for other analyses.	Composite tissue: • dioxins, • PCBs, • Tetrachloro-m-xylene, • Decachlorobipheny l, • Lipids. Replicates: • metals.
Mud Lake West	Upstream of Clough Island on the Minnesota shore	2016	Yes	• 3 samples • 1 pre-test sample • 1 lab control sample from West Bear Skin Lake	5 replicates per sample	• nickel, • zinc, • dioxins and furans, • lipids.
Reservoirs	Upstream of the North End District	2016	No	• 2 samples from Scanlon Reservoir • 4 samples from Thomson Reservoir • 1 sample from Boulder Reservoir (reference) • 1 pre-test sample	5 replicates per sample. Replicates composited for tissue analyses.	• methylmercury, • mercury, • lipids, • dioxins and furans.
		2017	Yes	• 5 samples from: -Boulder Reservoir -Scanlon Reservoir -Thomson Reservoir	5 replicates per sample	• dioxins and furans, • lipids.
		2019	Yes	• 5 samples from: -Erie Pier Pond -Boulder Reservoir -Scanlon Reservoir -Thomson Reservoir	5 replicates per sample	• PCBs and PAHs (Erie Pier Pond only) • dioxins and furans, • lipids.

3. GEOPHYSICAL SURVEY

3.1 HALLET DOCK 8 SLIP

The results of the bathymetric survey and sub-bottom profiling for Hallet Dock 8 Slip are included in Appendix A and are summarized in the subsequent sections.

3.1.1 Bathymetry

Water depths within the slip ranged from 10 ft in the extreme southeastern corner to 37 ft near the northeastern corner of the Hallet Dock 8. An overall average water depth of 29 to 30 ft was found in the majority of the slip. When the survey data were presented as lakebed elevation values, the bottom topography relative to International Great Lakes Datum of 1985 (IGLD85) was derived (Figure 3-1). As would be expected, the lowest elevations (564 ft) corresponded to the north-south oriented trough feature within the Hallet Dock 8 Slip. The highest elevations were documented along a ridge of sediment that exists along the eastern slip wall (590 ft) and a shoal of material at the northern limits of the BP Oil Dock (598 ft).

3.1.2 Sub-bottom Profiling

In general, the data were representative of a disturbed or modified bed with multiple, discontinuous strata visible in the top 15 to 20 ft of penetration. Three principal material types with different acoustic signatures at varying thicknesses comprised the sediment column.

3.2 OIL BARGE SLIP

The results of the bathymetric survey, sub-bottom profiling, and acoustic wall survey for Oil Barge Slip are included in Appendix A and are summarized in the subsequent sections.

3.2.1 Bathymetry

Shallow water and debris (timbers associated with a failing bulkhead) prevented access and complete coverage of the water body. Water depths ranged from 3 ft to 25 ft in the slip. When the bathymetric data were presented as lakebed elevation values, the bottom topography relative to IGLD85 was derived (Figure 3-2). In general, a topographic high point of 598 ft was measured in the southeast corner of the Oil Barge Dock Slip. The lowest elevations within the slip (576 ft) were encountered at the mouth of the slip and near its centerline. The bottom elevations at this location may be a relic of prior dredging, while shoaling just north of the slip opening appears to be filling the original access channel along the east and west margins, gradually increasing elevations to 581 and 582 ft.

3.2.2 Sub-bottom Profiling

Similar to the Hallet Dock 8 Slip, the sediment column displays evidence of a significantly disturbed or modified bed with several discontinuous strata visible in within 15 to 20 ft of the sediment-water interface. Three principal material types, each with unique acoustic signatures that were a product of either physical composition and/or degree of disturbance, were detected within sediment column. Recently deposited fine-grained sediments (silts) overlying mixed or chaotic layers of material were noted in the upper sediment column, while bedded, homogenous parent sediments (silty clays) were found at depth within the profile.

3.2.3 Acoustic Wall Survey

The west wall of the Oil Barge Dock slip retains a portion of the fill material used to create the BP Oil Barge Dock in 1907. The west wall appears to consist of a robust concrete cap placed on compacted fill material originally used to cover the freshwater marshland and replace the trestle system used to service a platform constructed in deeper water to the north.

The east wall of the Oil Barge Dock Slip retains a portion of the fill material used to expand the Great Lakes Coal and Dock Company Dock (now Midwest Energy Resources Dock) in 1919. The east wall is the product of different construction techniques employed in different timeframes. As a result, the condition of the wall segments at the time of the survey was directly dependent upon the construction technique employed, the material used, and the age of each segment.

3.3 GENERAL MILLS SLIP

The results of the bathymetric survey and sub-bottom profiling for General Mills Slip are included in Appendix A and are summarized in the subsequent sections.

3.3.1 Bathymetry

When corrected and referenced to the Low water datum (LWD) for Lake Superior, water depths within the confines of the slip ranged from 2 ft to 38 ft. An overall average water depth of 24 ft existed in the majority of the slip, while the waters in South Channel (north of the docks) were considerably deeper. When the survey data were presented as lakebed elevations relative to IGLD85, the bottom features within the General Mills Slip and adjacent areas displayed the same basic morphology but were referenced to a different vertical plane (Figure 3-3). As would be expected, the lowest elevations (560 ft) corresponded to the large trough feature northeast of the Midwest Energy Resources Dock. The highest elevations were documented along a ridge of sediment to the west of the slip that represents the ruins of the Great Northern Dock (599 ft), as well as the shoal of material at the northeastern limits of the survey area.

3.3.2 Sub-bottom Profiling

Similar to the other slips surveyed as part of this investigation, the acoustic profiles displayed evidence of multiple, distinct sediment strata within the upper sediment column. In general, fine-grained, lower density sediments (silts) with thicknesses ranging from 1 to 4 ft were found over intervals of mixed or chaotic layers of material. These mixed strata were 2 to 6 ft thick and commonly comprised of intervals of sand or sand mixed with silts and clays. The parent sediment was determined to be a homogenous, fine sand that resided below the localized disturbances caused by construction activity or repeated dredging to maintain suitable water depths for vessels utilizing the General Mills Dock.

3.4 TOWER AVENUE SLIP

The results of the bathymetric survey, sub-bottom profiling, and acoustic wall survey for Tower Avenue Slip are included in Appendix A and are summarized in the subsequent sections.

3.4.1 Bathymetry

Similar to the Oil Barge Dock Slip, shallow water and debris (trees and anthropogenic) prevented and complete coverage of the water body at the southwestern limits. When the bathymetric data were presented as lakebed elevation values, the bottom topography relative to IGLD85 was derived (Figure 3-4). In general, the topographic high points of 600 ft were detected at the northern end of the CHS Dock, as well as along the banks at the headwaters of the slip. The lowest elevation within the slip (561 ft) was measured at the entrance to the slip in proximity to the northwestern corner of the CHS Dock. The topographic low was a bottom depression caused by propeller wash of larger, loaded ships entering or leaving the berth. The elevations on the western side of the slip centerline were generally higher due to considerable shoaling and the lack of a need to dredge that side of the slip.

3.4.2 Sub-bottom Profiling

In general, the results for the Tower Avenue Slip were comparable to those derived for the General Mills Slip. Deposits of fine-grained material (silts) of varying thickness were detected at the sediment-water interface throughout the survey area. These lower density silts resided over mixed intervals of sand, silt and clay that comprise a layer of sediment that has been periodically disturbed by dredging, vessel movements, and other industrial activities within the slip.

3.4.3 Acoustic Wall Survey

The west wall of the Tower Avenue slip retains the fill material used to create the current Paper Calmenson Dock during its original construction in the late 1800s. The west wall appeared to consist of solid concrete above and below the waterline with little textural differences noted along the first 785 ft of the structure. In general, the wall surface residing under the waterline and behind the pilings appears intact, while sections of the wall above the waterline display a considerable amount of deterioration and spalling over its length.

The east wall of the Tower Avenue slip retains the fill material deposited in the late 1880s and used to create the structure now known as the CHS Dock. The entire east wall is comprised of steel sheet pile, and with one exception, appeared to be intact and in good condition.

The southeast wall of the Tower Avenue slip retains the fill material used to the create the base of the CHS Dock where it tied into the original Tower Bay shoreline and was comprised of concrete and timber. Similar to the west wall in the Oil Barge Dock Slip, the southeast wall in the Tower Avenue Slip appears to consist of a deteriorating concrete cap that was cast over the compacted fill material originally used to cover the freshwater marshland.

4. ANALCTICAL RESULTS FOR SEDIMENT

Site characterization data from the sampling effort in the North End District and Clough Island assessment areas are presented in Appendix E. Detected concentrations of constituents were compared to threshold, midpoint, and probable effects concentrations (TEC, MEC, and PEC) from DNR's Consensus-Based Sediment Quality Guidelines (SQGs) (Wisconsin DNR 2003), where available, and non-industrial and industrial direct contact and soil to groundwater residual contaminant levels (RCLs) or background threshold values (BTVs) under Wisconsin Administrative Code NR 720[1] as described in the QAPP (EA 2020); results of the data evaluation are summarized in Tables 4-1 through 4-7 and Appendixes E Attachment 1 (SQGs) and 2 (RCLs). Laboratory reports including microscopic coal reports, particle size results, and analytical laboratory reports are included in Appendixes F, G, and H respectively.

The analytical suite for each sample location was determined based on historical information and evaluated by EA in consultation with DNR. Each sediment sample location was analyzed for the following: TAL metals including mercury, TCL SVOCs (including 18 PAHs), TOC, grain size, and moisture content. Selected locations were also analyzed for additional parameters, including alkylated PAHs, TCL VOCs, dioxins/furans, organotins, aliphatic hydrocarbons, and microscopic analysis of coal particles.

4.1 DATA EVALUATION

The overall data quality objective for the project was to provide data of known and documented quality to characterize current site conditions within the North End District and Clough Island assessment areas. Data were validated by evaluating the completeness, correctness, and conformance of the data set against the method, standard operating procedure, or contract requirements documented in the QAPP (EA 2020). The overall data review and validation program attained the project objectives.

The validated data collected under this investigation were compared to Wisconsin DNR's SQGs to address the goals of this assessment (Wisconsin DNR 2003). Contaminant concentrations exceeding the applicable criteria were identified. Figures were prepared to visually present contaminant concentrations and identify potential focus areas within the study areas. The following sections provide detail on data treatment and processing. EA has prepared and submitted a Data Usability Assessment Report (DUAR) to summarize the data review and data validation performed on the data sets collected from the field investigation (EA 2021).

4.1.1 Data Validation

Analytical data were submitted to the Quality Assurance Technical Support Program of EPA's subcontractor, APTIM Federal Services, LLC, for 100% Tier I and 20 percent Tier II data validation as specified in the Great Lakes Legacy Act Data Reporting Standard (Version 5.0,

1 Default residual contaminant level (RCL) values for the direct contact and groundwater pathways are available in Excel spreadsheet format at https://dnr.wi.gov/topic/brownfields/soil.html (see RCL Spreadsheet; also includes cumulative hazard index and cancer risks) 10 NR 716.09(2)(f)1 and 3.

April 2020). Data validation included completeness and compliance checks, data assessment, and validation at Stage 2 following *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (Office of Solid Waste and Emergency Response No. 9200.1-85, EPA 540-R-08-005, 13 January 2009) in conjunction with the EPA *Contract Laboratory Program (CLP) National Functional Guidelines for High Resolution Superfund Methods, Organic, and Inorganic Data Review* (EPA 2016, 2017a, 2017b) to assess compliance with the laboratory Statement of Work.

4.1.2 Comparison to Sediment Quality Guidelines (SQGs)

SQGs were developed as informal (non-regulatory) guidelines for use in interpreting chemical data from analyses of sediments. Several biological-effects approaches have been used to assess freshwater sediment quality relative to the potential for adverse effects on benthic organisms, including the TEC/PEC (MacDonald et al. 2000) approach. The TEC and PEC levels were Fderived using concentrations with both effects and no observed effects (MacDonald et al. 2000). TECs typically represent concentrations below which adverse biological effects have been rarely observed, while PECs typically represent concentrations in the middle of the effects range and above which effects have been more frequently observed (MacDonald et al. 2000). Concentrations that are between the TEC and PEC represent incremental increases in toxicity; however, specific numerical values representing the degree of toxicity cannot be derived. The MEC is a concentration midway between the TEC and PEC concentrations.

Sediment concentrations were screened against the TEC, MEC, and PEC as described in the sections below. Supplemental data as described in Section 2.6 were included in data evaluations and summary tables. Data processing was completed in accordance with the considerations described in Sections 4.1.2 through 4.1.5. Given the extensive data set (including supplemental data) and to maintain consistency throughout the data evaluation process, field split and field duplicate samples were not included in tables, figures, summaries, and discussion in Chapter 4. Results for all samples including QA/QC samples are provided in Appendix E.

4.1.3 Comparison to Non-industrial and Industrial Direct Contact and Soil to Groundwater Residual Contaminant Levels

Sediment concentrations were also compared to default RCL non-industrial and industrial direct contact and soil to groundwater values for use in understanding future implications and application of requirements stated in NR 720, Wisconsin Administrative Code. Over 150 of the analytes evaluated were screened against RCL values. Given the extensive number of compounds with RCL values, the results of this screening are described in general in the sections below and detailed results are presented in Appendix E, Attachment 2. The results of this screening may be used in future decision making related to the disposal of contaminated materials. The direct contact and groundwater pathways are available in Excel spreadsheet format at https://dnr.wi.gov/topic/brownfields/soil.html (see RCL Spreadsheet; also includes cumulative hazard index and cancer risks) 10 NR 716.09(2)(f)1 and 3. For 16 metals, the RCL spreadsheet includes surficial soil BTVs in a separate column for use in comparing the metal concentrations in site soils. BTVs were used for screening site sediments where the BTV was above the RCL, including arsenic, manganese, and nickel.

4.1.4 Calculation of Totals for Polycyclic Aromatic Hydrocarbons and Polychlorinated Biphenyls

When calculating total PAHs, results that were J-qualified were calculated using the result value, and results that were U-qualified were calculated using one-half the method detection limit (MDL). Substituting one-half the MDL (not-detect [ND] = ½MDL) for each non-detect provides a conservative estimate of the concentration. This method, however, tends to produce results that are biased high, especially in data sets where many samples are non-detects. This overestimation is important to consider when comparing calculated total values to guidelines. The report text, tables, and figures are based on non-detects treated as one-half the MDL, given that the majority of samples were detects. Totals were also calculated using ND=0 and are included in results tables (Appendix E).

PAH18 totals were calculated summing the concentrations of the following individual PAHs : 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, and pyrene.

Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. The report text, tables, and figures are based on non-detects treated as zero, as the majority of PCB Aroclors were not detected.

4.1.5 Calculation of Toxicity Equivalency Quotients (TEQs)

The fish, mammal, and bird toxicity equivalency quotients (TEQs) for dioxin and furan congeners were calculated following the approach recommended by the World Health Organization (WHO) (Van den Berg et al. 1998). Each congener was multiplied by a WHO recommended toxicity equivalency factor for the appropriate receptor and then the congener concentrations were summed. The dioxin TEQs were calculated using ND = reporting limit (RL), ND=½RL, and ND=0. Substituting half the reporting limit (ND=½RL) for each value below the RL provides a conservative estimate of the concentration. This method, however, tends to produce results that are biased high, especially in data sets where the majority of samples are below the RL. The Kaplan-Meier estimation for non-detects was also performed on sediment data. The dioxin fish TEQ (ND=½RL) are used for comparison to the SQGs and RSLs (shown as TCDD TEQ or TCDD on Chapter 4 and 6 figures). Dioxin TEQs for each of the calculation methods are included in Appendix E.

4.1.6 Overlap in PAH and SVOC Results

Samples from the project were analyzed for PAH compounds using semivolatile organics SW846 8270; selected samples were analyzed for alkylated PAHs (34) EPA CLP

SOM02.4/SVOCS selected ion monitoring (SIM). The full scan analyses were reported with the full SOM02.4 compound list, which includes the PAH compounds (Appendix E, Attachment 3). For locations where both PAHs and SVOCs were analyzed, two results exist for individual PAH compounds. A comparison of the PAH18 totals from each method are provided in Appendix E, Attachment 3. In general, the difference is slight and does not result in an exceedance into a higher tier guideline (e.g., results do not change from TEC to MEC exceedance). The discussion of PAH18 values in the subsequent sections use the results from the SW846 method which was completed for samples from each location.

4.1.7 Limitations in Detection Limits

Screening values like the SQGs are derived based on conservative toxicity and exposure assumptions that do not take into account the analytical ability of standard procedures; consequently, the inability to achieve low values is a common occurrence, most frequently with the lower SQGs such as the TEC and MEC. Tables A-3a through A-3d of the QAPP present the MDLs and RLs for analyses by Eurofins TestAmerica, compared with the sediment screening levels (MacDonald et al. 2000; Wisconsin DNR 2003) and the Wisconsin RCL soil clean-up standards for the direct contact and groundwater pathways. To meet the objectives of the project, the MDL for each analyte for each sample should be less than the screening criteria. The MDLs for antimony and tributyltin are above the TEC sediment screening criteria. The MDLs for arsenic, thallium, and 1,2,3,7,8-PeCDD are above the non-industrial soil default RCL. The MDLs for 4 SVOCs (2,4-dinitrotoluene, 2,6-dinitrotoluene, atrazine, and pentachlorophenol), 17 SVOCs, 7 metals (antimony, arsenic, cadmium, cobalt, selenium, silver, and thallium), and 2,3,7,8-TCDD are above the Wisconsin groundwater RCL.

The uncertainty in results for these compounds is associated with equipment and laboratory abilities to quantitatively capture the presence of an analyte in a given medium. Factors such as the moisture content of samples, dilution factors, and sample mass considerations impact the ability of laboratory methods to achieve the low concentrations required to compare against certain SQGs. Additional detail on data usability is described in the DUAR (EA 2021).

4.1.8 Volatile Organic Compounds

Common VOC laboratory contaminants including acetone, methylene chloride, 2-butanone, and cyclohexane are frequently detected in both method blanks and site samples. These contaminants were detected at concentrations both close to the MDL and at concentrations greater than 10X the MDL in the samples collected under this investigation. Detailed in the DUAR, the following VOCs were detected in trip blanks and method blanks: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, chloroform, ethylbenzene, isopropylbenzene, methylene chloride, xylenes, and styrene. 1,1,2,2-Tetrachloroethane was only VOC detected in a trip blank. The VOCs detected in the trip blanks or method blanks were also detected in at least one sample. Methylene chloride was the VOC with the highest detected concentration.

4.2 HALLET DOCK 8 SLIP

Sediment was collected from six locations in the Hallet Dock 8 Slip area (HD-01 through HD-06). Samples were collected from the surface interval to a maximum of 4 ft below the sediment surface, with the exception of location HD-05 where samples were collected to a depth of 5 ft below the sediment surface based on core lithology and observation of potential contamination in the 3–4 ft interval. Samples were generally collected at 1-ft intervals. Refusal was not encountered at the locations in the Hallet Dock 8 Slip. Sediment recovery by location is provided in Table 2-3. Detailed lithographic descriptions of the cores are presented in Appendix C.

Exceedances of the TEC, MEC, and PEC in the Hallet Dock 8 Slip are summarized in Table 4-1 and Figures 4-1, 4-2, and 4-15 and detailed results are provided in Appendix E. Supplemental data described in Section 2.6 (EA 2016, 2017) are also included in Table 4-1 and Appendix E. Table 4-1 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.2.1 Lithology

The sediment cores collected within the Hallet Dock 8 Slip demonstrate a mixture of core profiles. Most cores were characterized by layers of very fine to medium sand, with some layers of silty sand, sandy silt, and sandy/silty gravel. Petroleum odors were observed in half of the cores within various sediment types and depths. Complete core logs and photographs are included in Appendixes C and D, respectively. A general description of cores collected during the investigation is included in the text that follows.

Cores collected in the Hallet Dock 8 Slip had varying lithology, but the majority of cores had layers of fine to medium sand. Three of the cores consisted of almost entirely sand (ND20-HD01, ND20-HD02, and ND20-HD03). Varying amounts of silt were abundant in three of the cores (ND20-HD04, ND20-HD05, and ND20-HD06) while two of these cores also contained layers of gravel (ND20-HD04 and ND20-HD06).

Petroleum odors were noted in three Hallet Dock 8 Slip cores (ND20-HD03, ND20-HD05 and ND20-HD-06) and a sheen was also observed for ND20-HD03. The core collected at ND20-HD03 contained a solid piece of wood taking up the entire 4-in. cross-section of the core.

4.2.2 Grain Size, Total Organic Carbon, and Coal

A total of 31 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method. Sediment in the Hallet Dock 8 Slip contained organic matter, with TOC ranging from 1,670 milligrams per kilogram (mg/kg) (0.2%) to 319,000 mg/kg (31.9%). TOC was not detected at four locations. TOC results are included on the individual analytical results tables (Appendix E).

Grain size data were collected from the surface interval at the 6 locations sampled in the Hallet Dock 8 Slip. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 6 submitted surface samples, 5 (83%) were primarily comprised (greater than 50%) of sand and gravel, and the remaining sample (17%) were primarily comprised of silt and clay. Surface grab samples with the highest percentage of sand (91%), silt (41%), clay (14%), and gravel (18%) were collected at locations ND20-HD06-SURF, ND20-HD01-SURF, ND20-HD04-SURF, and ND20-HD03-SURF, respectively. The surface samples within the Hallet Dock 8 Slip generally had decreasing silt/clay content and increasing sand content moving from the southernmost and internal parts of the slip to the northern entrance of the slip.

Microscopic coal results indicated that the 3 surface samples at the Hallet Dock 8 Slip ranged from 11% (ND20-HD01-SURF) to 27% (ND20-HD05-SURF) coal (Table 4-8).

Microscopic coal samples were taken from a depth of 1 to 2 ft below sediment surface at locations ND20-HD01, ND20-HD03, and ND20-HD05. Coal was not detected at ND20-HD01-1020. The layer that was sampled was a medium brown, dense, very fine sand which extended through to the bottom of the core; therefore, there was not likely to be coal below the 2 ft depth. Coal was detected at 32% at ND20-HD03-1020, but below 1.9 ft the lithology showed a medium brown, dense, very fine to medium sand that was unlikely to have coal. At ND20-HD05-1020, coal was measured at 8% (Table 4-8) and according to the lithology observations, the coal may have extended to deeper depths.

4.2.3 Volatile Organic Compounds

A total of 16 sediment samples at multiple depths intervals were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs. The following VOCs were detected in at least one sample: 1,2-dichloroethane, 2-butanone, acetone, methyl acetate, methylene chloride, and toluene. Toluene is the only detected VOC with SQG values and there were no exceedances (Table 4-1). Methylene chloride and toluene concentrations in at least one sample from the Hallet Dock 8 Slip exceed the groundwater RCL (Appendix E, Attachment 2).

4.2.4 Semivolatile Organic Compounds

A total of 36 sediment samples at multiple depth intervals were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results exceeded the SQGs at 7 of the 7 locations sampled for at least one SVOC. Exceedances of TEC guidelines occurred for 20 analytes, the MEC guideline was exceeded for 15 of the analytes, and the PEC guideline was exceeded for 12 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and naphthalene exceed the groundwater RCL; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene exceed the non-industrial RCL; and there were no exceedances of the industrial RCL.

Fifteen (42%) of the 36 samples exceeded the total 18 PAHs (ND=½RL) TEC, 6 (17%) samples exceeded the MEC, and no samples exceeded the PEC. In general, locations HD01, HD03, and HD04 showed more frequent exceedances of the SQGs or RCLs. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-1.

4.2.5 Polychlorinated Biphenyl Aroclors

A total of 6 sediment samples at multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 micrograms per kilogram (µg/kg), MEC of 368 µg/kg, and PEC of 676 µg/kg and there were no exceedances (Table 4-1). Individual Aroclor concentrations were compared to RCL values and there were no exceedances (Appendix E, Attachment 2).

4.2.6 Metals

A total of 36 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

There are 12 metals with SQG values. Metals results showed exceedances of the SQG values at 2 of the 7 locations sampled. Exceedances of the TEC occurred for 7 of 12 analytes, MEC guidelines were exceeded for 3 of 12 analytes, and PEC guidelines were exceeded for 2 of 12 analytes (manganese and nickel). The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-1.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 8 metals (aluminum, cadmium, cobalt, lead, mercury, nickel, selenium, and vanadium) (Appendix E, Attachment 2). The most frequent exceedances occurred at locations HD01 and HD06.

4.2.7 Dioxins/Furans

A total of 3 sediment samples were analyzed for dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at each of the 3 locations sampled. Exceedances of the TEC occurred for all 3 samples but the MEC guidelines and PEC guidelines were not exceeded. The number and percentage of samples exceeding SQGs are summarized in Table 4-1.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD and there were no exceedances of the non-industrial or industrial RCLs (Appendix E, Attachment 2).

4.2.8 Organotins

A total of 3 sediment samples were analyzed for organotins in accordance with EPA Method gas chromatography (GC)/mass spectrometry (MS) SIM and there were no detections (Table 4-1, Appendix E).

4.3 OIL BARGE DOCK SLIP

Sediment was collected from 17 locations in the Oil Barge Dock Slip area (BP-01 through BP-17). Samples were collected from the surface interval to a maximum of 20 ft below the sediment surface, as detailed in Table 2-5. Samples were generally collected on 2-ft intervals. Refusal was not encountered at the locations in the Oil Barge Dock Slip. Sediment recovery by location is provided in Table 2-3. Detailed lithographic descriptions of the cores are presented in Appendix C.

Exceedances of the TEC, MEC, and PEC in the Oil Barge Dock Slip are summarized in Table 4-2, Figures 4-3, 4-4, 4-15 and detailed results are provided in Appendix E. Supplemental data described in Section 2.6 (EA 2016, 2017) are also included in Table 4-2 and Appendix E. Table 4-2 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.3.1 Lithology

The sediment cores collected within the Oil Barge Dock Slip demonstrate a mixture of core profiles. Most cores were characterized by a combination of sand, silt, and clay with varying amounts of wood and organic material. Petroleum odors were noted in over half of the cores within various sediment types and depths. Complete core logs and photographs are included in Appendixes C and D, respectively. A general description of cores collected during the investigation is included in the text that follows.

Cores collected in the Oil Barge Dock Slip had varying lithology, but the majority of cores had layers of a combination of sand, silt, and clay. Two of the cores consisted of almost entirely sand (ND20-BP06, and ND20-BP15). Deeper layers of 12 of the cores contained clay (ND20-BP-01, ND20-BP02, ND20-BP03, ND20-BP05, ND20-BP07, ND20-BP08, ND20-BP09,

ND20-BP10, ND20-BP11, ND20-BP12, ND20-BP13, and ND20-BP14). Each of the 17 cores contained varying amount of silt. Each of the cores except ND20-BP06 and ND20-BP13 contained at least small amounts of gravel in at least one of the reported layers. Cores with at least one layer with more than trace amounts of gravel include ND20-BP02, ND20-BP05, ND20-BP07, ND20-BP08, ND20-BP09, ND20-BP10, ND20-BP12, ND20-BP14, ND20-BP15, and ND20-BP-16.

Petroleum odors and/or a sheen were present in all but five Oil Barge Dock Slip cores (ND20-HD01, ND20-BP12, ND20-BP13, ND20-BP15, and ND20-BP17). Nine cores contained layers that included wood pieces (ND20-BP01, ND20-BP02, ND20-BP03, ND20-BP10, ND20-BP11, ND20-BP12, ND20-BP14, ND20-BP15, and ND20-BP16).

4.3.2 Grain Size, Total Organic Carbon, and Coal

A total of 125 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method. Sediment in the Oil Barge Dock Slip contained organic matter, with TOC ranging from 5,120 mg/kg (0.5%) to 500,000 mg/kg (50.0%). TOC was not detected at two locations. TOC results are included on the individual analytical results tables (Appendix E).

Grain size data were collected from the surface interval at 16 locations in the Oil Barge Dock Slip (grain size data were not collected at BP01). Surface samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 16 submitted surface samples, 5 (31%) were primarily comprised (greater than 50%) of sand and gravel, and the remaining 11 samples (69%) were primarily comprised of silt and clay. Surface grab samples with the highest percentage of sand (89%), silt (56%), clay (55%), and gravel (4.9%) were collected at locations ND20-BP03-SURFTOX, ND20-BP17-SURF, ND20-BP09-SURF, and ND20-BP15-SURF, respectively. The surface samples within the Oil Barge Dock Slip generally had similar grain sizes throughout the slip.

Microscopic coal results indicated that the 11 surface samples at Oil Barge Dock Slip ranged from 3% (ND20-BP07-SURF, ND20-BP11-SURF, and ND20-BP15-SURF) to 88% (ND20-BP03-SURF) coal. Percent coal in the surface samples was very high for ND20-BP02-SURF (85%) and ND20-BP03-SURF (88%) compared to the other 9 surface samples which all had percent coal values less than 9% (Table 4-8).

Twenty-one microscopic coal samples were taken from depths ranging from 0.3 to 18 ft below sediment surface at 10 locations in the Oil Barge Dock Slip. Coal was detected in each sample. At locations ND20-BP12, ND20-BP16, and ND20-BP17, samples were taken only from 0.3 to 2 ft, all of which had coal measured at less than 5%. At locations ND20-BP01 and ND20-BP06 coal values were higher in the sample from 0.3 to 2 ft (72% and 15%, respectively) but dropped to less than 4% in the samples from 2 to 4 ft. Based on lithology, it does not seem likely that coal would be detected or detected at a high percentage at these locations deeper than 4 ft. At locations ND20-BP02 and ND20-BP05 coal was sampled only from 0.3 to 2 ft and 2 to 4 ft. Coal values at both locations and for both depths were high, increasing with depth at location ND20-BP02 (69% to 74%) and decreasing with depth at ND20-BP05 (47% to 23%). At

ND20-BP02 coal and petroleum odors were observed through a depth of 6.4 ft. At ND20-BP05, coal and petroleum odors were observed to 4.6 ft. At locations ND20-BP10, ND20-BP11, and ND20-BP15 coal was only sampled from 0.3 to 2 ft, but values ranged from 17% (ND20-BP15) to 61% (ND20-BP10). Based on the lithology, location ND20-BP10 would likely have minimal coal deeper than 2 ft because a layer of medium brown, dense, fine to medium sand spans from 1.1 to 7.2 ft. Location ND20-BP11 would also not likely have coal at deeper depths as the layer of black material with a sheen and odor only spans to a depth of 1.2 ft. At ND20-BP15, coal was observed through a depth of 2.4 ft. At location ND20-BP03, seven coal samples were taken from 2 to 18 ft in increments of 2 ft. The surface sample (ND20-BP03-SURF) had 88% coal, all of the samples below sediment surface from 2 to 14 ft had between 60% and 80% coal, and the deepest samples (ND20-BP03-1618) had 14% coal (Table 4-8).

4.3.3 Volatile Organic Compounds

A total of 131 sediment samples from multiple depths intervals were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs. The following VOCs were detected in at least one sample: 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2,4-trichlorobenzene, 1,2-dibromoethane, 1,2-dichlorobenzene, 1,2-dichloropropane, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-butanone, 2-hexanone, 4-methyl-2-pentanone, acetone, benzene, bromoform, carbon disulfide, chlorobenzene, chloroform, cis-1,2-dichloroethene, cyclohexane, ethylbenzene, isopropylbenzene, m,p-xylene, methyl acetate, methylcyclohexane, methylene chloride, o-xylene, styrene, tetrachloroethene, toluene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride. The SQG values are only available for: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, benzene, toluene, and xylenes (Table 4-2, Appendix E, Attachment 1). Concentrations of 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, and benzene were detected at concentrations exceeding the PEC in 5% of the samples and xylene concentrations were detected at concentrations exceeding the PEC in 13% of the samples.

Exceedances of the SQGs were limited to locations BP01, BP02, BP03, and SW15-SLB03. Results are summarized in Table 4-2; a full set of the validated data is provided in Appendix E.

Concentrations of the following VOCs exceeded the groundwater RCL in at least one sample from the Oil Barge Dock Slip (Appendix E, Attachment 2): 1,1,2,2-tetrachloroethane, 1,2-dibromoethane, 1,2-dichloropropane, 1,4-dichlorobenzene, acetone, benzene, bromoform, chloroform, cis-1,2-dichloroethene, ethylbenzene, methylene chloride, tetrachloroethene, toluene, trichloroethene, and vinyl chloride.

4.3.4 Semivolatile Organic Compounds

A total of 132 sediment samples from multiple depth intervals were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results exceeded the SQGs at 18 of the 18 locations sampled for at least one SVOC. Exceedances of TEC guidelines occurred for 20 analytes, the MEC guideline was exceeded for 16 of the analytes, and the PEC guideline was exceeded for 16 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and naphthalene exceeded the groundwater RCL; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene exceeded the non-industrial RCL; and benzo(a)pyrene exceeded the industrial RCL (Appendix E, Attachment 2).

Seventy-two (55%) of the samples exceeded the total 18 PAHs (ND=½MDL) TEC, 30 (23%) exceeded the MEC, and 19 (14%) exceeded the PEC. While exceedances of the PECs for individual SVOCs were observed at each location in the Oil Barge Dock Slip, the PEC was exceeded for 18 PAHs at locations BP01, BP02, BP03, BP04, BP06, BP10, BP11, and SW15-SLB03. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-2.

4.3.5 Polychlorinated Biphenyl Aroclors

A total of 13 sediment samples from multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg. There were two exceedances of the TEC (Table 4-2). Individual Aroclor concentrations were compared to RCL values and there were no exceedances (Appendix E, Attachment 2).

4.3.6 Metals

A total of 132 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results indicated exceedances of the SQGs at 16 of the 18 locations sampled. Exceedances of TEC occurred for 10 of 12 analytes, MEC guidelines were exceeded for 5 of 12 analytes, and PEC guidelines were exceeded for 4 of 12 analytes (arsenic, iron, lead, and manganese). The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-2.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 11 metals (aluminum, antimony, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, and vanadium), the non-industrial RCL was exceed for 3 metals (arsenic, iron, and lead), and the industrial RCL was exceeded for 2 metals (arsenic and lead) (Appendix E Attachment 2).

4.3.7 Dioxins/Furans

A total of 4 sediment samples were analyzed for dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at each of the 4 locations sampled. Exceedances of the TEC occurred for 4 samples, exceedance of the MEC guidelines occurred for 2 samples, and the PEC guideline was not exceeded. The number and percentage of samples exceeding SQGs are summarized in Table 4-2.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD and there were no exceedances of the non-industrial or industrial RCLs (Appendix E, Attachment 2).

4.3.8 Organotins

A total of 4 sediment samples were analyzed for organotins in accordance with EPA Method GC/MS SIM and there were no detections (Table 4-2, Appendix E).

4.4 GENERAL MILLS SLIP

Sediment was collected from 14 locations in the General Mills Slip area (GM-01 through GM-14). Samples were collected from the surface interval to a maximum of 10 ft below the sediment surface, as detailed in Table 2-6. Samples were generally collected on 2-ft intervals. Refusal was encountered at 4 locations (GM-01, GM-05, GM-12 and GM-13) in the General Mills Slip. Sediment recovery by location is provided in Table 2-3. Detailed lithographic descriptions of the cores are presented in Appendix C.

Exceedances of the TEC, MEC, and PEC in the General Mills Slip are summarized in Table 4-3, and detailed results are provided in Appendix E. Supplemental data described in Section 2.6 (EA 2016, 2017) are also included in Table 4-3, Figures 4-5, 4-6, 4-16 and Appendix E. Table 4-3 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.4.1 Lithology

The sediment cores collected within the General Mills Slip demonstrate a mixture of core profiles. Most cores were characterized by a combination of silt and clay near the top with fine and very fine sand at deeper depths. Petroleum odors were observed in only one core. Complete core logs and photographs are included in Appendixes C and D, respectively. A general description of cores collected during the investigation is included in the text that follows.

Cores collected in the General Mills Slip had varying lithology, but most cores had some combination of silt and clay near the top and fine to very fine sand at deeper depths. One core consisted of almost entirely sand (ND20-GM10). A brown fine to very fine sand exists in the deepest layer of 10 of the 13 cores (ND20-GM02, ND20-GM04, ND20-GM05, ND20-GM07, ND20-GM08, ND20-GM09, ND20-GM10, ND20-GM11, ND20-GM12, and ND20-GM14). The other 3 cores were dominated by silt and organics (ND20-GM01, ND20-GM03, and ND20-GM06). Core ND20-GM03 is the only core that exhibited a layer of gravel, although the layer only measured 1 in. in thickness.

In the General Mills Slip cores, a petroleum odor was noted in only ND20-GM01. Four cores contained layers that included wood pieces (ND20-GM01, ND20-GM02, ND20-GM04, and ND20-GM06).

4.4.2 Grain Size, Total Organic Carbon, and Coal

A total of 67 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method. Sediment in the General Mills Slip contained organic matter, with TOC ranging from 1,760 mg/kg (0.2%) to 100,000 mg/kg (10.0%). TOC was not detected at 3 locations. TOC results are included on the individual analytical results tables (Appendix E).

Grain size data were collected from the surface interval at 14 locations in the General Mills Slip. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 14 submitted surface samples, 2 (14%) were primarily comprised (greater than 50%) of sand and gravel, 11 samples (79%) were primarily comprised of silt and clay, and one (ND20-GM12-SURF) was comprised of equal parts sand and gravel, and silt and clay. Surface grab samples with the highest percentage of sand (80%), silt (51%), clay (43%), and gravel (1.7%) were collected at locations ND20-GM14-SURF, ND20-GM08-SURF, ND20-GM01-SURF, and ND20-GM12-SURF, respectively. The surface samples within the General Mills Slip generally had decreasing silt/clay contents and increasing sand content moving from the southernmost and internal part of the slip to the northern entrance of the slip.

Microscopic coal results indicated that the eight surface samples at the General Mills Slip ranged from 2% (ND20-GM14-SURF) to 12% (ND20-GM07-SURF) coal (Table 4-8).

Ten microscopic coal samples were taken from a depth of 0.3 to 4 ft at 6 locations in the General Mills Slip. Coal was detected in all samples and ranged from 1% at ND20-GM07-2040 to 8% at ND20-GM01-0320. For the four locations that had samples taken at both 0.3 to 2 ft and 2 to 4 ft (ND20-GM01, ND20-GM02, ND20-GM05, and ND20-GM07) the two layers had similar coal percentages. At ND20-GM12 and ND20-GM14 coal samples were only taken from 0.3 to 2 ft, both of which had 2% coal (Table 4-8).

4.4.3 Volatile Organic Compounds

A total of 3 sediment samples were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs. The only detected VOCs were 2-butanone and acetone, which do not have SQG values. There were no RCL exceedances observed for VOCs in the General Mills Slip. Results are summarized in Table 4-3; detailed results are provided in Appendix E.

4.4.4 Semivolatile Organic Compounds

A total of 67 sediment samples from multiple depths were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results exceeded the SQGs at 14 of the 14 locations sampled for at least one SVOC. Exceedances of TEC guidelines occurred for 19 analytes, the MEC guideline was exceeded for 18 of the analytes, and the PEC guideline was exceeded for 17 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and naphthalene exceeded the groundwater RCL; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene exceeded the non-industrial RCL; and benzo(a)pyrene exceeds the industrial RCL (Appendix E, Attachment 2).

Fifty-three (79%) of the samples exceeded the total 18 PAHs (ND=½RL) TEC, 28 (42%) exceeded the MEC, and 18 (27%) exceeded the PEC. While exceedances of individual SVOCs were observed at each location in the General Mills Slip, the sediment PEC value was exceeded for 18 PAHs at locations GM01, GM02, GM03, GM04, GM06, GM07, GM10, and GM12. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-3.

4.4.5 Polychlorinated Biphenyl Aroclors

A total of 22 sediment samples at multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg. There were 3 exceedances of the TEC and 1 exceedance of the MEC (Table 4-3). Individual Aroclor concentrations were compared to RCL values and Aroclor 1248 exceeds the non-industrial RCL (Appendix E, Attachment 2).

4.4.6 Metals

A total of 77 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results showed exceedances of the SQGs at 16 of the 17 locations sampled. Exceedances of the TEC occurred for 9 of 12 analytes, MEC guidelines were exceeded for 5 of 12 analytes, and PEC guidelines were exceeded for 2 of 12 analytes (lead and manganese). The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-3.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 11 metals (aluminum, antimony, cadmium, cobalt, copper, lead, mercury, nickel, selenium, silver, and vanadium); the non-industrial and industrial RCLs were not exceeded (Appendix E, Attachment 2).

The most frequent exceedances occurred for copper, iron, lead, and manganese. In general, locations GM01, GM02, GM03, and GM605 showed more frequent exceedances of the SQGs and RCLs.

4.4.7 Dioxins/Furans

A total of 3 sediment samples were analyzed for dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at each of the 3 locations sampled. Exceedances of the TEC occurred for 3 samples and exceedance of the MEC and the PEC guidelines occurred for 2 samples. The number and percentage of samples exceeding SQGs are summarized in Table 4-3.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD; the non-industrial RCLs were exceeded for 1,2,3,6,7,8-HxCDD, 1,2,3,7,8,9-HxCDD, 1,2,3,4,6,7,8-HpCDD, OCDD, 1,2,3,4,7,8-HxCDF, and 1,2,3,4,6,7,8-HpCDF; and industrial RCLs were exceeded for 1,2,3,4,6,7,8-HpCDD and OCDD (Appendix E, Attachment 2).

4.4.8 Organotins

A total of 39 sediment samples were analyzed for organotins in accordance with EPA Method GC/MS SIM. Tributyltin is the only organotin with SQG values or RCLs.

Concentrations were compared to the TEC, MEC, and PEC of 0.52, 1.73, and 2.94 µg/kg, respectively (Wisconsin DNR 2003). Organotin (tributyltin) results showed exceedances at 5 of the 11 locations sampled. The TEC was exceeded in 9 samples, the MEC in 8 samples, and the PEC in 7 samples. PEC exceedances were observed at sample locations GM09, GM11, and GM13. The number and percentage of samples exceeding SQGs for tributyltin are summarized in Table 4-3.

Tributyltin did not exceed RCL values (soil to groundwater RCL of 350,000 µg/kg, non-industrial RCL of 23,500 µg/kg, and industrial RCL of 350,000 µg/kg) (Appendix E, Attachment 2).

4.5 TOWER AVENUE SLIP

Sediment was collected from 22 locations in the Tower Avenue Slip area (TB-01 through TB-22). Samples were collected from the surface interval to a maximum of 20 ft below the sediment surface, as detailed in Table 2-7. Samples were generally collected on 2-ft intervals. Refusal was encountered at seven locations (TB-07, TB-13 through 17, and TB-21). Sediment recovery by location is provided in Table 2-3. Detailed lithographic descriptions of the cores are presented in Appendix C.

Exceedances of the TEC, MEC, and PEC in the Tower Avenue Slip are summarized in Table 4-4, and results are provided by sample and by location in Appendix E. Supplemental data described in Section 2.6 (EA 2016, 2017) are also included in Table 4-4, Figures 4-7, 4-8, 4-16 and Appendix E. Table 4-4 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.5.1 Lithology

The sediment cores collected within the Tower Avenue Slip demonstrate a mixture of core profiles. Most cores were characterized by a combination of silt and clay near the top with reddish brown very fine sand or fat clay at the bottom. Petroleum odors were noted in 7 of the 22 cores and a sheen was observed in only one. Complete core logs and photographs are included in Appendixes C and D, respectively. A general description of cores collected during the investigation is included in the text that follows.

Cores collected in the Tower Avenue Slip had varying lithology, but most cores had a combination of silt and clay near the top and reddish brown very fine sand or fat clay at the bottom. Reddish brown, high plasticity clay was observed at the bottom of six cores (ND20-TB09, ND20-TB13, ND20-TB14, ND20-TB15, ND20-TB19, and ND20-TB22). Medium brown or reddish brown, dense, very fine sand was observed at the bottom of 10 cores (ND20-TB01, ND20-TB02, ND20-TB03, ND20-TB04, ND20-TB07, ND20-TB10, ND20-TB11, ND20-TB17, ND20-TB18, and ND20-TB21).

In the Tower Avenue Slip cores, a sheen was present in only the core from ND20-TB01. In 7 cores a petroleum odor was noted (ND20-TB01, ND20-TB02, ND20-TB03, ND20-TB05, ND20-TB06, ND20-TB07, and ND20-TB11). Twelve cores contained layers that included wood pieces (ND20-TB01, ND20-TB02, ND20-TB04, ND20-TB06, ND20-TB07, ND20-TB08, ND20-TB10, ND20-TB12, ND20-TB13, ND20-TB20, ND20-TB21, and ND20-TB22).

4.5.2 Grain Size, Total Organic Carbon, and Coal

A total of 102 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method. Sediment in the Tower Avenue Slip contained organic matter, with TOC ranging from 1,510 mg/kg (0.2%) to 183,000 mg/kg (18.3%). TOC was not detected at one location. TOC results are included on the individual analytical results tables (Appendix E).

Grain size data were collected from the surface interval at 22 locations in the Tower Avenue Slip. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 22 submitted surface samples, 1 (5%) was primarily comprised (greater than 50%) of sand and gravel, and the remaining 21 samples (95%) were primarily comprised of silt and clay. Surface grab samples with the highest percentage of sand (65%), silt (52%), clay (61%), and gravel (6.9%) were collected at locations ND20-TB02-SURF, ND20-TB20-SURF, ND20-TB09-SURF, and ND20-TB14-SURF, respectively. The surface samples within the Tower Avenue Slip generally had a higher silt/clay contents near the southern portion of the slip where the slip is lined on each side by land, than the rest of the area.

Microscopic coal results show that the twelve surface samples at the Tower Avenue Slip ranged from 1% (ND20-TB10-SURF) to 9% (ND20-TB02-SURF) coal. Seven of the surface samples (ND20-TB01-SURF, ND20-TB03-SURF, ND20-TB04, ND20-TB05-SURF, ND20-TB10-SURF, ND20-TB15-SURF, and ND20-TB20-SURF) had 2% coal or less (Table 4-8).

Eight microscopic coal samples were taken from a depth of 2 to 4 ft. Coal was detected in each of the eight samples and ranged from 1% (ND20-TB05 and ND20-TB10) to 7% (ND20-TB04). Two coal samples were taken at a depth of 8 to 10 ft and ranged from 5% (ND20-TB03) to 9% (ND20-TB02). For locations ND20-TB08, ND20-TB09, and ND20-TB10, percent coal was low (< 4%) from 2 to 4 ft and would be expected to be low at deeper depths based on lithology. For locations ND20-TB01, ND20-TB04, ND20-TB05, ND20-TB06, and ND20-TB07, percent coal was low (< 7%) from 2 to 4 ft but might be expected to increase with depth before decreasing again with depth based on lithology. Deeper layers at locations ND20-TB02 and ND20-TB03 would be expected to have low to not detectable levels of coal starting at a depth of 17.1 ft and 10.6 ft, respectively (Table 4-8).

4.5.3 Volatile Organic Compounds

A total of 131 sediment samples from multiple depths intervals were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

The following VOCs were detected in at least one sample: 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 2-butanone, acetone, cyclohexane, isopropylbenzene, methyl acetate, methylcyclohexane, methylene chloride, o-xylene, tetrachloroethene, and toluene. SQG values are only available for: 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,4-dichlorobenzene, benzene, toluene, and xylenes (Table 4-4, Appendix E, Attachment 1). There were no SQG exceedances observed for VOCs in the Tower

Avenue Slip. Concentrations of 1,1,2,2-tetrachloroethane and methylene chloride exceed the groundwater RCL in at least one sample from the Tower Avenue Slip (Appendix E, Attachment 2). Results are summarized in Table 4-4, a full set of the results are provided in Appendix E.

4.5.4 Semivolatile Organic Compounds

A total of 116 sediment samples from multiple depths were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results exceeded the SQGs at each of the 25 locations sampled for at least one SVOC. Exceedances of TEC guidelines occurred for 19 analytes, the MEC guideline was exceeded for 18 of the analytes, and the PEC guideline was exceeded for 18 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, fluoranthene, naphthalene, and pyrene exceed the groundwater RCL; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a, h)anthracene, and indeno(1,2,3-c,d)pyrene exceeded the non-industrial RCL; and benzo(a)pyrene and dibenz(a,h)anthracene exceeded the industrial RCL (Appendix E, Attachment 2).

Ninety-two (79%) of the samples exceeded the total 18 PAHs (ND=½MDL) TEC, 45 (39%) exceeded the MEC, and 31 (27%) exceeded the PEC. While exceedances of individual SVOCs were observed at each location in the Tower Avenue Slip, the sediment PEC value was exceeded for 18 PAHs at locations TB01, TB02, TB03, TB04, TB05, TB06, TB07, TB08, TB09, SW15-SLB11, and SW15-SLB13. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-4.

4.5.5 Polychlorinated Biphenyl Aroclors

A total of 72 sediment samples from multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg. There were 39 exceedances of the TEC and 1 exceedance of the MEC and PEC at TB03 (Table 4-4). Individual Aroclor concentrations were compared to RCL values and Aroclor 1254 exceeds the non-industrial RCL at TB02 and TB03 (Appendix E, Attachment 2).

4.5.6 Metals

A total of 133 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results showed exceedances of the SQGs at each of the 30 locations sampled. Exceedances of TEC occurred for 12 of 12 analytes, MEC guidelines were exceeded for 9 of 12 analytes, and PEC guidelines were exceeded for 7 of 12 analytes (copper, iron, lead, manganese, mercury, silver, and zinc). PEC exceedances were observed at the following locations: TB01, TB02, TB03, TB04, TB05, TB06, TB07, TB08, TB09, TB19, TB20, TB22, SW15-SLB11, SW15-SLB13, and SW15-SLB15. The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-4.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 13 metals (aluminum, antimony, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, and vanadium) and the non-industrial and industrial RCLs were exceeded for 3 metals (arsenic, lead, and mercury) (Appendix E, Attachment 2).

4.5.7 Dioxins/Furans

A total of 11 sediment samples were analyzed or dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at each of the 7 locations sampled. Exceedances of the TEC occurred for 11 samples, exceedance of the MEC occurred for 7 samples, and the PEC guidelines were not exceeded. The number and percentage of samples exceeding SQGs are summarized in Table 4-4.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD; the non-industrial RCL was exceeded for 1,2,3,7,8-PeCDD; and industrial RCLs were not exceeded (Appendix E, Attachment 2).

4.5.8 Organotins

A total of 54 sediment samples were analyzed for organotins in accordance with EPA Method GC/MS SIM. Tributyltin is the only organotin with SQG values or RCLs.

Concentrations were compared to TEC, MEC, and PEC of 0.52, 1.73, and 2.94 µg/kg, respectively (Wisconsin DNR 2003). Organotin (tributyltin) results showed exceedances at 10 of the 18 locations sampled. The TEC was exceeded in 17 samples, the MEC in 14 samples, and the PEC in 12 samples. PEC exceedances were observed at sample locations TB16, TB19, TB20, TB21, TB22, SW15-SLB13, and SW15-SLB14. The number and percentage of samples exceeding SQGs for tributyltin are summarized in Table 4-4.

Tributyltin did not exceed RCL values (soil to groundwater RCL 350,000 µg/kg, non-industrial RCL 23,500 µg/kg and industrial RCL of 350,000 µg/kg) (Appendix E, Attachment 2).

4.6 ESTUARY FLATS

Sediment was collected from 18 locations in the Estuary Flats area (EF-01 through EF-18). Samples were collected from the surface interval to a maximum of 6 ft below the sediment surface, as detailed in Table 2-8. Samples were generally collected on 2-ft intervals. Refusal was not encountered in the Estuary Flats area. Sediment recovery by location is provided in Table 2-3. Detailed lithographic descriptions of the cores are presented in Appendix C.

Exceedances of the TEC, MEC, and PEC in the Estuary Flats are summarized in Table 4-5, Figures 4-9 and 4-10 and results are provided in Appendix E. Supplemental data described in Section 2.6 (EA 2016, 2017) are also included in Table 4-5 and Appendix E. Table 4-5 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.6.1 Lithology

The sediment cores collected within the Estuary Flats demonstrate a mixture of core profiles. Layers of sand were present in each of the eight cores with some cores also containing layers of silt, clay, and/or organics. No odor or sheen was present in any of the cores. Complete core logs and photographs are included in Appendixes C and D, respectively. A general description of cores collected during the investigation is included in the text that follows.

Cores collected in the Estuary Flats had varying lithology, but most cores had mostly sand near the top and either wood and other organics, or a mixture of some combination of clay, silt, and sand at the bottom. Cores with deeper layers containing wood and other organics include ND20-EF04, ND20-EF05, and ND2-EF06. Core ND20-EF08 contained almost entirely sand. Cores with deeper layers of silty clay or clayey sand included ND20-EF01, ND20-EF02, and ND20-EF07.

In the Estuary Flats, no sheen or odor was present in any of the cores. Five of the eight cores contained layers that included wood pieces (ND20-EF03, ND20-EF04, ND20-EF05, ND20-EF06, and ND20-EF08).

4.6.2 Grain Size and Total Organic Carbon

A total of 43 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method. Sediment in the Estuary Flats contained organic matter, with TOC ranging from 1,190 mg/kg (0.1%) to 461,000 mg/kg (46.1%). TOC was not detected at six locations. TOC results are included on the individual analytical results tables (Appendix E).

Grain size data were collected from the surface interval at the 18 locations sampled in the Estuary Flats area. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E.

Of 20 submitted surface samples, 13 (65%) were primarily comprised (greater than 50%) of sand and gravel, and the remaining 7 samples (35%) were primarily comprised of silt and clay. Surface grab samples with the highest percentage of sand (99%), silt (67%), clay (30%), and gravel (39%) were collected at locations ND20-EF06-SURF, ND20-EF10-SURFFD, ND20-EF15-SURF, and ND20-EF04-SURF, respectively. The surface samples within the Estuary Flats generally had varying grain sizes throughout the whole area.

4.6.3 Volatile Organic Compounds

A total of 34 sediment samples at multiple depths intervals were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs. The following VOCs were detected in at least one sample: 2-butanone, acetone, methylene chloride, and vinyl chloride. None of the detected VOCs have SQG values, but each of the detected VOCs have RCLs for comparison. Methylene chloride and vinyl chloride concentrations in at least one sample from Estuary Flats exceeded the groundwater RCL (Appendix E, Attachment 2).

4.6.4 Semivolatile Organic Compounds

A total of 43 sediment samples at multiple depth intervals were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results showed exceedances of the SQGs or RCLs at 12 of the 18 locations sampled. Exceedances of the TEC occurred for 18 analytes, the MEC was exceeded for 9 of the analytes, and the PEC was exceeded for 5 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and naphthalene exceed the groundwater RCL; benzo(a)pyrene and dibenz(a,h)anthracene exceeded the non-industrial RCL; and there were no exceedances of the industrial RCL (Appendix E, Attachment 2).

Twelve (28%) of the 36 samples exceeded the total 18 PAHs (ND= ½ the MDL) TEC and no samples exceeded the MEC or PEC. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-5.

4.6.5 Polychlorinated Biphenyl Aroclors

A total of 35 sediment samples at multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg and there was one exceedance of the TEC at EF03 (Table 4-5).

Individual Aroclor concentrations were compared to RCL values and there were no exceedances (Appendix E, Attachment 2).

4.6.6 Metals

A total of 50 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results showed exceedances of the SQGs at 9 of the 19 locations sampled. Exceedances of TEC guidelines occurred for 9 of 12 analytes, MEC guidelines were exceeded for 3 of 12 analytes (copper, iron, and manganese), and PEC guidelines were exceeded for 1 of 12 analytes (copper). The single PEC exceedance was observed at EF03. The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-5.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 11 metals (aluminum, antimony, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, and vanadium) and the non-industrial and industrial RCLs were exceeded for arsenic (Appendix E, Attachment 2).

4.6.7 Dioxins/Furans

A total of 7 sediment samples were analyzed or dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at 5 of the 7 locations sampled. Exceedances of the TEC occurred for 5 samples, exceedance of the MEC occurred for 2 samples, and the PEC guidelines were not exceeded. The number and percentage of samples exceeding SQGs are summarized in Table 4-5.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD; the non-industrial RCL was exceeded for 1,2,3,4,6,7,8-HpCDF; and industrial RCLs were not exceeded (Appendix E, Attachment 2).

4.7 CLOUGH ISLAND

Surface sediment was collected from 10 locations in the Clough Island area (CL-01 through CL-10). Samples were collected from the surface interval as detailed in Table 2-9. Refusal was not encountered in the Clough Island area. Sediment recovery and surface sample descriptions are provided in Table 2-2.

Exceedances of the TEC, MEC, and PEC in the Clough Island Area are summarized in Table 4-6, and results are provided in Appendix E. Supplemental data described in Section 2.6

(EA 2016, 2017) are also included in Table 4-6, Figures 4-11 and 4-12 and Appendix E. Table 4-6 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

4.7.1 Grain Size and Total Organic Carbon

Grain size data were collected from the surface interval at the 10 locations sampled in the Estuary Flats area. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 10 submitted surface samples, 2 (20%) were primarily comprised (greater than 50%) of sand and gravel, and the remaining 8 samples (80%) were primarily comprised of silt and clay. Surface grab samples with the highest percentage of sand (87%), silt (66%), clay (25%), and gravel (4.6%) were collected at locations ND20-CL10-SURF, ND20-CL09-SURF, ND20-CL05-SURF, and ND20-CL06-SURF, respectively. The surface samples within the Clough Island area generally had varying grain sizes throughout the whole area.

A total of 10 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method and ranged from 0.2% to 31.2% (1,800 mg/kg to 312,000). TOC results are included in Appendix E.

4.7.2 Semivolatile Organic Compounds

A total of 10 surface sediment samples were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results indicated exceedances of the SQGs or RCLs at 8 of the 10 locations sampled. Exceedances of the TEC occurred for 17 analytes, the MEC was exceeded for 8 of the analytes, and the PEC was exceeded for 5 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene exceeded the groundwater RCL; benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and dibenz(a,h)anthracene exceeded the non-industrial RCL; and there were no exceedances of the industrial RCL (Appendix E, Attachment 2).

Seven (70%) of the 10 samples exceeded the total 18 PAHs (ND=½MDL) TEC, 1 sample (10%) exceeded the MEC, and there were no samples that exceeded the PEC for total 18 PAHs. The number and percentage of samples exceeding SQGs for SVOCs including individual and total PAH compounds are summarized in Table 4-6.

4.7.3 Polychlorinated Biphenyl Aroclors

A total of 19 sediment samples at multiple depth intervals were analyzed for PCB Aroclors in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the SQG values: TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg and there was one exceedance of the TEC at UR34 (Table 4-6). Individual Aroclor concentrations were compared to RCL values and there were no exceedances (Appendix E, Attachment 2).

4.7.4 Metals

A total of 24 sediment samples from multiple depth intervals were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results showed exceedances of the SQGs at 12 of the 14 locations sampled. Exceedances of the TEC occurred for 10 of 12 analytes, MEC guidelines were exceeded for 5 of 12 analytes (chromium, iron, manganese, mercury, and nickel), and PEC guidelines were exceeded for 2 of 12 analytes (manganese and nickel). The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-6.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 11 metals (aluminum, antimony, arsenic, cadmium, cobalt, copper, lead, mercury, nickel, selenium, and vanadium) and the non-industrial and industrial RCLs was exceeded for arsenic. (Appendix E, Attachment 2).

4.7.5 Dioxins/Furans

A total of 19 sediment samples were analyzed or dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at 14 of the 14 locations sampled. Exceedances of the TEC occurred for 18 samples, exceedance of the MEC occurred for 7 samples, and exceedances of the PEC occurred for 4 samples. The number and percentage of samples exceeding SQGs are summarized in Table 4-6.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD; the non-industrial RCL was exceeded for 1,2,3,7,8-PeCDD, 1,2,3,6,7,8-HxCDF, and 1,2,3,4,6,7,8-HpCDF; and industrial RCLs were not exceeded (Appendix E, Attachment 2).

4.8 REFERENCE AREAS

Surface sediment was collected from 4 reference locations (SLBREF1, KBREF2, LFREF3, SBREF4). Samples were collected from the surface interval as detailed in Table 2-10. Refusal was not encountered in the reference areas. Sediment recovery and surface sample descriptions are provided in Table 2-2.

Exceedances of the TEC, MEC, and PEC in the Reference area samples are summarized in Table 4-7 and Figures 4-13, 4-14, 4-17 and results are provided in Appendix E. Table 4-7 includes the frequency of detection; maximum detected concentrations; the number of samples where the TEC, MEC, or PEC were exceeded; and the number of locations where SQGs were collectively exceeded. RCL exceedances are described in the text below and detailed in Appendix E, Attachment 2.

As shown in Table 4-7, a majority of the compounds analyzed in the Reference Areas were detected at concentrations exceeding the sediment TEC values. Far fewer compounds were observed exceeding the MEC value, these compounds included acenaphthene, dibenz(a,h)anthracene, iron, manganese, nickel. Only manganese was detected at one of the four Reference Area locations at concentration exceeding the PEC value.

When comparing Reference Area samples to the RCL values (Appendix E, Attachment 2), the soil to groundwater RCL was exceeded for methylene chloride, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, aluminum, cadmium, cobalt, lead, mercury, nickel, selenium, vanadium, and 2,3,7,8-TCDD. The non-industrial RCL was exceeded for benzo[a]pyrene, dibenz(a,h)anthracene, 1,2,3,7,8-PeCDD, 1,2,3,4,6,7,8-HpCDF (Appendix E, Attachment 2).

4.8.1 Grain Size and Total Organic Carbon

Grain size data were collected from the surface interval at the 4 reference area locations. Samples were analyzed in accordance with Method ASTM D422. Grain size results are included in Appendix E. Of 4 submitted surface samples, all 4 (100%) were primarily comprised (greater than 50%) of silt and clay. Surface grab samples with the highest percentage of sand (33%), silt (72%), and clay (43%) were collected at locations ND20-SBREF4-SURF, ND20-LFREF3-SURF, and ND20-SLBREF1-SURF, respectively. There was 0% gravel comprising each of the four reference location surface samples.

A total of 4 sediment samples were submitted for TOC analysis in accordance with the Lloyd Kahn Method and ranged from 2.8% to 5.5% (28,300 to 54,900). TOC results are included in Appendix E.

Microscopic coal results are reported for the four surface samples at the reference areas. Coal was not detected at ND20-SLBREF1, ND20-KBREF2, and ND20-SBREF4. Reference location ND20-LFREF3 had 1% microscopic coal (Table 4-8).

4.8.2 Volatile Organic Compounds

A total of 4 surface sediment samples were analyzed for VOCs in accordance with Method EPA SW846 8260D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

The following VOCs were detected in at least one sample: 2-butanone, acetone, and methylene chloride. SQG values are not available for the detected analytes. When compared to RCL values, methylene chloride exceeds the groundwater RCL (Appendix E, Attachment 2). Results are summarized in Table 4-7, and a full set of the validated data is provided in Appendix E.

4.8.3 Semivolatile Organic Compounds

A total of 4 surface sediment samples were analyzed for SVOCs (including 18 PAHs), in accordance with Method EPA SW 846 8270D. Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

SVOC results showed exceedances of the SQGs or RCLs at each of the 4 locations sampled. Exceedances of TEC guidelines occurred for 16 analytes, as well as the MEC for 2 of the analytes.

When compared to the RCL values, benzo(a)pyrene, benzo(b)fluoranthene, and chrysene exceeded the groundwater RCL; benzo(a)pyrene and dibenz(a, h)anthracene exceeded the non-industrial RCL; and none of the analytes exceeded the industrial RCL (Appendix E, Attachment 2).

Two samples exceeded the total 18 PAHs (ND=½MDL) TEC, and there were no samples that exceeded the MEC or PEC for 18 PAHs. The number and percentage of samples exceeding SQGs or RCLs for SVOCs including individual and total PAH compounds are summarized in Table 4-7.

4.8.4 Polychlorinated Biphenyl Aroclors

A total of 4 surface sediment samples were submitted for PCB Aroclor analysis in accordance with Method EPA CLP SOM02.4. Total PCB Aroclor concentrations were calculated by summing the concentrations of individual PCB Aroclors with NDs treated as 0. Total PCB Aroclor results were compared to the TEC of 60 µg/kg, MEC of 368 µg/kg, and PEC of 676 µg/kg and there were no exceedances (Table 4-7). Individual Aroclor concentrations were compared to RCL values and there were no exceedances (Appendix E, Attachment 2).

4.8.5 Metals

A total of 4 surface sediment samples were analyzed for TAL metals plus mercury (Method EPA CLP ISM02.4). Validated results were compared to the SQG values (TEC, MEC, and PEC) and RCLs.

Metals results showed exceedances of the SQGs at 3 of the 4 locations sampled. Exceedances of TEC guidelines occurred for 8 of 12 analytes, MEC guidelines were exceeded for 3 of 12 analytes (iron, manganese, and nickel), and PEC guidelines were exceeded for 1 of 12 analytes (manganese). The single PEC exceedance was observed at SLBREF1. The number and percentage of samples exceeding SQGs for individual metals are summarized in Table 4-7.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 8 metals (aluminum, cadmium, cobalt, lead, mercury, nickel, selenium, and vanadium) (Appendix E, Attachment 2).

4.8.6 Dioxins/Furans

A total of 4 sediment samples were analyzed or dioxin/furans analysis, in accordance with EPA Method 1613B. Dioxin fish TEQs were calculated (ND=½RL) for comparison to the SQG values (TEC, MEC, and PEC) and RCLs. Additional methods for TEQ summation (Section 4.1.3) were completed and are included in Appendix E.

Dioxin fish TEQ results showed exceedances of the SQG values at each of the 4 locations sampled. Exceedances of the TEC occurred for 4 samples and exceedance of the MEC and PEC occurred for 1 sample. The number and percentage of samples exceeding SQGs are summarized in Table 4-7.

When compared to the RCL values, the soil to groundwater RCL was exceeded for 2,3,7,8-TCDD; the non-industrial RCL was exceeded for 1,2,3,7,8-PeCDD and 1,2,3,4,6,7,8-HpCDF; and industrial RCLs were not exceeded (Appendix E, Attachment 2).

4.8.7 Organotins

A total of 4 sediment samples were analyzed for organotins in accordance with EPA Method GC/MS SIM and there were no detections (Table 4-7, Appendix E).

4.9 ALIPHATIC HYDROCARBON GAS CHROMATOGRAPHY

Samples collected in the St. Louis AOC in 2015 had high concentrations of PAHs (EA 2016 and 2017). In a 28 July 2017 Closure Not Recommended Letter, DNR requested that BP assess whether the Oil Barge Dock may have contributed to sediment contamination in the area. BP performed forensic analysis to determine the source of sediment contamination and concluded that the Dock was not a source (Antea Group 2017). DNR reviewed the analysis and independently evaluated the PAH results (Inman 2018). DNR found that there may be multiple sources and pathways (surface and subsurface) to the sediment contamination in the slip, but the Dock cannot be dismissed definitively based on the current information and analysis. Based on the PAH forensic analysis, historical transfer of petroleum products (gasoline, diesel, jet fuel, or crude oil) at the Dock, and the 100-year operational history at the Dock that mostly occurred prior to environmental law, the products transferred at the Dock are the most likely sources of

PAHs in the sediment. DNR recommended a detailed full scan GC/MS analysis for aliphatic hydrocarbons as well as microscopic analysis to detect coal particle, as suggested by Pace (Antea 2017). Therefore, a subset of the sediment samples collected in 2020 was submitted for GC/MS and microscopic coal analysis. The results of the microscopic coal analysis are presented in Table 4-8, and the discussed in the sections above for each area. The results of the full scan GC/MS analysis are discussed below.

Petroleum hydrocarbons are organic compounds consisting of carbon and hydrogen atoms. The hydrogen and carbon atoms in aliphatic hydrocarbons are usually linked together in chains that are straight, whereas aromatic hydrocarbons have ring structures with alternating single and double bonds. Crude oil contains hydrocarbons, other organic compounds that may contain sulfur, nitrogen, or oxygen; and inorganic compounds. The exact composition varies depending on the source of the crude oil as well as the refining process. During the refining process, crude oil is separated into fractions of different boiling point ranges such as naphtha, gasoline, jet fuel, diesel fuel, and heavier fuel oils (Figure 4-18) (TPHCWG 1998).

A total of 44 samples (51 including field splits and field duplicates) were submitted to Microbial for full scan GC/MS analysis. At least one sample from the following sample locations was submitted for analysis: BP01, BP02, BP03, BP05, BP07, BP10, BP12, BP15, TB01, TB03, TB05, TB06, TB07, TB10, TB15, TB17, TB20, SLBREF1, KBREF2, LFREF3, and ND20-SBREF4. The full scan GC/MS analysis results are included in Appendix H. Ion 85 and Ion 113 are expected to be useful in the identification of petroleum products. The identified compounds and peaks for Ion 85: n-Alkanes (C8-C40) and Ion 113: Iso-Alkanes and Isoprenoids are summarized in Table 4-9.

Figure 4-18 shows the range of carbon numbers present in common petroleum products (TPHCWG 1998). The range of carbon numbers in a sample can be compared to Figure 4-18 to attempt to identify a source type. It should be noted that source identification is complicated, and this does not definitively identify the source material.

Based on Figure 4-18, the Oil Barge Dock Slip samples generally have a range of carbon numbers that fit the profile of diesel fuel/middle distillates or fuel oils. Several samples have a range that could indicate jet fuel/kerosene since the upper end of the range of carbon numbers does not exceed C18 and two samples indicate only fuel oils since the upper end of the range extends to C27 and C29. Four surface samples were ND for alkanes.

The majority of the Tower Avenue Slip samples have a range of carbon numbers that also fit the profile of diesel fuel/middle distillates or fuel oils. Eight samples indicate fuel oils only since the upper end of the range extends to C26 to C31. One sample has a range that could indicate jet fuel/kerosene in addition to the other sources. Three samples at various depths were ND for alkanes.

The reference area SLBREF1 sample only identified C21, so the sample fits the profile of diesel fuel/middle distillates; fuel oils; and lube oil, motor oil, and grease. KBREF2 and SBREF4 fit the profile for diesel fuel/middle distillates or fuel oils. LFREF3 was ND for alkanes.

It should be noted that if the petroleum products are degraded or consist of mixtures of products, the identified n-alkanes and isoalkanes may not represent the complete carbon range of the products. Calculating hydrocarbon source ratios may be useful to compare if a product in several samples has come from the same source. Petroleum forensics can be quite complex, and a comprehensive interpretive report may provide more insight to definitively determine the source.

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5. TOXICITY AND BIOACCUMULATION TESTING RESULTS

Toxicity and bioaccumulation testing was conducted by EA's Ecotoxicology Laboratory located in Hunt Valley, Maryland. The following surface sediment samples were collected for toxicity tests: 4 reference samples (KBREF2, LFREF3, SBREF4, and SLBREF1) and 27 site samples (BP02, BP03, BP05, BP07, CL01, CL02, CL03, CL04, CL05, CL06, CL07, CL08, CL09, CL10, GM02, GM04, GM08, HD01, HD03, HD04, TB01, TB03, TB06, TB07, TB10, TB15, and TB20).

Toxicity testing included 28-day sediment toxicity tests with *Hyalella azteca* (freshwater amphipod) and 10-day *Chironomus dilutus* (freshwater midge), evaluating the effects on survival and growth (determined by dry weight and ash free dry weight for *H. azteca* and *C. dilutus*, respectively) of the test organisms compared to control and/or reference locations. The testing consisted of a 28- or 10-day sediment exposure period, after which the organisms were retrieved from the sediment and survival was recorded. The organisms were processed for dry weight determinations (Methods EPA 100.1 and 100.2) to measure growth. Survival (percent survival) and growth (mean dry weight or mean ash free dry weight) results were statistically compared to reference and control samples. Samples with statistically significant lower survival, fecundity (*H. aztec*a only), and growth were identified.

Bioaccumulation testing consisted of 28-day bioaccumulation exposures with *Lumbriculus variegatus* (freshwater oligochaete worm) (EPA 100.3) on surface sediment samples from the following locations: 4 reference samples (KBREF2, LFREF3, SBREF4, and SLBREF1) and 20 site samples (CL01, CL02, CL03, CL04, CL05, CL06, CL07, CL08, CL09, CL10, GM02, GM04, GM08, TB01, TB03, TB06, TB07, TB10, TB15, and TB20). Following a 28-day sediment exposure period, organisms were retrieved from the sediment and allowed to depurate their digestive tracts for approximately 24 hours. After the depuration period, the organisms were placed into analytical jars and submitted for chemical analysis. The testing produced five replicates per sediment sample and control. Pre-test (control) tissues, which represent the constituent tissue concentrations in the test organisms upon arrival to the testing laboratory and prior to laboratory exposures, were also submitted for chemical analysis. Appendix I includes a complete report of the Toxicity and Bioaccumulation testing completed in EA's Ecotoxicology Laboratory. The tissues were processed and analyzed for mercury (EPA CLP ISM02.4/HG) (all samples), organotins (EPA Method 8323) (General Mills and Tower Avenue Slips, reference, and pre-test samples), dioxin/furans (EPA Method 1613B) (Clough Island, reference, and pre-test samples), and percent lipids (Gravimetric Determination) (all samples).

Tissue concentrations from the organisms exposed to the site samples were compared to reference and control tissue. Samples with statistically higher tissue concentrations when compared to reference and/or control tissue samples were identified.

Survival and growth results from *H. azteca* and *C. dilutus* toxicity testing are presented in Figures 5-1 and 5-2, and Tables 5-1 and 5-2, respectively. Figure 5-3 presents the UV exposure survival and fecundity results Figures 5-4 through 5-6 presents the observed toxicological effects to *H. azteca* and *C. dilutus* noted at the locations that were used for toxicity testing for

Hallet Dock 8 Slip and Oil Barge Dock Slip, General Mills and Tower Avenue Slips, and Clough Island, respectively. Table 5-3 presents the mean lipid concentration in tissue from each location and Tables 5-4 through 5-6 and Figures 5-7 and 5-8 present mean *L. variegatus* tissue concentrations of mercury, organotins, and dioxins/furans, in the Tower Avenue/General Mills Slips and Clough Island Area, respectively. Replicate tissue concentrations for each location are presented in Appendix E, Attachment 5 and the results of the statistical comparison of bioaccumulation tissue data are presented in Appendix E, Attachment 6. Results are discussed further in the following sections.

5.1 *CHIRONOMUS DILUTUS* SEDIMENT TOXICITY TEST

The results of the *C. dilutus* sediment toxicity tests complied with current National Environmental Laboratory Accreditation Conference (NELAC) standards. The survival and growth results of the *C. dilutus* toxicity tests were statistically analyzed according to EPA guidance (2000) to determine if any of the site sediments were significantly different (p=0.05) from the control or reference sediment. If the data were normally distributed, then a t-Test was performed to detect statistically significant differences between test sediments, control sediment, and the reference sediment. If the data distribution was non-normal, then a Wilcoxon Two-Sample Test was used to compare the group means. Shapiro-Wilk’s Test was used to determine if the data were normally distributed, and the F-Test was used to test for homogeneity of variance. Samples with statistically significant lower survival and growth when compared to each of the reference samples (KBREF2, LFREF3, SBREF4, and SLBREF1) and the laboratory control sample were identified.

After 10 days of exposure, mean survival in 23 of the 27 sediment samples was significantly less (p=0.05) than the laboratory control. Survival in the reference samples ranged from 74 to 83%. Survival from the Hallet Dock 8 Slip ranged from 26 to 63% and survival in each of the 3 samples was significantly less than at least one of the reference samples. Survival from the Oil Barge Dock Slip ranged from 66 to 80% and survival in 3 of the 4 samples was significantly less than at least one of the reference samples. Survival from the General Mills Slip ranged from 80 to 91% and survival was not significantly different from the reference samples. Survival from the Tower Avenue Slip ranged from 20 to 86% and survival in 6 of the 7 samples was significantly less than at least one of the reference samples. Survival from Clough Island ranged from 64 to 93% and survival in 6 of the 10 samples was significantly less than at least one of the reference samples.

Three sediment samples were collected from the project area for 10-day *Chironomus riparius* toxicity testing in 2015 (EA 2016). Figure 5-4 presents the results for SW15-SLB02 collected from the Hallet Dock 8 Slip and Figure 5-5 presents the results for SW15-SLB05 and SW15-SLB14, collected from the General Mills and Tower Avenue Slips, respectively. Results for each of the three samples indicated that survival was statistically different from the control.

Mean ash-free dry weights (growth) in the sediment samples from each area ranged from 1.229 to 1.125 milligrams (mg) per organism (laboratory control), 0.580 to 0.925 mg per organism (reference), 0.587 to 0.826 mg per organism (Hallet Dock 8 Slip), 1.162 to 1.325 mg per organism (Oil Barge Dock Slip), 0.773 to 1.268 mg per organism (General Mills Slip), 0.504 to 1.031 mg per organism (Tower Avenue Slip), and 0.689 to 1.218 mg (Clough Island). Growth at four locations (CL06, HD04, TB01, and TB06) was significantly lower than at least one of the reference samples (Table 5-1 and Figure 5-1). Figures 5-4 through 5-6 present the geographical distribution of toxicological effects at the locations with co-located toxicity testing.

5.2 *HYALELLA AZTECA* SEDIMENT TOXICITY TEST

The results of the *H. azteca* sediment toxicity tests complied with current NELAC standards. The survival, fecundity, and growth results of the *H. azteca* toxicity tests were statistically analyzed according to the EPA guidance (2000) to determine if any of the site sediments were significantly different (p=0.05) from the control or reference sediment. If the data were normally distributed, then a t-Test was performed to detect statistically significant differences between test sediments and the reference sediment. If the data distribution was non-normal, then a Wilcoxon Two-Sample Test was used to compare the group means. Shapiro-Wilk's Test was used to determine if the data were normally distributed, and the F-Test was used to test for homogeneity of variance. Samples with statistically significant lower survival, fecundity, and growth when compared to each of the reference samples (KBREF2, LFREF3, SBREF4, and SLBREF1) and the laboratory control sample were identified. After 28 days of exposure, mean survival in 22 of the 27 sediment samples was significantly less (p=0.05) than the laboratory control. Survival from the reference samples ranged from 84 to 89%. Survival from the Hallet Dock 8 Slip ranged from 65 to 85% and survival in 2 of the 3 samples was significantly less than at least one of the reference samples. Survival from the Oil Barge Dock Slip ranged from 83 to 91% and survival in the 4 samples was not significantly different from the reference samples. Survival from the General Mills Slip ranged from 68 to 78% and survival in each of the 3 samples was significantly less than at least one of the reference samples. Survival from the Tower Avenue Slip ranged from 61 to 90% and survival in 4 of the 7 samples was significantly less than at least one of the reference samples. Survival from Clough Island ranged from 71 to 90% and survival in 4 of the 10 samples was significantly less than at least one of the reference samples.

Three sediment samples were collected from the project area for 28-day *H. azteca* toxicity testing in 2015 (EA 2016). Figure 5-4 presents the results for SW15-SLB02 collected from the Hallet Dock 8 Slip and Figure 5-5 presents the results for SW15-SLB05 and SW15-SLB14, collected from the General Mills and Tower Avenue Slips, respectively. Results for each of the three samples indicated toxicological effects for at least one test end point. The end points that were statistically different from the control were: survival (SW15-SLB02), growth (SW15-SLB05), and growth and fecundity (SW15-SLB14).
Following survival determination, the amphipods were exposed to a 7.5 microwatts per square centimeters intensity UV light for 4 hours and assessed for mortality immediately afterward. For most samples, survival after the UV light exposure did not change, with the exception of the following which showed a slight decrease in survival: CL04, TB07, TB10, TB15, and TB20.

Surviving *H. azteca* were observed for the formation of eggs in the oviducts or in the brood pouch. Fecundity from the reference samples ranged from 70 to 76%. Fecundity from the Hallet Dock 8 Slip ranged from 42 to 63% and fecundity in each of the 3 samples was significantly less than at least one of the reference samples. Fecundity from the Oil Barge Dock Slip ranged from 63 to 72% and fecundity in 1 of the 4 samples was significantly less than at least one of the reference samples. Fecundity from the General Mills Slip ranged from 68 to 71% and fecundity in the 3 samples was not significantly different from the reference samples. Fecundity from the Tower Avenue Slip ranged from 36 to 74% and fecundity in 4 of the 7 samples was significantly less than at least one of the reference samples. Fecundity from Clough Island ranged from 50 to 74% and fecundity in 6 of the 10 samples was significantly less than at least one of the reference samples.

Mean ash-free dry weight (growth) in the sediment samples from the laboratory control was 0.282 mg per organism. The mean ash-free dry weights from each area ranged from 0.278 to 0.301 mg per organism (reference), 0.285 to 0.364 mg per organism (Hallet Dock 8 Slip), 0.258 to 0.449 mg per organism (Oil Barge Dock Slip), 0.305 to 0.398 mg per organism (General Mills Slip), 0.214 to 0.305 mg per organism (Tower Avenue Slip), and 0.252 to 0.464 mg (Clough Island). Growth at eight locations (BP07, CL01, CL02, TB01, TB03, TB06, TB07, TB10, TB15, and TB20) was significantly lower than at least one of the reference samples (Table 5-2 and Figure 5-2). Figures 5-4 through 5-6 present the geographical distribution of toxicological effects at the locations with co-located toxicity testing.

5.3 *LUMBRICULUS VARIEGATUS* 28-DAY BIOACCUMULATION TEST

The results of the *L. variegatus* sediment 28-day bioaccumulation tests complied with current NELAC standards. Organisms were exposed to site sediments and reference sediments. Tissue results were compared between organisms exposed to site sediments and reference sediments as well as pre-test tissue. Pre-test tissue represents organism tissue upon receipt at the ecotoxicology laboratory (prior to test initiation). These tissues originate from organisms that are sacrificed from each shipment and subsequently frozen. These organisms are not exposed to test sediments, but contaminants in their tissues represent baseline contaminants that accumulated in their natural environment. Results are reported as wet weight.

Tissue chemistry results of the 20 site samples were compared to the 4 reference locations and pre-test samples to test the null hypothesis that site sample concentrations are not greater than reference/pre-test concentrations at the 95% significance level ($\alpha = 5\%$). Statistical analyses of dioxins and organotins were conducted on lipid-normalized (wet weight) concentrations. Due to the prevalence of non-detect data with different censoring limits (MDL or RL), comparisons were conducted using the generalized Wilcoxon test (aka, Gehan test) for multiple comparisons of censored data sets (Gehan 1965). Type I errors were controlled by adjusting the significance probabilities for the number of hypothesis tests (m) performed using the Benjamini and Hochberg's (1995) linear step-up procedure (BH). The FDR is the expected proportion of Type I (aka, false positive) errors among the significant results (i.e., discoveries). The FDR for a Type I error rate α using the BH procedure was controlled as follows:

1. The unadjusted right-tailed p-values were ordered as $p_1 \leq p_2 \leq \cdots \leq p_m$.

2. Next the test with the highest rank j for which the value p_j is less than or equal to $\frac{j}{m} \times \alpha$ was determined.
3. Adjusted p-values were computed as $p_j^* = \frac{m \times p_j}{j}$.
4. Adjusted p-values $p_j^* \leq \alpha$ were declared as significant exceedances of reference/pre-test data.

Like all multiple comparison adjustments, the level of adjustment is directly proportional to the number of hypothesis tests performed. Therefore, the number of hypothesis tests was limited to comparing the 20 site samples to the 4 reference locations and pre-test samples. Restricting the comparisons to the site data maximizes the statistical power to discover exceedances of the site data to reference/pre-test data. Statistical computations were conducted with SAS/STAT® software version 14.2.

The mercury, dioxin/furans, and organotin mean tissue concentrations from each of the 4 reference samples (KBREF2, LFREF3, SBREF4, and SLBREF1) and the mean pre-test tissue were compared to mean tissue concentrations from all 20 of the site samples for mercury, 10 Clough Island samples for dioxins/furans, and 10 North End District samples (3 General Mills Slip and 7 Tower Avenue Slip samples) for organotins. The results of the comparisons are included in Appendix E, Attachment 6 and a summary of the results with significant differences are included in Table 5-4 for General Mills Slip, Table 5-5 for Tower Avenue Slip, and Table 5-6 for Clough Island samples. Figures 5-7 and 5-8 present results for mercury, tributyltin and Fish Dioxin TEQ (ND=RL) spatially in the General Mills and Tower Avenue Slip and Clough Island Area respectively. The results are described below by analyte.

Regional bioaccumulation data are available for the following sites: 40th Avenue West, Munger Landing, Mud Lake West, Erie Pier Pond, Boulder Reservoir, Scanlon Reservoir, and Thomson Reservoir as noted in Section 2.6. Due to the small sample sizes for the Reservoirs, Mud Lake West, and Munger Landing and the lack of available replicate data for 40th Avenue West, the regional bioaccumulation data were compared to the North End District and Clough Island bioaccumulation data semi-quantitatively. Regional samples were analyzed for mercury and dioxins/furans but not organotins.

Figure 5-9 through 5-12 present the available data as mean plots of mercury and dioxin concentrations. The means plots are used to analyze the way in which the mean varies between the regional locations and the samples collected in 2020, as such each point is connected by a line. A mean plot can show whether there were any shifts in location, what the magnitude of any shifts might be, and if there are any distinct patterns. They allow us to check assumptions we might make of our data pool staying generally constant—or not—over time and location. Mean plots can be used to show the standard deviation around each mean. Figures 5-9 through 5-12 do not include standard deviation bars as the number of replicates varied by sample location based on recovered tissue mass and study objectives for supplemental data sets. The regional locations are ranked by comparing the mean concentrations of mercury and dioxin TEQ. Figure 5-9 presents the mean plots of mercury for all of the sites. The regional data were analyzed for dioxins/furans but reporting of the dioxin TEQ varies based on the site. To make appropriate comparisons to the dioxin TEQs from the regional tissue data, the 2020 data were used to calculate the dioxin TEQs in the same manner. Figures 5-10 through 5-12 present the mean plots for 2005 WHO Dioxin TEQ (ND=0), 2005 WHO Dioxin TEQ (ND=1/2RL), and Fish Dioxin TEQ (ND=RL).

5.3.1 Mercury

Each of the tissue samples was analyzed for mercury and none of the mercury concentrations in the 20 site tissue samples were significantly different ($p < 0.5$) from any of the reference or pre-test samples.

The mean mercury tissue concentration among regions orders as follows (starting with areas with lowest concentrations): 40th Avenue West < Munger Landing < General Mills Slip = SLBREF1 = SBREF4 < Clough Island < LFREF3 < KBREF2 < Thomson Reservoir < Scanlon Reservoir < Boulder Reservoir < Tower Avenue Slip.

5.3.2 Dioxins/Furans

The 4 reference samples, pre-test, and 10 Clough Island samples were analyzed for dioxins/furans. Bird (ND=0 and ND= 1/2 RL), fish (ND=0 and ND= 1/2 RL), and mammal (ND=0, ND= 1/2 RL, and ND=RL) dioxin TEQs were calculated. The results of the comparisons are as follows:

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized bird, fish, and mammal dioxin TEQ (ND=0) pre-test tissue concentrations but not statistically different from reference tissue concentrations: CL08 and CL09.

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized 1,2,3,4,6,7,8-HpCDD and 1,2,3,4,6,7,8-HpCDF tissue concentrations from at least one reference site and the pre-test tissue concentration: CL02 and CL08.

- CL08 was statistically different ($p < 0.05$) from the lipid-normalized 1,2,3,4,7,8-HxCDF 1,2,3,7,8-PeCDD, and 1,2,3,7,8-PeCDF tissue concentrations from at least one reference site and the pre-test tissue concentration.

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized 2,3,7,8-TCDD tissue concentrations from at least one reference site and the pre-test tissue concentration: CL06 and CL08.

- CL02 was statistically different ($p < 0.05$) from the lipid-normalized OCDD tissue concentrations from at least one reference site and the pre-test tissue concentration.

The mean plots vary based on the method of calculation of the dioxin TEQ because the totals are dependent on how non-detects are handled. Therefore, there is high level of uncertainty in the ranking. The regional ranking based on dioxin TEQ tissue concentrations for the sites (starting with areas with lowest concentrations) is as follows: Mud Lake West < Boulder Reservoir < Erie Pier Pond < 40th Avenue West < Thomson Reservoir < SLBREF1 = KBREF2 = LFREF3 = Scanlon Reservoir < Clough Island < SBREF4 < Munger Landing.

5.3.3 Organotins

The 4 reference samples, pre-test, 3 General Mills Slip, and 7 Tower Avenue Slip samples were analyzed for organotins. Organotins analysis included monobutyltin, dibtutyltin, tributyltin, and tetra-n-butyltin. The pre-test data for each of the monobutyltin replicates were rejected during data validation so the comparison of the site data to pre-test data cannot be performed for monobutyltin. The results of the comparisons are as follows:

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized monbutyltin tissue concentrations from at least one reference site tissue concentration: GM04, GM08, and TB20. The pre-test data for each of the monobutyltin replicates was rejected by data validators so the comparison of the site data to pre-test data was not performed for monobutyltin.

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized dibutylin tissue concentrations from at least one reference site and the pre-test tissue concentration: GM02, GM04, GM08, and TB20.

- The following samples were statistically different ($p < 0.05$) from the lipid-normalized tributyltin tissue concentrations from at least one reference site and the pre-test tissue concentration: GM04, GM08, and TB20.

- None of the tetra-n-butyltin concentrations in the 20 site tissue samples was significantly different ($p < 0.5$) from any of the reference or pre-test samples.

5.4 SEDIMENT TOXICITY AND BIOACCUMULATION TESTING SUMMARY

The results of the toxicity and bioaccumulation testing indicated the following:

- Site locations HD01, HD03, HD04, BP02, BP03, BP05, TB01, TB03, TB06, TB07, TB10, TB15, CL03, CL05, CL06, CL07, CL09, and CL10 had an adverse effect on *C. dilutus* survival in the 10-day sediment exposures. Sites CL06, HD04, TB01, and TB06 had an adverse effect on mean ash-free dry weight (growth) of *C. dilutus* (Table 5-1 and Figure 5-1).

- Site locations HD03, HD04, GM02, GM04, GM08, TB01, TB03, TB07, TB10, CL02, CL06, CL07, and CL09 had an adverse effect on *H. azteca* survival in the 28-day sediment exposures. Sites HD01, HD03, HD04, BP07, TB01, TB06, TB07, TB10, CL01, CL02, CL05, CL06, CL09, CL10 had an adverse effect on *H. azteca* fecundity in the 28-day sediment exposures. Sites BP07, CL01, CL02, TB01, TB03, TB06, TB07, TB10, TB15, and TB20 had an adverse effect on mean dry weight (growth) of *H. azteca* (Table 5-2 and Figure 5-2).

- Overall, significantly inhibited survival when compared to reference samples was observed at nine site locations (HD03, HD04, TB01, TB03, TB07, TB10, CL06, CL07, and CL09) for both *H. azteca* and *C. dilutus*.

- Overall, significantly inhibited growth when compared to reference samples was observed at two site locations (TB01 and TB06) for both *H. azteca* and *C. dilutus*.

- Two sites (CL08 and TB20) were not toxic to either *H. azteca* or *C. dilutus* for either survival (including after UV exposure), fecundity, or growth.

- Mercury concentrations in *L. variegatus* tissue were not statistically different (higher) than the reference site and pre-test tissue concentrations for each tested location.

- Dioxin TEQ concentrations in *L. variegatus* tissue were not statistically different (higher) than the reference site concentrations for each tested location. Individual dioxins/furans tissue concentrations were statistically different (higher) than the reference site and pre-test tissue concentrations for CL02, CL06, and CL08.

- At least one of the organotin concentrations (lipid-normalized) in *L. variegatus* tissue was statistically different (higher) than the reference site and pre-test tissue concentrations for GM02, GM04, GM08, and TB20.

The results of the toxicity testing with *H. azteca* and *C. dilutus* indicated that there was no significant impact on the surviving organism's ability to grow during the toxicity test. As a part of the data evaluation, the observed statistical difference for survival was evaluated for both species. The results of that evaluation indicated that the organisms were of adequate quality as evident by an acceptable reference toxicant test conducted on the test species and a performance in the laboratory control that met test acceptability criteria. Additionally, the test data were reviewed for: test condition and procedural errors; within treatment variability; and test sensitivity. Evaluation of test conditions and procedures indicated that the response pattern was not a result of water quality abnormalities in isolated replicates, or procedural errors such as improper randomization, which could adversely impact survival in a specific sample.

The data were further evaluated against the co-located reference sediment chemical data, these findings are described further in the following section.

6. SUMMARY OF FINDINGS

The North End District and Clough Island Sediment Characterization was conducted to obtain the data necessary to conduct a screening level assessment of the chemical contamination in the North End District and Clough Island areas of the St. Louis River and Bay AOC. These efforts were conducted in coordination with DNR and EPA. The investigations, including geophysical surveys, sediment sampling activities and sediment, biological and tissue testing methods, were carried out in accordance with procedures outlined in the Sampling and Survey QAPPs (Appendix K) with FSP attachments (EA 2019 and 2020) and as described in this SIR. For each sample, Table 6-1 presents a summary of findings for toxicity test results, surface sample SQG exceedances, bioaccumulation test results, and microscopic coal results.

6.1 GEOPHYSICAL SURVEY

Geophysical surveying efforts, including precision multibeam bathymetric, sub-bottom profiling, and an acoustic dock wall survey, were conducted prior to sediment sampling to establish a basemap of the project area. In addition, the completion of these efforts provided the water depths, bottom elevations, and apparent sediment thickness data necessary for evaluations of the volumes of sediment that could be removed as part of future remediation efforts. The multibeam bathymetric and sub-bottom profiling surveys were completed in the Hallet Dock 8 Slip, Oil Barge Dock Slip, General Mills Slip, and Tower Avenue Slip. However, the dock wall acoustic surveys were only completed within the Oil Barge Dock and Tower Avenue Slips.

These evaluations utilized various forms of remote sensing, which in turn produced high-resolution base maps of water depth and lakebed elevation for each slip surveyed. In addition, these data were used to develop a digital elevation model (DEM) suitable for the creation of a site model within a GIS environment. Additionally, the geophysical effort included the completion of underwater acoustic imagery surveys of the quay walls within the Oil Barge Dock and Tower Avenue Slips. These images of the submerged components of each wall were merged with corresponding digital photographs of the above water portions of each wall to support a first order assessment of conditions and stability of these structures.

Ultimately, these geophysical data sets data will be used in conjunction with chemical analytical data to evaluate initial extents of sediment contamination as described below. They are sufficiently robust for use as part of future feasibility studies or to serve as the basis of remedial design evaluations. Key findings from each area are summarized below.

6.1.1 Hallet Dock 8 Slip

The Hallet Dock 8 slip is currently 140 wide and 2,400 ft long, with the southern limits of the slip corresponding to the relic (1890) shoreline. When corrected and referenced to the LWD for Lake Superior (601.1 ft), water depths within the slip ranged from 10 ft in the extreme southeastern corner to 37 ft near the northeastern corner of the Hallet Dock 8. In general, the sub-bottom data were representative of a disturbed or modified bed with multiple, discontinuous strata visible in the top 15 to 20 ft of penetration.

6.1.2 Oil Barge Dock

The Oil Barge Slip is currently an 840-ft-long and 95-ft-wide slip that resides between the BP Oil Dock and Midwest Energy Resources Dock. The Oil Barge Dock Slip survey area was comprised of the 2-acre parcel of submerged lands between the eastern and western walls, as well as 4.8 acres of coverage that extended into St. Louis Bay. Multibeam bathymetry data were collected from the approximate centerline of South Channel to the limits of navigation in the headwaters to the south. Shallow water and debris (timbers associated with a failing bulkhead) prevented access and complete coverage of the water body. Minimum water depths of 3 ft were detected in the southeastern limits of coverage, while a maximum water depth of 25 ft was measured at the entrance to the slip near the centerline.

Sub-bottom profiling data were collected over 10 north-south oriented survey transects within the 95-ft-wide BP Oil Barge Dock Slip. Similar to the Hallet Dock 8 Slip, the sediment column displays evidence of a significantly disturbed or modified bed with several discontinuous strata visible in within 15 to 20 ft of the sediment-water interface. Three principal material types, each with unique acoustic signatures that were a product of either physical composition and/or degree of disturbance, were detected within sediment column. Recently deposited fine-grained sediments (silts) overlying mixed or chaotic layers of material were noted in the upper sediment column, while bedded, homogenous parent sediments (silty clays) were found at depth within the profile. The thickness of each type of material encountered varied significantly based on location within the slip, bathymetry, degree of anthropogenic influence, and structural integrity of the adjacent walls.

In general, the west wall between Stations 0+00 and 1+20 appeared intact but displayed signs of damage and deterioration both above and below the waterline. The east wall is the product of different construction techniques employed in different timeframes. As a result, the condition of the wall segments at the time of the survey was directly dependent upon the construction technique employed, the material used, and the age of each segment.

Additional investigation of stability by means of divers or remotely operated vehicle (ROV) and potential mitigation measures would be recommended during future evaluations of potential remedial actions in this area.

6.1.3 General Mills Slip

The General Mill Slip is located at the confluence of St. Louis Bay to the northwest and Howards Bay to the east. The General Mills Slip is approximately 1,800 ft long and extends 500 ft south of the 1880s historical shoreline for this portion of Superior. The General Mills Slip survey area was comprised of the 7.4-acre parcel of submerged lands between the General Mills Dock to the east and ruins of the Great Northern Dock to the west, plus 6.7 acres of coverage that extended into South Channel and St. Louis Bay. When corrected and referenced to the LWD for Lake Superior, water depths within the confines of the slip ranged from 2 ft in the extreme southeastern corner and southwestern margin of the coverage area to 38 ft at the center of a discrete scour feature near the centerline of the slip.

Sub-bottom profiling data were collected over 10 north-south oriented transects established within the 180-ft-wide General Mills Slip survey area. Similar to the other slips surveyed as part of this investigation, the acoustic profiles displayed evidence of multiple, distinct sediment strata within the upper sediment column. In general, fine-grained, lower density sediments (silts) with thicknesses ranging from 1 to 4 ft were found over intervals of mixed or chaotic layers of material. These mixed strata were 2 to 6 ft thick and commonly comprised of intervals of sand or sand mixed with silts and clays. The parent sediment was determined to be a homogenous, fine sand that resided below the localized disturbances caused by construction activity or repeated dredging to maintain suitable water depths for vessels utilizing the General Mills Dock.

6.1.4 Tower Avenue Slip

The Tower Avenue Slip is located in Howards Bay and bounded by the Paper Calmenson to the west and CHS docks to the east. The Tower Avenue Slip survey area covered 16.9 acres of submerged lands within the confines of the slip, as well as 8.7 acres of coverage that extended into Howards Bay. The Tower Avenue Slip extends approximately 2,770 ft from Howards Bay into the headwaters before terminating at an earthen berm and several outfall structures in various states of repair. Access to the slip from Howards Bay appears to be restricted to a relatively narrow, 300-ft-wide passage between a shallow embayment to the west exhibiting depths ranging from 4 to 20 ft and the CHS dock to the east. Once the Paper Calmenson Dock is encountered at the approximate midpoint of the slip, the width tapers to approximately 250 ft, then further constricts to less than 200 ft at the headwaters. A minimum depth of 1 ft was detected along the western and eastern banks within the headwaters of the slip, as well as the northern and eastern limits of the CHS Dock. A maximum water depth of 41 ft was measured along the northwestern margin of the CHS Dock and again within a roughly circular bottom feature 45 ft northwest of the dock.

Sub-bottom profiling data were collected over 10 transects established within the Tower Avenue Slip survey area, each approximately 2,800 ft long and oriented parallel to the long axis of the slip. In general, the results for the Tower Avenue Slip were comparable to those derived for the General Mills Slip. Deposits of fine-grained material (silts) of varying thickness were detected at the sediment-water interface throughout the survey area. These lower density silts resided over mixed intervals of sand, silt and clay that comprise a layer of sediment that has been periodically disturbed by dredging, vessel movements, and other industrial activities within the slip. Due to the shallow water depths in the southwestern extents of the survey area, several artifacts (acoustic multiples) were captured in the acoustic record along with the desired sonar returns. These acoustic multiples limited the value of the sub-bottom data collected in the shallows by obscuring any backscatter deeper than 10 ft below the sediment-water interface.

The west wall of the Tower Avenue slip retains the fill material used to create the current Paper Calmenson Dock during its original construction in the late 1800s. It was imaged using both the multibeam echosounder system system and the side-scan sonar over a distance of approximately

850 ft. In general, the wall surface residing under the waterline and behind the pilings appears intact, while sections of the wall above the waterline display a considerable amount of deterioration and spalling over its length. The east wall of the Tower Avenue slip retains the fill material deposited in the late 1880s and used to create the structure now known as the CHS Dock. The entire east wall is comprised of steel sheet pile that was driven into the Tower Bay sediments. The entire east wall is comprised of steel sheet pile, and with one exception, appeared to be intact and in good condition. The southeast wall of the Tower Avenue slip retains the fill material used to the create the base of the CHS Dock where it tied into the original Tower Bay shoreline. In contrast to the east wall, the southeast wall was comprised of concrete and timber. Similar to the west wall in the Oil Barge Dock Slip, the southeast wall in the Tower Avenue Slip appears to consist of a deteriorating concrete cap that was cast over the compacted fill material originally used to cover the freshwater marshland. Besides the obvious deterioration of the concrete cap between Stations 0+00 and 1+50, there were also some indications of fill material loss into the slip, suggesting existing or prior breaches in the wall. Between Stations 1+50 and 2+40 the concrete cap displayed less evidence of deterioration and the support structure under the waterline appeared to be intact. From Station 2+40 to the limits of sonar coverage the concrete cap and structural components below the waterline appeared relatively intact.

Additional investigation of stability by means of divers or ROV and potential mitigation measures may be recommended in certain areas along the Tower Bay walls during future evaluations of potential remedial actions in this area.

6.2 SEDIMENT INVESTIGATION

Sediment sampling was conducted from 22 June through 4 July 2020. Samples were collected from the OSI R/V *Candu*, as well as EA's M/V *Chinook* 26-ft sampling vessel. Surface grab samples were collected using a ponar sampler at the majority of location and a pneumatic vibratory coring system was used to collect samples at depths up to 20 ft. Analytical samples were submitted to Eurofins TestAmerica in Burlington, Vermont, and Pittsburgh, Pennsylvania.

Site characterization data from the sampling effort in the North End District and Clough Island assessment areas are summarized in Chapter 4 presented in detail in Appendix E. Detected concentrations of constituents were compared to threshold, midpoint, and probable effects concentrations (TEC, MEC, and PEC) from DNR's Consensus-Based SQGs (Wisconsin DNR 2003), where available, and non-industrial and industrial direct contact and soil to groundwater RCLs or BTVs under Wisconsin Administrative Code NR 720. Results of the screening evaluation are summarized in Tables 4-1 through 4-7 and Appendix E, Attachment 1, and Appendix E, Attachment 2.

Figures 6-1 through 6-14 identify analytes exceeding the TEC, MEC and PEC values in each area of the site. Locations with samples exceeding PECs were distinguished in the QAPP decision criteria as potential areas to be prioritized and recommended for further investigation or remediation. Exceedances of the PEC values were identified in each area of the site; however, very limited exceedances were observed in the Hallet Dock 8 Slip and Estuary Flats Areas (Figures 6-1, 6-2, 6-9 and 6-10). In other areas, findings were as follows:

- In the Oil Barge Dock Slip, PEC exceedances were observed for numerous organics (1,2-dichlorobenzene, 1,4-dichlorobenzene, benzene, xylene, PAH18), and metals (including arsenic, iron, lead and manganese) at the head of the slip, and at depth for a limited number of locations and compounds in the middle to outer portions of the slip (Figures 6-3 and 6-4).

- Most locations sampled in the General Mills Slip showed exceedances of the PEC for organic compounds including PAH18, dioxins, and tributyltin (Figure 6-5); concentrations in the surface intervals were generally lower than samples collected at depth. A limited number of locations (Figure 6-6) showed exceedances of the PEC for metals (lead and manganese) between the head and middle portion of the slip.

- In the Tower Avenue Slip, organics (PAH18, PCBs, tributyltin) were detected in subsurface samples at the head through the middle of the slip; metals including copper, iron, lead, mercury, silver, zinc exceeded the PEC in subsurface samples at these locations (Figure 6-8). Locations from approximately the midpoint of the slip to the outer extent showed generally lower concentrations of metals and organics, with the exception of samples located at the mouth of the slip and into Superior Bay. A group of locations in this area including one surface sample and five locations with samples at depth exceeded the PEC for tributyltin.

Data at select locations were collected for informational purposes, and potential application in subsequent source tracking and forensic evaluation in the Oil Barge Dock, General Mills and Tower Avenue slips. Select samples were analyzed for alkylated PAHs, aliphatic hydrocarbons (C8-C40), and coal particles (microscopic coal analysis). Results of this analysis are discussed in Chapter 4 and provided in Appendix E.

6.3 TOXICITY AND BIOACCUMULATION TESTING

Toxicity and bioaccumulation testing was conducted by EA's Ecotoxicology Laboratory located in Hunt Valley, Maryland. Surface sediment samples were collected for toxicity tests from 27 locations across the site and at 4 reference stations.

Toxicity testing included 28-day sediment toxicity tests with *Hyalella azteca* (freshwater amphipod) and 10-day *Chironomus dilutus* (freshwater midge), evaluating the effects on survival and growth (determined by dry weight and ash free dry weight for *H. azteca* and *C. dilutus*, respectively) of the test organisms compared to control and/or reference locations. The testing consisted of a 28- or 10-day sediment exposure period, after which the organisms were retrieved from the sediment and survival was recorded. Survival (percent survival) and growth (mean dry weight or mean ash free dry weight) results were statistically compared to reference and control samples. Samples with statistically significant lower survival, fecundity (*H. azteca* only), and growth were identified.

Bioaccumulation testing consisted of 28-day bioaccumulation exposures with *Lumbriculus variegatus* (freshwater oligochaete worm) on surface sediment samples from the 4 reference locations and 20 site samples. The testing produced 5 replicates per sediment sample and control. Pre-test (control) tissues, which represent the constituent tissue concentrations in the test organisms upon arrival to the testing laboratory and prior to laboratory exposures, were also submitted for chemical analysis.

The results of the toxicity and bioaccumulation testing indicated the following:

- Site locations HD01, HD03, HD04, BP02, BP03, BP05, TB01, TB03, TB06, TB07, TB10, TB15, CL03, CL05, CL06, CL07, CL09, and CL10 had an adverse effect on *C. dilutus* survival in the 10-day sediment exposures. Sites CL06, HD04, TB01, and TB06 had an adverse effect on mean ash-free dry weight (growth) of *C. dilutus* (Table 5-1 and Figure 5-1).

- Site locations HD03, HD04, GM02, GM04, GM08, TB01, TB03, TB07, TB10, CL02, CL06, CL07, and CL09 had an adverse effect on *H. azteca* survival in the 28-day sediment exposures. Sites HD01, HD03, HD04, BP07, TB01, TB06, TB07, TB10, CL01, CL02, CL05, CL06, CL09, CL10 had an adverse effect on *H. azteca* fecundity in the 28-day sediment exposures. Sites BP07, CL01, CL02, TB01, TB03, TB06, TB07, TB10, TB15, and TB20 had an adverse effect on mean dry weight (growth) of *H. azteca* (Table 5-2 and Figure 5-2).

- Overall, significantly inhibited survival when compared to reference samples was observed at 9 site locations (HD03, HD04, TB01, TB03, TB07, TB10, CL06, CL07, and CL09) for both *H. azteca* and *C. dilutus*.

- Overall, significantly inhibited growth when compared to reference samples was observed at 2 site locations (TB01 and TB06) for both *H. azteca* and *C. dilutus*.

- Two sites (CL08 and TB20) were not toxic to either *H. azteca* or *C. dilutus* for either survival (including after UV exposure), fecundity, or growth.

- Mercury concentrations in *L. variegatus* tissue were not statistically different (higher) than the reference site and pre-test tissue concentrations for each tested location.

- Dioxin TEQ concentrations in *L. variegatus* tissue were not statistically different (higher) than the reference site concentrations for each tested location. Individual dioxins/furans tissue concentrations were statistically different (higher) than the reference site and pre-test tissue concentrations for CL02, CL06, and CL08.

At least one of the organotin concentrations (lipid-normalized) in *L. variegatus* tissue was statistically different (higher) than the reference site and pre-test tissue concentrations for GM02, GM04, GM08, and TB20.

Overall, significantly inhibited survival when compared to reference samples was observed at 9 site locations (HD03, HD04, TB01, TB03, TB07, TB10, CL06, CL07, and CL09) for both *H. azteca and C. dilutus*. Findings at these locations were further evaluated against the co-located reference sediment chemical data and surface sediment characteristics and field observations (Table 6-1).

The following sections summarize the physical and chemical characteristics and visual observations of the sediment at each of the nine site locations where significantly inhibited survival was observed in both *H. azteca* and *C. dilutus*.

6.3.1 Hallet Dock 8 Slip (HD03 and HD04)

Surface sediment concentrations at HD03 and HD04 exceeded TEC values for PAH18 and dioxin. Microscopic coal concentrations at HD03 were 25%, but microscopic coal was not analyzed at HD04. The next closet location, HD05, contained coal in the surface interval at 27%. The surface sample at HD03 was described as light brown silts with trace clays and loose cohesion; a high density of coal chunks was observed in the sample. There was no odor and a slight sheen was also observed. At HD04 the surface sediment was described as light brown silts over medium brown silty-clays with loose/medium cohesion. Coal chunks were observed throughout and petroleum odor and sheen was noted.

6.3.2 Tower Bay (TB01, -03, -07, -10, -06 [growth])

Tower Bay locations TB01, -03, -07, -10 had surficial sediment concentrations for PAH18, metals, and dioxin exceeding the MEC. At location TB07, the PEC was exceeded for metals, and at TB06, the TEC was exceeded for metals. The microscopic coal results at each of the Tower Bay locations was below 5%.

At location TB01, sediments were described as light brown silty-clays with low/medium cohesion, small sheens, no odor, and vegetative debris. At TB03, similar light brown silty-clays with low/medium cohesion were observed, and no odor or sheen was noted. The sample at TB03 contained woody/vegetative debris. At TB06 there were medium brown silts over medium brown silty-clay with medium cohesion, a slight petroleum odor, and a sheen present. At TB07 and 10, light brown silts over light brown silty-clays with low/medium cohesion were observed. Sheens were observed at TB07, but no odor was observed in TB07 and TB10.

6.3.3 Clough Island (CL06, -07, -09)

Surface sediment concentrations at CL06 and CL07 exceeded PEC values for dioxin, and the MEC was exceeded for dioxin at CL09. At CL09 the PEC was exceeded for manganese. CL06 and 07 also had metals TEC and MEC exceedances. Microscopic coal was not analyzed in the

Clough Island Area. Surface sediment at CL06, 07 and 09 was described as medium browns silts over clays with vegetation observed at CL06 and 07. No sheen was observed in either of the three samples, an organic odor was described at CL07, and no other odors were observed at CL06 and 09.

6.4 VOLUME ANALYSIS

Volume estimates of contaminated sediments in Hallet Dock 8 Slip, Oil Barge Slip, General Mills Slip, and Tower Avenue Slip were calculated in GIS based on the exceedance of the PEC or MEC for any analyte (metal or organic) and the maximum depth in which that exceedance occurred at each location within its representative slip. To determine the volumes, EA utilized ArcGIS Toolbox to develop surfaces of the exceedances in each slip and calculate the volumes based on the depths from the sediment surface to the exceedance surface. This process involved the development of three DEM surfaces created in GIS using kriging as the interpolation method. The first DEM represented the sediment surface and was developed based on the bathymetric surface elevation of the boring at which the PEC (or MEC) exceedance was found (Table 6-2). The second DEM represented the maximum depth of PEC exceedances. The third DEM represented the maximum depth of the MEC exceedances. Each of the exceedance surfaces were then calculated for contaminated sediment volume by using the cut/fill tool in the ArcGIS Toolbox. The cut/fill tool estimated the volume between the bottom surface (MEC or PEC surface) with the sediment surface.

The first set of volumes included the full slip area (from wall to wall) and a second set of volumes was calculated by narrowing the slip area with a 25-ft buffer inward from each slip wall (Figure 6-15). This was to account for geotechnical considerations related to removals along significant structures. Further consideration will be required during feasibility and design to account for additional offsets and sloping required outside the buffer zone to support the desired depth of dredge cut.

The calculated volumes for each exceedance surface are as follows:

Area	Full Slip Area (CY)		25 ft Buffered Area (CY)	
	PEC	MEC	PEC	MEC
Hallet Dock	3,675	7,888	3,242	7,055
Oil Barge	8,698	13,883	4,197	6,730
General Mills	32,740	43,288	26,393	34,697
Tower Ave	91,576	115,659	68,147	86,587

Boring locations in Hallet Dock Slip were focused along the eastern side of the slip (west side recently dredged), the DEM for this slip was developed from the boring locations at the eastern edge of the slip to the approximate centerline of the slip. EA also considered a 25-ft buffer along the edges of each slip to account for geotechnical considerations related to removals along significant structures. Further consideration will be required during feasibility and design to account for additional offsets and sloping required outside the buffer zone to support the desired depth of dredge cut.

In addition to volume estimates based on the SQGs, EA compared concentrations to Non-industrial and Industrial Direct Contact and Soil to Groundwater RCLs. At the request of DNR, EA has included the elevations, within each area, where the exceedances occur for each of the RCLs. This information was developed to allow DNR to apply different cut depths for making a determination about and areas contribution to BUIs.

	Elevation of RCL Exceedances (IGLD85 ft)		
Area	**Groundwater RCL**	**Non-Industrial RCL**	**Industrial RCL**
Hallet Dock 8 Slip	568.04	575.54	None
Oil Barge Dock	568.30	573.89	574.22
General Mills Slip	564.83	565.00	569.00
Tower Avenue Slip	565.38	567.52	575.07
Estuary Flats	586.29	586.29	597.68
Clough Island	None	None	None

EA has also included elevations for each sample interval in the project database allowing DNR to further evaluate exceedances by location using either SQG and/or RCL exceedances.

6.5 RECOMMEDATIONS FOR FUTURE WORK

Exceedances of DNR's SQGs, observed toxicological effects, and general BUIs for the area suggest that further evaluation and consideration of potential remedial actions will continue for areas in the North End District and Clough Island study area. The data collected during the site characterization will allow for the development of a site conceptual model to define the site exposure boundaries, chemicals of concern, potential human health and ecological receptors, anticipated source pathways, and fate and transport processes. Site-specific considerations given the location of the project and the broader AOC restoration efforts, and stakeholder goals will aid in the selection of effective remedial options based on the site-specific physical, chemical, biological and waterway use characteristics.

For purposes of remedial action option evaluation or feasibility study level evaluations, the data collected and summarized in this report provide extensive vertical and horizontal delineation both chemically and lithologically, sufficient for remedial options evaluation. The bathymetric and geophysical survey data (inclusive of the dock wall survey, sub bottom profiling and multi-beam bathymetry) presented in Section 3 and Appendix A provide full coverage and are likely sufficient for both alternative evaluation and potentially design, contingent on the project schedule and alternative selected. The toxicological data provide an additional line of evidence suggesting potential impacts in multiple locations across the site.

Early identification of site-specific considerations including current and future land and waterway use (navigation, recreation, habitat goals, future development, etc.) will directly influence the evaluation of remedial alternatives, specifically in the slips within the North End District and with consideration of the overall goals and BUI removal in the AOC.

Additional data collection activities are recommended following the identification and screening of remedial technologies to support remedy design. Certain data needs will be applicable to multiple technologies including:

- Demonstration of source control (including potential groundwater pathway in the Oil Barge Dock Slip)
- Topographic/shoreline survey
- Utility mapping desktop study and in-water survey
- Benthic community assessment or synthesis of available data
- Cultural and archaeological resource evaluation
- Wetland delineation and mapping, where applicable

Based on the physical, chemical and biological data collected to date at the site, it is likely that one or more of the following remedial technologies could be considered in one or more of the areas within the North End District and Clough Island vicinity. Additional key data needs to further support potential technologies are identified below:

- Monitored Natural Recovery or Enhanced Monitored Natural Recovery:
    - Detailed evaluation of surficial sediment concentrations and net sediment deposition to identify the potential for ongoing deposition and mixing to meet project goals.
    - Bioavailability assessment to further evaluate risk, develop clean up levels, and identify areas that may contribute to site risk. This evaluation may include evaluation of sediment geochemical parameters [acid volatile sulfides, redox, additional information on organic carbon] and porewater concentrations.
    - Evaluation of hydrodynamics and sediment mobility including an evaluation of the potential for scour, vessel prop wash, resuspension, and other sediment transport processes.
- Capping
    - Current and future land and waterway uses, including but not limited to water depths required for navigation, potential for cap disturbance, anticipated future uses of slips.
    - Data collection to support cap design including, but not limited to:
        - Porewater concentration data,
        - Groundwater upwelling rates estimated through modeling or direct measurement,
        - Estimated depths of bioturbation,
        - Potential rooting depths for waterfronts with natural shorelines conducive to habitat restoration (rather than structures),
        - Sediment hydrodynamics/potential for erosion and/or scour.
    - Sediment stability and settlement evaluation and collection of geotechnical data as needed.
    - Slope stability evaluation
    - Structure integrity for settlement-induced downdrag loading, if applicable

- Removal
    - Structural evaluation around dock walls and shoreline structures, including baseline structure conditions assessment
    - Slope stability evaluation
    - Structural engineering evaluation for evaluation dredging in proximity to structures
    - Current and future land and waterway use, including water depths for compatibility with navigational uses (and recreational uses where applicable)
    - Sediment geotechnical properties (grain size, bulk density, Atterberg limits, moisture content, organic matter content, etc.)
    - Data for disposal options (paint filter, TCLP, etc.)

Evaluation of the benefits associated with removal in areas with lower contaminant levels at the surface or, areas near structures with contamination at depth that may be infeasible to remove without some form of cap or residuals cover.

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Figures

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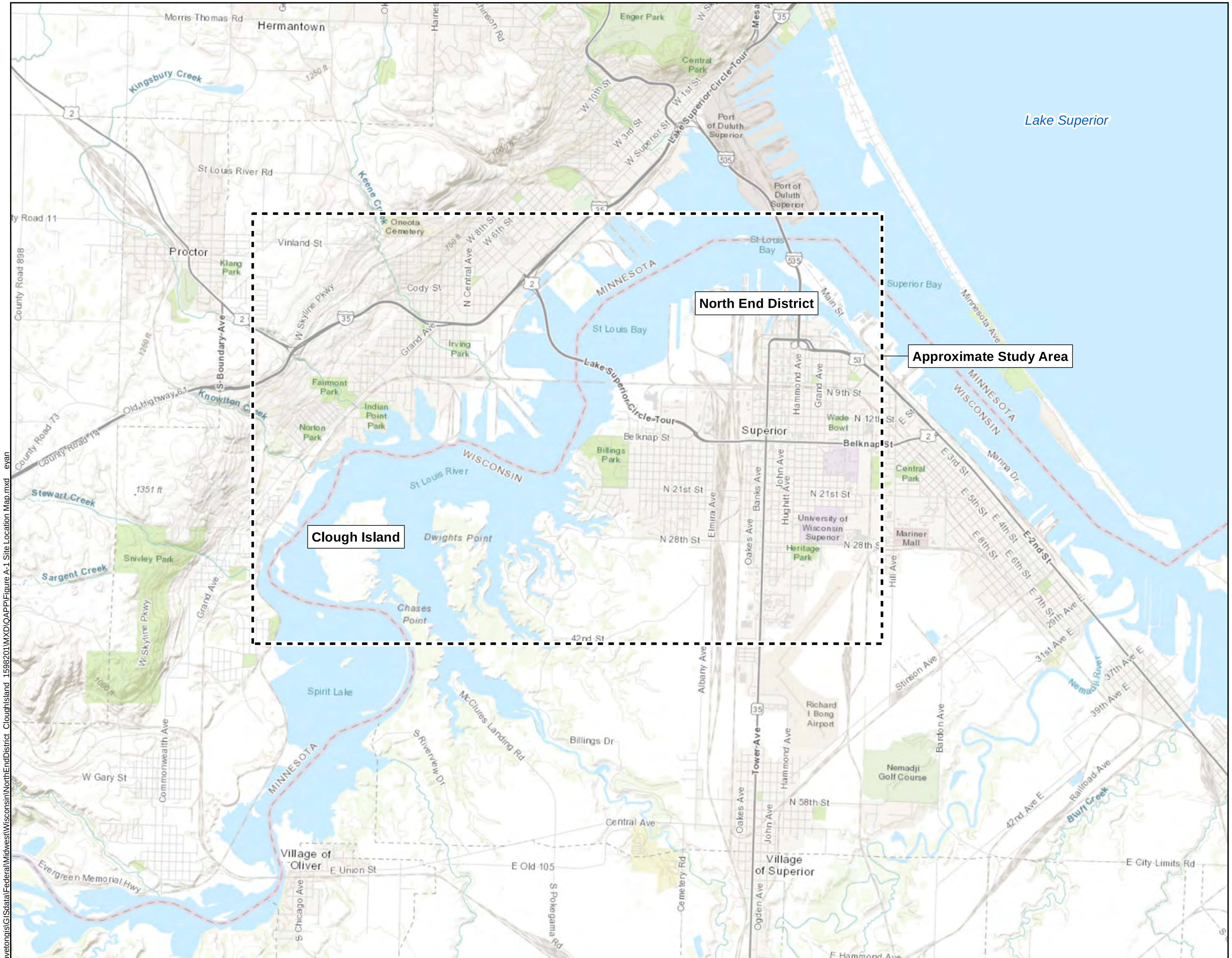

Legend

Approximate Study Area

Map Date: 11/5/2019
Source: ESRI Basemap 2018
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 1 2
Miles

Figure 1-1
Site Location Map
North End District and Clough Island
Superior, Wisconsin

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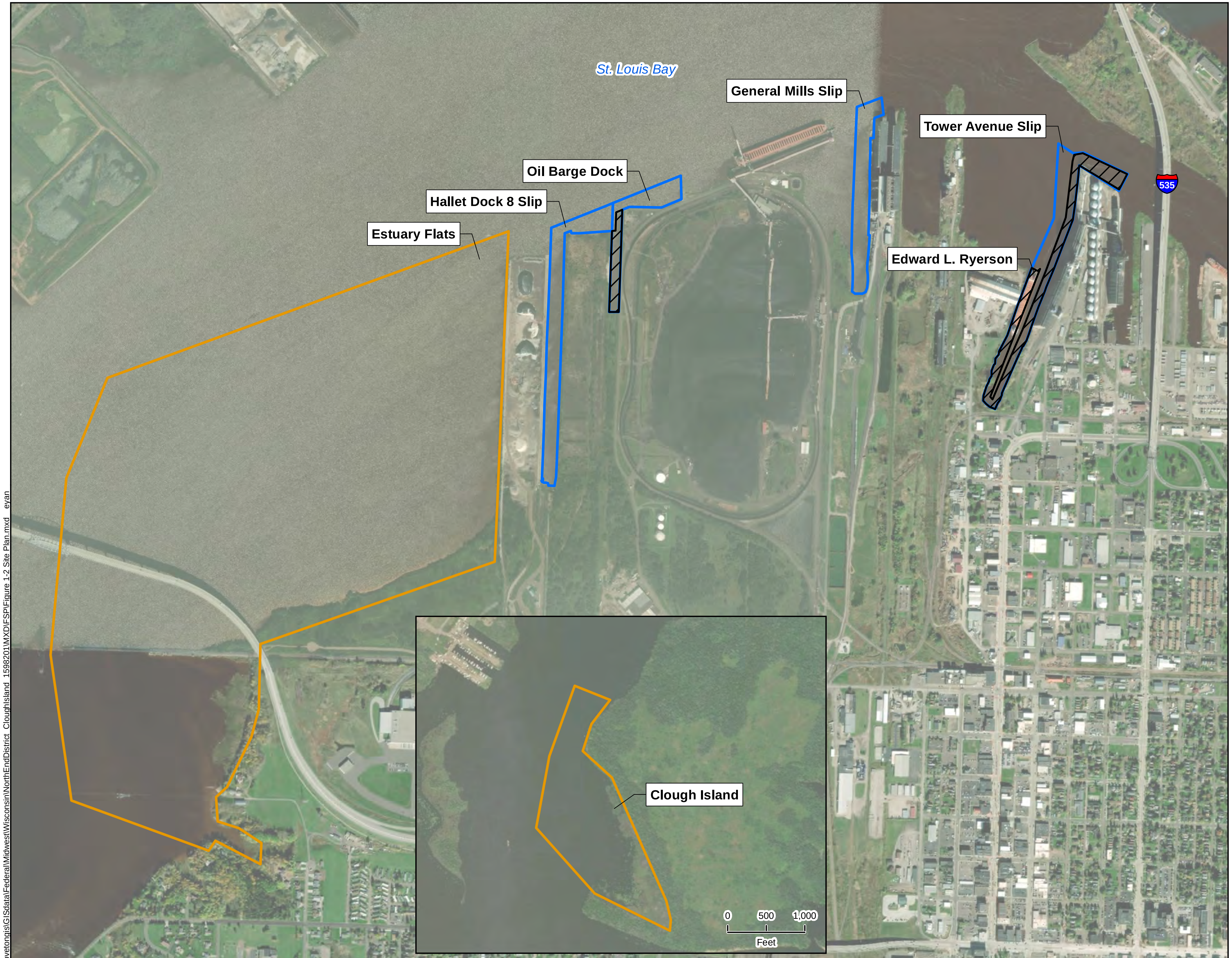
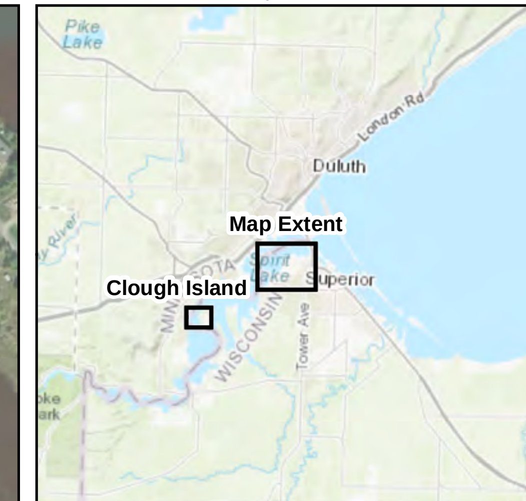


VICINITY MAP



Legend

- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)
- Dock Walls Acoustic Survey Area (11.28 ac)

Map Date: 2/7/2020
Source: ESRI Basemap 2018
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 1,000 2,000
Feet

Figure 1-2
Site Plan
North End District and Clough Island
Superior, Wisconsin

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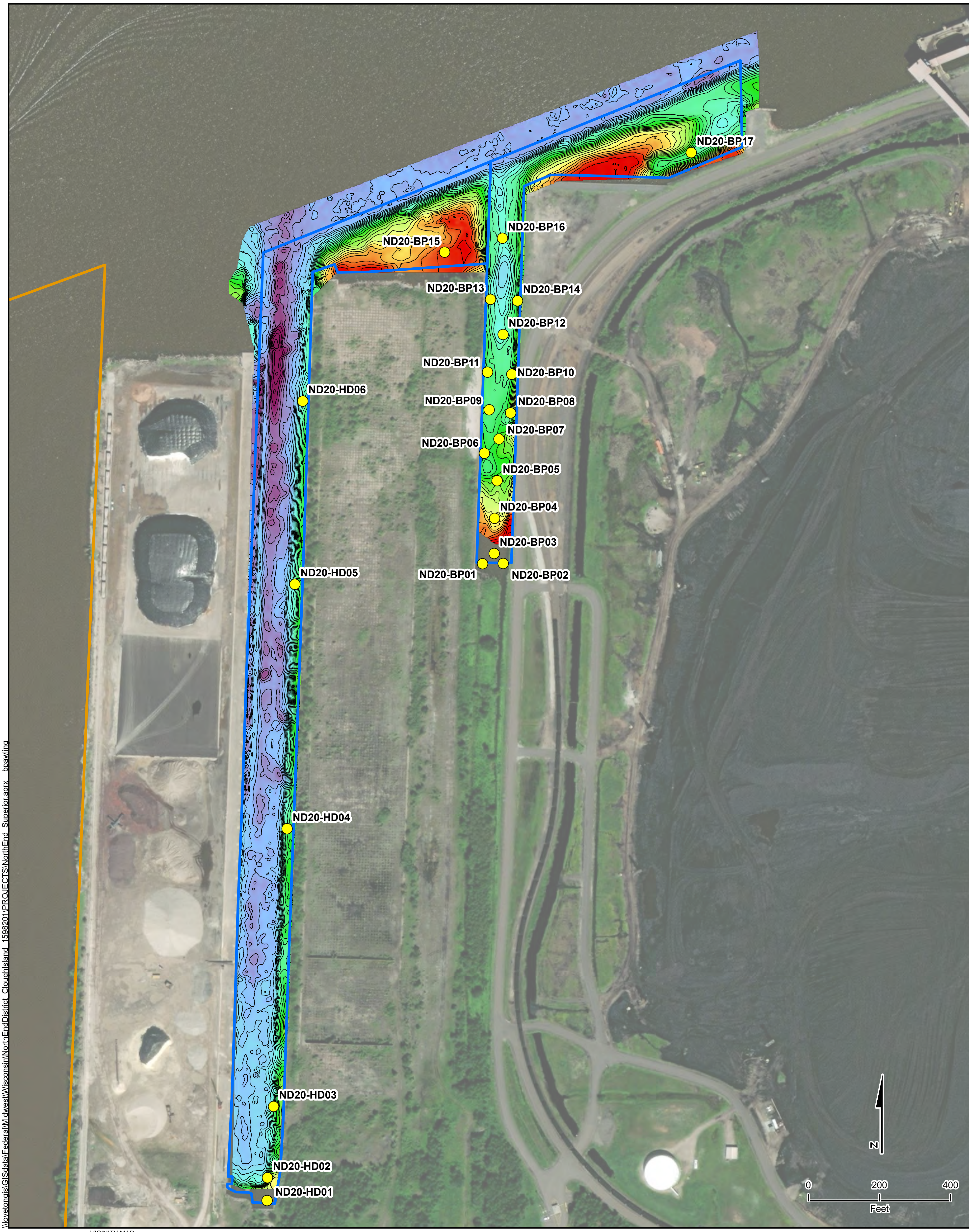
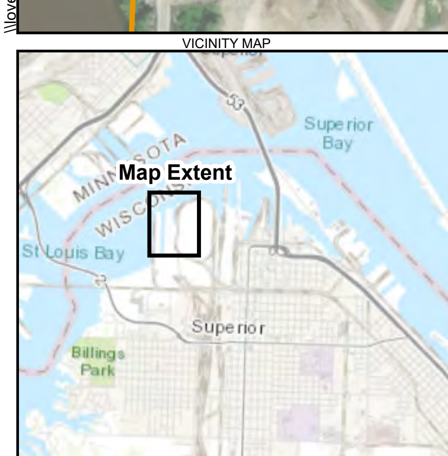




Legend

- Sediment Sample Location (Core and Grab)
- Elevation Contour (IGLD85 Feet)
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

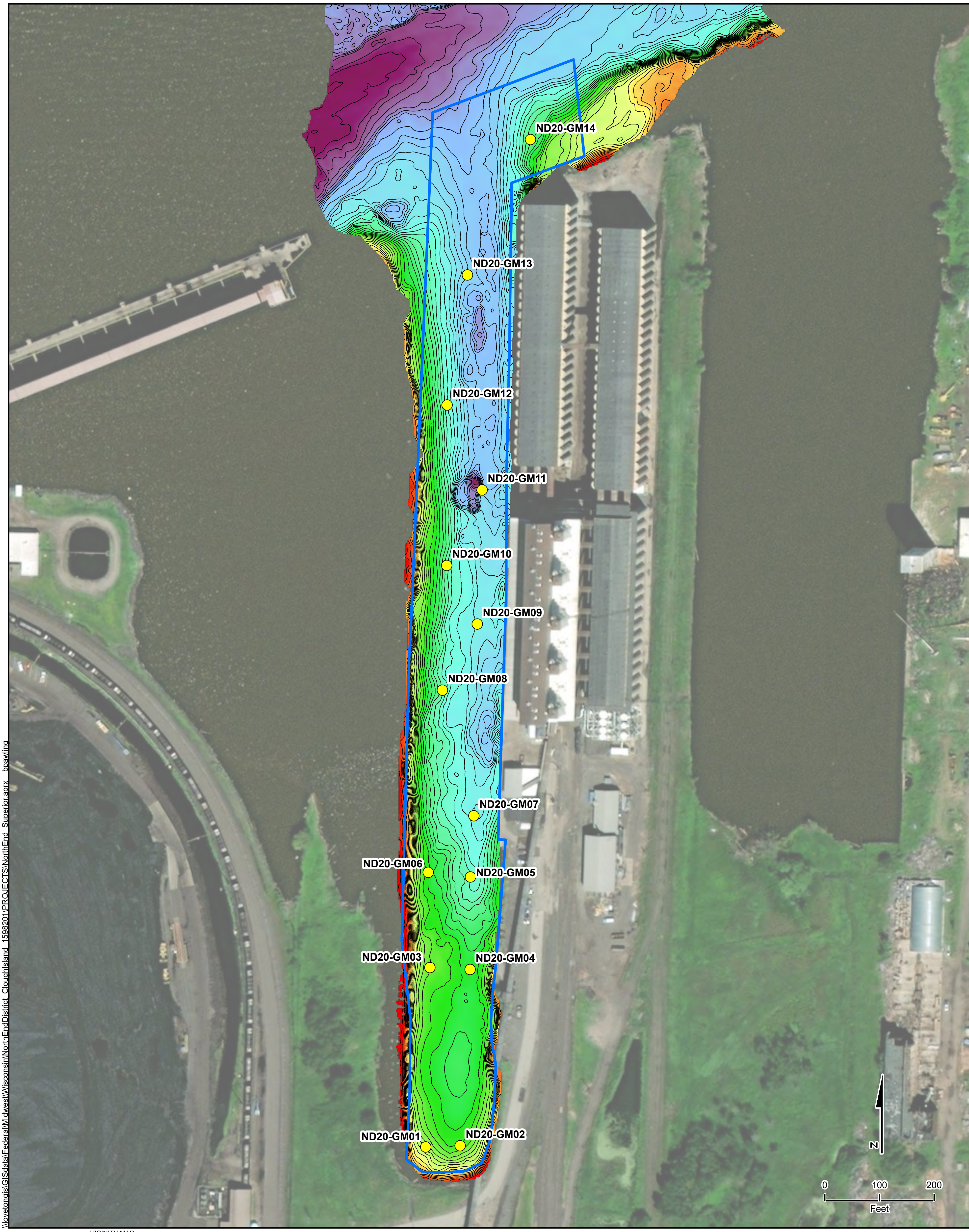
598

564

Figure 2-1
Bathymetry
Hallet Dock 8 Slip and Oil Barge Dock
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/8/2021
Source: ESRI Basemap 2018
Projection: NAD 1983 State Plane Wisconsin North US Foot

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)



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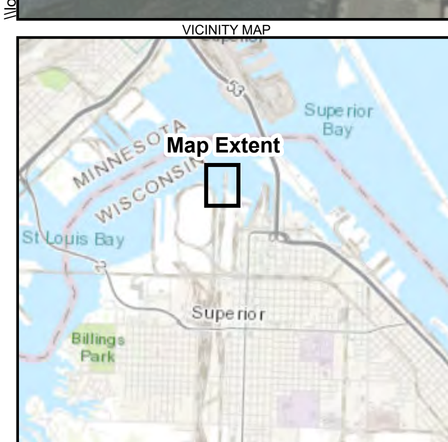
VICINITY MAP



Legend

- Sediment Sample Location (Core and Grab)
- Elevation Contour (IGLD85 Feet)
- Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

600.5

561.5

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

Figure 2-2
Bathymetry
General Mills Slip
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/8/2021
Source: ESRI Basemap 2018
Projection: NAD 1983 State Plane Wisconsin North US Foot

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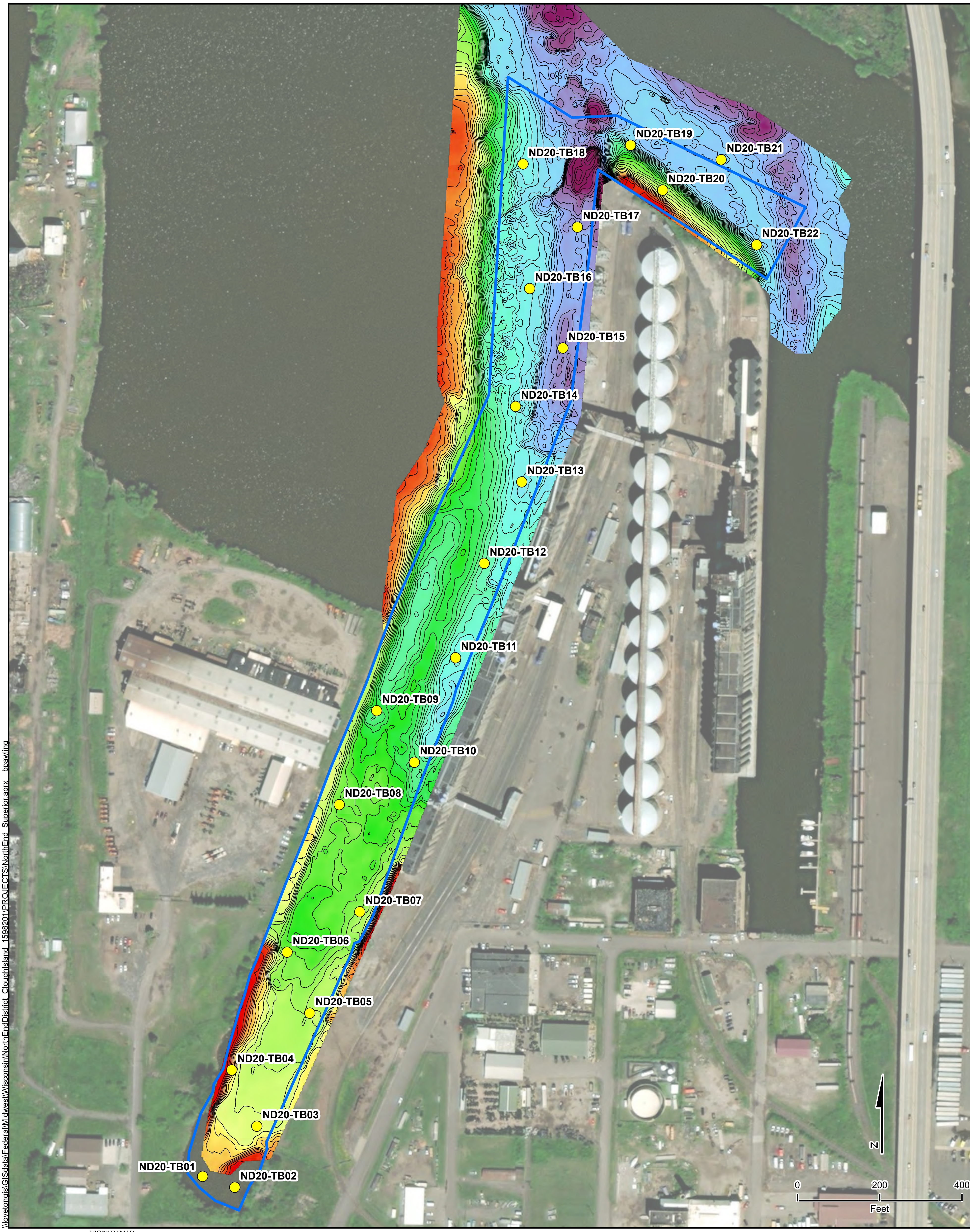
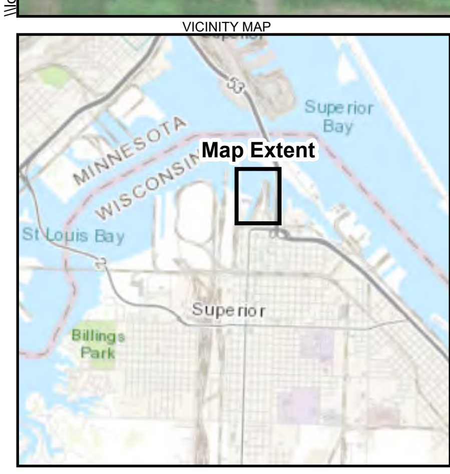


VICINITY MAP



Legend

- Sediment Sample Location (Core and Grab)
- Elevation Contour (IGLD85 Feet)
- Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

600.5

559

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

Figure 2-3
Bathymetry
Tower Avenue Slip
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/8/2021
Source: ESRI Basemap 2018
Projection: NAD 1983 State Plane
Wisconsin North US Foot

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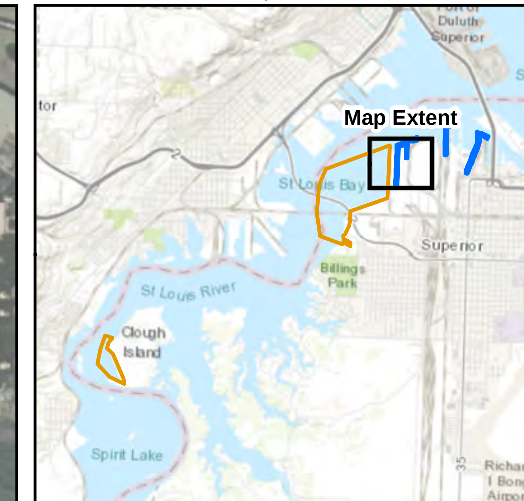
VICINITY MAP



Legend

- Sediment Sample Location (Core and Grab)
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 200 400
Feet

Figure 2-4
Actual Sample Locations
Hallet Dock 8 Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict CloughIsland 1598201\MXD\SSTM\SSTM Figure 2-4 Actual Sample Locs Hallet Dock Slip 8.mxd bpawling

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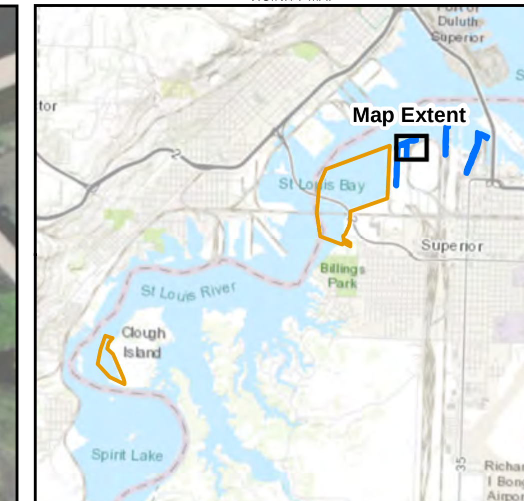

Legend

- Sediment Sample Location (Core and Grab)
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 100 200
Feet

Figure 2-5
Actual Sample Locations
Oil Barge Dock
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\loveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-5 Actual Sample Locs Oil Barge Dock.mxd bpawling

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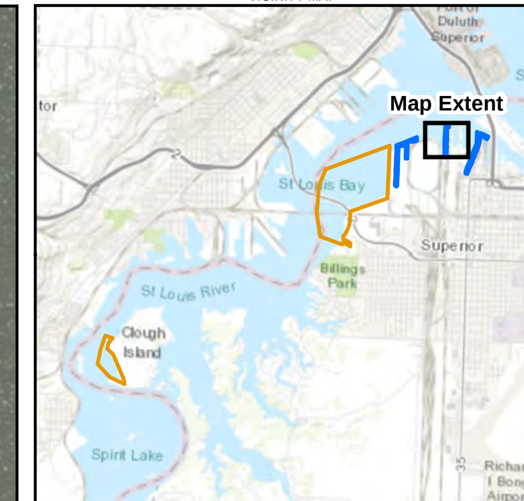
VICINITY MAP



Legend

- Sediment Sample Location (Core and Grab)
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 200 400
Feet

Figure 2-6
Actual Sample Locations
General Mills Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-6 Actual Sample Locs General Mills Slip.mxd bpawling

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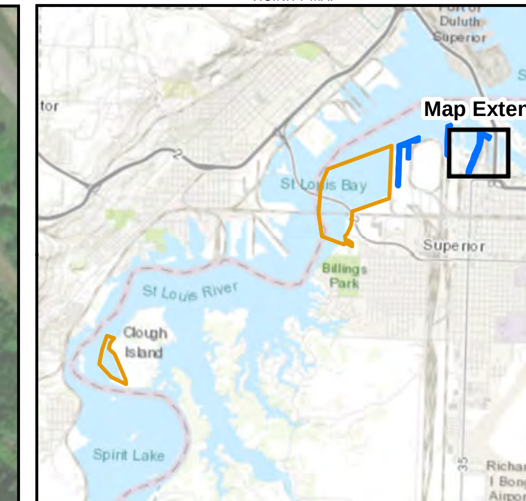

Legend

- Sediment Sample Location (Core and Grab)
- Stormwater Outfall
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 200 400
Feet

Figure 2-7
Actual Sample Locations
Tower Avenue Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-7 Actual Sample Locs Tower Avenue Slip.mxd bpawling

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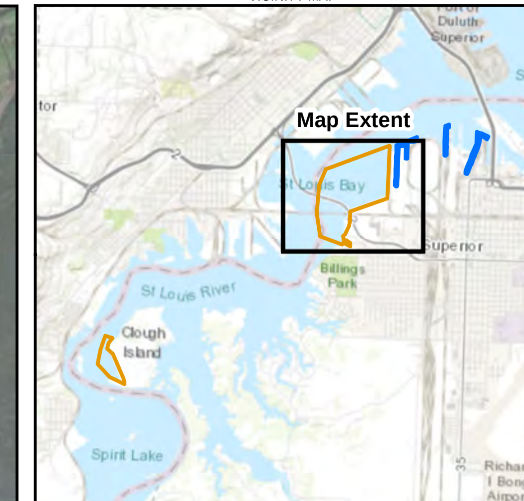
VICINITY MAP



Legend

- Sediment Sample Location (Core and Grab)
- Sediment Sample Location Surface Sample (Grab) Only
- Stormwater Outfall
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 500 1,000
Feet

Figure 2-8
Actual Sample Locations
Estuary Flats
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-8 Actual Sample Locs Estuary Flats.mxd bpawling

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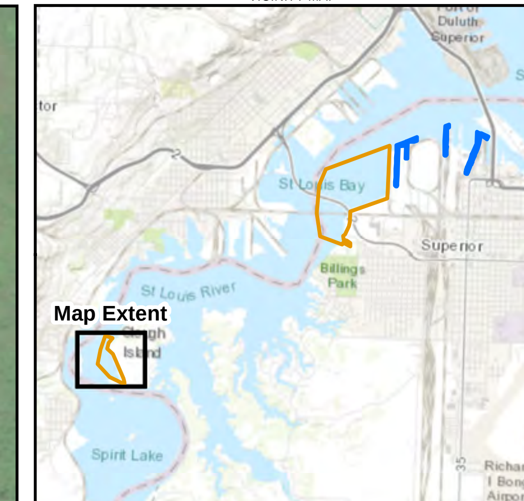

Legend

- Sediment Sample Location Surface Sample (Grab) Only
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 200 400
Feet

Figure 2-9
Actual Sample Locations
Clough Island
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\loveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-9 Actual Sample Locs Clough Island.mxd bpawling

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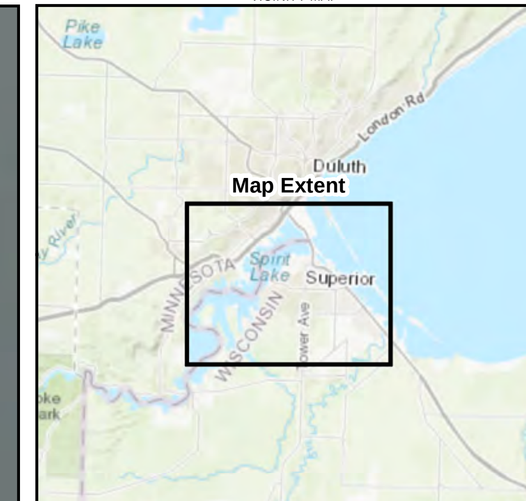
VICINITY MAP



Legend

- Sediment Sample Location Surface Sample (Grab) Only
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.50 ac)

Map Date: 6/14/2021
Source: ESRI Basemap 2019
Projection: NAD 1983 State Plane Wisconsin North US Foot

N

0 2,000 4,000
Feet

Figure 2-10
Reference Locations
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\loveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\SSTM\SSTM Figure 2-10 Actual Reference Locations.mxd bpawling

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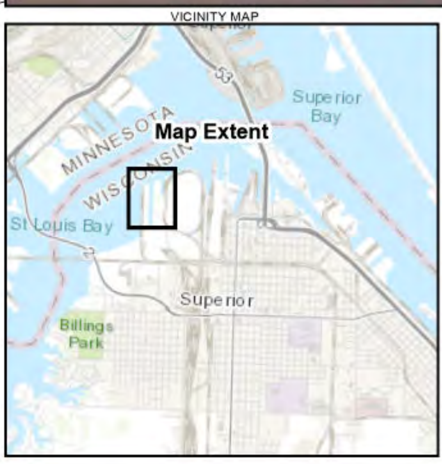
VICINITY MAP



Legend

Elevation Contour (IGLD85 Feet)

Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

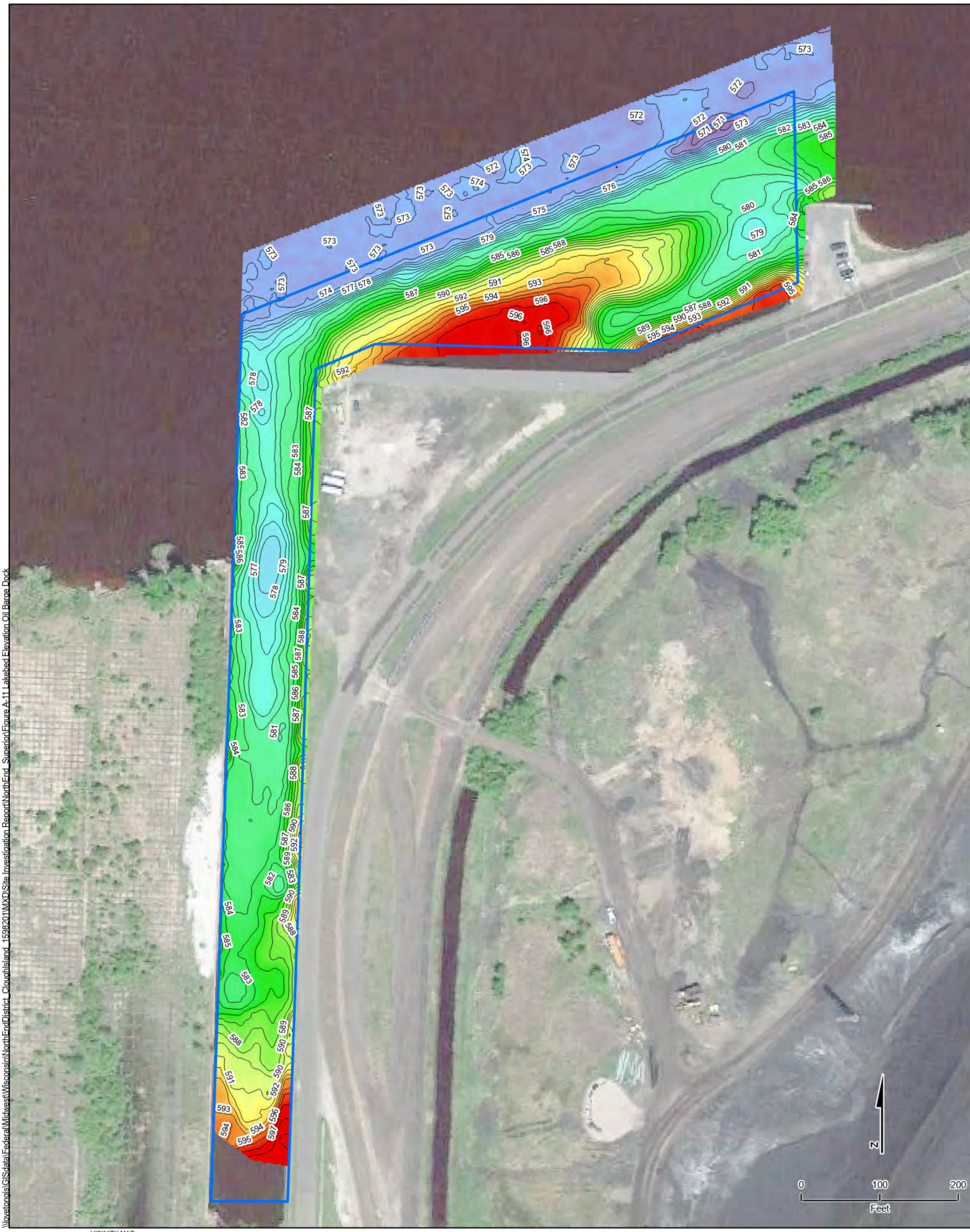
598

564

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

Figure 3-1
Lakebed Elevation
Hallet Dock 8 Slip
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/3/2021
Source: Google Earth 06/2017
Projection: NAD 1983 State Plane
Wisconsin North US Foot



VICINITY MAP

Map Extent

Legend

Elevation Contour (IGLD85 Feet)

Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

598

564

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

Figure 3-2
Lakebed Elevation
Oil Barge Dock
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/3/2021
Source: Google Earth 06/2017
Projection: NAD 1983 State Plane Wisconsin North US Foot

\\Woetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\NorthEnd_Superior\Figure A-11 Lakebed Elevation Oil Barge Dock

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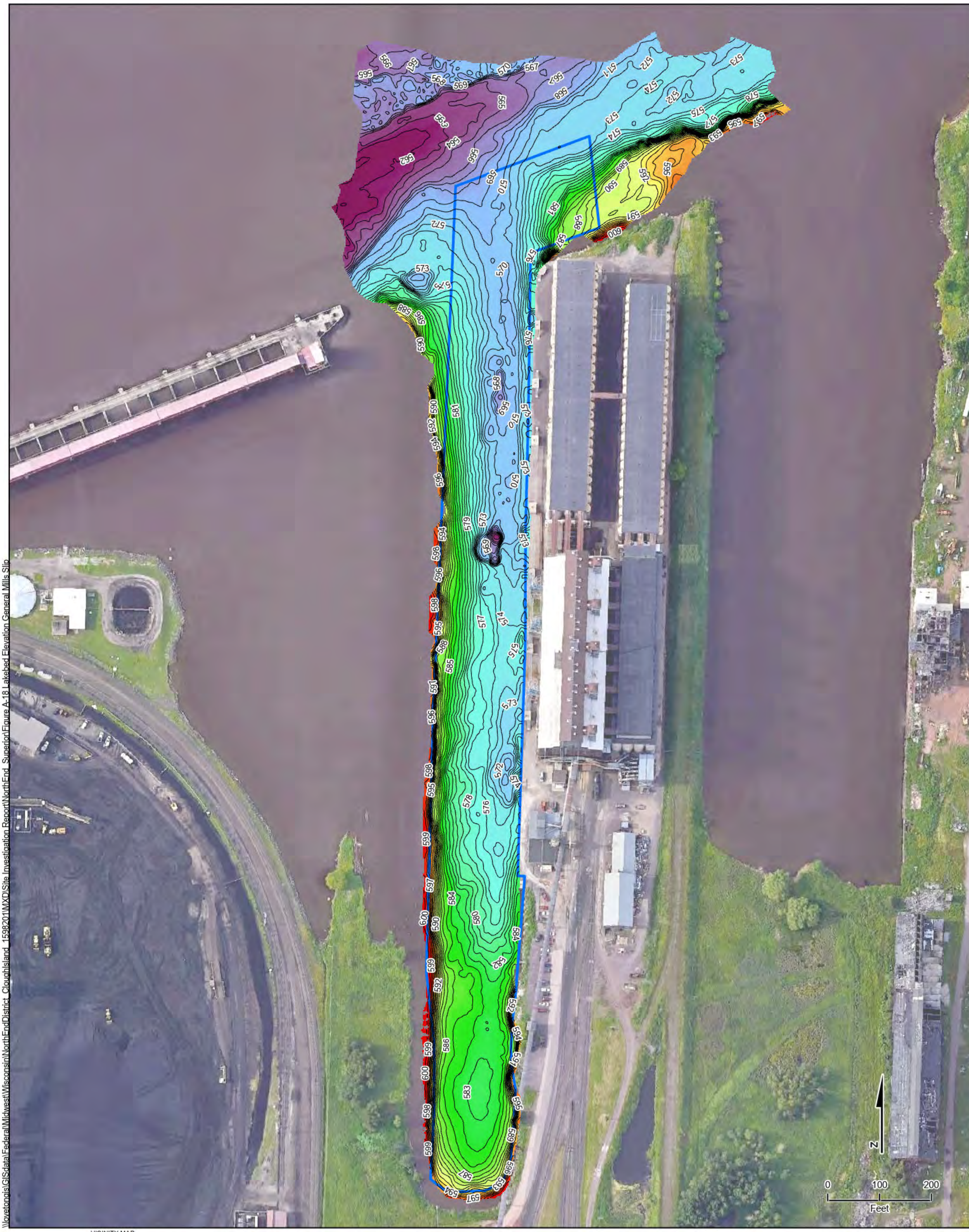

Legend

Elevation Contour (IGLD85 Feet)

Sediment Characterization and Survey Area (39.50 ac)

Elevation (IGLD85 Feet)

600.5

561.5

Figure 3-3
Lakebed Elevation
General Mills Slip
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/3/2021
Source: Google Earth 05/2017
Projection: NAD 1983 State Plane Wisconsin North US Foot

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

\\eatongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\NorthEnd_Superior\Figure A-18 Lakebed Elevation General Mills Slip

Legend

Elevation Contour (IGLD85 Feet)

Sediment Characterization and Survey Area (39.65 ac)

Elevation (IGLD85 Feet)

600.5

559

Notes:
Ordinary High Water (OHW) = 603.1 (IGLD85 Feet)
Low Water Datum (LWD) = 601.1 (IGLD85 Feet)

Figure 3-4
Lakebed Elevation
Tower Avenue Slip
North End District and Clough Island
Superior, Wisconsin

Map Date: 6/3/2021
Source: Google Earth 05/2017
Projection: NAD 1983 State Plane
Wisconsin North US Foot

\\eaetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\NorthEnd_Superior\Figure A-26 Lakebed Elevation Tower Avenue Slip

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ND20-HD06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	1233.0	NT	NT	NT
0.3-1 ft	6.1 U	3.3 U	1.7 U	3.2 U	2.8 U	7.1 U	302.5	NT	NT	NT
1-2 ft	NT	NT	NT	NT	NT	NT	**2040.0**	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	1381.1	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	188.6	NT	NT	NT

ND20-HD05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	5.2 U	2.8 U	1.4 U	2.7 U	2.4 U	6 U	1162.35	NT	NT	NT
0.3-1 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.3 U	1566.0	NT	NT	NT
1-2 ft	5.8 U	3.1 U	1.6 U	3.1 U	2.6 U	6.7 U	**4342.0**	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	**3898.0**	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	1420.0	NT	NT	NT
4-5 ft	NT	NT	NT	NT	NT	NT	23.67	NT	NT	NT

ND20-HD04

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.8 U	4.2 U	2.1 U	4.1 U	3.6 U	9.1 U	**6154.0**	7.2	**5.4684**	2.3 UJ
0.3-1 ft	5.5 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**20290.0**	NT	NT	NT
1-2 ft	NT	NT	NT	NT	NT	NT	**13969.0**	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	**13109.0**	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	**8687.5**	NT	NT	NT

ND20-HD03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	5.6 U	3 U	1.5 U	3 U	2.5 U	6.5 U	**7231.0**	8.3	**5.6371**	2.3 UJ
0.3-1 ft	4.7 U	2.5 U	1.3 U	2.5 U	2.1 U	5.5 U	**22090.0**	NT	NT	NT
1-2 ft	NT	NT	NT	NT	NT	NT	**14150.0**	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	547.31	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	63.21	NT	NT	NT

SW15-SLB02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	160 U	120 U	120 U	110 U	650 J	240 U	**7881.0**	12	NT	NT
0.5-2 ft	53 U	40 U	41 U	38 U	36 U	82 U	104.65	0	NT	NT
2-4 ft	56 U	42 U	44 U	41 U	38 U	88 U	105.75	0	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	107.85	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	101.35	NT	NT	NT

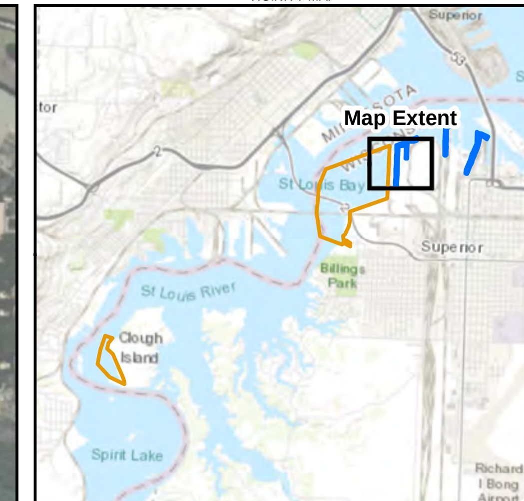
ND20-HD02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	4.8 U	2.6 U	1.3 U	2.6 U	2.2 U	5.6 U	**1832.5**	NT	NT	NT
0.3-1 ft	4.8 U	2.6 U	1.3 U	2.5 U	2.2 U	5.6 U	**2716.2**	NT	NT	NT
1-2 ft	NT	NT	NT	NT	NT	NT	261.0	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	166.8	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	137.9	NT	NT	NT

ND20-HD01

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	5.9 U	3.2 U	1.6 U	3.1 U	2.7 U	6.8 U	**19108.0**	47.3	**5.8883**	2.5 UJ
0.3-1 ft	4.3 U	2.3 U	1.2 U	2.3 U	1.9 U	4.9 U	144.07	NT	NT	NT
1-2 ft	NT	NT	NT	NT	NT	NT	11.995	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	12.535	NT	NT	NT
3-4 ft	NT	NT	NT	NT	NT	NT	13.06	NT	NT	NT

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 200 400
Feet

N

Figure 4-1
Hallet Dock 8 Slip Results - Organics
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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ND20-HD06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.54 U	2.6	0.16 U	11.3	7.2	13300.0	5.7	255	0.035 U	10.6	0.1 U	36.2
0.3-1 ft	0.59 U	2.4	0.18 U	12.3	7.5	12100.0	5.8 J	212 J	0.028 U	10.6 J	0.11 U	33.2 J
1-2 ft	0.69 U	3.6	0.37 J	19.5	15.1	18500.0	15.6 J	318 J	0.067 J	16.8 J	0.13 U	74 J
2-3 ft	0.44 U	3.8	0.24 J	11	15.4	16800.0	23.8 J	353 J	0.047 J	**49.9 J**	0.084 U	83.3 J
3-4 ft	0.53 U	4.5	0.34 J	12.5	10.1	14100.0	**106 J**	139 J	0.031 U	**37 J**	0.1 U	86.7 J

ND20-HD05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.48 U	2.2	0.14 U	10.5	6.3	11000.0	4.5	140	0.032 U	9.2	0.091 U	26.6
0.3-1 ft	0.57 U	3.0	0.26 J	16.1	10.7	16000.0	10.3 J	207 J	0.033 U	13.4 J	0.11 U	50.9 J
1-2 ft	0.63 U	4.3	0.46 J	19.2	17.1	18600.0	21.1 J	201 J	0.081 J	16.6 J	0.12 U	90.4 J
2-3 ft	0.76 U	6.1	0.58 J	23	25.4	**24200.0**	32.5 J	221 J	0.16	19.4 J	0.14 U	**141 J**
3-4 ft	0.5 U	3.7	0.26 J	13.3	10.8	14000.0	31.5 J	138 J	0.082 J	13.2 J	0.095 U	60 J
4-5 ft	0.51 U	1.7	0.15 U	10.6	6	9380.0	2.8 J	119 J	0.029 U	9.6 J	0.096 U	19.3 J

ND20-HD04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.56 U	3.3	0.3 J	14.5	10.2	15100.0	23.4 J	356 J	0.05 J	13.4 J	0.11 U	57.7 J
0.3-1 ft	0.61 U	3.9	0.33 J	14.5	12.8	14800.0	13.3 J	213 J	0.041 J	13.7 J	0.12 U	54.8 J
1-2 ft	0.52 U	5.0	0.44 J	16.6	17.4	18200.0	23 J	198 J	0.075 J	17.2 J	0.098 U	88.6 J
2-3 ft	0.53 U	6.0	0.39 J	14	16.3	16000.0	27.1 J	141 J	0.1 J	15.9 J	0.1 U	84.8 J
3-4 ft	0.52 U	6.9	0.56	13.6	20.8	17300.0	27.9 J	188 J	**0.23**	15.9 J	0.099 U	**125 J**

ND20-HD03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.62 U	3.1	0.25 J	13.9	10.8	14300.0	8.9 J	332 J	0.064 J	12.4 J	0.12 U	46.1 J
0.3-1 ft	0.52 U	4.6	0.18 J	9.7	9.7	11500.0	11.7	120	0.057 J	9.7	0.099 U	37.9
1-2 ft	0.59 U	6.2	0.2 J	11.9	15.3	10200.0	21.3	122	0.086 J	11.3	0.11 U	43.4
2-3 ft	0.44 U	1.8	0.13 U	8.2	5.1	8160.0	3	118	0.03 U	7.3	0.083 U	14.5
3-4 ft	0.49 U	1.5	0.15 U	7.9	4	7830.0	2.3	94.2	0.031 J	6.3	0.093 U	12.5

SW15-SLB02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.42 UJ	6.4	0.69 J	28.3	22.1	**28700.0**	17.3	**720**	0.063 U	22.4	0.12 U	90.3
0.5-2 ft	0.21 UJ	3.5	0.3 J	14.9	13.5	14800.0	4.5	360	0.032 U	13.9	0.058 U	27.9
2-4 ft	0.21 UJ	2.3	0.31 J	14.4	13.7	11900.0	4.6	415	0.034 U	13.1	0.057 U	27.5
4-6 ft	0.22 UJ	1.9	0.22 J	10.5	8.2	9860.0	3.2	244	0.035 U	10	0.061 U	19.1
6-8 ft	0.25 UJ	1.9	0.26 J	9	5.7	9010.0	2.5	196	0.031 U	8.2	0.069 U	15.6

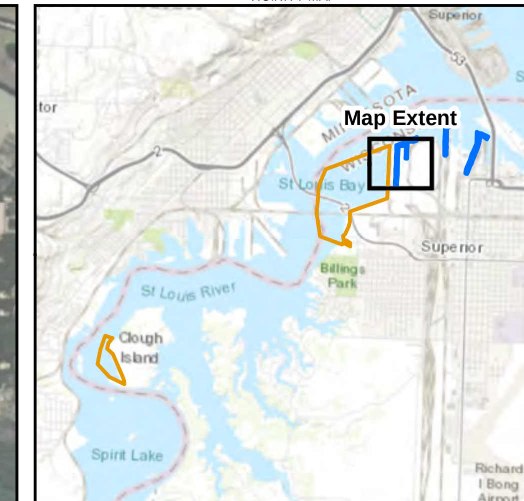
ND20-HD02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.49 U	2.8	0.2 J	14	10.7	13600.0	15.2	247	0.034 U	12	0.092 U	42.1
0.3-1 ft	0.53 U	2.5	0.2 J	14.3	17.9	13000.0	5.5	283	0.048 J	13.1	0.1 U	25.1
1-2 ft	0.53 U	2.2	0.16 U	14.2	10.2	12300.0	5.1	205	0.028 U	12.5	0.1 U	21.9
2-3 ft	0.49 U	1.8	0.14 U	11.7	8.4	10300.0	4.5	186	0.032 U	10.7	0.092 U	19.4
3-4 ft	0.39 U	2.2	0.11 U	12.3	8.9	11400.0	6.2	161	0.027 U	11.1	0.073 U	21.3

ND20-HD01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.65 U	3.1	0.29 J	15.1	14.6	17000.0	13.2 J	387 J	0.083 J	13.2 J	0.12 U	54.5 J
0.3-1 ft	0.44 U	3.0	0.2 J	**50.3**	9.5	15000.0	22.3	**1420**	0.028 U	9.8	0.084 U	30.7
1-2 ft	0.51 U	2.1	0.17 J	10.4	8	9140.0	3	184	0.029 U	9.7	0.096 U	18.5
2-3 ft	0.53 U	2.6	0.18 J	12.9	9.9	11500.0	3.6	227	0.037 J	11.7	0.1 U	22.6
3-4 ft	0.47 U	2.5	0.16 J	11.2	8.9	10700.0	3.3	213	0.03 U	11.4	0.088 U	21.5

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 200 400
Feet

N

Figure 4-2
Hallet Dock **8** Slip Results - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\Wovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-2 Hallet Dock Slip 8 Results Metals.mxd bpawling

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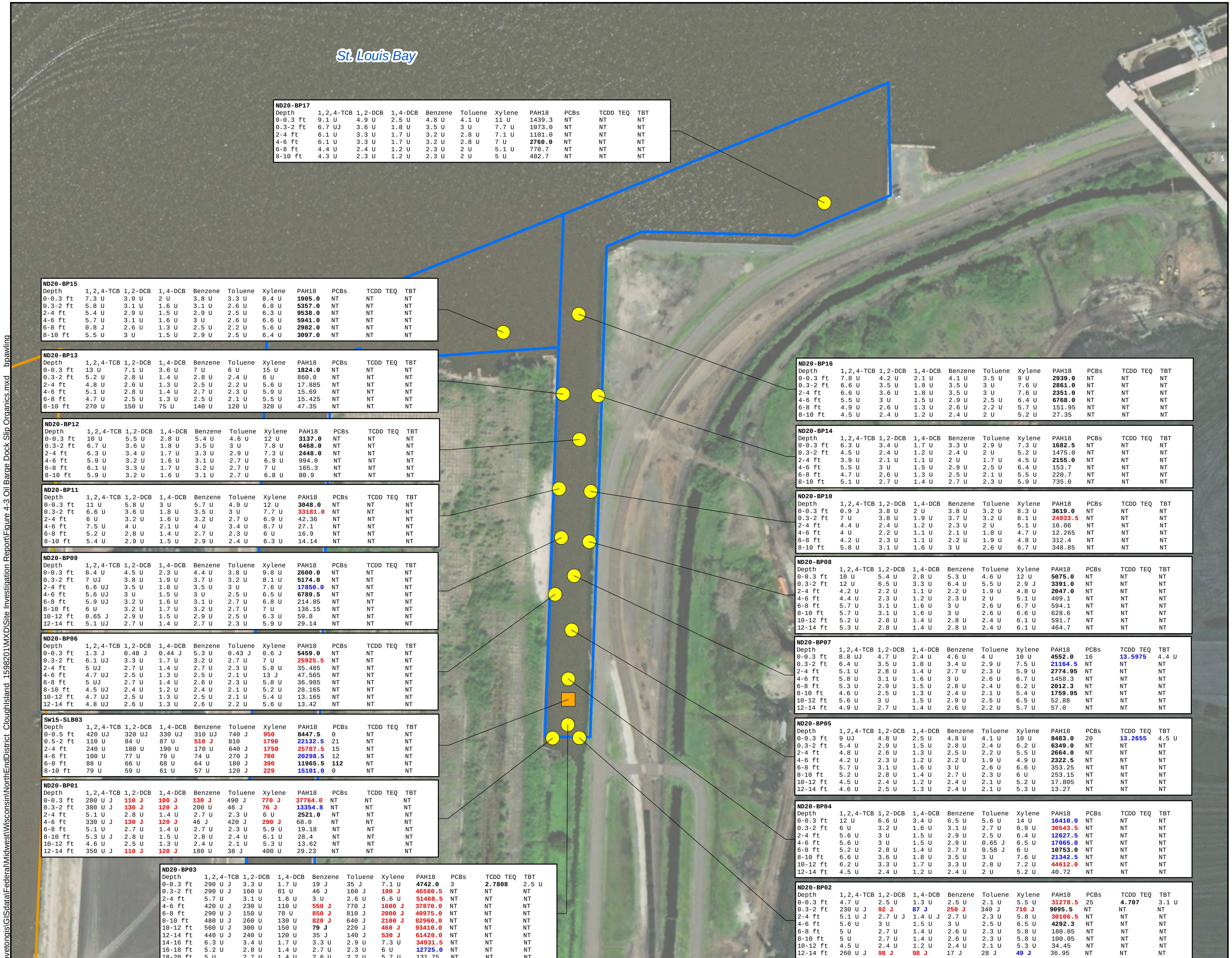
\\loveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-3 Oil Barge Dock Slip Organics.mxd bpawling



ND20-BP17

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	9.1 U	4.9 U	2.5 U	4.8 U	4.1 U	11 U	1439.3	NT	NT	NT
0.3-2 ft	6.7 UJ	3.6 U	1.8 U	3.5 U	3 U	7.7 U	1073.0	NT	NT	NT
2-4 ft	6.1 U	3.3 U	1.7 U	3.2 U	2.8 U	7.1 U	1101.0	NT	NT	NT
4-6 ft	6.1 U	3.3 U	1.7 U	3.2 U	2.8 U	7 U	**2760.0**	NT	NT	NT
6-8 ft	4.4 U	2.4 U	1.2 U	2.3 U	2 U	5.1 U	770.7	NT	NT	NT
8-10 ft	4.3 U	2.3 U	1.2 U	2.3 U	2 U	5 U	482.7	NT	NT	NT

ND20-BP15

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.3 U	3.9 U	2 U	3.8 U	3.3 U	8.4 U	**1905.0**	NT	NT	NT
0.3-2 ft	5.8 U	3.1 U	1.6 U	3.1 U	2.6 U	6.8 U	**5357.0**	NT	NT	NT
2-4 ft	5.4 U	2.9 U	1.5 U	2.9 U	2.5 U	6.3 U	**9538.0**	NT	NT	NT
4-6 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	**5941.0**	NT	NT	NT
6-8 ft	0.8 J	2.6 U	1.3 U	2.5 U	2.2 U	5.6 U	**2982.0**	NT	NT	NT
8-10 ft	5.5 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**3097.0**	NT	NT	NT

ND20-BP13

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	13 U	7.1 U	3.6 U	7 U	6 U	15 U	**1824.0**	NT	NT	NT
0.3-2 ft	5.2 U	2.8 U	1.4 U	2.8 U	2.4 U	6 U	860.0	NT	NT	NT
2-4 ft	4.8 U	2.6 U	1.3 U	2.5 U	2.2 U	5.6 U	17.885	NT	NT	NT
4-6 ft	5.1 U	2.8 U	1.4 U	2.7 U	2.3 U	5.9 U	15.69	NT	NT	NT
6-8 ft	4.7 U	2.5 U	1.3 U	2.5 U	2.1 U	5.5 U	15.425	NT	NT	NT
8-10 ft	270 U	150 U	75 U	140 U	120 U	320 U	47.35	NT	NT	NT

ND20-BP12

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	10 U	5.5 U	2.8 U	5.4 U	4.6 U	12 U	**3137.0**	NT	NT	NT
0.3-2 ft	6.7 U	3.6 U	1.8 U	3.5 U	3 U	7.8 U	**6468.0**	NT	NT	NT
2-4 ft	6.3 U	3.4 U	1.7 U	3.3 U	2.9 U	7.3 U	**2448.0**	NT	NT	NT
4-6 ft	5.9 U	3.2 U	1.6 U	3.1 U	2.7 U	6.9 U	994.0	NT	NT	NT
6-8 ft	6.1 U	3.3 U	1.7 U	3.2 U	2.7 U	7 U	165.3	NT	NT	NT
8-10 ft	5.9 U	3.2 U	1.6 U	3.1 U	2.7 U	6.8 U	80.9	NT	NT	NT

ND20-BP11

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	11 U	5.8 U	3 U	5.7 U	4.9 U	12 U	**3048.0**	NT	NT	NT
0.3-2 ft	6.6 U	3.6 U	1.8 U	3.5 U	3 U	7.7 U	**33181.0**	NT	NT	NT
2-4 ft	6 U	3.2 U	1.6 U	3.2 U	2.7 U	6.9 U	42.36	NT	NT	NT
4-6 ft	7.5 U	4 U	2.1 U	4 U	3.4 U	8.7 U	27.1	NT	NT	NT
6-8 ft	5.2 U	2.8 U	1.4 U	2.7 U	2.3 U	6 U	16.9	NT	NT	NT
8-10 ft	5.4 U	2.9 U	1.5 U	2.9 U	2.4 U	6.3 U	14.14	NT	NT	NT

ND20-BP09

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.4 U	4.5 U	2.3 U	4.4 U	3.8 U	9.8 U	**2600.0**	NT	NT	NT
0.3-2 ft	7 UJ	3.8 U	1.9 U	3.7 U	3.2 U	8.1 U	**5174.0**	NT	NT	NT
2-4 ft	6.6 UJ	3.5 U	1.8 U	3.5 U	3 U	7.6 U	**17850.0**	NT	NT	NT
4-6 ft	5.6 UJ	3 U	1.5 U	3 U	2.5 U	6.5 U	**6789.5**	NT	NT	NT
6-8 ft	5.9 UJ	3.2 U	1.6 U	3.1 U	2.7 U	6.8 U	214.85	NT	NT	NT
8-10 ft	6 U	3.2 U	1.7 U	3.2 U	2.7 U	7 U	136.15	NT	NT	NT
10-12 ft	0.65 J	2.9 U	1.5 U	2.9 U	2.5 U	6.3 U	59.8	NT	NT	NT
12-14 ft	5.1 UJ	2.7 U	1.4 U	2.7 U	2.3 U	5.9 U	29.14	NT	NT	NT

ND20-BP06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	1.3 J	0.48 J	0.44 J	5.3 U	0.43 J	0.6 J	**5459.0**	NT	NT	NT
0.3-2 ft	6.1 UJ	3.3 U	1.7 U	3.2 U	2.7 U	7 U	**25925.5**	NT	NT	NT
2-4 ft	5 UJ	2.7 U	1.4 U	2.7 U	2.3 U	5.8 U	35.485	NT	NT	NT
4-6 ft	4.7 UJ	2.5 U	1.3 U	2.5 U	2.1 U	13 J	47.565	NT	NT	NT
6-8 ft	5 UJ	2.7 U	1.4 U	2.6 U	2.3 U	5.8 U	36.985	NT	NT	NT
8-10 ft	4.5 UJ	2.4 U	1.2 U	2.4 U	2.1 U	5.2 U	28.165	NT	NT	NT
10-12 ft	4.7 UJ	2.5 U	1.3 U	2.5 U	2.1 U	5.4 U	13.165	NT	NT	NT
12-14 ft	4.8 UJ	2.6 U	1.3 U	2.6 U	2.2 U	5.6 U	13.42	NT	NT	NT

SW15-SLB03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	420 UJ	320 UJ	330 UJ	310 UJ	740 J	**950**	**8447.5**	0	NT	NT
0.5-2 ft	110 U	84 U	87 U	**510 J**	810	**1790**	**22132.5**	21	NT	NT
2-4 ft	240 U	180 U	190 U	170 U	640 J	**1750**	**25787.5**	15	NT	NT
4-6 ft	100 U	77 U	79 U	74 U	270 J	**780**	**20298.5**	12	NT	NT
6-8 ft	88 U	66 U	68 U	64 U	180 J	**390**	**11965.5**	**112**	NT	NT
8-10 ft	79 U	59 U	61 U	57 U	120 J	**229**	**15101.0**	0	NT	NT

ND20-BP01

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	280 U J	**110 J**	**100 J**	**130 J**	490 J	**770 J**	**37764.0**	NT	NT	NT
0.3-2 ft	380 U J	**130 J**	**120 J**	200 U	46 J	**76 J**	**13354.8**	NT	NT	NT
2-4 ft	5.1 U	2.8 U	1.4 U	2.7 U	2.3 U	6 U	**2521.0**	NT	NT	NT
4-6 ft	330 U J	**130 J**	**120 J**	46 J	420 J	**290 J**	68.0	NT	NT	NT
6-8 ft	5.1 U	2.7 U	1.4 U	2.7 U	2.3 U	5.9 U	19.18	NT	NT	NT
8-10 ft	5.3 U J	2.8 U	1.5 U	2.8 U	2.4 U	6.1 U	28.4	NT	NT	NT
10-12 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.3 U	13.62	NT	NT	NT
12-14 ft	350 U J	**110 J**	**120 J**	180 U	38 J	400 U	29.23	NT	NT	NT

ND20-BP03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	290 U J	3.3 U	1.7 U	19 J	35 J	7.1 U	**4742.0**	3	**2.7808**	2.5 U
0.3-2 ft	290 U J	160 U	81 U	46 J	160 J	**190 J**	**46580.5**	NT	NT	NT
2-4 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	**51468.5**	NT	NT	NT
4-6 ft	420 U J	230 U	110 U	**550 J**	770 J	**1600 J**	**37870.0**	NT	NT	NT
6-8 ft	290 U J	150 U	78 U	**850 J**	810 J	**2000 J**	**40975.0**	NT	NT	NT
8-10 ft	480 U J	260 U	130 U	**820 J**	640 J	**2100 J**	**82960.0**	NT	NT	NT
10-12 ft	560 U J	300 U	150 U	**79 J**	220 J	**460 J**	**93410.0**	NT	NT	NT
12-14 ft	440 U J	240 U	120 U	35 J	140 J	**530 J**	**61420.0**	NT	NT	NT
14-16 ft	6.3 U	3.4 U	1.7 U	3.3 U	2.9 U	7.3 U	**34931.5**	NT	NT	NT
16-18 ft	5.2 U	2.8 U	1.4 U	2.7 U	2.3 U	6 U	**12725.0**	NT	NT	NT
18-20 ft	5 U	2.7 U	1.4 U	2.6 U	2.2 U	5.7 U	131.75	NT	NT	NT

ND20-BP16

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.8 U	4.2 U	2.1 U	4.1 U	3.5 U	9 U	**2939.0**	NT	NT	NT
0.3-2 ft	6.6 U	3.5 U	1.8 U	3.5 U	3 U	7.6 U	**2861.0**	NT	NT	NT
2-4 ft	6.6 U	3.6 U	1.8 U	3.5 U	3 U	7.6 U	**2351.0**	NT	NT	NT
4-6 ft	5.5 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**6768.0**	NT	NT	NT
6-8 ft	4.9 U	2.6 U	1.3 U	2.6 U	2.2 U	5.7 U	151.95	NT	NT	NT
8-10 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	27.35	NT	NT	NT

ND20-BP14

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	6.3 U	3.4 U	1.7 U	3.3 U	2.9 U	7.3 U	**1682.5**	NT	NT	NT
0.3-2 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	1475.0	NT	NT	NT
2-4 ft	3.9 U	2.1 U	1.1 U	2 U	1.7 U	4.5 U	**2155.0**	NT	NT	NT
4-6 ft	5.5 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	153.7	NT	NT	NT
6-8 ft	4.7 U	2.6 U	1.3 U	2.5 U	2.1 U	5.5 U	220.7	NT	NT	NT
8-10 ft	5.1 U	2.7 U	1.4 U	2.7 U	2.3 U	5.9 U	735.0	NT	NT	NT

ND20-BP10

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	0.9 J	3.8 U	2 U	3.8 U	3.2 U	8.3 U	**3619.0**	NT	NT	NT
0.3-2 ft	7 U	3.8 U	1.9 U	3.7 U	3.2 U	8.1 U	**24933.5**	NT	NT	NT
2-4 ft	4.4 U	2.4 U	1.2 U	2.3 U	2 U	5.1 U	16.06	NT	NT	NT
4-6 ft	4 U	2.2 U	1.1 U	2.1 U	1.8 U	4.7 U	12.265	NT	NT	NT
6-8 ft	4.2 U	2.3 U	1.1 U	2.2 U	1.9 U	4.8 U	312.4	NT	NT	NT
8-10 ft	5.8 U	3.1 U	1.6 U	3 U	2.6 U	6.7 U	348.85	NT	NT	NT

ND20-BP08

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	10 U	5.4 U	2.8 U	5.3 U	4.6 U	12 U	**5075.0**	NT	NT	NT
0.3-2 ft	12 U	6.5 U	3.3 U	6.4 U	5.5 U	2.9 J	**3391.0**	NT	NT	NT
2-4 ft	4.2 U	2.2 U	1.1 U	2.2 U	1.9 U	4.8 U	**2047.0**	NT	NT	NT
4-6 ft	4.4 U	2.3 U	1.2 U	2.3 U	2 U	5.1 U	409.1	NT	NT	NT
6-8 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.7 U	594.1	NT	NT	NT
8-10 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	628.6	NT	NT	NT
10-12 ft	5.2 U	2.8 U	1.4 U	2.8 U	2.4 U	6.1 U	591.7	NT	NT	NT
12-14 ft	5.3 U	2.8 U	1.4 U	2.8 U	2.4 U	6.1 U	464.7	NT	NT	NT

ND20-BP07

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.8 UJ	4.7 U	2.4 U	4.6 U	4 U	10 U	**4552.0**	16	**13.5975**	4.4 U
0.3-2 ft	6.4 U	3.5 U	1.8 U	3.4 U	2.9 U	7.5 U	**21164.5**	NT	NT	NT
2-4 ft	5.1 U	2.8 U	1.4 U	2.7 U	2.3 U	5.9 U	**2774.95**	NT	NT	NT
4-6 ft	5.8 U	3.1 U	1.6 U	3 U	2.6 U	6.7 U	1458.3	NT	NT	NT
6-8 ft	5.3 U	2.9 U	1.5 U	2.8 U	2.4 U	6.2 U	**2012.3**	NT	NT	NT
8-10 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.4 U	**1759.95**	NT	NT	NT
10-12 ft	5.6 U	3 U	1.5 U	2.9 U	2.5 U	6.5 U	52.88	NT	NT	NT
12-14 ft	4.9 U	2.7 U	1.4 U	2.6 U	2.2 U	5.7 U	57.0	NT	NT	NT

ND20-BP05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	9 UJ	4.8 U	2.5 U	4.8 U	4.1 U	10 U	**8483.0**	20	**13.2655**	4.5 U
0.3-2 ft	5.4 U	2.9 U	1.5 U	2.8 U	2.4 U	6.2 U	**6349.0**	NT	NT	NT
2-4 ft	4.8 U	2.6 U	1.3 U	2.5 U	2.2 U	5.5 U	**2664.0**	NT	NT	NT
4-6 ft	4.2 U	2.3 U	1.2 U	2.2 U	1.9 U	4.9 U	**2322.5**	NT	NT	NT
6-8 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	353.25	NT	NT	NT
8-10 ft	5.2 U	2.8 U	1.4 U	2.7 U	2.3 U	6 U	253.15	NT	NT	NT
10-12 ft	4.5 U	2.4 U	1.2 U	2.4 U	2.1 U	5.2 U	17.805	NT	NT	NT
12-14 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.3 U	13.27	NT	NT	NT

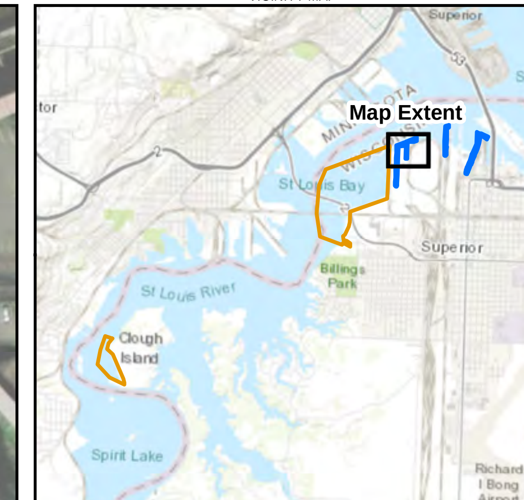
ND20-BP04

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	12 U	6.6 U	3.4 U	6.5 U	5.6 U	14 U	**16410.0**	NT	NT	NT
0.3-2 ft	6 U	3.2 U	1.6 U	3.1 U	2.7 U	6.9 U	**30543.5**	NT	NT	NT
2-4 ft	5.6 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**12627.5**	NT	NT	NT
4-6 ft	5.6 U	3 U	1.5 U	2.9 U	0.65 J	6.5 U	**17065.0**	NT	NT	NT
6-8 ft	5.2 U	2.8 U	1.4 U	2.7 U	0.58 J	6 U	**10753.0**	NT	NT	NT
8-10 ft	6.6 U	3.6 U	1.8 U	3.5 U	3 U	7.6 U	**21342.5**	NT	NT	NT
10-12 ft	6.2 U	3.3 U	1.7 U	3.3 U	2.8 U	7.2 U	**44612.0**	NT	NT	NT
12-14 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	40.72	NT	NT	NT

ND20-BP02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	4.7 U	2.5 U	1.3 U	2.5 U	2.1 U	5.5 U	**31278.5**	25	**4.707**	3.1 U
0.3-2 ft	230 U J	**92 J**	**87 J**	**250 J**	340 J	**710 J**	**9095.5**	NT	NT	NT
2-4 ft	5.1 U J	2.7 U J	1.4 U J	2.7 U	2.3 U	5.8 U	**30106.5**	NT	NT	NT
4-6 ft	5.6 U	3 U	1.5 U	3 U	2.5 U	6.5 U	**4292.3**	NT	NT	NT
6-8 ft	5 U	2.7 U	1.4 U	2.6 U	2.3 U	5.8 U	180.05	NT	NT	NT
8-10 ft	5 U	2.7 U	1.4 U	2.6 U	2.3 U	5.8 U	100.05	NT	NT	NT
10-12 ft	4.5 U	2.4 U	1.2 U	2.4 U	2.1 U	5.3 U	34.45	NT	NT	NT
12-14 ft	260 U J	**98 J**	**98 J**	17 J	28 J	**49 J**	36.95	NT	NT	NT

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in **blue** exceed the MEC.
Concentrations shown in **red** exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/3/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 100 200
Feet

N

Figure 4-3
Oil Barge Dock Slip - Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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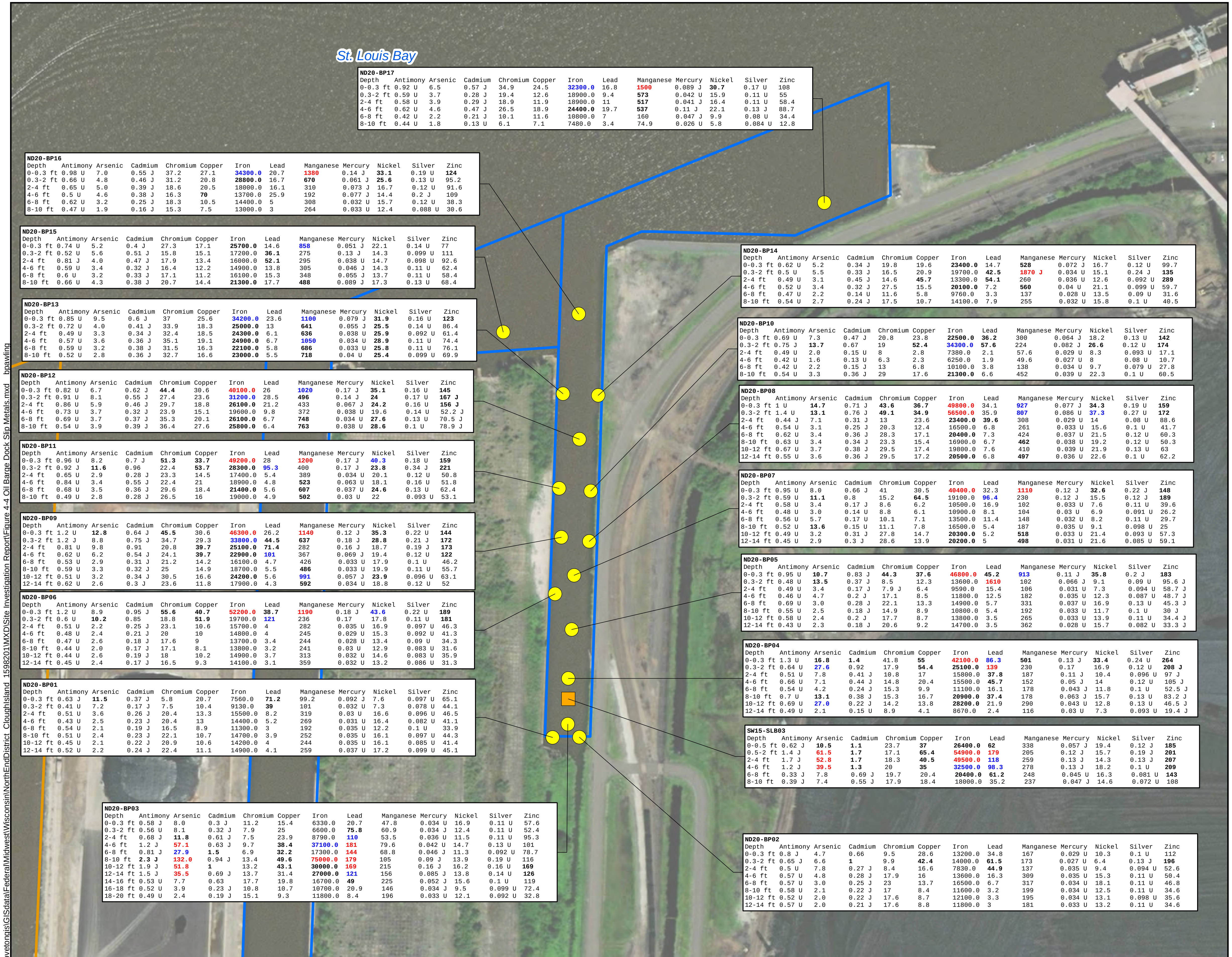


ND20-BP17

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.92 U	6.5	0.57 J	34.9	24.5	**32300.0**	16.8	**1500**	0.089 J	**30.7**	0.17 U	108
0.3-2 ft	0.59 U	3.7	0.28 J	19.4	12.6	18900.0	9.4	**573**	0.042 U	15.9	0.11 U	55
2-4 ft	0.58 U	3.9	0.29 J	18.9	11.9	18900.0	11	**517**	0.041 J	16.4	0.11 U	58.4
4-6 ft	0.62 U	4.6	0.47 J	26.5	18.9	**24400.0**	19.7	**537**	0.11 J	22.1	0.13 J	88.7
6-8 ft	0.42 U	2.2	0.21 J	10.1	11.6	10800.0	7	160	0.047 J	9.9	0.08 U	34.4
8-10 ft	0.44 U	1.8	0.13 U	6.1	7.1	7480.0	3.4	74.9	0.026 U	5.8	0.084 U	12.8

ND20-BP16

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.98 U	7.0	0.55 J	37.2	27.1	**34300.0**	20.7	**1380**	0.14 J	**33.1**	0.19 U	**124**
0.3-2 ft	0.66 U	4.8	0.46 J	31.2	20.8	**28800.0**	16.7	**670**	0.061 J	**25.6**	0.13 U	95.2
2-4 ft	0.65 U	5.0	0.39 J	18.6	20.5	18000.0	16.1	310	0.073 J	16.7	0.12 U	91.6
4-6 ft	0.5 U	4.6	0.38 J	16.3	**70**	13700.0	25.9	192	0.077 J	14.4	0.2 J	109
6-8 ft	0.62 U	3.2	0.25 J	18.3	10.5	14400.0	5	308	0.032 U	15.7	0.12 U	38.3
8-10 ft	0.47 U	1.9	0.16 J	15.3	7.5	13000.0	3	264	0.033 U	12.4	0.088 U	30.6

ND20-BP15

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.74 U	5.2	0.4 J	27.3	17.1	**25700.0**	14.6	**858**	0.051 J	22.1	0.14 U	77
0.3-2 ft	0.52 U	5.6	0.51 J	15.8	15.1	17200.0	**36.1**	275	0.13 J	14.3	0.099 U	111
2-4 ft	0.81 J	4.0	0.47 J	17.9	13.4	16000.0	**52.1**	295	0.038 U	14.7	0.098 U	92.6
4-6 ft	0.59 U	3.4	0.32 J	16.4	12.2	14900.0	13.8	305	0.046 J	14.3	0.11 U	62.4
6-8 ft	0.6 U	3.2	0.33 J	17.1	11.2	16100.0	15.3	348	0.055 J	13.7	0.11 U	58.4
8-10 ft	0.66 U	4.3	0.38 J	20.7	14.4	**21300.0**	17.7	**488**	0.089 J	17.3	0.13 U	68.4

ND20-BP13

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.85 U	9.5	0.6 J	37	25.6	**34200.0**	23.6	**1100**	0.079 J	**31.9**	0.16 U	**123**
0.3-2 ft	0.72 U	4.0	0.41 J	33.9	18.3	**25000.0**	13	**641**	0.055 J	**25.5**	0.14 U	86.4
2-4 ft	0.49 U	3.3	0.34 J	32.4	18.5	**24300.0**	6.1	**636**	0.038 U	**25.9**	0.092 U	61.4
4-6 ft	0.57 U	3.6	0.36 J	35.1	19.1	**24900.0**	6.7	**1050**	0.034 U	**28.9**	0.11 U	74.4
6-8 ft	0.59 U	3.2	0.38 J	31.5	16.3	**22100.0**	5.8	**686**	0.033 U	**25.8**	0.11 U	76.1
8-10 ft	0.52 U	2.8	0.36 J	32.7	16.6	**23000.0**	5.5	**718**	0.04 U	**25.4**	0.099 U	69.9

ND20-BP12

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.82 U	6.7	0.62 J	**44.4**	30.6	**40100.0**	26	**1020**	0.17 J	**35.1**	0.16 U	**145**
0.3-2 ft	0.91 U	8.1	0.55 J	27.4	23.6	**31200.0**	28.5	**496**	0.14 J	**24**	0.17 U	**167 J**
2-4 ft	0.86 U	5.9	0.46 J	29.7	18.8	**26100.0**	21.2	433	0.067 J	**24.2**	0.16 U	**156 J**
4-6 ft	0.73 U	3.7	0.32 J	23.9	15.1	19600.0	9.8	372	0.038 U	19.6	0.14 U	52.2 J
6-8 ft	0.69 U	3.7	0.37 J	35.3	20.1	**26100.0**	6.7	**748**	0.034 U	**27.6**	0.13 U	70.5 J
8-10 ft	0.54 U	3.9	0.39 J	36.4	27.6	**25800.0**	6.4	**763**	0.038 U	**28.6**	0.1 U	78.9 J

ND20-BP11

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.96 U	8.2	0.7 J	**51.3**	**33.7**	**49200.0**	28	**1200**	0.17 J	**40.3**	0.18 U	**159**
0.3-2 ft	0.92 J	**11.6**	0.96	22.4	**53.7**	**28300.0**	**95.3**	400	0.17 J	**23.8**	0.34 J	**221**
2-4 ft	0.65 U	2.9	0.28 J	23.3	14.5	17400.0	5.4	389	0.034 U	20.1	0.12 U	50.8
4-6 ft	0.84 U	3.4	0.55 J	22.4	21	18900.0	4.8	**523**	0.063 U	18.1	0.16 U	51.8
6-8 ft	0.68 U	3.5	0.36 J	29.6	18.4	**21400.0**	5.6	**607**	0.037 U	**24.6**	0.13 U	62.4
8-10 ft	0.49 U	2.8	0.28 J	26.5	16	19000.0	4.9	**502**	0.03 U	22	0.093 U	53.1

ND20-BP09

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 U	**12.8**	0.64 J	**45.5**	30.6	**46300.0**	26.2	**1140**	0.12 J	**35.3**	0.22 U	**144**
0.3-2 ft	1.2 J	8.8	0.75 J	34.7	29.3	**33800.0**	**44.5**	**637**	0.18 J	**28.8**	0.21 J	**172**
2-4 ft	0.81 U	9.8	0.91	20.8	**39.7**	**25100.0**	**71.4**	282	0.16 J	18.7	0.19 J	**173**
4-6 ft	0.62 U	6.2	0.54 J	24.1	**39.7**	**22900.0**	**101**	367	0.069 J	19.4	0.12 U	**122**
6-8 ft	0.53 U	2.9	0.31 J	21.2	14.2	16100.0	4.7	426	0.033 U	17.9	0.1 U	46.2
8-10 ft	0.59 U	3.3	0.32 J	25	14.9	18700.0	5.5	**486**	0.033 U	19.9	0.11 U	55.7
10-12 ft	0.51 U	3.2	0.34 J	30.5	16.6	**24200.0**	5.6	**991**	0.057 J	**23.9**	0.096 U	63.1
12-14 ft	0.62 U	2.6	0.3 J	23.6	11.8	17900.0	4.3	**592**	0.034 U	18.8	0.12 U	52

ND20-BP06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 U	8.9	0.95 J	**55.6**	**40.7**	**52200.0**	**38.7**	**1190**	0.18 J	**43.6**	0.22 U	**189**
0.3-2 ft	0.6 U	**10.2**	0.85	18.8	**51.9**	19700.0	**121**	236	0.17	17.8	0.11 U	**181**
2-4 ft	0.51 U	2.2	0.25 J	23.1	10.6	15700.0	4	282	0.035 U	16.9	0.097 U	46.3
4-6 ft	0.48 U	2.4	0.21 J	20	10	14800.0	4	245	0.029 U	15.3	0.092 U	41.3
6-8 ft	0.47 U	2.6	0.18 J	17.6	9	13700.0	3.4	244	0.028 U	13.4	0.09 U	34.3
8-10 ft	0.44 U	2.0	0.17 J	17.1	8.1	13800.0	3.2	241	0.03 U	12.9	0.083 U	31.6
10-12 ft	0.44 U	2.6	0.19 J	18	10.2	14900.0	3.7	313	0.032 U	14.6	0.083 U	35.9
12-14 ft	0.45 U	2.4	0.17 J	16.5	9.3	14100.0	3.1	359	0.032 U	13.2	0.086 U	31.3

ND20-BP01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.63 J	**11.5**	0.37 J	5.8	20.7	7560.0	**71.2**	99.2	0.092 J	7.6	0.097 U	65.1
0.3-2 ft	0.41 U	7.2	0.17 J	7.5	10.4	9130.0	**39**	101	0.032 U	7.3	0.078 U	44.1
2-4 ft	0.51 U	3.6	0.26 J	20.4	13.3	15500.0	8.2	319	0.03 U	16.6	0.096 U	46.5
4-6 ft	0.43 U	2.5	0.23 J	20.4	13	14400.0	5.2	269	0.031 U	16.4	0.082 U	41.1
6-8 ft	0.54 U	2.1	0.19 J	16.5	8.9	11300.0	3	192	0.035 U	12.2	0.1 U	33.9
8-10 ft	0.51 U	2.4	0.23 J	22.1	10.7	14700.0	3.9	252	0.035 U	16.1	0.097 U	44.3
10-12 ft	0.45 U	2.1	0.22 J	20.9	10.6	14200.0	4	244	0.035 U	16.1	0.085 U	41.4
12-14 ft	0.52 U	2.2	0.24 J	22.4	11.1	14900.0	4.1	259	0.037 U	17.2	0.099 U	45.1

ND20-BP03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.58 J	8.0	0.3 J	11.2	15.4	6330.0	20.7	47.8	0.034 U	16.9	0.11 U	57.6
0.3-2 ft	0.56 U	8.1	0.32 J	7.9	25	6600.0	**75.8**	60.9	0.034 J	12.4	0.11 U	52.4
2-4 ft	0.68 J	**11.8**	0.61 J	7.5	23.9	8790.0	**110**	53.5	0.036 U	11.5	0.11 U	95.3
4-6 ft	1.2 J	**57.1**	0.63 J	9.7	**38.4**	**37100.0**	**181**	79.6	0.042 U	14.7	0.13 U	101
6-8 ft	0.81 J	**27.9**	**1.5**	6.9	**32.2**	17300.0	**144**	68.8	0.046 J	11.3	0.092 U	78.7
8-10 ft	**2.3 J**	**132.0**	0.94 J	13.4	**49.6**	**75000.0**	**179**	105	0.09 J	13.9	0.19 U	116
10-12 ft	1.9 J	**51.8**	**1**	13.2	**43.1**	**30000.0**	**169**	215	0.16 J	16.2	0.16 U	**169**
12-14 ft	1.5 J	**35.5**	0.69 J	13.7	31.4	**27000.0**	**121**	156	0.085 J	13.8	0.14 U	**126**
14-16 ft	0.53 U	7.7	0.63	17.7	19.8	16700.0	**49**	225	0.052 J	15.6	0.1 U	119
16-18 ft	0.52 U	3.9	0.23 J	10.8	10.7	10700.0	20.9	146	0.034 J	9.5	0.099 U	72.4
18-20 ft	0.49 U	2.4	0.19 J	15.1	9.3	11800.0	8.4	196	0.033 U	12.1	0.092 U	32.8

ND20-BP14

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.62 U	5.2	0.34 J	19.8	19.6	**23400.0**	14.7	**528**	0.072 J	16.7	0.12 U	99.7
0.3-2 ft	0.5 U	5.5	0.33 J	16.5	20.9	19700.0	**42.5**	**1870 J**	0.034 U	15.1	0.24 J	**135**
2-4 ft	0.49 U	3.1	0.45 J	14.6	**45.7**	13300.0	**54.1**	260	0.036 U	12.6	0.092 U	**289**
4-6 ft	0.52 U	3.4	0.32 J	27.5	15.5	**20100.0**	7.2	**560**	0.04 U	21.1	0.099 U	59.7
6-8 ft	0.47 U	2.2	0.14 U	11.6	5.8	9760.0	3.3	137	0.028 U	13.5	0.09 U	31.6
8-10 ft	0.54 U	2.7	0.24 J	17.5	10.7	14100.0	7.9	255	0.032 U	15.8	0.1 U	40.5

ND20-BP10

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.69 U	7.3	0.47 J	20.8	23.8	**22500.0**	**36.2**	300	0.064 J	18.2	0.13 U	**142**
0.3-2 ft	0.75 J	**13.7**	0.67	19	**52.4**	**34300.0**	**57.6**	224	0.082 J	**26.6**	0.12 U	**174**
2-4 ft	0.49 U	2.0	0.15 U	8	2.8	7380.0	2.1	57.6	0.029 U	8.3	0.093 U	17.1
4-6 ft	0.42 U	1.6	0.13 U	6.3	2.3	6250.0	1.9	49.6	0.027 U	8	0.08 U	10.7
6-8 ft	0.42 U	2.2	0.15 J	13	6.8	10100.0	3.8	138	0.034 U	9.7	0.079 U	27.8
8-10 ft	0.54 U	3.3	0.36 J	29	17.6	**21300.0**	6.6	452	0.039 U	22.3	0.1 U	60.5

ND20-BP08

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1 U	**14.7**	0.71 J	**43.6**	**36.7**	**49800.0**	34.1	**927**	0.077 J	**34.3**	0.19 U	**159**
0.3-2 ft	1.4 U	**13.1**	0.76 J	**49.1**	**34.9**	**56500.0**	35.9	**807**	0.086 U	**37.3**	0.27 U	**172**
2-4 ft	0.44 J	7.1	0.31 J	13	23.6	**23400.0**	**39.6**	308	0.029 U	14	0.08 U	88.6
4-6 ft	0.54 U	3.1	0.25 J	20.3	12.4	16500.0	6.8	261	0.033 U	15.6	0.1 U	41.7
6-8 ft	0.62 U	3.4	0.36 J	28.3	17.1	**20400.0**	7.3	424	0.037 U	21.5	0.12 U	60.3
8-10 ft	0.63 U	3.4	0.34 J	23.3	15.4	16900.0	6.7	**462**	0.038 U	19.2	0.12 U	50.3
10-12 ft	0.67 U	3.7	0.38 J	29.5	17.4	19800.0	7.6	410	0.039 U	21.9	0.13 U	63
12-14 ft	0.55 U	3.6	0.36 J	29.5	17.2	**20500.0**	6.8	**497**	0.036 U	22.6	0.1 U	62.2

ND20-BP07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.95 U	8.0	0.66 J	41	30.5	**40400.0**	32.3	**1110**	0.12 J	**32.6**	0.22 J	**148**
0.3-2 ft	0.59 U	**11.1**	0.8	15.2	**64.5**	19100.0	**96.4**	230	0.12 J	15.5	0.12 J	**189**
2-4 ft	0.58 U	3.4	0.17 J	8.6	6.2	10500.0	16.9	102	0.033 U	7.6	0.11 U	39.6
4-6 ft	0.48 U	3.0	0.14 U	8.8	6.1	10900.0	8.1	104	0.03 U	6.9	0.091 U	26.2
6-8 ft	0.56 U	5.7	0.17 U	10.1	7.1	13500.0	11.4	148	0.032 U	8.2	0.11 U	29.7
8-10 ft	0.52 U	**13.6**	0.15 U	11.1	7.8	16500.0	5.4	187	0.035 U	9.1	0.098 U	25
10-12 ft	0.49 U	3.2	0.31 J	27.8	14.7	**20300.0**	5.2	**518**	0.033 U	21.4	0.093 U	57.3
12-14 ft	0.45 U	2.9	0.3 J	28.6	13.9	**20200.0**	5	**498**	0.031 U	21.6	0.085 U	59.1

ND20-BP05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.95 U	**10.7**	0.83 J	**44.3**	**37.6**	**46800.0**	**45.2**	**913**	0.11 J	**35.8**	0.2 J	**183**
0.3-2 ft	0.48 U	**13.5**	0.37 J	8.5	12.3	13600.0	**1610**	102	0.066 J	9.1	0.09 U	95.6 J
2-4 ft	0.49 U	3.4	0.17 J	7.9 J	6.4	9590.0	15.4	106	0.031 U	7.3	0.094 U	58.7 J
4-6 ft	0.46 U	4.7	0.2 J	17.1	8.5	11800.0	12.5	182	0.035 U	12.3	0.087 U	48.7 J
6-8 ft	0.69 U	3.0	0.28 J	22.1	13.3	14900.0	5.7	331	0.037 U	16.9	0.13 U	45.3 J
8-10 ft	0.55 U	2.5	0.18 J	14.9	8.9	10800.0	5.4	192	0.033 U	11.7	0.1 U	30 J
10-12 ft	0.58 U	2.4	0.2 J	17.7	8.7	13800.0	3.5	265	0.033 U	13.9	0.11 U	34.4 J
12-14 ft	0.43 U	2.3	0.18 J	20.6	9.2	14700.0	3.5	362	0.028 U	15.7	0.082 U	33.3 J

ND20-BP04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.3 U	**16.8**	**1.4**	41.8	**55**	**42100.0**	**86.3**	**501**	0.13 J	**33.4**	0.24 U	**264**
0.3-2 ft	0.64 U	**27.6**	0.92	17.9	**54.4**	**25100.0**	**139**	230	0.17	16.9	0.12 U	**208 J**
2-4 ft	0.51 U	7.8	0.41 J	10.8	17	15800.0	**37.8**	187	0.11 J	10.4	0.096 U	97 J
4-6 ft	0.66 U	7.1	0.44 J	14.8	20.4	15500.0	**45.7**	152	0.05 J	14	0.12 U	105 J
6-8 ft	0.54 U	4.2	0.24 J	15.3	9.9	11100.0	16.1	178	0.043 J	11.8	0.1 U	52.5 J
8-10 ft	0.7 U	**13.1**	0.38 J	15.3	16.7	**20900.0**	**37.4**	178	0.063 J	15.7	0.13 U	83.2 J
10-12 ft	0.69 U	**27.0**	0.22 J	14.2	13.8	**28200.0**	21.9	290	0.043 U	12.8	0.13 U	46.5 J
12-14 ft	0.49 U	2.1	0.15 U	8.9	4.1	8670.0	2.4	116	0.03 U	7.3	0.093 U	19.4 J

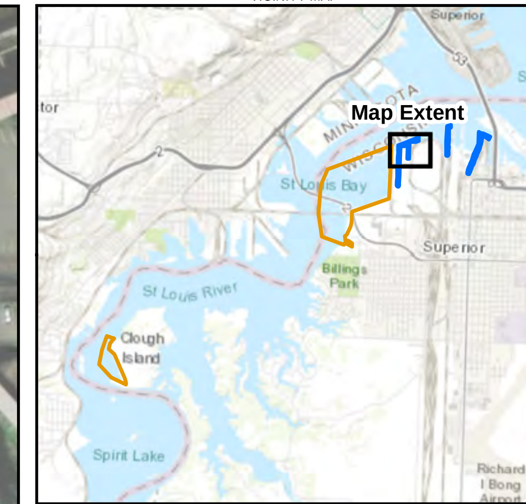
SW15-SLB03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.62 J	**10.5**	**1.1**	23.7	**37**	**26400.0**	**62**	338	0.057 J	19.4	0.12 J	**185**
0.5-2 ft	1.4 J	**61.5**	**1.7**	17.1	**65.4**	**54900.0**	**179**	205	0.12 J	15.7	0.19 J	**201**
2-4 ft	1.7 J	**52.8**	**1.7**	18.3	**40.5**	**49500.0**	**118**	259	0.13 J	14.3	0.13 J	**207**
4-6 ft	1.2 J	**39.5**	**1.3**	20	**35**	**32500.0**	**98.3**	278	0.13 J	18.2	0.1 U	**209**
6-8 ft	0.33 J	7.8	0.69 J	19.7	20.4	**20400.0**	**61.2**	248	0.045 U	16.3	0.081 U	**143**
8-10 ft	0.39 J	7.4	0.55 J	17.9	18.4	18000.0	35.2	237	0.047 J	14.6	0.072 U	108

ND20-BP02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.8 J	4.7	0.66	9.5	28.6	13200.0	34.8	167	0.029 U	10.3	0.1 U	112
0.3-2 ft	0.65 J	6.6	**1**	9.9	**42.4**	14000.0	**61.5**	173	0.027 U	6.4	0.13 J	**196**
2-4 ft	0.5 U	7.8	0.27 J	8.4	16.6	7830.0	**44.9**	137	0.035 U	9.4	0.094 U	52.6
4-6 ft	0.57 U	4.8	0.28 J	17.9	16	13600.0	16.3	309	0.035 U	15.3	0.11 U	50.4
6-8 ft	0.57 U	3.0	0.25 J	23	13.7	16500.0	6.7	317	0.034 U	18.1	0.11 U	46.8
8-10 ft	0.58 U	2.1	0.22 J	17	8.4	11600.0	3.2	199	0.034 U	12.5	0.11 U	34.6
10-12 ft	0.52 U	2.0	0.22 J	17.6	8.7	12100.0	3.3	195	0.034 U	13.1	0.098 U	35.6
12-14 ft	0.57 U	2.0	0.21 J	17.6	8.8	11800.0	3	181	0.033 U	13.2	0.11 U	34.6

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/3/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 100 200
Feet

N

Figure 4-4
Oil Barge Dock Slip - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\loveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-4 Oil Barge Dock Slip Metals.mxd bpawling

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ND20-GM14

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	579.4	NT	NT	2.1 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	14226.0	NT	NT	2.1 U
2-4 ft	NT	NT	NT	NT	NT	NT	16.56	NT	NT	2.1 U
4-6 ft	NT	NT	NT	NT	NT	NT	15.765	NT	NT	2.1 U

ND20-GM13

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	1289.0	NT	NT	4.5

ND20-GM12

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**1720.0**	7	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**11160.0**	26	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	1491.4	3.7	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	28781.0	36	NT	NT

ND20-GM10

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2901.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	30155.0	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	34620.0	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**10693.0**	NT	NT	NT

ND20-GM08

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.4 U	4.5 U	2.3 U	4.4 U	3.8 U	9.7 U	**2810.0**	NT	**8.0589**	2.9 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	18335.0	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	17442.0	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	15414.0	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	1251.3	NT	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	12.86	NT	NT	NT

SW15-SLB05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	13	NT	14
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	50	NT	23
2-4 ft	NT	NT	NT	NT	NT	NT	None	**198**	NT	NT

ND20-GM06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**3369.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**5475.0**	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	61260.0	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	19372.0	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	47220.0	NT	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	21950.0	NT	NT	NT

ND20-GM03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**6862.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	33870.0	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	38240.0	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	23910.0	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	64440.0	NT	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	26760.0	NT	NT	NT

ND20-GM01

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**10663.0**	32	NT	5 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	54170.0	40	NT	3.6 U
2-4 ft	NT	NT	NT	NT	NT	NT	41300.0	20	NT	2.9 U

SW15-SLB07

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	6	NT	NT

ND20-GM11

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**1617.0**	NT	NT	19 J
0.3-2 ft	NT	NT	NT	NT	NT	NT	**4921.0**	NT	NT	2.3 U
2-4 ft	NT	NT	NT	NT	NT	NT	12401.0	NT	NT	2.2 U
4-6 ft	NT	NT	NT	NT	NT	NT	**7302.0**	NT	NT	5.3

ND20-GM09

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2398.0**	NT	NT	3.2 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**5472.0**	NT	NT	2.9 U
2-4 ft	NT	NT	NT	NT	NT	NT	**9467.0**	NT	NT	28 J+
4-6 ft	NT	NT	NT	NT	NT	NT	**7589.0**	NT	NT	81
6-8 ft	NT	NT	NT	NT	NT	NT	15.395	NT	NT	1.8 U
8-10 ft	NT	NT	NT	NT	NT	NT	13.08	NT	NT	**0.58 J**

ND20-GM07

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**4450.0**	NT	NT	3.5 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**11176.0**	NT	NT	2.9
2-4 ft	NT	NT	NT	NT	NT	NT	14947.0	NT	NT	2.5 U
4-6 ft	NT	NT	NT	NT	NT	NT	146140.0	NT	NT	2.2 U
6-8 ft	NT	NT	NT	NT	NT	NT	15.76	NT	NT	1.8 U
8-10 ft	NT	NT	NT	NT	NT	NT	13.575	NT	NT	1.8 U

ND20-GM05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**7603.0**	15	NT	3.9 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**4249.0**	16	NT	3.3 U
2-4 ft	NT	NT	NT	NT	NT	NT	**7466.0**	650	NT	3 U
4-6 ft	NT	NT	NT	NT	NT	NT	19.58	0	NT	1.9 U
6-8 ft	NT	NT	NT	NT	NT	NT	13.345	0	NT	2 U

ND20-GM04

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	11 U	5.9 U	3 U	5.8 U	4.9 U	13 U	**7217.0**	21	22.23	4.3 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	14095.0	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	38680.0	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	43800.0	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**10893.0**	NT	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	13.635	NT	NT	NT

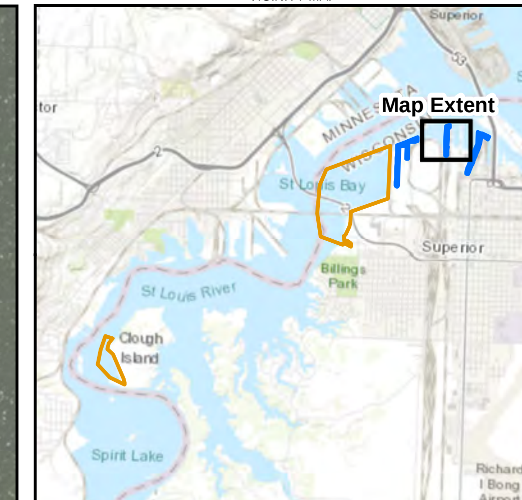
SW15-SLB06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	17	NT	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	30	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	40	NT	NT

ND20-GM02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	11 U	6.1 U	3.1 U	6 U	5.2 U	13 U	**5677.0**	33	65.44	4.2 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	23000.0	NT	NT	3.3 U
2-4 ft	NT	NT	NT	NT	NT	NT	12919.0	NT	NT	2.6 U
4-6 ft	NT	NT	NT	NT	NT	NT	39070.0	NT	NT	2.7 U
6-8 ft	NT	NT	NT	NT	NT	NT	32100.0	NT	NT	2.8 U
8-10 ft	NT	NT	NT	NT	NT	NT	**8829.0**	NT	NT	2.1 U

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 200 400
Feet

N

Figure 4-5
General Mills Slip - Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-5 General Mills Slip-Organics.mxd bpawling

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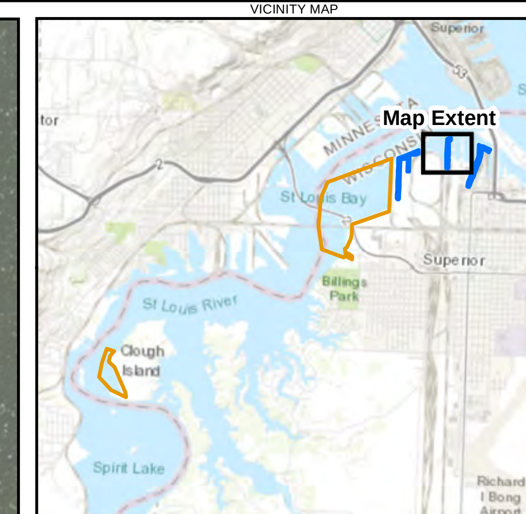

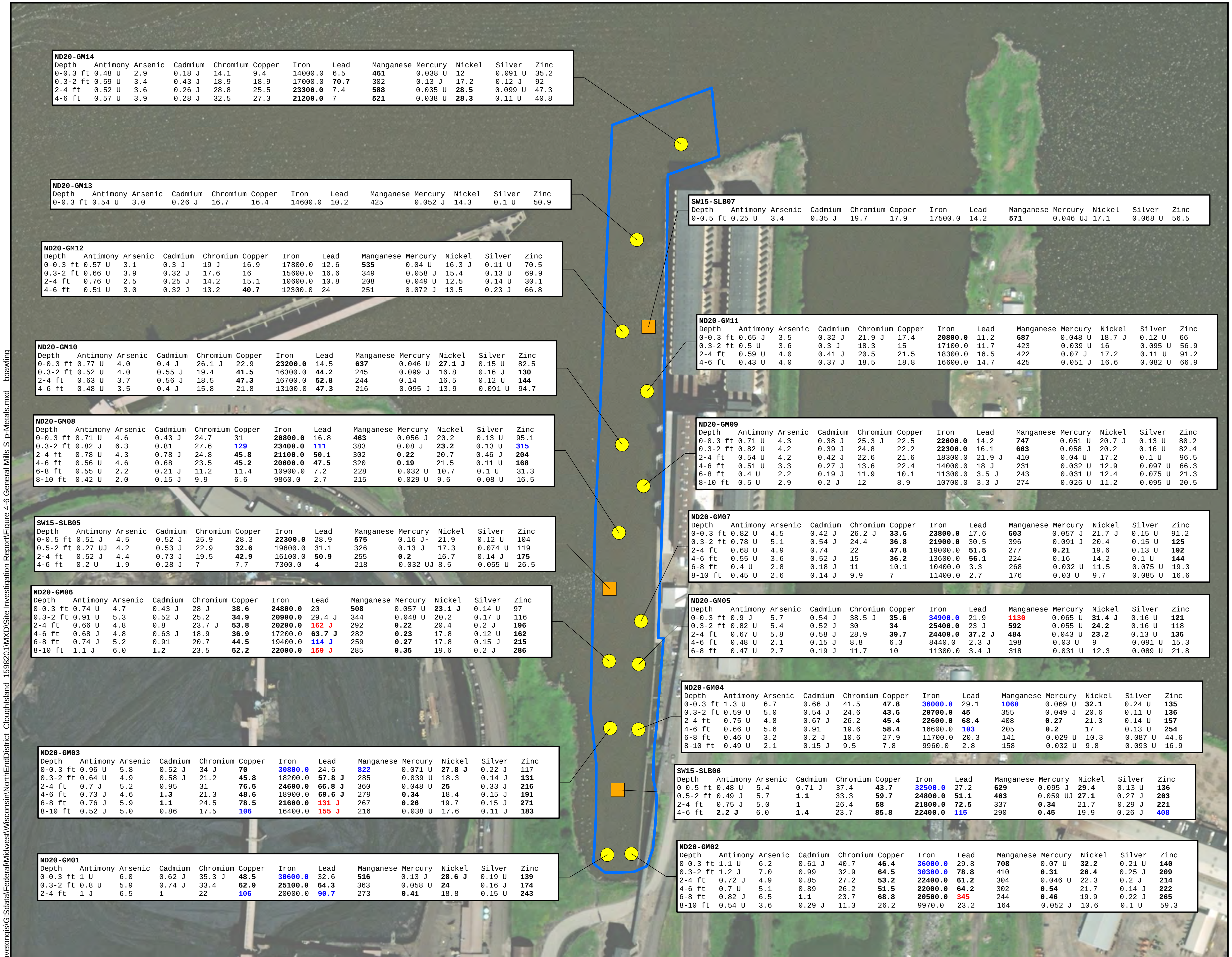

ND20-GM14

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.48 U	2.9	0.18 J	14.1	9.4	14000.0	6.5	**461**	0.038 U	12	0.091 U	35.2
0.3-2 ft	0.59 U	3.4	0.43 J	18.9	18.9	17000.0	**70.7**	302	0.13 J	17.2	0.12 J	92
2-4 ft	0.52 U	3.6	0.26 J	28.8	25.5	**23300.0**	7.4	**588**	0.035 U	**28.5**	0.099 U	47.3
4-6 ft	0.57 U	3.9	0.28 J	32.5	27.3	**21200.0**	7	**521**	0.038 U	**28.3**	0.11 U	40.8

ND20-GM13

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.54 U	3.0	0.26 J	16.7	16.4	14600.0	10.2	425	0.052 J	14.3	0.1 U	50.9

ND20-GM12

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.57 U	3.1	0.3 J	19 J	16.9	17800.0	12.6	**535**	0.04 U	16.3 J	0.11 U	70.5
0.3-2 ft	0.66 U	3.9	0.32 J	17.6	16	15600.0	16.6	349	0.058 J	15.4	0.13 U	69.9
2-4 ft	0.76 U	2.5	0.25 J	14.2	15.1	10600.0	10.8	208	0.049 U	12.5	0.14 U	30.1
4-6 ft	0.51 U	3.0	0.32 J	13.2	**40.7**	12300.0	24	251	0.072 J	13.5	0.23 J	66.8

ND20-GM10

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.77 U	4.0	0.4 J	26.1 J	22.9	**23200.0**	14.5	**637**	0.046 U	**27.1 J**	0.15 U	82.5
0.3-2 ft	0.52 U	4.0	0.55 J	19.4	**41.5**	16300.0	**44.2**	245	0.099 J	16.8	0.16 J	**130**
2-4 ft	0.63 U	3.7	0.56 J	18.5	**47.3**	16700.0	**52.8**	244	0.14	16.5	0.12 U	**144**
4-6 ft	0.48 U	3.5	0.4 J	15.8	21.8	13100.0	**47.3**	216	0.095 J	13.9	0.091 U	94.7

ND20-GM08

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.71 U	4.6	0.43 J	24.7	31	**20800.0**	16.8	**463**	0.056 J	20.2	0.13 U	95.1
0.3-2 ft	0.82 J	6.3	0.81	27.6	**129**	**23400.0**	**111**	383	0.08 J	**23.2**	0.13 U	**315**
2-4 ft	0.78 U	4.3	0.78 J	24.8	**45.8**	**21100.0**	**50.1**	302	**0.22**	20.7	0.46 J	**204**
4-6 ft	0.56 U	4.6	0.68	23.5	**45.2**	**20600.0**	**47.5**	320	**0.19**	21.5	0.11 U	**168**
6-8 ft	0.55 U	2.2	0.21 J	11.2	11.4	10900.0	7.2	228	0.032 U	10.7	0.1 U	31.3
8-10 ft	0.42 U	2.0	0.15 J	9.9	6.6	9860.0	2.7	215	0.029 U	9.6	0.08 U	16.5

SW15-SLB05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.51 J	4.5	0.52 J	25.9	28.3	**22300.0**	28.9	**575**	0.16 J-	21.9	0.12 U	104
0.5-2 ft	0.27 UJ	4.2	0.53 J	22.9	**32.6**	19600.0	31.1	326	0.13 J	17.3	0.074 U	119
2-4 ft	0.52 J	4.4	0.73 J	19.5	**42.9**	16100.0	**50.9**	255	**0.2**	16.7	0.14 J	**175**
4-6 ft	0.2 U	1.9	0.28 J	7	7.7	7300.0	4	218	0.032 UJ	8.5	0.055 U	26.5

ND20-GM06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.74 U	4.7	0.43 J	28 J	**38.6**	**24800.0**	20	**508**	0.057 U	**23.1 J**	0.14 U	97
0.3-2 ft	0.91 U	5.3	0.52 J	25.2	**34.9**	**20900.0**	29.4 J	344	0.048 U	20.2	0.17 U	116
2-4 ft	0.66 U	4.8	0.8	23.7 J	**53.8**	**20200.0**	**162 J**	292	**0.22**	20.4	0.2 J	**196**
4-6 ft	0.68 J	4.8	0.63 J	18.9	**36.9**	17200.0	**63.7 J**	282	**0.23**	17.8	0.12 U	**162**
6-8 ft	0.74 J	5.2	0.91	20.7	**44.5**	19400.0	**114 J**	259	**0.27**	17.8	0.15 J	**215**
8-10 ft	1.1 J	6.0	**1.2**	23.5	**52.2**	**22000.0**	**159 J**	285	**0.35**	19.6	0.2 J	**286**

ND20-GM03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.96 U	5.8	0.52 J	34 J	**70**	**30800.0**	24.6	**822**	0.071 U	**27.8 J**	0.22 J	117
0.3-2 ft	0.64 U	4.9	0.58 J	21.2	**45.8**	18200.0	**57.8 J**	285	0.039 U	18.3	0.14 J	**131**
2-4 ft	0.7 J	5.2	0.95	31	**76.5**	**24600.0**	**66.8 J**	360	0.048 U	**25**	0.33 J	**216**
4-6 ft	0.73 J	4.6	**1.3**	21.3	**48.6**	18900.0	**69.6 J**	279	**0.34**	18.4	0.15 J	**191**
6-8 ft	0.76 J	5.9	**1.1**	24.5	**78.5**	**21600.0**	**131 J**	267	**0.26**	19.7	0.15 J	**271**
8-10 ft	0.52 J	5.0	0.86	17.5	**106**	16400.0	**155 J**	216	0.038 U	17.6	0.11 J	**183**

ND20-GM01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1 U	6.0	0.62 J	35.3 J	**48.5**	**30600.0**	32.6	**516**	0.13 J	**28.6 J**	0.19 U	**139**
0.3-2 ft	0.8 U	5.9	0.74 J	33.4	**62.9**	**25100.0**	**64.3**	363	0.058 U	**24**	0.16 J	**174**
2-4 ft	1 J	6.5	**1**	22	**106**	20000.0	**90.7**	273	**0.41**	18.8	0.15 U	**243**

SW15-SLB07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.25 U	3.4	0.35 J	19.7	17.9	17500.0	14.2	**571**	0.046 UJ	17.1	0.068 U	56.5

ND20-GM11

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.65 J	3.5	0.32 J	21.9 J	17.4	**20800.0**	11.2	**687**	0.048 U	18.7 J	0.12 U	66
0.3-2 ft	0.5 U	3.6	0.3 J	18.3	15	17100.0	11.7	423	0.039 U	16	0.095 U	56.9
2-4 ft	0.59 U	4.0	0.41 J	20.5	21.5	18300.0	16.5	422	0.07 J	17.2	0.11 U	91.2
4-6 ft	0.43 U	4.0	0.37 J	18.5	18.8	16600.0	14.7	425	0.051 J	16.6	0.082 U	66.9

ND20-GM09

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.71 U	4.3	0.38 J	25.3 J	22.5	**22600.0**	14.2	**747**	0.051 U	20.7 J	0.13 U	80.2
0.3-2 ft	0.82 U	4.2	0.39 J	24.8	22.2	**22300.0**	16.1	**663**	0.058 J	20.2	0.16 U	82.4
2-4 ft	0.54 U	4.2	0.42 J	22.6	21.6	18300.0	21.9 J	410	0.04 U	17.2	0.1 U	96.5
4-6 ft	0.51 U	3.3	0.27 J	13.6	22.4	14000.0	18 J	231	0.032 U	12.9	0.097 U	66.3
6-8 ft	0.4 U	2.2	0.19 J	11.9	10.1	11300.0	3.5 J	243	0.031 U	12.4	0.075 U	21.3
8-10 ft	0.5 U	2.9	0.2 J	12	8.9	10700.0	3.3 J	274	0.026 U	11.2	0.095 U	20.5

ND20-GM07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.82 U	4.5	0.42 J	26.2 J	**33.6**	**23800.0**	17.6	**603**	0.057 J	21.7 J	0.15 U	91.2
0.3-2 ft	0.78 U	5.1	0.54 J	24.4	**36.8**	**21900.0**	30.5	396	0.091 J	20.4	0.15 U	**125**
2-4 ft	0.68 U	4.9	0.74	22	**47.8**	19000.0	**51.5**	277	**0.21**	19.6	0.13 U	**192**
4-6 ft	0.55 U	3.6	0.52 J	15	**36.2**	13600.0	**56.1**	224	0.16	14.2	0.1 U	**144**
6-8 ft	0.4 U	2.8	0.18 J	11	10.1	10400.0	3.3	268	0.032 U	11.5	0.075 U	19.3
8-10 ft	0.45 U	2.6	0.14 J	9.9	7	11400.0	2.7	176	0.03 U	9.7	0.085 U	16.6

ND20-GM05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.9 J	5.7	0.54 J	38.5 J	**35.6**	**34900.0**	21.9	**1130**	0.065 U	**31.4 J**	0.16 U	**121**
0.3-2 ft	0.82 U	5.4	0.52 J	30	**34**	**25400.0**	23 J	**592**	0.055 U	**24.2**	0.16 U	118
2-4 ft	0.67 U	5.8	0.58 J	28.9	**39.7**	**24400.0**	**37.2 J**	**484**	0.043 U	**23.2**	0.13 U	**136**
4-6 ft	0.48 U	2.1	0.15 J	8.8	6.3	8440.0	2.3 J	198	0.03 U	9	0.091 U	15.3
6-8 ft	0.47 U	2.7	0.19 J	11.7	10	11300.0	3.4 J	318	0.031 U	12.3	0.089 U	21.8

ND20-GM04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.3 U	6.7	0.66 J	41.5	**47.8**	**36000.0**	29.1	**1060**	0.069 U	**32.1**	0.24 U	**135**
0.3-2 ft	0.59 U	5.0	0.54 J	24.6	**43.6**	**20700.0**	**45**	355	0.049 J	20.6	0.11 U	**136**
2-4 ft	0.75 U	4.8	0.67 J	26.2	**45.4**	**22600.0**	**68.4**	408	**0.27**	21.3	0.14 U	**157**
4-6 ft	0.66 U	5.6	0.91	19.6	**58.4**	16600.0	**103**	205	**0.2**	17	0.13 U	**254**
6-8 ft	0.46 U	3.2	0.2 J	10.6	27.9	11700.0	20.3	141	0.029 U	10.3	0.087 U	44.6
8-10 ft	0.49 U	2.1	0.15 J	9.5	7.8	9960.0	2.8	158	0.032 U	9.8	0.093 U	16.9

SW15-SLB06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.48 U	5.4	0.71 J	37.4	**43.7**	**32500.0**	27.2	**629**	0.095 J-	**29.4**	0.13 U	**136**
0.5-2 ft	0.49 J	5.7	**1.1**	33.3	**59.7**	**24800.0**	**51.1**	**463**	0.059 UJ	**27.1**	0.27 J	**203**
2-4 ft	0.75 J	5.0	**1**	26.4	**58**	**21800.0**	**72.5**	337	**0.34**	21.7	0.29 J	**221**
4-6 ft	**2.2 J**	6.0	**1.4**	23.7	**85.8**	**22400.0**	**115**	290	**0.45**	19.9	0.26 J	**408**

ND20-GM02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.1 U	6.2	0.61 J	40.7	**46.4**	**36000.0**	29.8	**708**	0.07 U	**32.2**	0.21 U	**140**
0.3-2 ft	1.2 J	7.0	0.99	32.9	**64.5**	**30300.0**	**78.8**	410	**0.31**	**26.4**	0.25 J	**209**
2-4 ft	0.72 J	4.9	0.85	27.2	**53.2**	**22400.0**	**61.2**	304	0.046 U	22.3	0.2 J	**214**
4-6 ft	0.7 U	5.1	0.89	26.2	**51.5**	**22000.0**	**64.2**	302	**0.54**	21.7	0.14 J	**222**
6-8 ft	0.82 J	6.5	**1.1**	23.7	**68.8**	**20500.0**	**345**	244	**0.46**	19.9	0.22 J	**265**
8-10 ft	0.54 U	3.6	0.29 J	11.3	26.2	9970.0	23.2	164	0.052 J	10.6	0.1 U	59.3

Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 200 400
Feet

N

Figure 4-6
General Mills Slip - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\voyetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-6 General Mills Slip-Metals.mxd bpawling

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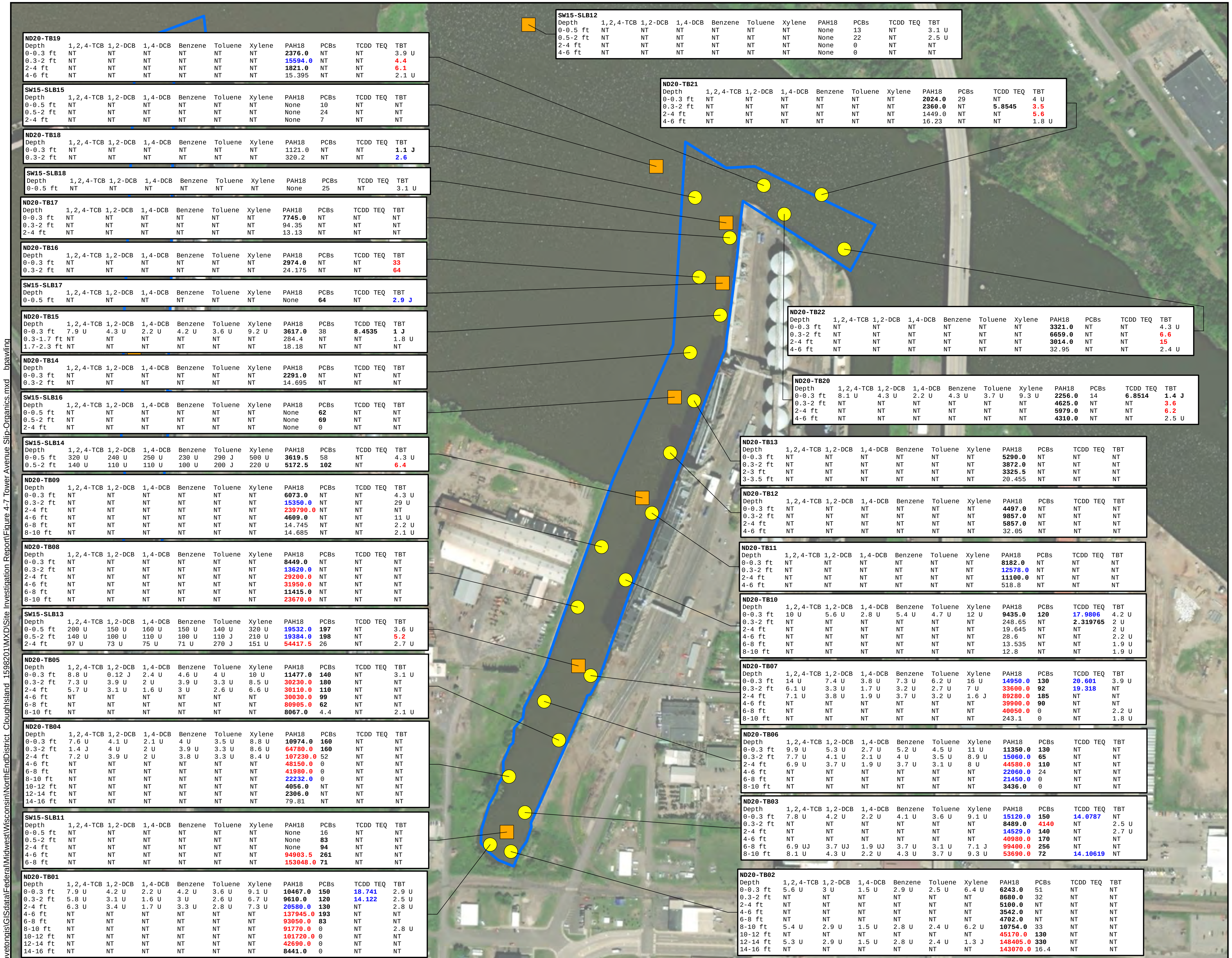


SW15-SLB12

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	13	NT	3.1 U
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	22	NT	2.5 U
2-4 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT

ND20-TB19

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2376.0**	NT	NT	3.9 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**15594.0**	NT	NT	**4.4**
2-4 ft	NT	NT	NT	NT	NT	NT	**1821.0**	NT	NT	**6.1**
4-6 ft	NT	NT	NT	NT	NT	NT	15.395	NT	NT	2.1 U

ND20-TB21

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2024.0**	29	NT	4 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**2360.0**	NT	**5.8545**	**3.5**
2-4 ft	NT	NT	NT	NT	NT	NT	1449.0	NT	NT	**5.6**
4-6 ft	NT	NT	NT	NT	NT	NT	16.23	NT	NT	1.8 U

SW15-SLB15

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	10	NT	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	24	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	7	NT	NT

ND20-TB18

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	1121.0	NT	NT	**1.1 J**
0.3-2 ft	NT	NT	NT	NT	NT	NT	320.2	NT	NT	**2.6**

SW15-SLB18

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	25	NT	3.1 U

ND20-TB17

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**7745.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	94.35	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	13.13	NT	NT	NT

ND20-TB16

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2974.0**	NT	NT	**33**
0.3-2 ft	NT	NT	NT	NT	NT	NT	24.175	NT	NT	**64**

SW15-SLB17

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	**64**	NT	**2.9 J**

ND20-TB22

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**3321.0**	NT	NT	4.3 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**6659.0**	NT	NT	**6.6**
2-4 ft	NT	NT	NT	NT	NT	NT	**3014.0**	NT	NT	**15**
4-6 ft	NT	NT	NT	NT	NT	NT	32.95	NT	NT	2.4 U

ND20-TB15

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.9 U	4.3 U	2.2 U	4.2 U	3.6 U	9.2 U	**3617.0**	38	**8.4535**	**1 J**
0.3-1.7 ft	NT	NT	NT	NT	NT	NT	284.4	NT	NT	1.8 U
1.7-2.3 ft	NT	NT	NT	NT	NT	NT	18.18	NT	NT	NT

ND20-TB14

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2291.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	14.695	NT	NT	NT

ND20-TB20

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.1 U	4.3 U	2.2 U	4.3 U	3.7 U	9.3 U	**2256.0**	14	**6.8514**	**1.4 J**
0.3-2 ft	NT	NT	NT	NT	NT	NT	**4625.0**	NT	NT	**3.6**
2-4 ft	NT	NT	NT	NT	NT	NT	**5979.0**	NT	NT	**6.2**
4-6 ft	NT	NT	NT	NT	NT	NT	**4310.0**	NT	NT	2.5 U

SW15-SLB16

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	**62**	NT	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	**69**	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT

ND20-TB13

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**5290.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**3872.0**	NT	NT	NT
2-3 ft	NT	NT	NT	NT	NT	NT	**3325.5**	NT	NT	NT
3-3.5 ft	NT	NT	NT	NT	NT	NT	20.455	NT	NT	NT

SW15-SLB14

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	320 U	240 U	250 U	230 U	290 J	500 U	**3619.5**	58	NT	4.3 U
0.5-2 ft	140 U	110 U	110 U	100 U	200 J	220 U	**5172.5**	**102**	NT	**6.4**

ND20-TB12

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**4497.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**9857.0**	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	**5857.0**	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	32.05	NT	NT	NT

ND20-TB09

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**6073.0**	NT	NT	4.3 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	**15350.0**	NT	NT	29 U
2-4 ft	NT	NT	NT	NT	NT	NT	**239790.0**	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**4609.0**	NT	NT	11 U
6-8 ft	NT	NT	NT	NT	NT	NT	14.745	NT	NT	2.2 U
8-10 ft	NT	NT	NT	NT	NT	NT	14.685	NT	NT	2.1 U

ND20-TB11

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**8182.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**12578.0**	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	**11100.0**	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	518.8	NT	NT	NT

ND20-TB08

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**8449.0**	NT	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**13620.0**	NT	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	**29200.0**	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**31950.0**	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**11415.0**	NT	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	**23670.0**	NT	NT	NT

ND20-TB10

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	10 U	5.6 U	2.8 U	5.4 U	4.7 U	12 U	**9435.0**	**120**	**17.9806**	4.2 U
0.3-2 ft	NT	NT	NT	NT	NT	NT	248.65	NT	**2.319765**	2 U
2-4 ft	NT	NT	NT	NT	NT	NT	19.645	NT	NT	2 U
4-6 ft	NT	NT	NT	NT	NT	NT	28.6	NT	NT	2.2 U
6-8 ft	NT	NT	NT	NT	NT	NT	13.535	NT	NT	1.9 U
8-10 ft	NT	NT	NT	NT	NT	NT	12.8	NT	NT	1.9 U

SW15-SLB13

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	200 U	150 U	160 U	150 U	140 U	320 U	**19532.0**	**197**	NT	3.6 U
0.5-2 ft	140 U	100 U	110 U	100 U	110 J	210 U	**19384.0**	**198**	NT	**5.2**
2-4 ft	97 U	73 U	75 U	71 U	270 J	151 U	**54417.5**	26	NT	2.7 U

ND20-TB07

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	14 U	7.4 U	3.8 U	7.3 U	6.2 U	16 U	**14950.0**	**130**	**20.601**	3.9 U
0.3-2 ft	6.1 U	3.3 U	1.7 U	3.2 U	2.7 U	7 U	**33600.0**	**92**	**19.318**	NT
2-4 ft	7.1 U	3.8 U	1.9 U	3.7 U	3.2 U	1.6 J	**89280.0**	**185**	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**39900.0**	**90**	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**40050.0**	0	NT	2.2 U
8-10 ft	NT	NT	NT	NT	NT	NT	243.1	0	NT	1.8 U

ND20-TB05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.8 U	0.12 J	2.4 U	4.6 U	4 U	10 U	**11477.0**	**140**	NT	3.1 U
0.3-2 ft	7.3 U	3.9 U	2 U	3.9 U	3.3 U	8.5 U	**30230.0**	**180**	NT	NT
2-4 ft	5.7 U	3.1 U	1.6 U	3 U	2.6 U	6.6 U	**30110.0**	**110**	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**30030.0**	**99**	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**80905.0**	**62**	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	**8067.0**	4.4	NT	2.1 U

ND20-TB06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	9.9 U	5.3 U	2.7 U	5.2 U	4.5 U	11 U	**11350.0**	**130**	NT	NT
0.3-2 ft	7.7 U	4.1 U	2.1 U	4 U	3.5 U	8.9 U	**15060.0**	**65**	NT	NT
2-4 ft	6.9 U	3.7 U	1.9 U	3.7 U	3.1 U	8 U	**44580.0**	**110**	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**22060.0**	24	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**21450.0**	0	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	**3436.0**	0	NT	NT

ND20-TB04

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.6 U	4.1 U	2.1 U	4 U	3.5 U	8.8 U	**10974.0**	**160**	NT	NT
0.3-2 ft	1.4 J	4 U	2 U	3.9 U	3.3 U	8.6 U	**64780.0**	**160**	NT	NT
2-4 ft	7.2 U	3.9 U	2 U	3.8 U	3.3 U	8.4 U	**107230.0**	52	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**48150.0**	0	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**41980.0**	0	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	**22232.0**	0	NT	NT
10-12 ft	NT	NT	NT	NT	NT	NT	**4056.0**	NT	NT	NT
12-14 ft	NT	NT	NT	NT	NT	NT	**2306.0**	NT	NT	NT
14-16 ft	NT	NT	NT	NT	NT	NT	79.81	NT	NT	NT

ND20-TB03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.8 U	4.2 U	2.2 U	4.1 U	3.6 U	9.1 U	**15120.0**	**150**	**14.0787**	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**8489.0**	**4140**	NT	2.5 U
2-4 ft	NT	NT	NT	NT	NT	NT	**14529.0**	**140**	NT	2.7 U
4-6 ft	NT	NT	NT	NT	NT	NT	**40980.0**	**170**	NT	NT
6-8 ft	6.9 UJ	3.7 UJ	1.9 UJ	3.7 U	3.1 U	7.1 J	**99400.0**	**256**	NT	NT
8-10 ft	8.1 U	4.3 U	2.2 U	4.3 U	3.7 U	9.3 U	**53690.0**	**72**	**14.10619**	NT

SW15-SLB11

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	16	NT	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	**83**	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	**94**	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**94903.5**	**261**	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**153048.0**	**71**	NT	NT

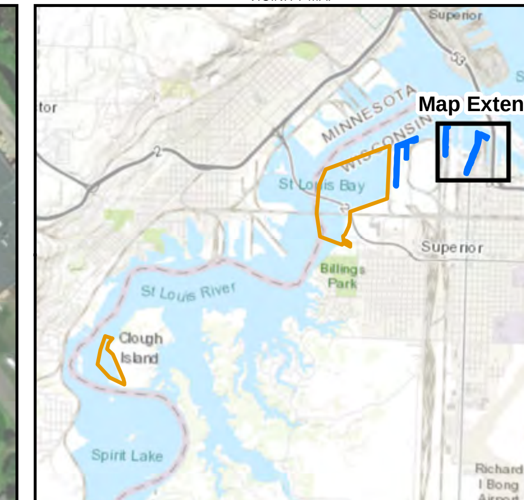
ND20-TB01

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.9 U	4.2 U	2.2 U	4.2 U	3.6 U	9.1 U	**10467.0**	**150**	**18.741**	2.9 U
0.3-2 ft	5.8 U	3.1 U	1.6 U	3 U	2.6 U	6.7 U	**9610.0**	**120**	**14.122**	2.5 U
2-4 ft	6.3 U	3.4 U	1.7 U	3.3 U	2.8 U	7.3 U	**20580.0**	**130**	NT	2.8 U
4-6 ft	NT	NT	NT	NT	NT	NT	**137945.0**	**193**	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**93050.0**	**83**	NT	NT
8-10 ft	NT	NT	NT	NT	NT	NT	**91770.0**	0	NT	2.8 U
10-12 ft	NT	NT	NT	NT	NT	NT	**101720.0**	0	NT	NT
12-14 ft	NT	NT	NT	NT	NT	NT	**42690.0**	0	NT	NT
14-16 ft	NT	NT	NT	NT	NT	NT	**8441.0**	0	NT	NT

ND20-TB02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	5.6 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**6243.0**	51	NT	NT
0.3-2 ft	NT	NT	NT	NT	NT	NT	**8680.0**	32	NT	NT
2-4 ft	NT	NT	NT	NT	NT	NT	**5100.0**	NT	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	**3542.0**	NT	NT	NT
6-8 ft	NT	NT	NT	NT	NT	NT	**4702.0**	NT	NT	NT
8-10 ft	5.4 U	2.9 U	1.5 U	2.8 U	2.4 U	6.2 U	**10754.0**	33	NT	NT
10-12 ft	NT	NT	NT	NT	NT	NT	**45170.0**	**130**	NT	NT
12-14 ft	5.3 U	2.9 U	1.5 U	2.8 U	2.4 U	1.3 J	**148405.0**	**330**	NT	NT
14-16 ft	NT	NT	NT	NT	NT	NT	**143070.0**	16.4	NT	NT

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 200 400
Feet

N

Figure 4-7
Tower Avenue Slip - Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-7 Tower Avenue Slip-Organics.mxd bpawling

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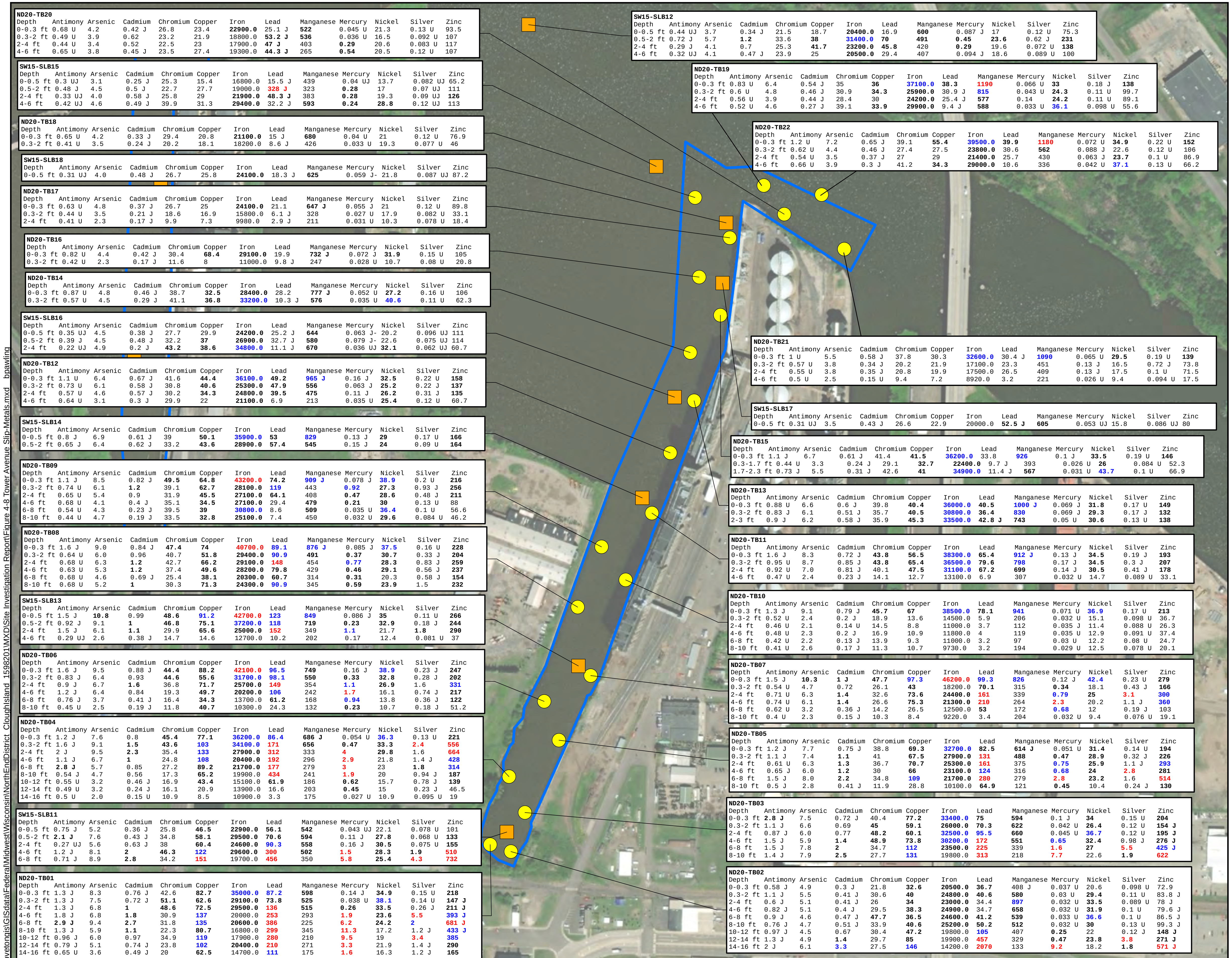


ND20-TB20

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.68 U	4.2	0.42 J	26.8	23.4	**22900.0**	25.1 J	**522**	0.045 U	21.3	0.13 U	93.5
0.3-2 ft	0.49 U	3.9	0.62	23.2	21.9	18800.0	**53.2 J**	**536**	0.036 U	16.5	0.092 U	107
2-4 ft	0.44 U	3.4	0.52	22.5	23	17900.0	**47 J**	403	**0.29**	20.6	0.083 U	117
4-6 ft	0.65 U	3.8	0.45 J	23.5	27.4	19300.0	**44.3 J**	265	**0.54**	20.5	0.12 U	107

SW15-SLB15

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.3 UJ	3.1	0.25 J	25.3	15.4	16800.0	15.5 J	439	0.04 UJ	13.7	0.082 UJ	65.2
0.5-2 ft	0.48 J	4.5	0.5 J	22.7	27.7	19000.0	**328 J**	323	**0.28**	17	0.07 UJ	111
2-4 ft	0.33 UJ	4.0	0.58 J	25.8	29	**21900.0**	**48.3 J**	383	**0.28**	19.3	0.09 UJ	**126**
4-6 ft	0.42 UJ	4.6	0.49 J	39.9	31.3	**29400.0**	32.2 J	**593**	**0.24**	**28.8**	0.12 UJ	113

ND20-TB18

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.65 U	4.2	0.33 J	29.4	20.8	**21100.0**	15 J	**680**	0.04 U	21	0.12 U	76.9
0.3-2 ft	0.41 U	3.5	0.24 J	20.2	18.1	18200.0	8.6 J	426	0.033 U	19.3	0.077 U	46

SW15-SLB18

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.31 UJ	4.0	0.48 J	26.7	25.8	**24100.0**	18.3 J	**625**	0.059 J-	21.8	0.087 UJ	87.2

ND20-TB17

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.63 U	4.8	0.37 J	26.7	25	**24100.0**	21.1	**647 J**	0.055 J	21	0.12 U	89.8
0.3-2 ft	0.44 U	3.5	0.21 J	18.6	16.9	15800.0	6.1 J	328	0.027 U	17.9	0.082 U	33.1
2-4 ft	0.41 U	2.3	0.17 J	9.9	7.3	9980.0	2.9 J	211	0.031 U	10.3	0.078 U	18.4

ND20-TB16

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.82 U	4.4	0.42 J	30.4	**68.4**	**29100.0**	19.9	**732 J**	0.072 J	**31.9**	0.15 U	105
0.3-2 ft	0.42 U	2.3	0.17 J	11.6	8	11000.0	9.8 J	247	0.028 U	10.7	0.08 U	20.8

ND20-TB14

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.87 U	4.8	0.46 J	38.7	**32.5**	**28400.0**	28.2	**777 J**	0.052 U	**27.2**	0.16 U	106
0.3-2 ft	0.57 U	4.5	0.29 J	41.1	**36.8**	**33200.0**	10.3 J	**576**	0.035 U	**40.6**	0.11 U	62.3

SW15-SLB16

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.35 UJ	4.5	0.38 J	27.7	29.9	**24200.0**	25.2 J	**644**	0.063 J-	20.2	0.096 UJ	111
0.5-2 ft	0.39 J	4.5	0.48 J	32.2	**37**	**26900.0**	32.7 J	**580**	0.079 J-	22.6	0.075 UJ	114
2-4 ft	0.22 UJ	4.9	0.2 J	**43.2**	**38.6**	**34800.0**	11.1 J	**670**	0.036 UJ	**32.1**	0.062 UJ	60.7

ND20-TB12

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.1 U	6.4	0.67 J	41.6	**44.4**	**36100.0**	**49.2**	**965 J**	0.16 J	**32.5**	0.22 U	**158**
0.3-2 ft	0.73 U	6.1	0.58 J	30.8	**40.6**	**25300.0**	**47.9**	**556**	0.063 J	**25.2**	0.22 J	**137**
2-4 ft	0.57 U	4.6	0.57 J	30.2	**34.3**	**24800.0**	**39.5**	**475**	0.11 J	**26.2**	0.31 J	**135**
4-6 ft	0.64 U	3.1	0.3 J	29.9	22	**21100.0**	6.9	213	0.035 U	**25.4**	0.12 U	60.7

SW15-SLB14

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.8 J	6.9	0.61 J	39	**50.1**	**35900.0**	**53**	**829**	0.13 J	**29**	0.17 U	**166**
0.5-2 ft	0.65 J	6.4	0.62 J	33.2	**43.6**	**28900.0**	**57.4**	**545**	0.15 J	**24**	0.09 U	**164**

ND20-TB09

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.1 J	8.5	0.82 J	**49.5**	**64.8**	**43200.0**	**74.2**	**909 J**	0.078 J	**38.9**	0.2 U	**216**
0.3-2 ft	0.74 U	6.1	**1.2**	39.1	**62.7**	**28100.0**	**119**	443	**0.92**	**27.3**	0.93 J	**256**
2-4 ft	0.65 U	5.4	0.9	31.9	**45.5**	**27100.0**	**64.1**	408	**0.47**	**28.6**	0.48 J	**211**
4-6 ft	0.68 U	4.1	0.4 J	35.1	**34.5**	**27100.0**	29.4	**479**	**0.21**	**30**	0.13 U	88
6-8 ft	0.54 U	4.3	0.23 J	39.5	**39**	**30800.0**	8.6	**509**	0.035 U	**36.4**	0.1 U	56.6
8-10 ft	0.44 U	4.7	0.19 J	33.5	**32.8**	**25100.0**	7.4	450	0.032 U	**29.6**	0.084 U	46.2

ND20-TB08

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.6 J	9.0	0.84 J	**47.4**	**74**	**40700.0**	**89.1**	**876 J**	0.085 J	**37.5**	0.16 U	**228**
0.3-2 ft	0.64 U	6.0	0.96	40.7	**51.8**	**29400.0**	**90.9**	**491**	**0.37**	**30.7**	0.33 J	**204**
2-4 ft	0.68 U	6.3	**1.2**	42.7	**66.2**	**29100.0**	**148**	454	**0.77**	**28.3**	0.83 J	**259**
4-6 ft	0.63 U	5.3	**1.2**	37.4	**49.6**	**28200.0**	**79.8**	429	**0.46**	**29.1**	0.56 J	**237**
6-8 ft	0.68 U	4.6	0.69 J	25.4	**38.1**	**20300.0**	**60.7**	314	**0.31**	20.3	0.58 J	**154**
8-10 ft	0.68 U	5.2	**1**	30.3	**71.3**	**24300.0**	**90.9**	345	**0.59**	**23.9**	1.5	**232**

SW15-SLB13

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	1.5 J	**10.8**	0.99	**48.6**	**91.2**	**42700.0**	**123**	**849**	0.086 J	**35**	0.11 U	**266**
0.5-2 ft	0.92 J	9.1	**1**	**46.8**	**75.1**	**37200.0**	**118**	**719**	**0.23**	**32.9**	0.18 J	**244**
2-4 ft	1.5 J	6.1	**1.1**	29.9	**65.6**	**25000.0**	**152**	349	**1.1**	21.7	**1.8**	**290**
4-6 ft	0.29 UJ	2.6	0.38 J	14.7	14.6	12700.0	10.2	202	0.17	12.4	0.081 U	37

ND20-TB06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.6 J	9.5	0.88 J	**44.4**	**88.2**	**42100.0**	**96.5**	**749**	0.16 J	**38.9**	0.23 J	**247**
0.3-2 ft	0.83 J	6.4	0.93	**44.6**	**55.6**	**31700.0**	**98.1**	**550**	**0.33**	**32.8**	0.28 J	**202**
2-4 ft	0.9 J	6.7	**1.6**	36.8	**71.7**	**25700.0**	**149**	354	**1.1**	**26.9**	1.6	**331**
4-6 ft	1.2 J	6.4	0.84	19.3	**49.7**	**20200.0**	**106**	242	**1.7**	16.1	0.74 J	**217**
6-8 ft	0.76 J	3.7	0.41 J	16.4	**34.3**	13700.0	**61.2**	168	**0.94**	13.8	0.36 J	**122**
8-10 ft	0.45 U	2.5	0.19 J	11.8	**40.7**	10300.0	24.3	132	**0.23**	10.7	0.18 J	51.2

ND20-TB04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 J	7.6	0.8	**45.4**	**77.1**	**36200.0**	**86.4**	**686 J**	0.054 U	**36.3**	0.13 U	**221**
0.3-2 ft	1.6 J	9.1	**1.5**	**43.6**	**103**	**34100.0**	**171**	**656**	**0.47**	**33.3**	**2.4**	**556**
2-4 ft	2 J	9.5	**2.3**	35.4	**133**	**27900.0**	**312**	333	**4**	**29.8**	1.6	**664**
4-6 ft	1.1 J	6.7	**1**	24.8	**108**	**20400.0**	**192**	296	**2.9**	21.8	1.4 J	**428**
6-8 ft	**2.8 J**	5.7	0.85	27.2	**89.2**	**21700.0**	**177**	279	**3**	23	**1.8**	**314**
8-10 ft	0.54 J	4.7	0.56	17.3	**65.2**	19900.0	**434**	241	**1.9**	20	0.94 J	**187**
10-12 ft	0.55 U	3.2	0.46 J	16.9	**43.4**	15100.0	**61.9**	186	**0.62**	15.7	0.78 J	**139**
12-14 ft	0.49 U	3.2	0.24 J	16.1	20.9	13900.0	16.6	203	**0.45**	15	0.23 J	46.5
14-16 ft	0.5 U	2.0	0.15 U	10.9	8.5	10900.0	3.3	175	0.027 U	10.9	0.095 U	19

SW15-SLB11

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.75 J	5.2	0.36 J	25.8	**46.5**	**22900.0**	**56.1**	**542**	0.043 UJ	22.1	0.078 U	101
0.5-2 ft	**2.1 J**	7.6	0.43 J	34.8	**58.1**	**29500.0**	**70.6**	**594**	0.11 J	**27.8**	0.068 U	**133**
2-4 ft	0.27 UJ	5.6	0.63 J	38	**60.4**	**24600.0**	**90.3**	**558**	0.16 J	**30.5**	0.075 U	**155**
4-6 ft	1.2 J	8.1	**2**	**46.3**	**122**	**29600.0**	**300**	**502**	**1.5**	**28.3**	**1.9**	**510**
6-8 ft	0.71 J	8.9	**2.8**	34.2	**151**	19700.0	**456**	350	**5.8**	**25.4**	**4.3**	**732**

ND20-TB01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.3 J	8.3	0.76 J	42.6	**82.7**	**35000.0**	**87.2**	**598**	0.14 J	**34.9**	0.15 U	**218**
0.3-2 ft	1.3 J	7.5	0.72 J	**51.1**	**62.6**	**29100.0**	**73.8**	**525**	0.038 U	**38.1**	0.14 U	**147 J**
2-4 ft	1.3 J	6.8	**1**	**48.6**	**72.5**	**29500.0**	**136**	**515**	**0.26**	**33.5**	0.26 J	**211 J**
4-6 ft	1.8 J	6.8	**1.8**	30.9	**137**	20000.0	**253**	293	**1.9**	**23.6**	**5.5**	**393 J**
6-8 ft	**2.9 J**	9.4	**2.7**	31.8	**135**	**20600.0**	**386**	225	**6.2**	**24.2**	**2**	**681 J**
8-10 ft	1.3 J	5.9	**1.1**	22.3	**80.7**	16800.0	**299**	345	**11.3**	17.2	1.2 J	**433 J**
10-12 ft	0.96 J	6.0	0.97	34.9	**119**	17900.0	**280**	210	**9.5**	19	**3.4**	**385**
12-14 ft	0.79 J	5.1	0.74 J	23.8	**102**	**20400.0**	**210**	271	**3.3**	21.9	1.4 J	**290**
14-16 ft	0.65 U	3.6	0.49 J	20	**62.5**	14700.0	**111**	175	**1.6**	16.3	1.2 J	**165**

SW15-SLB12

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.44 UJ	3.7	0.34 J	21.5	18.7	**20400.0**	16.9	**600**	0.087 J	17	0.12 U	75.3
0.5-2 ft	0.72 J	5.7	**1.2**	33.6	**38**	**31400.0**	**70**	**491**	**0.45**	**23.6**	0.62 J	**231**
2-4 ft	0.29 J	4.1	0.7	25.3	**41.7**	**23200.0**	**45.8**	420	**0.29**	19.6	0.072 U	**138**
4-6 ft	0.32 UJ	4.1	0.47 J	23.9	25	**20500.0**	29.4	407	0.094 J	18.6	0.089 U	100

ND20-TB19

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.83 U	6.4	0.54 J	35	**36**	**37100.0**	**38.3**	**1190**	0.066 U	**33**	0.18 J	**138**
0.3-2 ft	0.6 U	4.8	0.46 J	30.9	**34.3**	**25900.0**	30.9 J	**815**	0.043 U	**24.3**	0.11 U	99.7
2-4 ft	0.56 U	3.9	0.44 J	28.4	30	**24200.0**	25.4 J	**577**	0.14	**24.2**	0.11 U	89.1
4-6 ft	0.52 U	4.6	0.27 J	39.1	**33.9**	**29900.0**	9.4 J	**588**	0.033 U	**36.1**	0.098 U	55.6

ND20-TB22

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 U	7.2	0.65 J	39.1	**55.4**	**39500.0**	**39.9**	**1180**	0.072 U	**34.9**	0.22 U	**152**
0.3-2 ft	0.62 U	4.4	0.46 J	27.4	27.5	**23800.0**	30.6	**562**	0.088 J	22.6	0.12 U	106
2-4 ft	0.54 U	3.5	0.37 J	27	29	**21400.0**	25.7	430	0.063 J	**23.7**	0.1 U	86.9
4-6 ft	0.66 U	3.9	0.3 J	41.2	**34.3**	**29000.0**	10.6	336	0.042 U	**37.1**	0.13 U	66.2

ND20-TB21

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1 U	5.5	0.58 J	37.8	30.3	**32600.0**	30.4 J	**1090**	0.065 U	**29.5**	0.19 U	**139**
0.3-2 ft	0.57 U	3.8	0.34 J	20.2	21.9	17100.0	23.3	451	0.13 J	16.5	0.72 J	73.8
2-4 ft	0.55 U	3.8	0.35 J	20.8	19.9	17500.0	26.5	409	0.13 J	17.5	0.1 U	71.5
4-6 ft	0.5 U	2.5	0.15 U	9.4	7.2	8920.0	3.2	221	0.026 U	9.4	0.094 U	17.5

SW15-SLB17

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.31 UJ	3.5	0.43 J	26.6	22.9	20000.0	**52.5 J**	**605**	0.053 UJ	15.8	0.086 UJ	80

ND20-TB15

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.1 J	6.7	0.61 J	41.4	**41.5**	**36200.0**	33.8	**926**	0.1 J	**33.5**	0.19 U	**146**
0.3-1.7 ft	0.44 U	3.3	0.24 J	29.1	**32.7**	**22400.0**	9.7 J	393	0.026 U	**26**	0.084 U	52.3
1.7-2.3 ft	0.73 J	5.5	0.31 J	42.6	**41**	**34900.0**	11.4 J	**567**	0.031 U	**43.7**	0.1 U	66.9

ND20-TB13

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.88 U	6.6	0.6 J	39.8	**40.4**	**36000.0**	**40.5**	**1000 J**	0.069 J	**31.8**	0.17 U	**149**
0.3-2 ft	0.83 J	6.1	0.51 J	35.7	**40.5**	**30800.0**	**36.4**	**830**	0.069 J	**29.3**	0.17 J	**132**
2-3 ft	0.9 J	6.2	0.58 J	35.9	**45.3**	**33500.0**	**42.8 J**	**743**	0.05 U	**30.6**	0.13 U	**138**

ND20-TB11

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.6 J	8.3	0.72 J	**43.8**	**56.5**	**38300.0**	**65.4**	**912 J**	0.13 J	**34.5**	0.19 J	**193**
0.3-2 ft	0.95 U	8.7	0.85 J	**43.8**	**65.4**	**36500.0**	**79.6**	**798**	0.17 J	**34.5**	0.3 J	**207**
2-4 ft	0.92 U	7.0	0.81 J	40.1	**47.5**	**31100.0**	**67.2**	**699**	0.14 J	**30.5**	0.41 J	**178**
4-6 ft	0.47 U	2.4	0.23 J	14.1	12.7	13100.0	6.9	307	0.032 U	14.7	0.089 U	33.1

ND20-TB10

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.3 J	9.1	0.79 J	**45.7**	**67**	**38500.0**	**78.1**	**941**	0.071 U	**36.9**	0.17 U	**213**
0.3-2 ft	0.52 U	2.4	0.2 J	18.9	13.6	14500.0	5.9	206	0.032 U	15.1	0.098 U	36.7
2-4 ft	0.46 U	2.1	0.14 U	14.5	8.8	11000.0	3.7	112	0.035 J	11.4	0.088 U	26.3
4-6 ft	0.48 U	2.3	0.2 J	16.9	10.9	11800.0	4	119	0.035 U	12.9	0.091 U	37.4
6-8 ft	0.42 U	2.2	0.13 J	13.9	9.3	11000.0	3.2	97	0.03 U	12.2	0.08 U	24.7
8-10 ft	0.41 U	2.6	0.17 J	11.3	10.7	9730.0	3.2	194	0.029 U	12.5	0.078 U	20.1

ND20-TB07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.5 J	**10.3**	**1 J**	**47.7**	**97.3**	**46200.0**	**99.3**	**826**	0.12 J	**42.4**	0.23 U	**279**
0.3-2 ft	0.54 U	4.7	0.72	26.1	**43**	18200.0	**70.1**	315	**0.34**	18.1	0.43 J	**166**
2-4 ft	0.71 U	6.3	**1.4**	32.6	**73.6**	**24400.0**	**161**	339	**0.79**	**25**	**3.1**	**300**
4-6 ft	0.74 U	6.1	**1.4**	26.6	**75.3**	**21300.0**	**210**	264	**2.3**	20.2	1.1 J	**360**
6-8 ft	0.62 U	3.2	0.36 J	14.2	26.5	12500.0	**53**	172	**0.68**	12	0.19 J	103
8-10 ft	0.4 U	2.3	0.15 J	10.3	8.4	9220.0	3.4	204	0.032 U	9.4	0.076 U	19.1

ND20-TB05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 J	7.7	0.75 J	38.8	**69.3**	**32700.0**	**82.5**	**614 J**	0.051 U	**31.4**	0.14 U	**194**
0.3-2 ft	1.1 J	7.4	**1.1**	41	**67.5**	**27900.0**	**131**	**488**	**0.47**	**28.9**	0.32 J	**226**
2-4 ft	0.61 U	6.3	**1.3**	36.7	**70.7**	**25300.0**	**161**	375	**0.75**	**25.9**	1.1 J	**293**
4-6 ft	0.65 J	6.0	**1.2**	30	**66**	**23100.0**	**124**	316	**0.68**	**24**	**2.8**	**281**
6-8 ft	1.5 J	8.0	**2.2**	34.8	**109**	**21700.0**	**280**	279	**2.8**	**23.2**	1.6	**514**
8-10 ft	0.5 J	2.8	0.41 J	11.9	28.8	10100.0	**64.9**	121	**0.45**	10.4	0.24 J	**130**

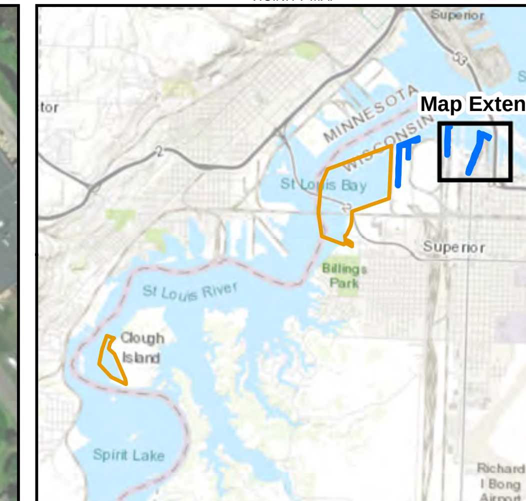
ND20-TB03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	**2.8 J**	7.5	0.72 J	40.4	**77.2**	**33400.0**	**75**	**594**	0.1 J	**34**	0.15 U	**204**
0.3-2 ft	1.1 J	6.6	0.69	**45**	**59.1**	**26000.0**	**70.3**	**622**	0.042 U	**26.4**	0.12 U	**154 J**
2-4 ft	0.87 J	6.0	0.77	**48.2**	**60.1**	**32500.0**	**95.5**	**660**	0.045 U	**36.7**	0.12 U	**195 J**
4-6 ft	1.5 J	5.9	**1.4**	**48.9**	**73.8**	**30200.0**	**172**	**551**	**0.65**	**32.4**	0.98 J	**276 J**
6-8 ft	1.5 J	7.8	**2**	34.7	**112**	**23500.0**	**225**	339	**1.6**	**27**	**5.5**	**425 J**
8-10 ft	1.4 J	7.9	**2.5**	27.7	**131**	19800.0	**313**	218	**7.7**	22.6	**1.9**	**622**

ND20-TB02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.58 J	4.9	0.3 J	21.8	**32.6**	**20500.0**	**36.7**	408 J	0.037 U	20.6	0.098 U	72.9
0.3-2 ft	1.1 J	5.5	0.41 J	30.6	**40**	**24800.0**	**40.6**	**580**	0.03 U	**29.4**	0.11 U	83.8 J
2-4 ft	0.6 J	5.1	0.41 J	26	**34**	**23000.0**	34.4	**897**	0.032 U	**33.5**	0.089 U	78 J
4-6 ft	0.82 J	5.1	0.4 J	29.5	**38.3**	**24900.0**	34.7	**658**	0.032 U	**31.9**	0.1 U	79.6 J
6-8 ft	0.9 J	4.6	0.47 J	**47.7**	**36.5**	**24600.0**	**41.2**	**539**	0.033 U	**36.6**	0.1 U	86.5 J
8-10 ft	0.76 J	4.7	0.51 J	33.9	**40.6**	**25200.0**	**50.2**	**512**	0.032 U	**30**	0.13 U	99.3 J
10-12 ft	0.97 J	4.5	0.67	30.4	**47.2**	19800.0	**105**	407	**0.25**	22	0.12 J	**148 J**
12-14 ft	1.3 J	4.9	**1.4**	29.7	**85**	19900.0	**457**	329	**0.47**	**23.8**	**3.8**	**271 J**
14-16 ft	2 J	6.1	**3.3**	27.5	**146**	14200.0	**2070**	133	**9.2**	18.2	**1.8**	**571 J**

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 200 400
Feet

N

Figure 4-8
Tower Avenue Slip - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict CloughIsland 1598201\MXD\Site Investigation Report\Figure 4-8 Tower Avenue Slip-Metals.mxd bpawling

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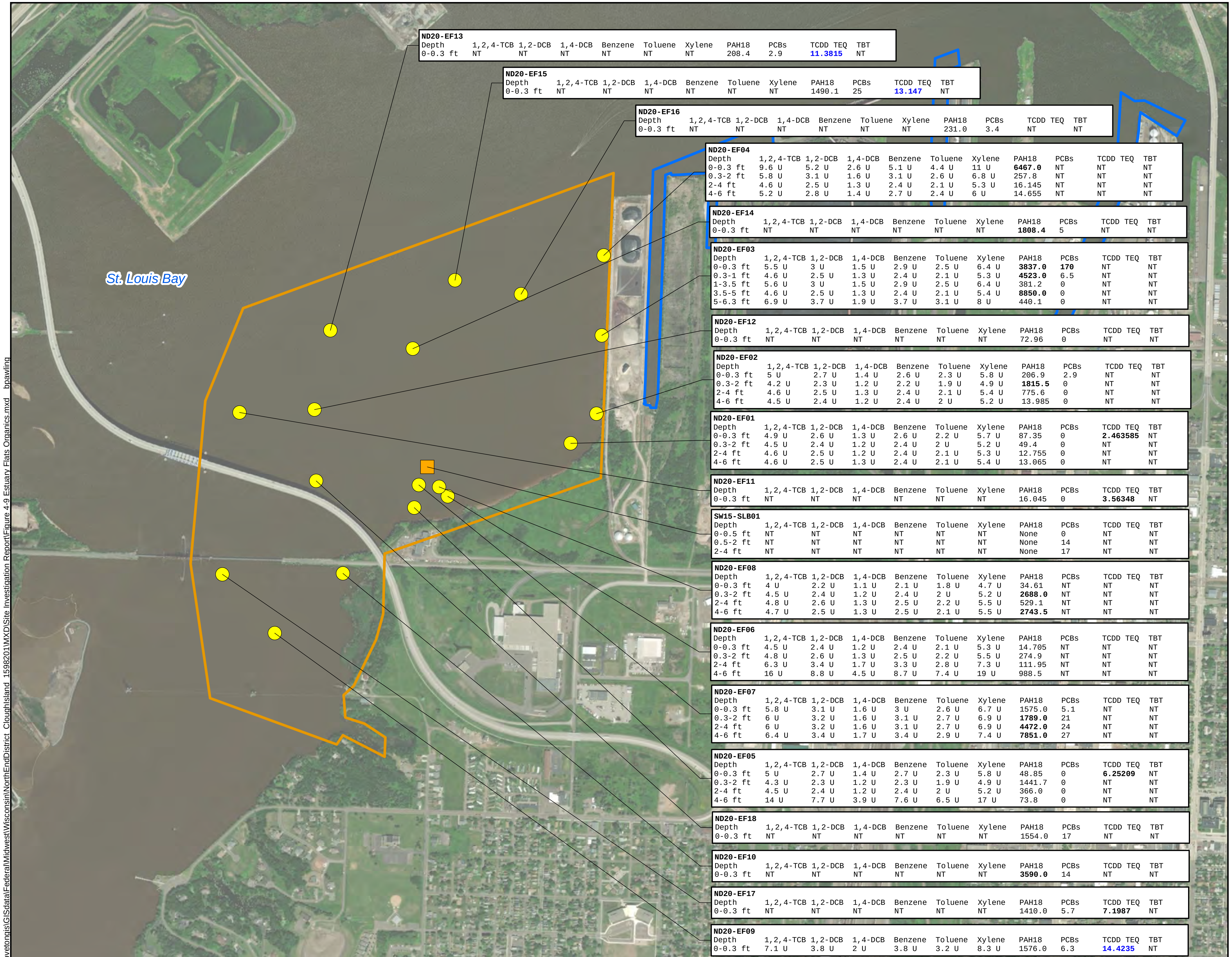
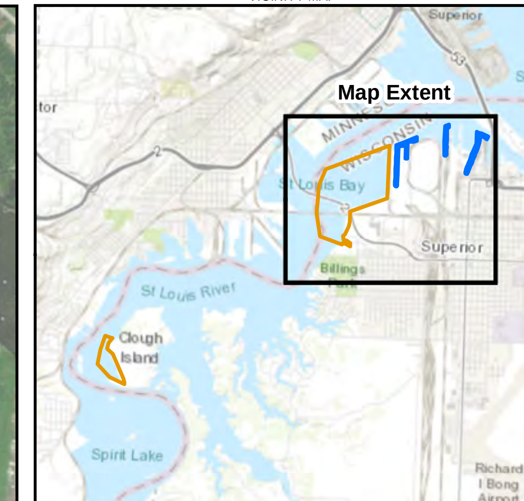


Sample	Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
ND20-EF13	0-0.3 ft	NT	NT	NT	NT	NT	NT	208.4	2.9	11.3815	NT
ND20-EF15	0-0.3 ft	NT	NT	NT	NT	NT	NT	1490.1	25	13.147	NT
ND20-EF16	0-0.3 ft	NT	NT	NT	NT	NT	NT	231.0	3.4	NT	NT
ND20-EF04	0-0.3 ft	9.6 U	5.2 U	2.6 U	5.1 U	4.4 U	11 U	**6467.0**	NT	NT	NT
	0.3-2 ft	5.8 U	3.1 U	1.6 U	3.1 U	2.6 U	6.8 U	257.8	NT	NT	NT
	2-4 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.3 U	16.145	NT	NT	NT
	4-6 ft	5.2 U	2.8 U	1.4 U	2.7 U	2.4 U	6 U	14.655	NT	NT	NT
ND20-EF14	0-0.3 ft	NT	NT	NT	NT	NT	NT	**1808.4**	5	NT	NT
ND20-EF03	0-0.3 ft	5.5 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	**3837.0**	**170**	NT	NT
	0.3-1 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.3 U	**4523.0**	6.5	NT	NT
	1-3.5 ft	5.6 U	3 U	1.5 U	2.9 U	2.5 U	6.4 U	381.2	0	NT	NT
	3.5-5 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.4 U	**8850.0**	0	NT	NT
	5-6.3 ft	6.9 U	3.7 U	1.9 U	3.7 U	3.1 U	8 U	440.1	0	NT	NT
ND20-EF12	0-0.3 ft	NT	NT	NT	NT	NT	NT	72.96	0	NT	NT
ND20-EF02	0-0.3 ft	5 U	2.7 U	1.4 U	2.6 U	2.3 U	5.8 U	206.9	2.9	NT	NT
	0.3-2 ft	4.2 U	2.3 U	1.2 U	2.2 U	1.9 U	4.9 U	**1815.5**	0	NT	NT
	2-4 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.4 U	775.6	0	NT	NT
	4-6 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	13.985	0	NT	NT
ND20-EF01	0-0.3 ft	4.9 U	2.6 U	1.3 U	2.6 U	2.2 U	5.7 U	87.35	0	**2.463585**	NT
	0.3-2 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	49.4	0	NT	NT
	2-4 ft	4.6 U	2.5 U	1.2 U	2.4 U	2.1 U	5.3 U	12.755	0	NT	NT
	4-6 ft	4.6 U	2.5 U	1.3 U	2.4 U	2.1 U	5.4 U	13.065	0	NT	NT
ND20-EF11	0-0.3 ft	NT	NT	NT	NT	NT	NT	16.045	0	**3.56348**	NT
SW15-SLB01	0-0.5 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT
	0.5-2 ft	NT	NT	NT	NT	NT	NT	None	14	NT	NT
	2-4 ft	NT	NT	NT	NT	NT	NT	None	17	NT	NT
ND20-EF08	0-0.3 ft	4 U	2.2 U	1.1 U	2.1 U	1.8 U	4.7 U	34.61	NT	NT	NT
	0.3-2 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	**2688.0**	NT	NT	NT
	2-4 ft	4.8 U	2.6 U	1.3 U	2.5 U	2.2 U	5.5 U	529.1	NT	NT	NT
	4-6 ft	4.7 U	2.5 U	1.3 U	2.5 U	2.1 U	5.5 U	**2743.5**	NT	NT	NT
ND20-EF06	0-0.3 ft	4.5 U	2.4 U	1.2 U	2.4 U	2.1 U	5.3 U	14.705	NT	NT	NT
	0.3-2 ft	4.8 U	2.6 U	1.3 U	2.5 U	2.2 U	5.5 U	274.9	NT	NT	NT
	2-4 ft	6.3 U	3.4 U	1.7 U	3.3 U	2.8 U	7.3 U	111.95	NT	NT	NT
	4-6 ft	16 U	8.8 U	4.5 U	8.7 U	7.4 U	19 U	988.5	NT	NT	NT
ND20-EF07	0-0.3 ft	5.8 U	3.1 U	1.6 U	3 U	2.6 U	6.7 U	1575.0	5.1	NT	NT
	0.3-2 ft	6 U	3.2 U	1.6 U	3.1 U	2.7 U	6.9 U	**1789.0**	21	NT	NT
	2-4 ft	6 U	3.2 U	1.6 U	3.1 U	2.7 U	6.9 U	**4472.0**	24	NT	NT
	4-6 ft	6.4 U	3.4 U	1.7 U	3.4 U	2.9 U	7.4 U	**7851.0**	27	NT	NT
ND20-EF05	0-0.3 ft	5 U	2.7 U	1.4 U	2.7 U	2.3 U	5.8 U	48.85	0	**6.25209**	NT
	0.3-2 ft	4.3 U	2.3 U	1.2 U	2.3 U	1.9 U	4.9 U	1441.7	0	NT	NT
	2-4 ft	4.5 U	2.4 U	1.2 U	2.4 U	2 U	5.2 U	366.0	0	NT	NT
	4-6 ft	14 U	7.7 U	3.9 U	7.6 U	6.5 U	17 U	73.8	0	NT	NT
ND20-EF18	0-0.3 ft	NT	NT	NT	NT	NT	NT	1554.0	17	NT	NT
ND20-EF10	0-0.3 ft	NT	NT	NT	NT	NT	NT	**3590.0**	14	NT	NT
ND20-EF17	0-0.3 ft	NT	NT	NT	NT	NT	NT	1410.0	5.7	**7.1987**	NT
ND20-EF09	0-0.3 ft	7.1 U	3.8 U	2 U	3.8 U	3.2 U	8.3 U	1576.0	6.3	14.4235	NT

\\lovelongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-9 Estuary Flats Organics.mxd bpawling

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 500 1,000
Feet

N

Figure 4-9
Estuary Flats - Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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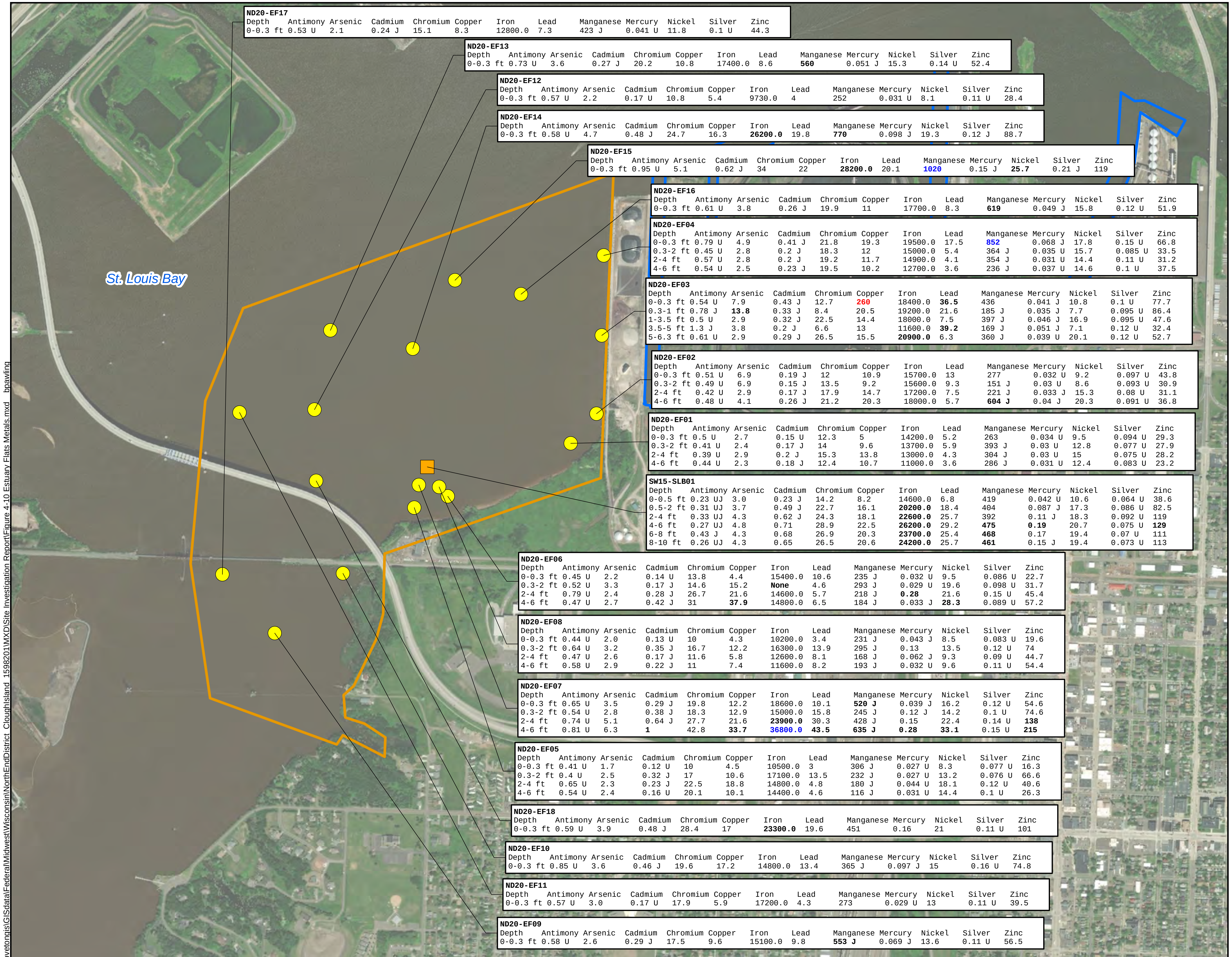


ND20-EF17

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.53 U	2.1	0.24 J	15.1	8.3	12800.0	7.3	423 J	0.041 U	11.8	0.1 U	44.3

ND20-EF13

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.73 U	3.6	0.27 J	20.2	10.8	17400.0	8.6	**560**	0.051 J	15.3	0.14 U	52.4

ND20-EF12

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.57 U	2.2	0.17 U	10.8	5.4	9730.0	4	252	0.031 U	8.1	0.11 U	28.4

ND20-EF14

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.58 U	4.7	0.48 J	24.7	16.3	**26200.0**	19.8	**770**	0.098 J	19.3	0.12 J	88.7

ND20-EF15

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.95 U	5.1	0.62 J	34	22	**28200.0**	20.1	**1020**	0.15 J	**25.7**	0.21 J	119

ND20-EF16

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.61 U	3.8	0.26 J	19.9	11	17700.0	8.3	**619**	0.049 J	15.8	0.12 U	51.9

ND20-EF04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.79 U	4.9	0.41 J	21.8	19.3	19500.0	17.5	**852**	0.068 J	17.8	0.15 U	66.8
0.3-2 ft	0.45 U	2.8	0.2 J	18.3	12	15000.0	5.4	364 J	0.035 U	15.7	0.085 U	33.5
2-4 ft	0.57 U	2.8	0.2 J	19.2	11.7	14900.0	4.1	354 J	0.031 U	14.4	0.11 U	31.2
4-6 ft	0.54 U	2.5	0.23 J	19.5	10.2	12700.0	3.6	236 J	0.037 U	14.6	0.1 U	37.5

ND20-EF03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.54 U	7.9	0.43 J	12.7	**260**	18400.0	**36.5**	436	0.041 J	10.8	0.1 U	77.7
0.3-1 ft	0.78 J	**13.8**	0.33 J	8.4	20.5	19200.0	21.6	185 J	0.035 J	7.7	0.095 U	86.4
1-3.5 ft	0.5 U	2.9	0.32 J	22.5	14.4	18000.0	7.5	397 J	0.046 J	16.9	0.095 U	47.6
3.5-5 ft	1.3 J	3.8	0.2 J	6.6	13	11600.0	**39.2**	169 J	0.051 J	7.1	0.12 U	32.4
5-6.3 ft	0.61 U	2.9	0.29 J	26.5	15.5	**20900.0**	6.3	360 J	0.039 U	20.1	0.12 U	52.7

ND20-EF02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.51 U	6.9	0.19 J	12	10.9	15700.0	13	277	0.032 U	9.2	0.097 U	43.8
0.3-2 ft	0.49 U	6.9	0.15 J	13.5	9.2	15600.0	9.3	151 J	0.03 U	8.6	0.093 U	30.9
2-4 ft	0.42 U	2.9	0.17 J	17.9	14.7	17200.0	7.5	221 J	0.033 J	15.3	0.08 U	31.1
4-6 ft	0.48 U	4.1	0.26 J	21.2	20.3	18000.0	5.7	**604 J**	0.04 J	20.3	0.091 U	36.8

ND20-EF01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.5 U	2.7	0.15 U	12.3	5	14200.0	5.2	263	0.034 U	9.5	0.094 U	29.3
0.3-2 ft	0.41 U	2.4	0.17 J	14	9.6	13700.0	5.9	393 J	0.03 U	12.8	0.077 U	27.9
2-4 ft	0.39 U	2.9	0.2 J	15.3	13.8	13000.0	4.3	304 J	0.03 U	15	0.075 U	28.2
4-6 ft	0.44 U	2.3	0.18 J	12.4	10.7	11000.0	3.6	286 J	0.031 U	12.4	0.083 U	23.2

SW15-SLB01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.23 UJ	3.0	0.23 J	14.2	8.2	14600.0	6.8	419	0.042 U	10.6	0.064 U	38.6
0.5-2 ft	0.31 UJ	3.7	0.49 J	22.7	16.1	**20200.0**	18.4	404	0.087 J	17.3	0.086 U	82.5
2-4 ft	0.33 UJ	4.3	0.62 J	24.3	18.1	**22600.0**	25.7	392	0.11 J	18.3	0.092 U	119
4-6 ft	0.27 UJ	4.8	0.71	28.9	22.5	**26200.0**	29.2	**475**	**0.19**	20.7	0.075 U	**129**
6-8 ft	0.43 J	4.3	0.68	26.9	20.3	**23700.0**	25.4	**468**	0.17	19.4	0.07 U	111
8-10 ft	0.26 UJ	4.3	0.65	26.5	20.6	**24200.0**	25.7	**461**	0.15 J	19.4	0.073 U	113

ND20-EF06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.45 U	2.2	0.14 U	13.8	4.4	15400.0	10.6	235 J	0.032 U	9.5	0.086 U	22.7
0.3-2 ft	0.52 U	3.3	0.17 J	14.6	15.2	**None**	4.6	293 J	0.029 U	19.6	0.098 U	31.7
2-4 ft	0.79 U	2.4	0.28 J	26.7	21.6	14600.0	5.7	218 J	**0.28**	21.6	0.15 U	45.4
4-6 ft	0.47 U	2.7	0.42 J	31	**37.9**	14800.0	6.5	184 J	0.033 J	**28.3**	0.089 U	57.2

ND20-EF08

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.44 U	2.0	0.13 U	10	4.3	10200.0	3.4	231 J	0.043 J	8.5	0.083 U	19.6
0.3-2 ft	0.64 U	3.2	0.35 J	16.7	12.2	16300.0	13.9	295 J	0.13	13.5	0.12 U	74
2-4 ft	0.47 U	2.6	0.17 J	11.6	5.8	12600.0	8.1	168 J	0.062 J	9.3	0.09 U	44.7
4-6 ft	0.58 U	2.9	0.22 J	11	7.4	11600.0	8.2	193 J	0.032 U	9.6	0.11 U	54.4

ND20-EF07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.65 U	3.5	0.29 J	19.8	12.2	18600.0	10.1	**520 J**	0.039 J	16.2	0.12 U	54.6
0.3-2 ft	0.54 U	2.8	0.38 J	18.3	12.9	15000.0	15.8	245 J	0.12 J	14.2	0.1 U	74.6
2-4 ft	0.74 U	5.1	0.64 J	27.7	21.6	**23900.0**	30.3	428 J	0.15	22.4	0.14 U	**138**
4-6 ft	0.81 U	6.3	**1**	42.8	**33.7**	36800.0	**43.5**	**635 J**	**0.28**	**33.1**	0.15 U	**215**

ND20-EF05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.41 U	1.7	0.12 U	10	4.5	10500.0	3	306 J	0.027 U	8.3	0.077 U	16.3
0.3-2 ft	0.4 U	2.5	0.32 J	17	10.6	17100.0	13.5	232 J	0.027 U	13.2	0.076 U	66.6
2-4 ft	0.65 U	2.3	0.23 J	22.5	18.8	14800.0	4.8	180 J	0.044 U	18.1	0.12 U	40.6
4-6 ft	0.54 U	2.4	0.16 U	20.1	10.1	14400.0	4.6	116 J	0.031 U	14.4	0.1 U	26.3

ND20-EF18

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.59 U	3.9	0.48 J	28.4	17	**23300.0**	19.6	451	0.16	21	0.11 U	101

ND20-EF10

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.85 U	3.6	0.46 J	19.6	17.2	14800.0	13.4	365 J	0.097 J	15	0.16 U	74.8

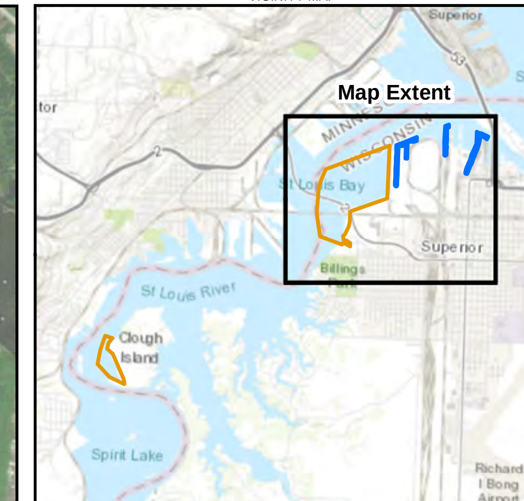
ND20-EF11

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.57 U	3.0	0.17 U	17.9	5.9	17200.0	4.3	273	0.029 U	13	0.11 U	39.5

ND20-EF09

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.58 U	2.6	0.29 J	17.5	9.6	15100.0	9.8	**553 J**	0.069 J	13.6	0.11 U	56.5

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 500 1,000
Feet

N

Figure 4-10
Estuary Flats - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-10 Estuary Flats Metals.mxd bpawling

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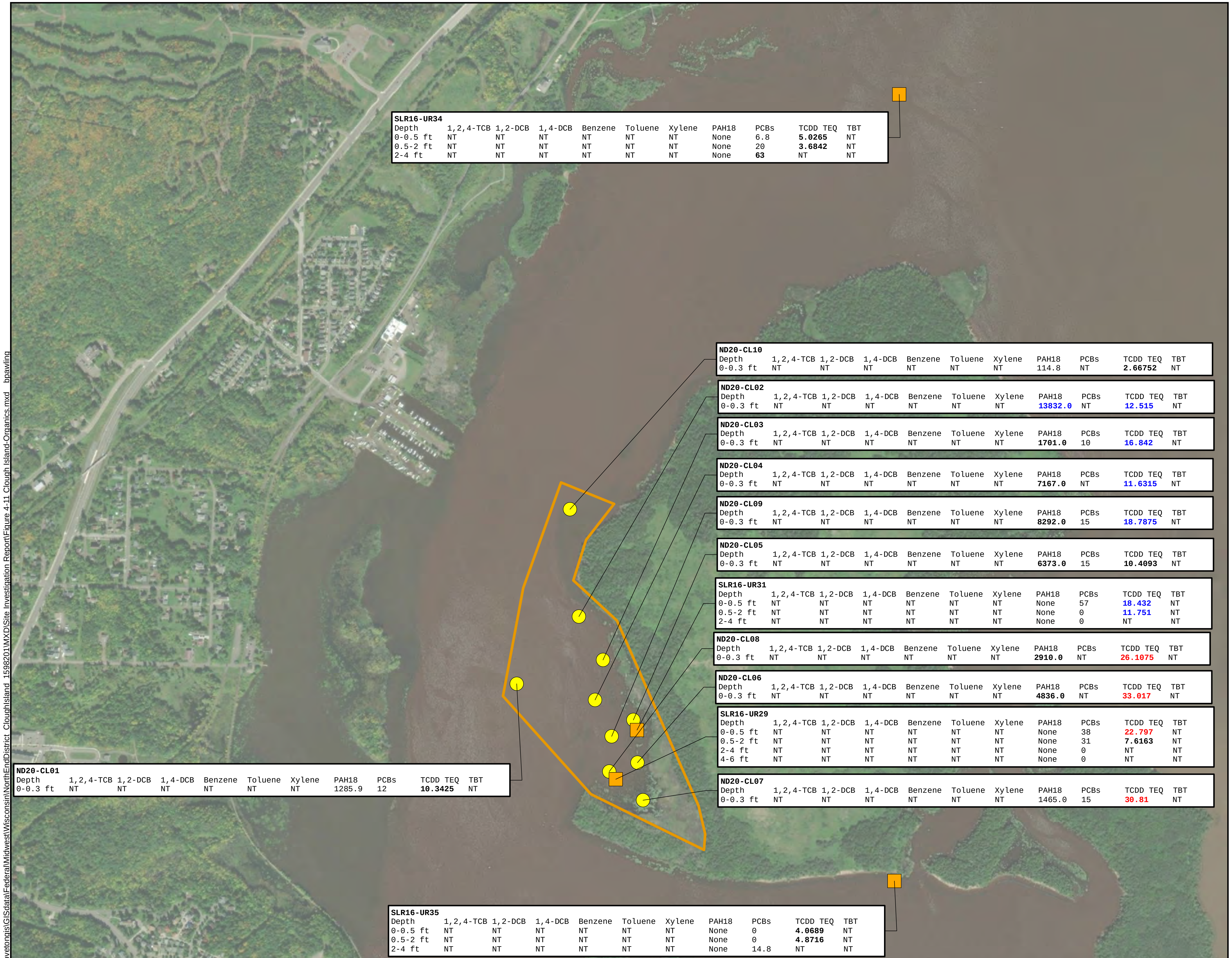


SLR16-UR34

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	6.8	**5.0265**	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	20	**3.6842**	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	**63**	NT	NT

ND20-CL10

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	114.8	NT	**2.66752**	NT

ND20-CL02

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**13832.0**	NT	**12.515**	NT

ND20-CL03

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**1701.0**	10	**16.842**	NT

ND20-CL04

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**7167.0**	NT	**11.6315**	NT

ND20-CL09

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**8292.0**	15	**18.7875**	NT

ND20-CL05

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**6373.0**	15	**10.4093**	NT

SLR16-UR31

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	57	**18.432**	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	0	**11.751**	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT

ND20-CL08

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**2910.0**	NT	**26.1075**	NT

ND20-CL06

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	**4836.0**	NT	**33.017**	NT

SLR16-UR29

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	38	**22.797**	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	31	**7.6163**	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT
4-6 ft	NT	NT	NT	NT	NT	NT	None	0	NT	NT

ND20-CL07

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	1465.0	15	**30.81**	NT

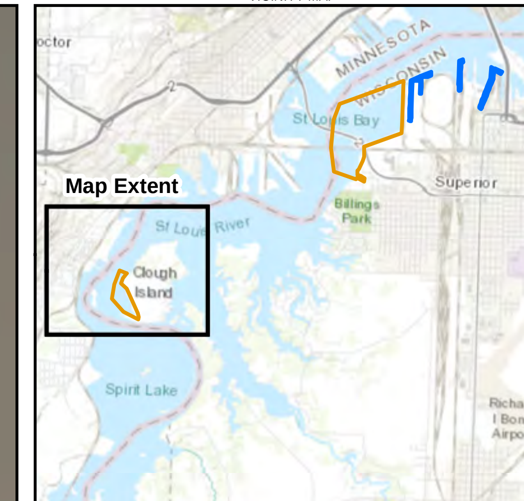
ND20-CL01

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	NT	NT	NT	NT	NT	NT	1285.9	12	**10.3425**	NT

SLR16-UR35

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.5 ft	NT	NT	NT	NT	NT	NT	None	0	**4.0689**	NT
0.5-2 ft	NT	NT	NT	NT	NT	NT	None	0	**4.8716**	NT
2-4 ft	NT	NT	NT	NT	NT	NT	None	14.8	NT	NT

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in **blue** exceed the MEC.
Concentrations shown in **red** exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = Not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 500 1,000
Feet

N

Figure 4-11
Clough Island - Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\wovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-11 Clough Island-Organics.mxd bpawling

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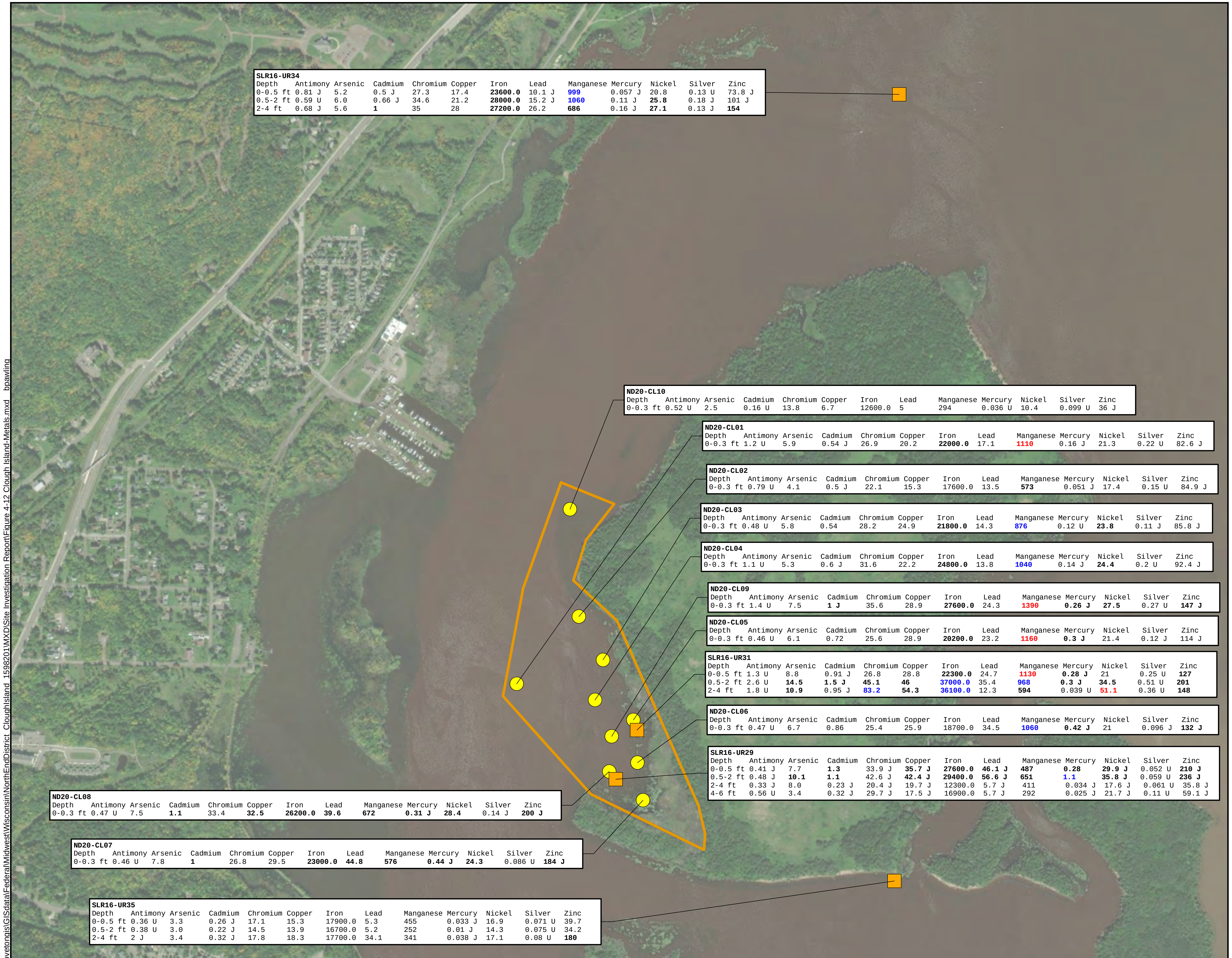


SLR16-UR34

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.81 J	5.2	0.5 J	27.3	17.4	**23600.0**	10.1 J	**999**	0.057 J	20.8	0.13 U	73.8 J
0.5-2 ft	0.59 U	6.0	0.66 J	34.6	21.2	**28000.0**	15.2 J	**1060**	0.11 J	**25.8**	0.18 J	101 J
2-4 ft	0.68 J	5.6	**1**	35	28	**27200.0**	26.2	**686**	0.16 J	**27.1**	0.13 J	**154**

ND20-CL10

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.52 U	2.5	0.16 U	13.8	6.7	12600.0	5	294	0.036 U	10.4	0.099 U	36 J

ND20-CL01

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.2 U	5.9	0.54 J	26.9	20.2	**22000.0**	17.1	**1110**	0.16 J	21.3	0.22 U	82.6 J

ND20-CL02

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.79 U	4.1	0.5 J	22.1	15.3	17600.0	13.5	**573**	0.051 J	17.4	0.15 U	84.9 J

ND20-CL03

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.48 U	5.8	0.54	28.2	24.9	**21800.0**	14.3	**876**	0.12 U	**23.8**	0.11 J	85.8 J

ND20-CL04

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.1 U	5.3	0.6 J	31.6	22.2	**24800.0**	13.8	**1040**	0.14 J	**24.4**	0.2 U	92.4 J

ND20-CL09

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	1.4 U	7.5	**1 J**	35.6	28.9	**27600.0**	24.3	**1390**	**0.26 J**	**27.5**	0.27 U	**147 J**

ND20-CL05

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.46 U	6.1	0.72	25.6	28.9	**20200.0**	23.2	**1160**	**0.3 J**	21.4	0.12 J	114 J

SLR16-UR31

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	1.3 U	8.8	0.91 J	26.8	28.8	**22300.0**	24.7	**1130**	**0.28 J**	21	0.25 U	**127**
0.5-2 ft	2.6 U	**14.5**	**1.5 J**	**45.1**	**46**	**37000.0**	35.4	**968**	**0.3 J**	**34.5**	0.51 U	**201**
2-4 ft	1.8 U	**10.9**	0.95 J	**83.2**	**54.3**	**36100.0**	12.3	**594**	0.039 U	**51.1**	0.36 U	**148**

ND20-CL06

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.47 U	6.7	0.86	25.4	25.9	18700.0	34.5	**1060**	**0.42 J**	21	0.096 J	**132 J**

SLR16-UR29

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.41 J	7.7	**1.3**	33.9 J	**35.7 J**	**27600.0**	**46.1 J**	**487**	**0.28**	**29.9 J**	0.052 U	**210 J**
0.5-2 ft	0.48 J	**10.1**	**1.1**	42.6 J	**42.4 J**	**29400.0**	**56.6 J**	**651**	**1.1**	**35.8 J**	0.059 U	**236 J**
2-4 ft	0.33 J	8.0	0.23 J	20.4 J	19.7 J	12300.0	5.7 J	411	0.034 J	17.6 J	0.061 U	35.8 J
4-6 ft	0.56 U	3.4	0.32 J	29.7 J	17.5 J	16900.0	5.7 J	292	0.025 J	21.7 J	0.11 U	59.1 J

ND20-CL08

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.47 U	7.5	**1.1**	33.4	**32.5**	**26200.0**	**39.6**	**672**	**0.31 J**	**28.4**	0.14 J	**200 J**

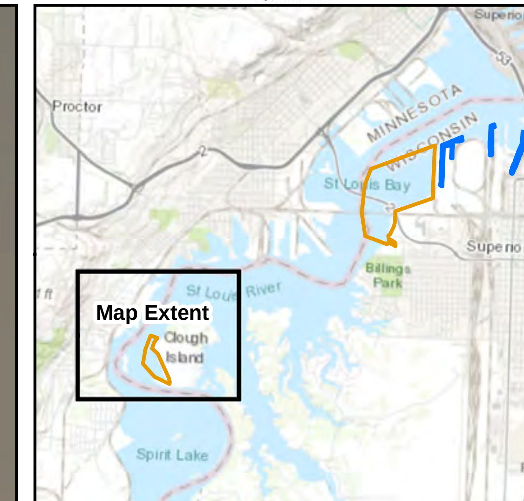
ND20-CL07

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.3 ft	0.46 U	7.8	**1**	26.8	29.5	**23000.0**	**44.8**	**576**	**0.44 J**	**24.3**	0.086 U	**184 J**

SLR16-UR35

Depth	Antimony	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Silver	Zinc
0-0.5 ft	0.36 U	3.3	0.26 J	17.1	15.3	17900.0	5.3	455	0.033 J	16.9	0.071 U	39.7
0.5-2 ft	0.38 U	3.0	0.22 J	14.5	13.9	16700.0	5.2	252	0.01 J	14.3	0.075 U	34.2
2-4 ft	2 J	3.4	0.32 J	17.8	18.3	17700.0	34.1	341	0.038 J	17.1	0.08 U	**180**

VICINITY MAP



Legend

- Sediment Sample Location
- Historical Sediment Sample Location
- Sediment Characterization Area (468.74 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 500 1,000
Feet

N

Figure 4-12
Clough Island - Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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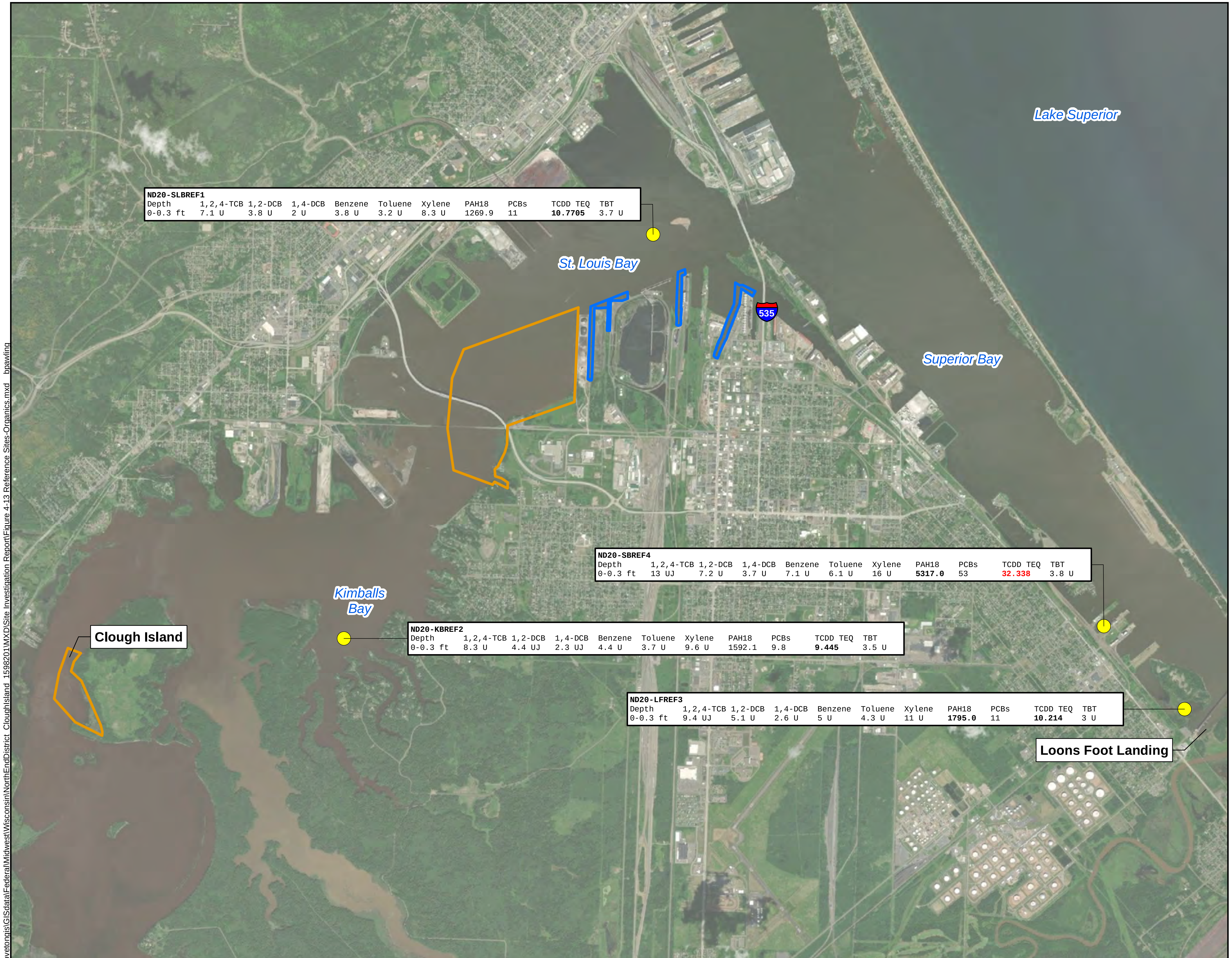


ND20-SLBREF1

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	7.1 U	3.8 U	2 U	3.8 U	3.2 U	8.3 U	1269.9	11	**10.7705**	3.7 U

ND20-SBREF4

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	13 UJ	7.2 U	3.7 U	7.1 U	6.1 U	16 U	**5317.0**	53	**32.338**	3.8 U

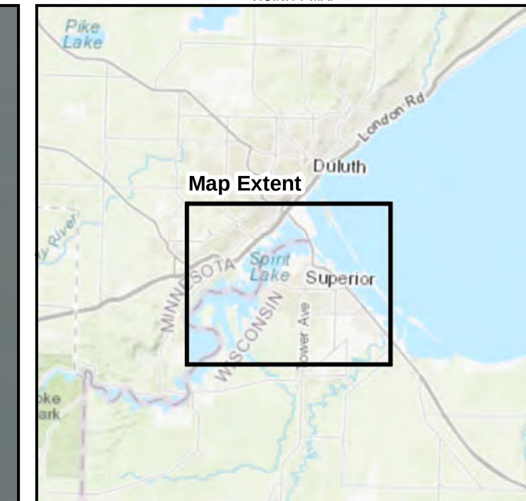
ND20-KBREF2

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	8.3 U	4.4 UJ	2.3 UJ	4.4 U	3.7 U	9.6 U	1592.1	9.8	**9.445**	3.5 U

ND20-LFREF3

Depth	1,2,4-TCB	1,2-DCB	1,4-DCB	Benzene	Toluene	Xylene	PAH18	PCBs	TCDD TEQ	TBT
0-0.3 ft	9.4 UJ	5.1 U	2.6 U	5 U	4.3 U	11 U	**1795.0**	11	**10.214**	3 U

VICINITY MAP



Legend

- Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in ug/kg.
Fish TEQ results are in pg/g.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in **blue** exceed the MEC.
Concentrations shown in **red** exceed the PEC.
TCDD TEQ in text boxes calculated as Fish Dioxin TEQ (ND=1/2RL)

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
NT = not tested.
ug/kg - Micrograms per kilogram
pg/g - Picograms per gram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Analyte	Abbreviation	TEC	MEC	PEC
		(ug/kg)		
1,2,4-Trichlorobenzene	1,2,4-TCB	8	13	18
1,2-Dichlorobenzene	1,2-DCB	23		23
1,4-Dichlorobenzene	1,4-DCB	31	60.5	90
Benzene	Benzene	57	83.5	110
Toluene	Toluene	890	1345	1800
Xylene	Xylene	25	37.5	50
Total PAH18 ND=1/2RL	PAH18	1610	12205	22800
Total PCBs ND=0	PCBs	60	368	676
FISH TEQ (ND=1/2RL)	TCDD TEQ	0.85	11.2	21.5
Tributyltin	TBT	0.52	1.73	2.94

0 0.5 1
Miles

N

Figure 4-13
Reference Sites-Organics
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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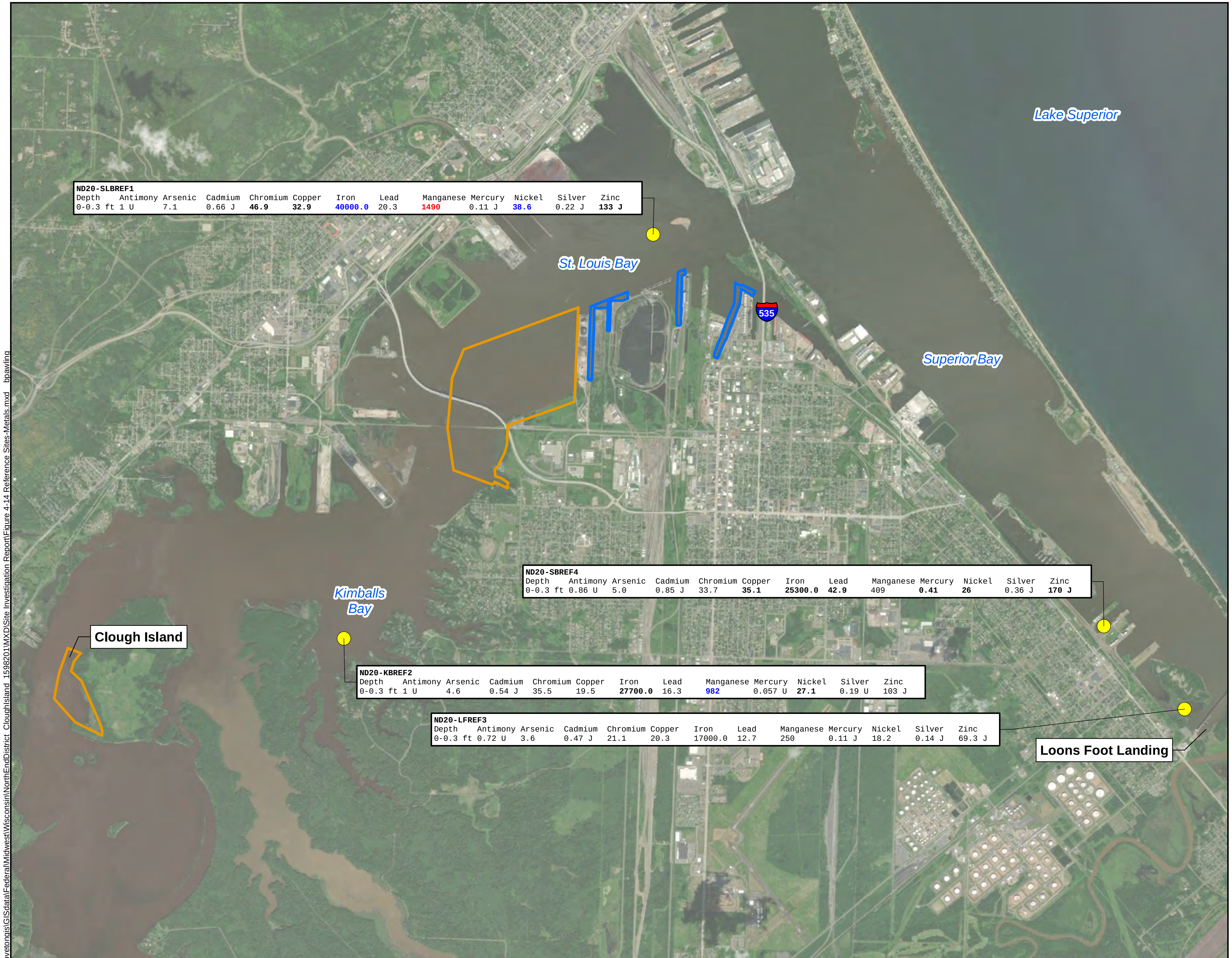
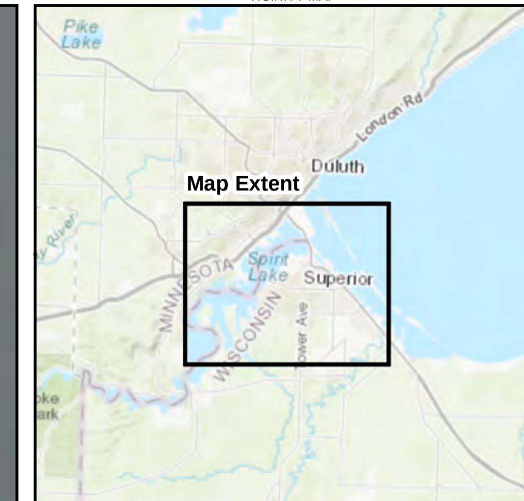


VICINITY MAP



Legend

- Sediment Sample Location
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in mg/kg.
Concentrations shown in **BOLD** exceed the TEC.
Concentrations shown in blue exceed the MEC.
Concentrations shown in red exceed the PEC.

Acronyms:
J = Indicates that the concentration is an estimated value.
U = Indicates the analyte was analyzed for but not detected.
mg/kg - Milligrams per Kilogram
TEC = Threshold Effect Concentration
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

Metal	TEC	MEC	PEC
	(mg/kg)		
Antimony	2	13.5	25
Arsenic	9.8	21.4	33
Cadmium	0.99	3	5
Chromium	43	76.5	110
Copper	32	91	150
Iron	20000	30000	40000
Lead	36	83	130
Manganese	460	780	1100
Mercury	0.18	0.64	1.1
Nickel	23	36	49
Silver	1.6	1.9	2.2
Zinc	120	290	460

0 0.5 1
Miles

N

Figure 4-14
Reference Sites-Metals
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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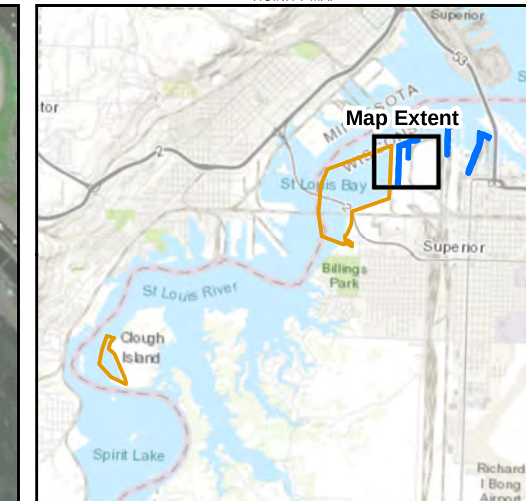
VICINITY MAP



Legend

Microscopic Coal Result

- 0 - 3 %
- 3.1 - 5 %
- 5.1 - 12 %
- 12.1 - 69 %
- > 69 %
- Not Tested
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in %.

Acronyms:
ND = Non Detect.

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 200 400
Feet

N

Figure 4-15
Hallet Dock 8 Slip and Oil Barge Slip - Microscopic Coal Results
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\Woetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-15 Hallet Dock Slip 8 Oil Barge Microscopic Coal Results.mxd bpawling

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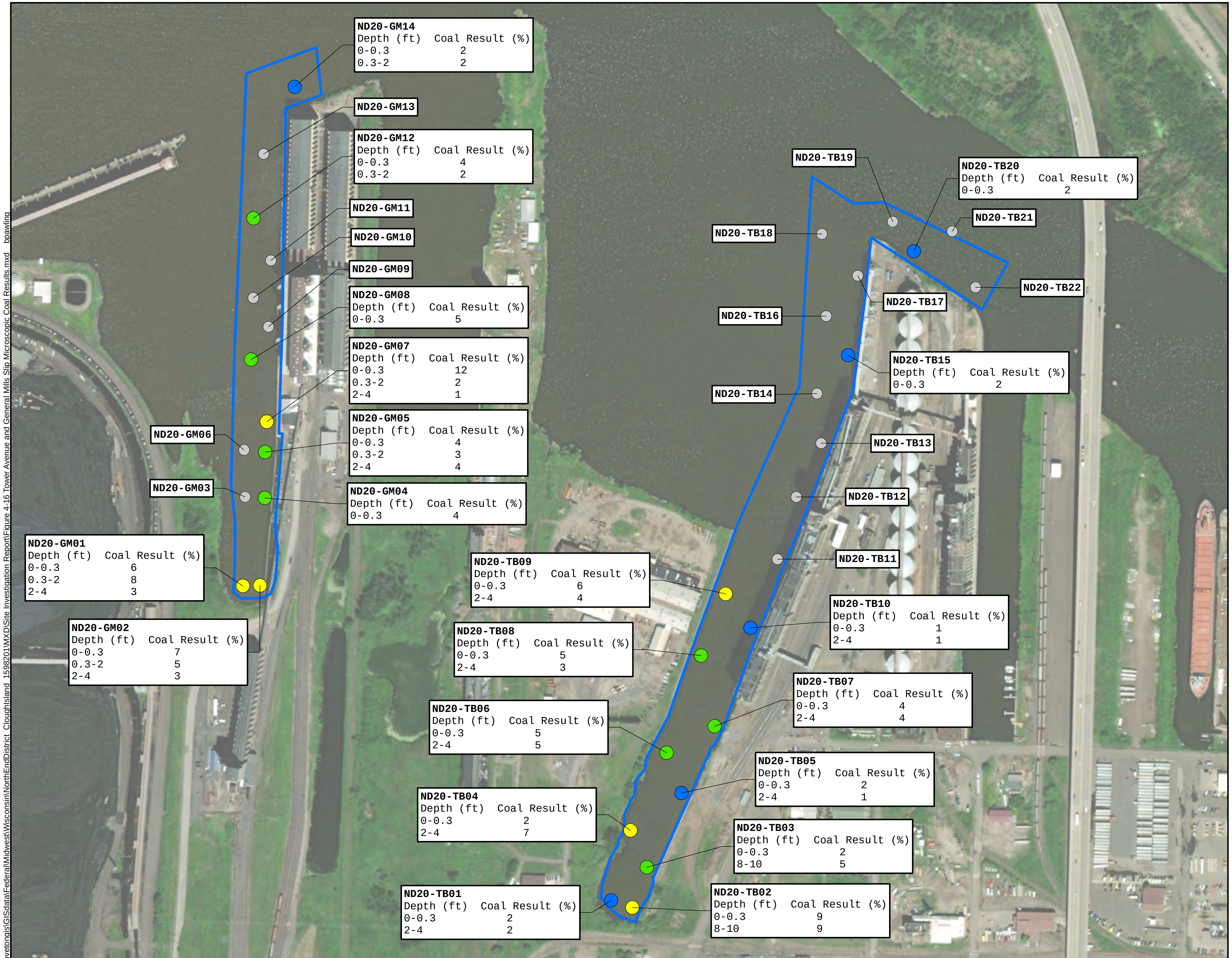
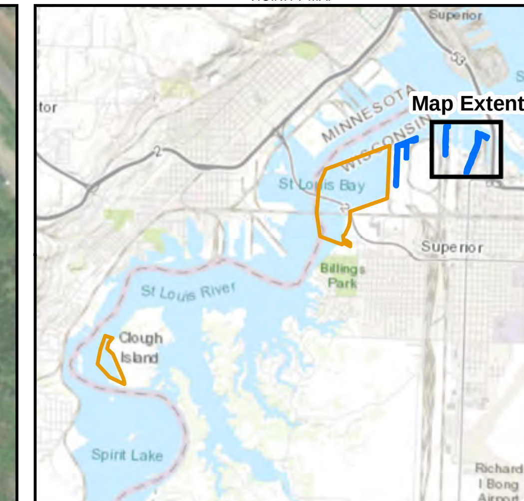


VICINITY MAP



Legend

Microscopic Coal Result

- 0 - 3 %
- 3.1 - 5 %
- 5.1 - 12 %
- 12.1 - 69 %
- > 69 %
- Not Tested
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in %.

Acronyms:
ND = Non Detect.

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 200 400
Feet

N

Figure 4-16
Tower Avenue and General Mills Slip - Microscopic Coal Results
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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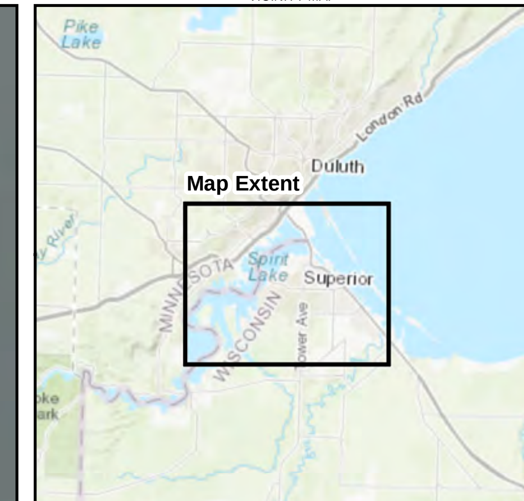
VICINITY MAP



Legend

Microscopic Coal Result

- 0 - 3 %
- 3.1 - 5 %
- 5.1 - 12 %
- 12.1 - 69 %
- > 69 %
- Sediment Characterization Area (468.74 ac)
- Sediment Characterization and Survey Area (39.65 ac)

Notes:
Sample results are in %.

Acronyms:
ND = Non Detect.

Map Date: 6/2/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 0.5 1
Miles

N

Figure 4-17
Reference Sites-Microscopic Coal Results
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\loveto\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 4-17 Reference Sites Microscopic Coal Results.mxd bpawling

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Figure 4-18: Common petroleum products and boiling point ranges (TPHCWG 1998)
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin

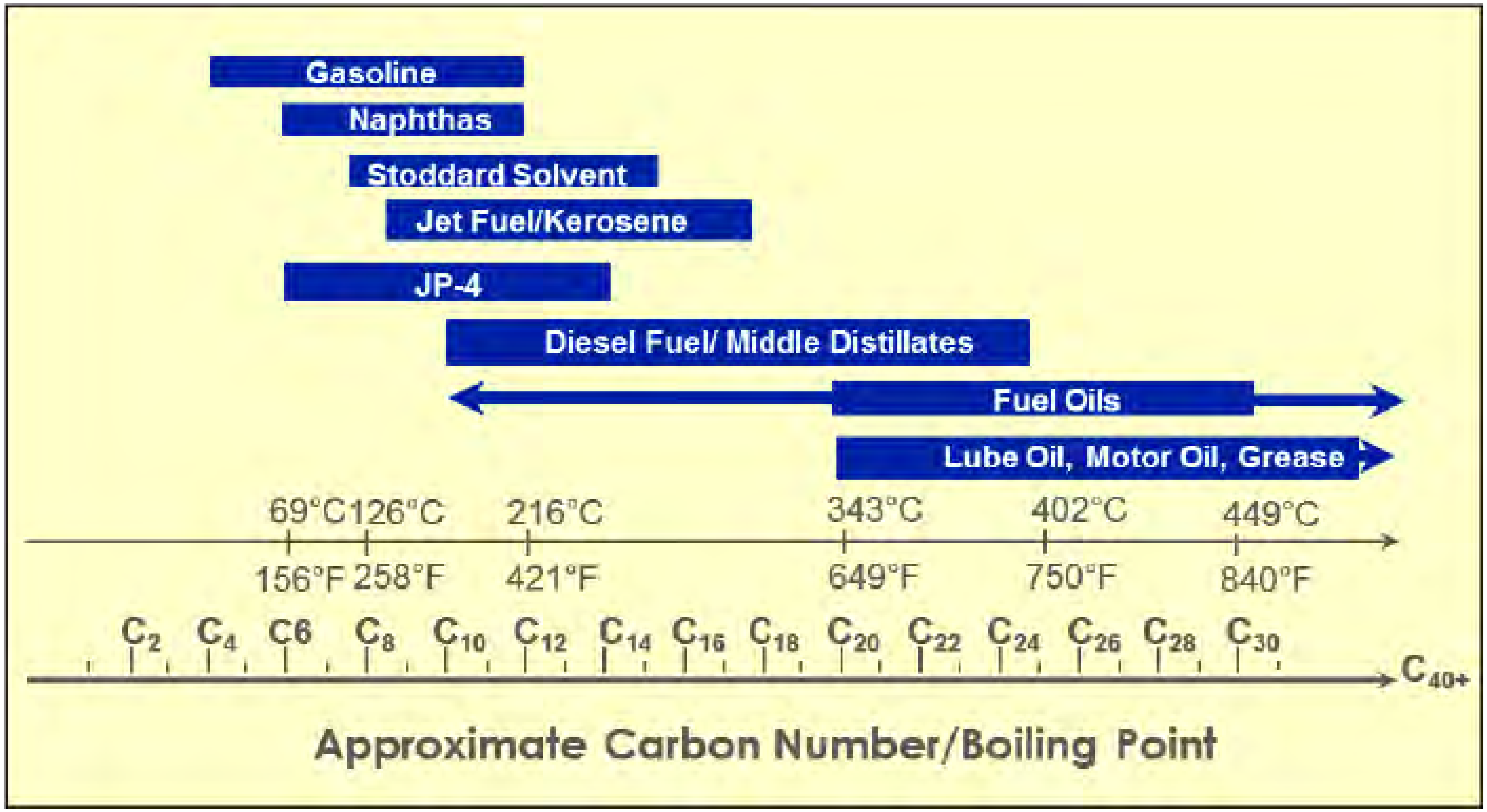
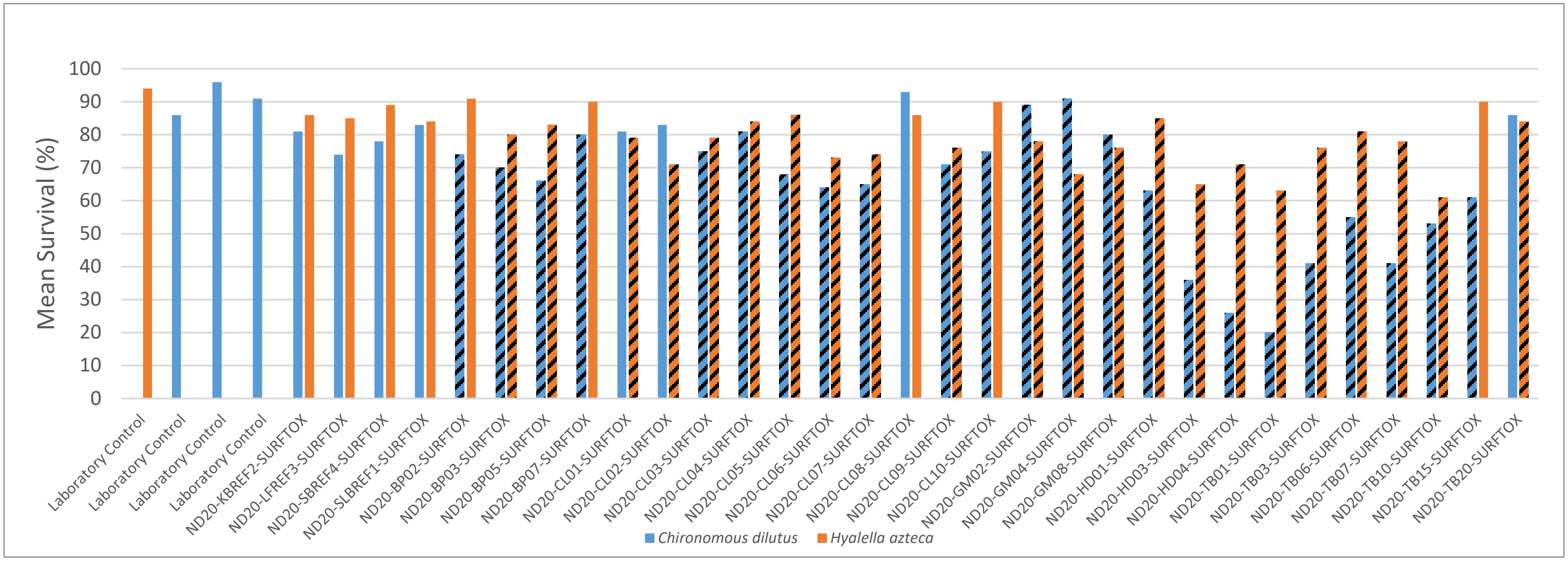


Figure 5-1: Sediment Toxicity Testing Survival Results
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Note: Patterned cells are significantly different than at least one control or reference sample (p=0.05)

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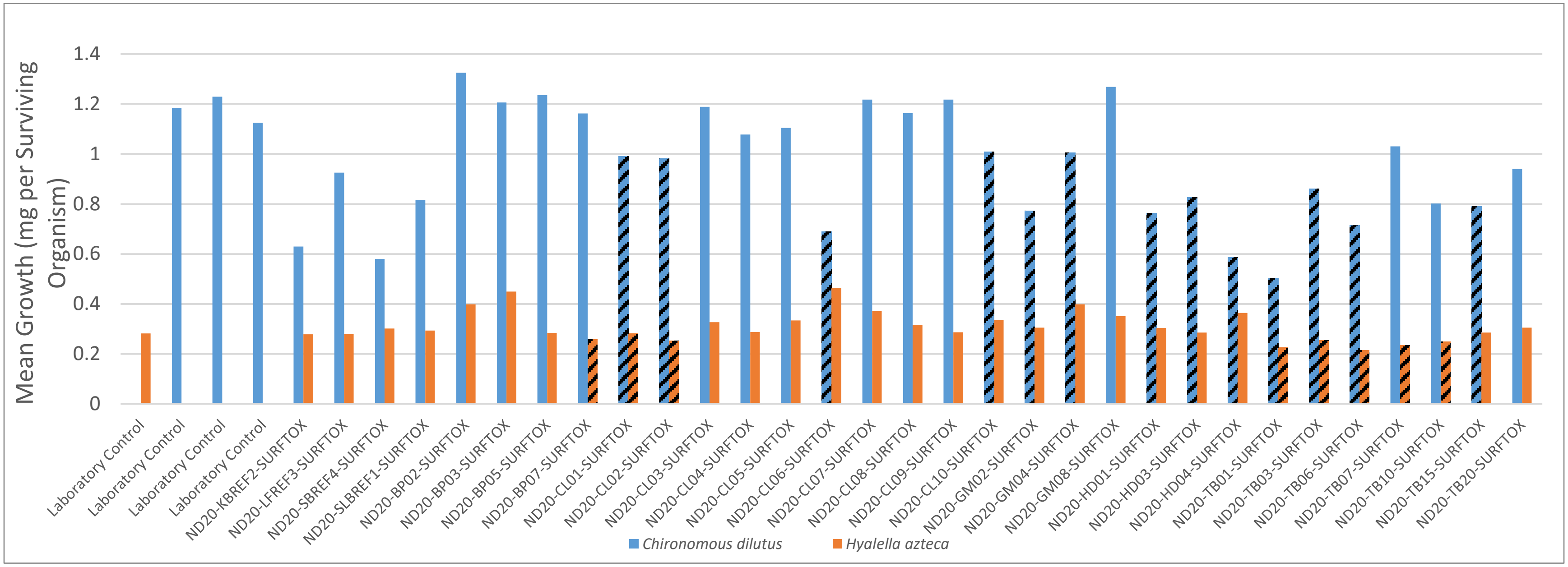
Figure 5-2: Sediment Toxicity Testing Growth Results
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Note: Patterned cells are significantly different than at least one control or reference sample (p=0.05)

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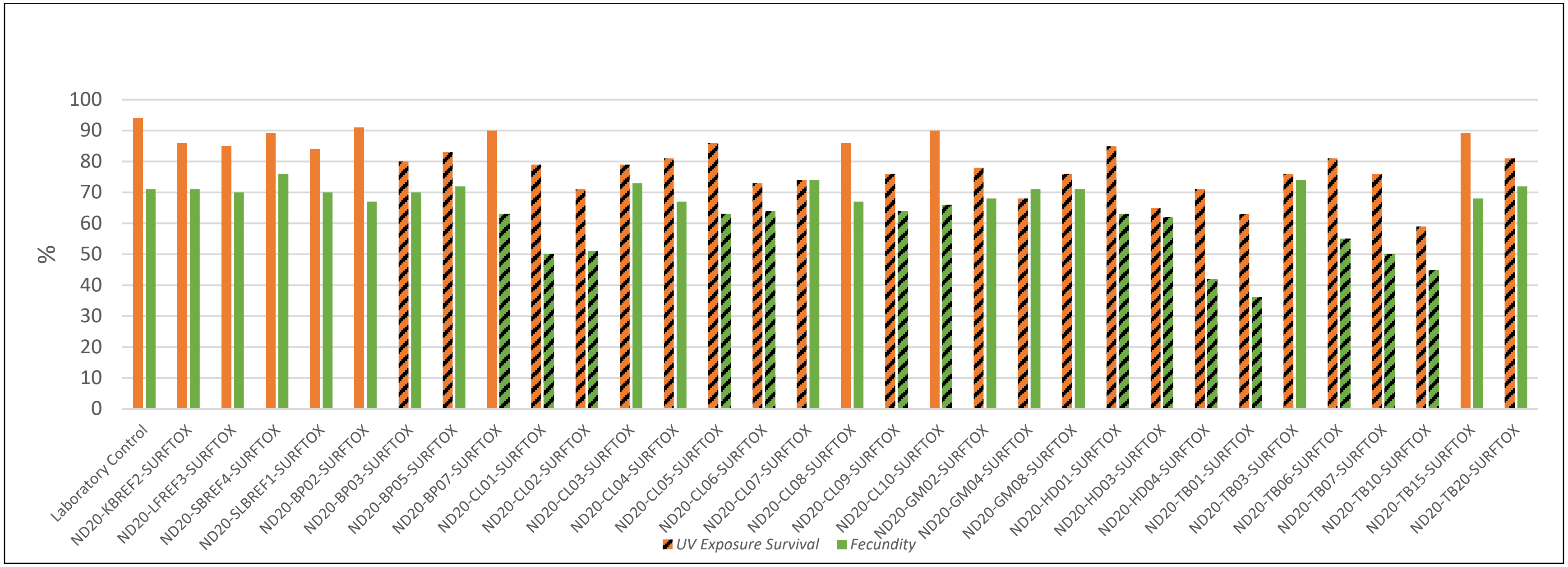
Figure 5-3: Sediment Toxicity Testing UV Exposure Survival and Fecundity Results
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Note: Patterned cells are significantly different than at least one control or reference sample (p=0.05)

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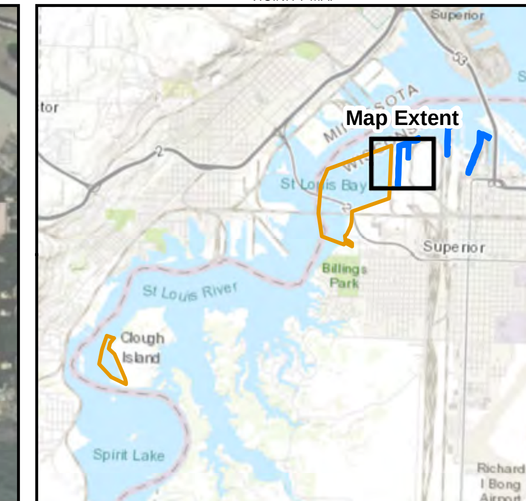
Map Date: 6/3/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

VICINITY MAP



Legend

Sampling Location

Sediment Characterization Area (468.74 ac)

Sediment Characterization and Survey Area (39.65 ac)

Shading indicates bioassay results were significantly different (p=0.05) from reference sample.

1	2
3	4

1 = Survival Significance for *H. azteca*
2 = UV Survival Significance for *H. azteca*
3 = Fedundity Significance for *H. azteca*
4 = Growth Significance for *H. azteca*

1 2

1 = Survival Significance for *C. dilutus*
2 = Growth Significance for *C. dilutus*

Previous Study Toxicity Results - Superior Bay and St. Louis Bay (EA 2015)
Observed Toxicological Effects (results statistically different from control)

2
1 3
4

1 = *C. riparius* (midge) 10-day survival
2 = *H. azteca* (amphipod) 28-day survival
3 = *H. azteca* (amphiod) Growth Rate
4 = *H. azteca* (amphiod) Mean Fecundity as Percent Females with Eggs
White indicates no toxicity observed

Figure 5-4
Hallet Dock 8 Slip and Oil Barge Dock Slip - Geographical Distribution of Bioassay Results for Survival and Growth
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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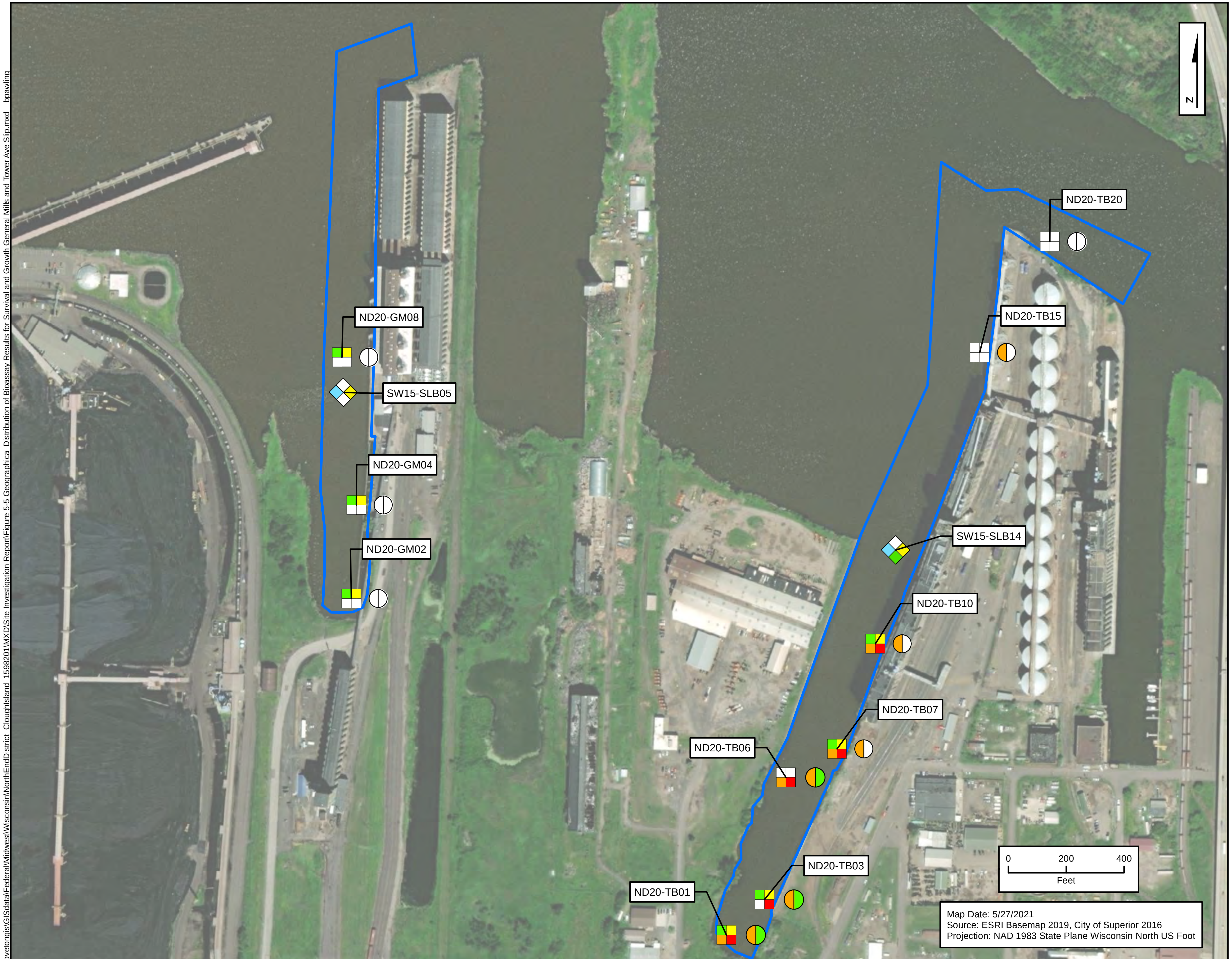
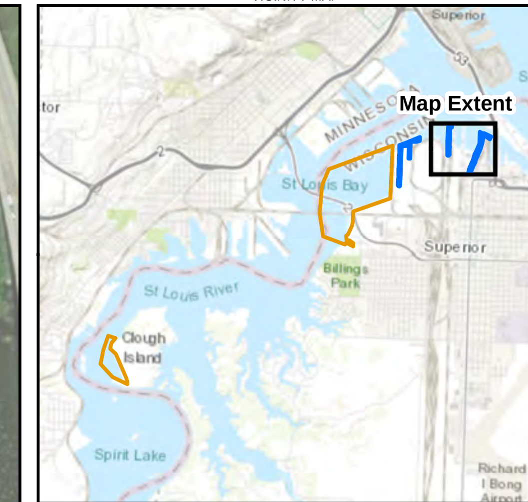


VICINITY MAP



Legend

Sampling Location

Sediment Characterization Area (468.74 ac)

Sediment Characterization and Survey Area (39.65 ac)

Shading indicates bioassay results were significantly different (p=0.05) from reference sample.

1 = Survival Significance for *H. azteca*
2 = UV Survival Significance for *H. azteca*
3 = Fedundity Significance for *H. azteca*
4 = Growth Significance for *H. azteca*

1 = Survival Significance for *C. dilutus*
2 = Growth Significance for *C. dilutus*

Previous Study Toxicity Results - Superior Bay and St. Louis Bay (EA 2015)

Observed Toxicological Effects (results statistically different from control)

1 = *C. riparius* (midge) 10-day survival
2 = *H. azteca* (amphipod) 28-day survival
3 = *H. azteca* (amphiod) Growth Rate
4 = *H. azteca* (amphiod) Mean Fecundity as Percent Females with Eggs
White indicates no toxicity observed

Figure 5-5
General Mills and Tower Avenue Slip - Geographical Distribution of Bioassay Results for Survival and Growth
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\lovetongis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 5-5 Geographical Distribution of Bioassay Results for Survival and Growth General Mills and Tower Ave Slip.mxd bpawling

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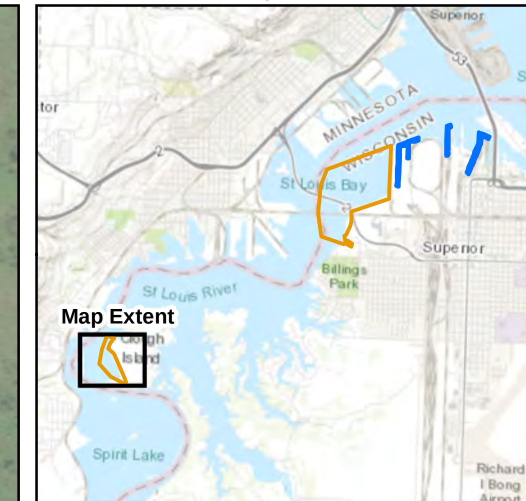
\\lovetongis\GISdata\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 5-4 Geographical Distribution of Bioassay Results for Survival and Growth Clough Island.mxd bpawling

VICINITY MAP



Legend

Sampling Location

Sediment Characterization Area (468.74 ac)

Shading indicates bioassay results were significantly different (p=0.05) from reference sample.

1	2
3	4

1 = Survival Significance for *H. azteca*
2 = UV Survival Significance for *H. azteca*
3 = Fedundity Significance for *H. azteca*
4 = Growth Significance for *H. azteca*

1 2

1 = Survival Significance for *C. dilutus*
2 = Growth Significance for *C. dilutus*

Map Date: 2/10/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 200 400
Feet

N

Figure 5-6
Clough Island - Geographical Distribution of Bioassay Results for Survival and Growth
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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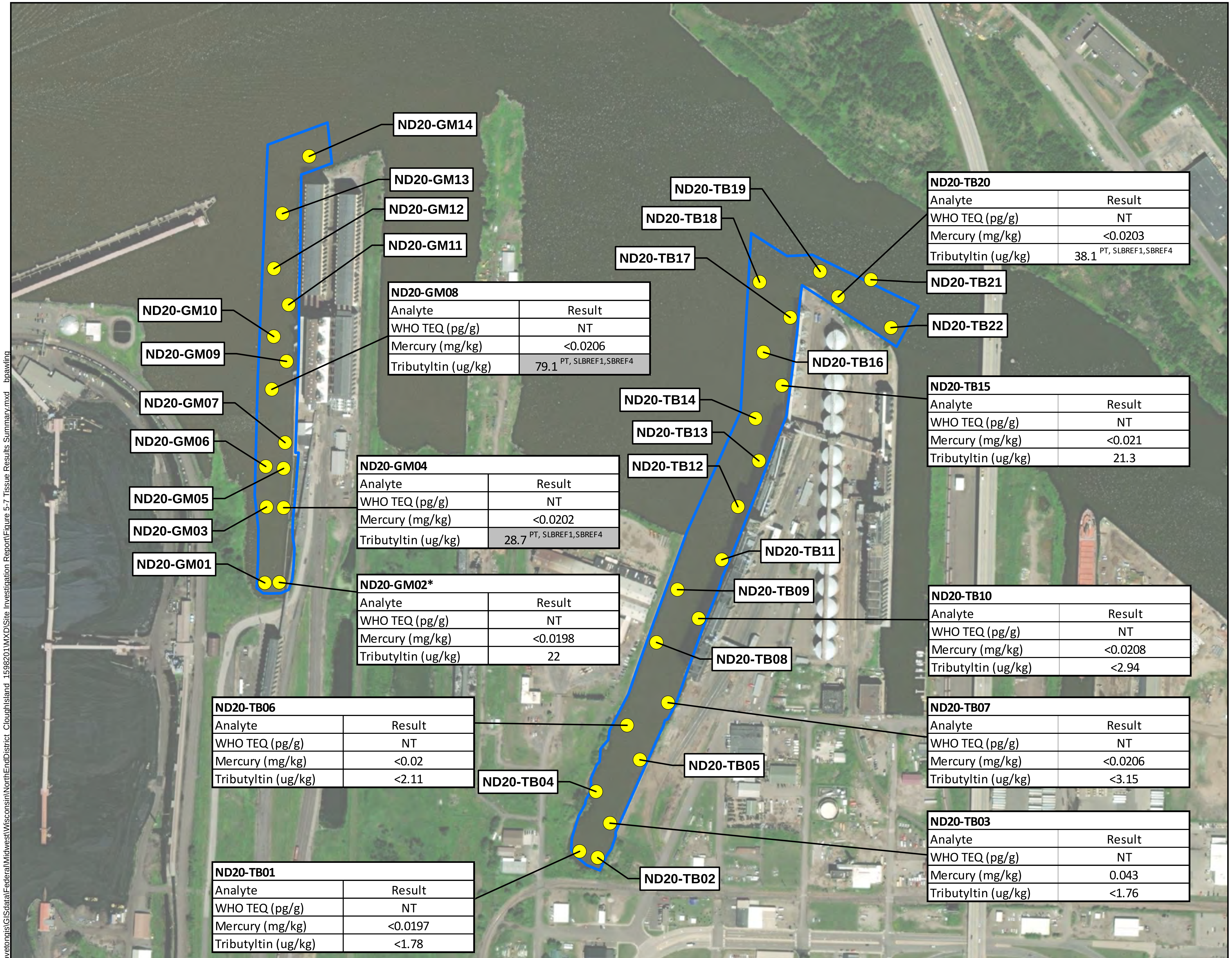


ND20-GM08

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0206
Tributyltin (ug/kg)	79.1 PT, SLBREF1,SBREF4

ND20-GM04

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0202
Tributyltin (ug/kg)	28.7 PT, SLBREF1,SBREF4

ND20-GM02*

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0198
Tributyltin (ug/kg)	22

ND20-TB06

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.02
Tributyltin (ug/kg)	<2.11

ND20-TB01

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0197
Tributyltin (ug/kg)	<1.78

ND20-TB20

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0203
Tributyltin (ug/kg)	38.1 PT, SLBREF1,SBREF4

ND20-TB15

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.021
Tributyltin (ug/kg)	21.3

ND20-TB10

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0208
Tributyltin (ug/kg)	<2.94

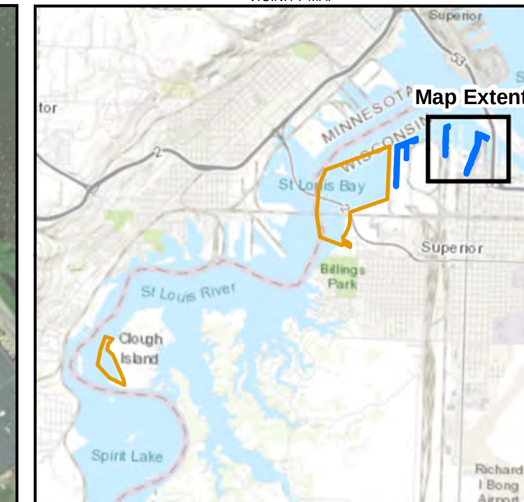
ND20-TB07

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	<0.0206
Tributyltin (ug/kg)	<3.15

ND20-TB03

Analyte	Result
WHO TEQ (pg/g)	NT
Mercury (mg/kg)	0.043
Tributyltin (ug/kg)	<1.76

VICINITY MAP



Legend

Sample Location

Sediment Characterization and Survey Area (39.65 ac)

Analyte	Sample Location	Reference Area Mean*	Units
Mercury	PRETEST	<0.0197	mg/kg
	ND20-SLBREF1	<0.02	
	ND20-KBREF2	<0.0205	
	ND20-LFREF3	0.029	
	ND20-SBREF4	0.027	
WHO TEQ (ND=1/2DL)	PRETEST	20.2	pg/g
	ND20-SLBREF1	18.1	
	ND20-KBREF2	16.9	
	ND20-LFREF3	20.6	
	ND20-SBREF4	16.4	
Tributyltin	PRETEST	<1.73	ug/kg
	ND20-SLBREF1	<1.86	
	ND20-KBREF2	14.8	
	ND20-LFREF3	8.26	
	ND20-SBREF4	<1.95	

Notes:
Grey shading indicates result showed statistical difference from reference location in superscript:
PT-Pretest
SLBREF1-St. Louis Bay reference location
KBREF2-Kimballs Bay reference location
LFREF3-Loons Foot Landing reference location
SBREF4-Superior Bay reference location
Lipid normalized values reported for WHO TEQ and Tributyltin
WHO TEQ calculated using nondetects equal to 1/2 the detection limit
*Location showed statistical difference from reference (SLBREF1) for dibutyltin

Acronyms:
pg/g - picograms per gram
mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram
NT = Not tested

Map Date: 6/3/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 200 400
Feet

N

Figure 5-7
Tissue Results Summary General Mills and Tower Avenue Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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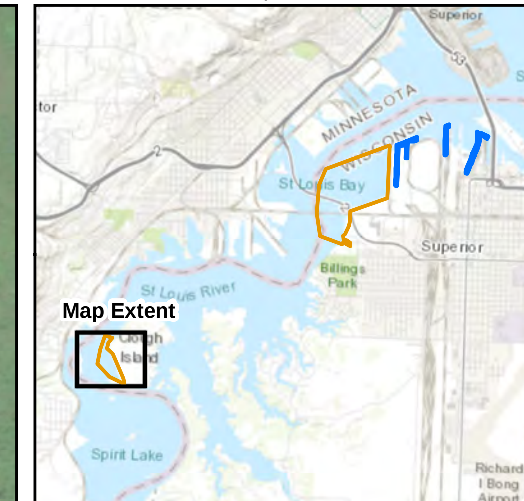
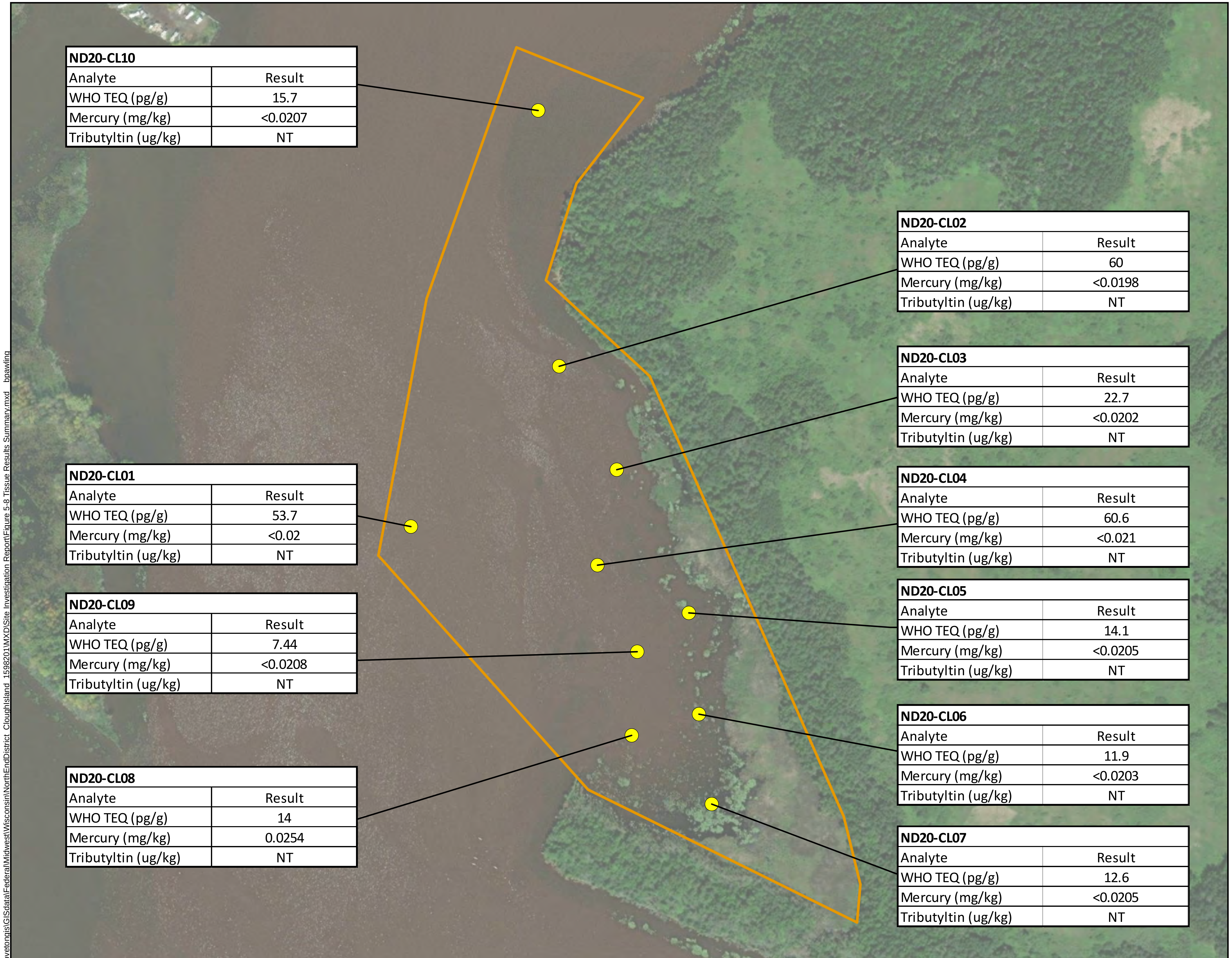


VICINITY MAP



ND20-CL10	
Analyte	Result
WHO TEQ (pg/g)	15.7
Mercury (mg/kg)	<0.0207
Tributyltin (ug/kg)	NT

ND20-CL02	
Analyte	Result
WHO TEQ (pg/g)	60
Mercury (mg/kg)	<0.0198
Tributyltin (ug/kg)	NT

ND20-CL03	
Analyte	Result
WHO TEQ (pg/g)	22.7
Mercury (mg/kg)	<0.0202
Tributyltin (ug/kg)	NT

ND20-CL01	
Analyte	Result
WHO TEQ (pg/g)	53.7
Mercury (mg/kg)	<0.02
Tributyltin (ug/kg)	NT

ND20-CL04	
Analyte	Result
WHO TEQ (pg/g)	60.6
Mercury (mg/kg)	<0.021
Tributyltin (ug/kg)	NT

ND20-CL09	
Analyte	Result
WHO TEQ (pg/g)	7.44
Mercury (mg/kg)	<0.0208
Tributyltin (ug/kg)	NT

ND20-CL05	
Analyte	Result
WHO TEQ (pg/g)	14.1
Mercury (mg/kg)	<0.0205
Tributyltin (ug/kg)	NT

ND20-CL06	
Analyte	Result
WHO TEQ (pg/g)	11.9
Mercury (mg/kg)	<0.0203
Tributyltin (ug/kg)	NT

ND20-CL08	
Analyte	Result
WHO TEQ (pg/g)	14
Mercury (mg/kg)	0.0254
Tributyltin (ug/kg)	NT

ND20-CL07	
Analyte	Result
WHO TEQ (pg/g)	12.6
Mercury (mg/kg)	<0.0205
Tributyltin (ug/kg)	NT

Legend

- Sample Location
- Sediment Characterization Area (468.74 ac)

Analyte	Sample Location	Reference Area Mean*	Units
Mercury	PRETEST	<0.0197	mg/kg
	ND20-SLBREF1	<0.02	
	ND20-KBREF2	<0.0205	
	ND20-LFREF3	0.029	
	ND20-SBREF4	0.027	
WHO TEQ (ND=1/2DL)	PRETEST	20.2	pg/g
	ND20-SLBREF1	18.1	
	ND20-KBREF2	16.9	
	ND20-LFREF3	20.6	
	ND20-SBREF4	16.4	
Tributyltin	PRETEST	<1.73	ug/kg
	ND20-SLBREF1	<1.86	
	ND20-KBREF2	14.8	
	ND20-LFREF3	8.26	
	ND20-SBREF4	<1.95	

Notes:
Shading indicates result showed statistical difference from reference location in superscript:
PT-Pretest
SLBREF1-St. Louis Bay reference location
KBREF2-Kimballs Bay reference location
LFREF3-Loons Foot Landing reference location
SBREF4-Superior Bay reference location
Lipid normalized values reported for WHO TEQ and Tributyltin
WHO TEQ calculated using nondetects equal to 1/2 the detection limit

Acronyms:
pg/g - picograms per gram
mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram
NT = Not tested

Map Date: 6/3/2021
Source: ESRI Basemap 2019, City of Superior 2016
Projection: NAD 1983 State Plane Wisconsin North US Foot

0 200 400
Feet

N

Figure 5-8
Tissue Results Summary Clough Island
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

\\Woveton\gis\GIS\data\Federal\Midwest\Wisconsin\NorthEndDistrict_CloughIsland_1598201\MXD\Site Investigation Report\Figure 5-8 Tissue Results Summary.mxd bpawling

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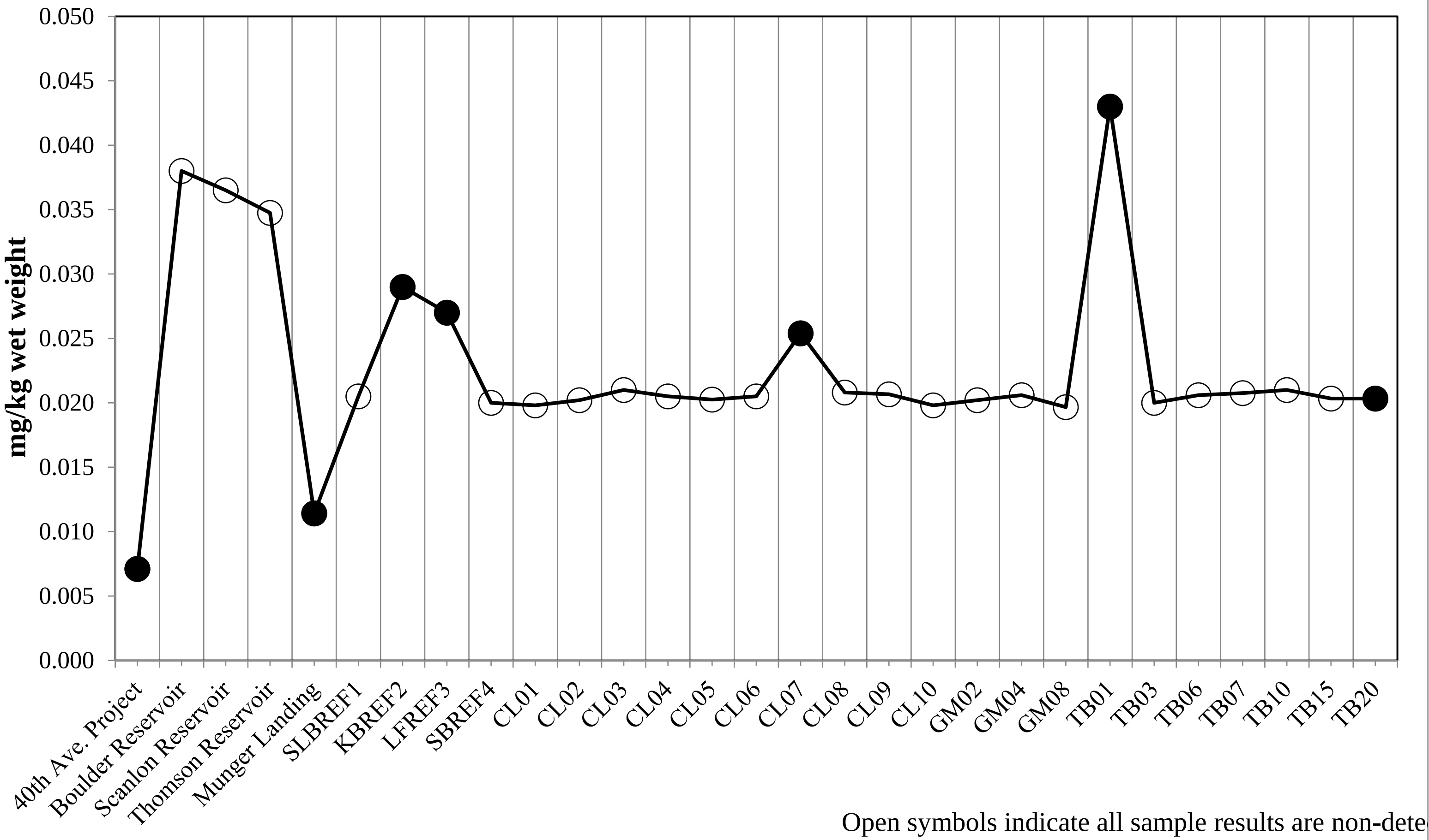
Figure 5-9: Mean Plot for Mercury in *Lumbriculus variegatus* Tissue
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Regional results are included with 2020 samples for comparison. 40th Avenue Project data is based on 19 samples (each with 4 replicates) from 2014. Boulder Reservoir data is based on 1 sample from 2016, Scanlon Reservoir data is based on 2 samples from 2016, and Thomson Reservoir data is based on 4 samples from 2016. Munger Landing data is based on 4 samples (each with 5 replicates) from 2016. Erie Pier Pond and Mud Lake West tissue was not analyzed for mercury.

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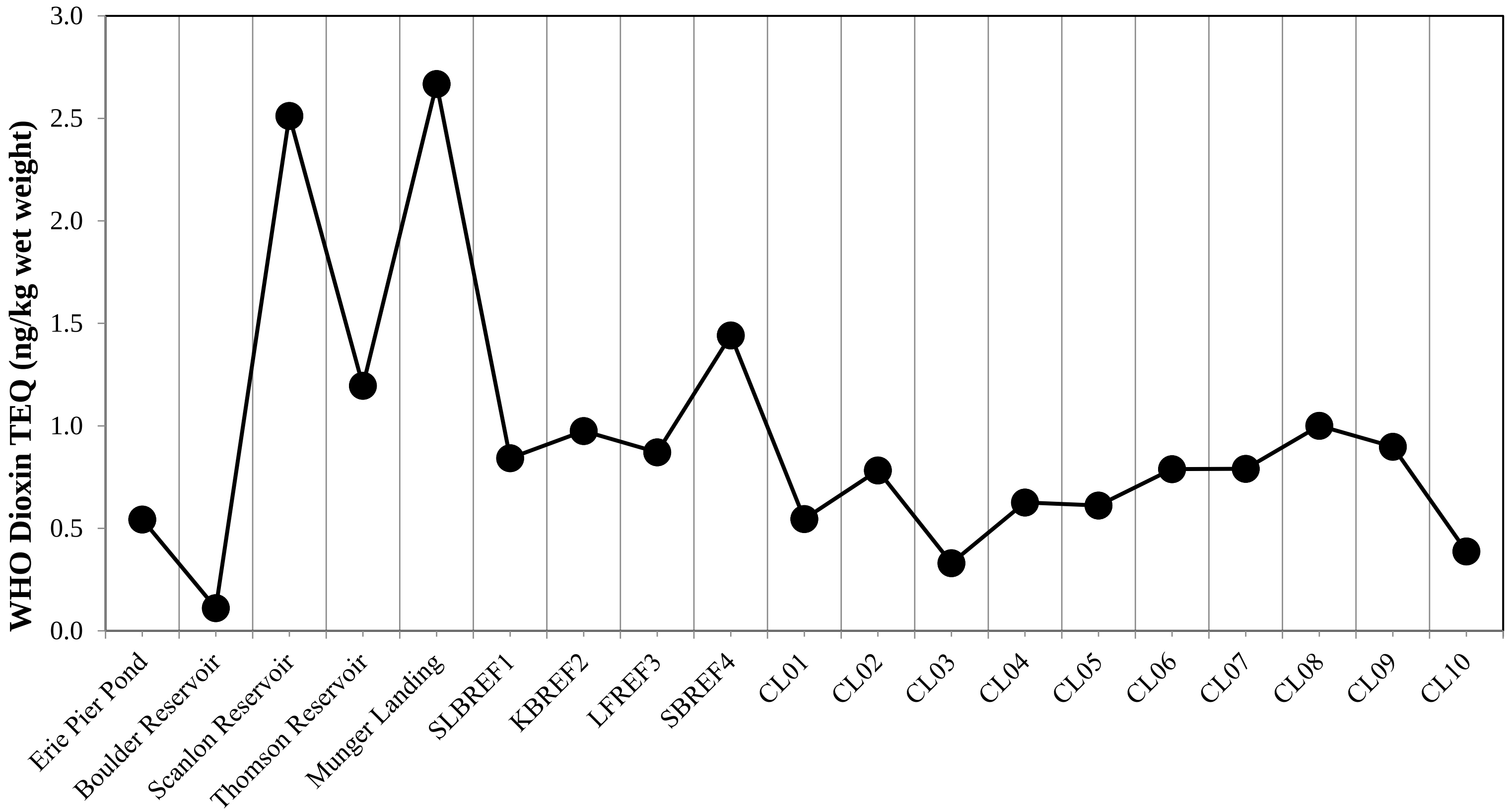
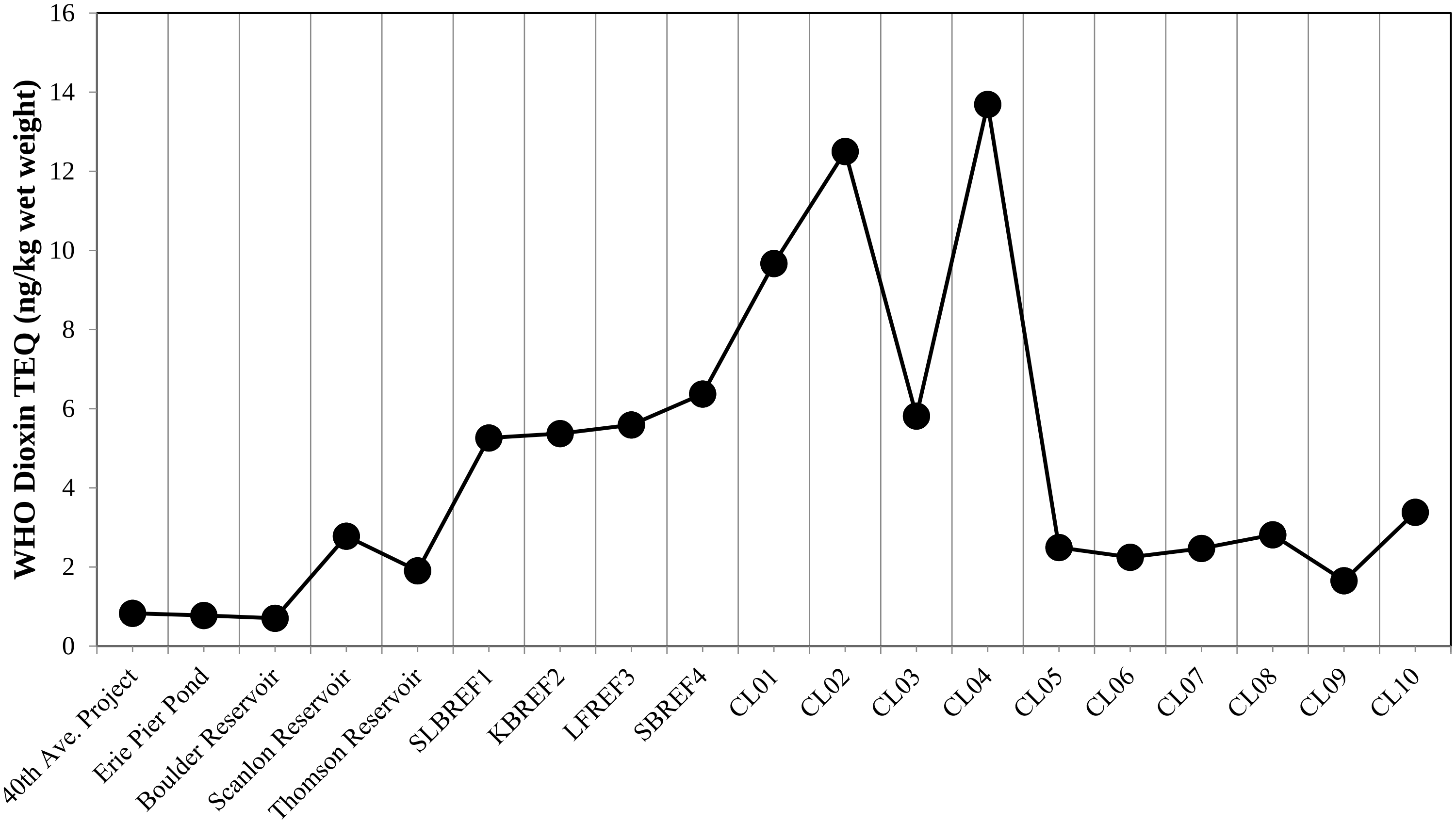
Figure 5-10: Mean Plot for 2005 WHO Dioxin TEQ (ND=0) in *Lumbriculus variegatus* Tissue
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Regional results are included with 2020 samples for comparison. Erie Pier Pond data is based on 5 samples (each with 5 replicates) collected in 2019. Boulder Reservoir data is based on 1 sample from 2016, 5 samples from 2017, and 5 samples from 2019. Scanlon Reservoir data is based on 2 samples from 2016, 5 samples from 2017, and 5 samples from 2019. Thomson Reservoir data is based on 4 samples from 2016, 5 samples from 2017, and 5 samples from 2019. The 2017 and 2019 reservoir data had 5 replicates per sample, except for two replicates (one from Scanlon Station 4 and one from Boulder Station 4) that were excluded after outlier analysis and in 2016 the resevoir sample tissue from the 5 replicates was homogenized before analysis due to low tissue volume. Munger Landing data is based on 4 composite samples (no replicates) from 2016. The regional data were analyzed for dioxins/furans but reporting of the dioxin TEQ varies based on the site. 40th Avenue Project and Mud Lake West dioxin TEQs were not calculated via 2005 WHO (ND=0) and are not included.

Figure 5-11: Mean Plot for 2005 WHO Dioxin TEQ (ND=1/2DL) in *Lumbriculus variegatus* Tissue
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Regional results are included with 2020 samples for comparison. 40th Avenue Project data is based on 19 samples (each with 4 replicates) from 2014. Erie Pier Pond data is based on 5 samples (each with 5 replicates) collected in 2019. Boulder Reservoir data is based on 5 samples from 2017 and 5 samples from 2019. Scanlon Reservoir data is based on 5 samples from 2017 and 5 samples from 2019. Thomson Reservoir data is based on 5 samples from 2017 and 5 samples from 2019. The 2017 and 2019 reservoir data had 5 replicates per sample, except for two replicates (one from Scanlon Station 4 and one from Boulder Station 4) that were excluded after outlier analysis. The regional data were analyzed for dioxins/furans but reporting of the dioxin TEQ varies based on the site. Mud Lake West and Munger Landing dioxin TEQs were not calculated via 2005 WHO (ND=1/2DL) and are not included.

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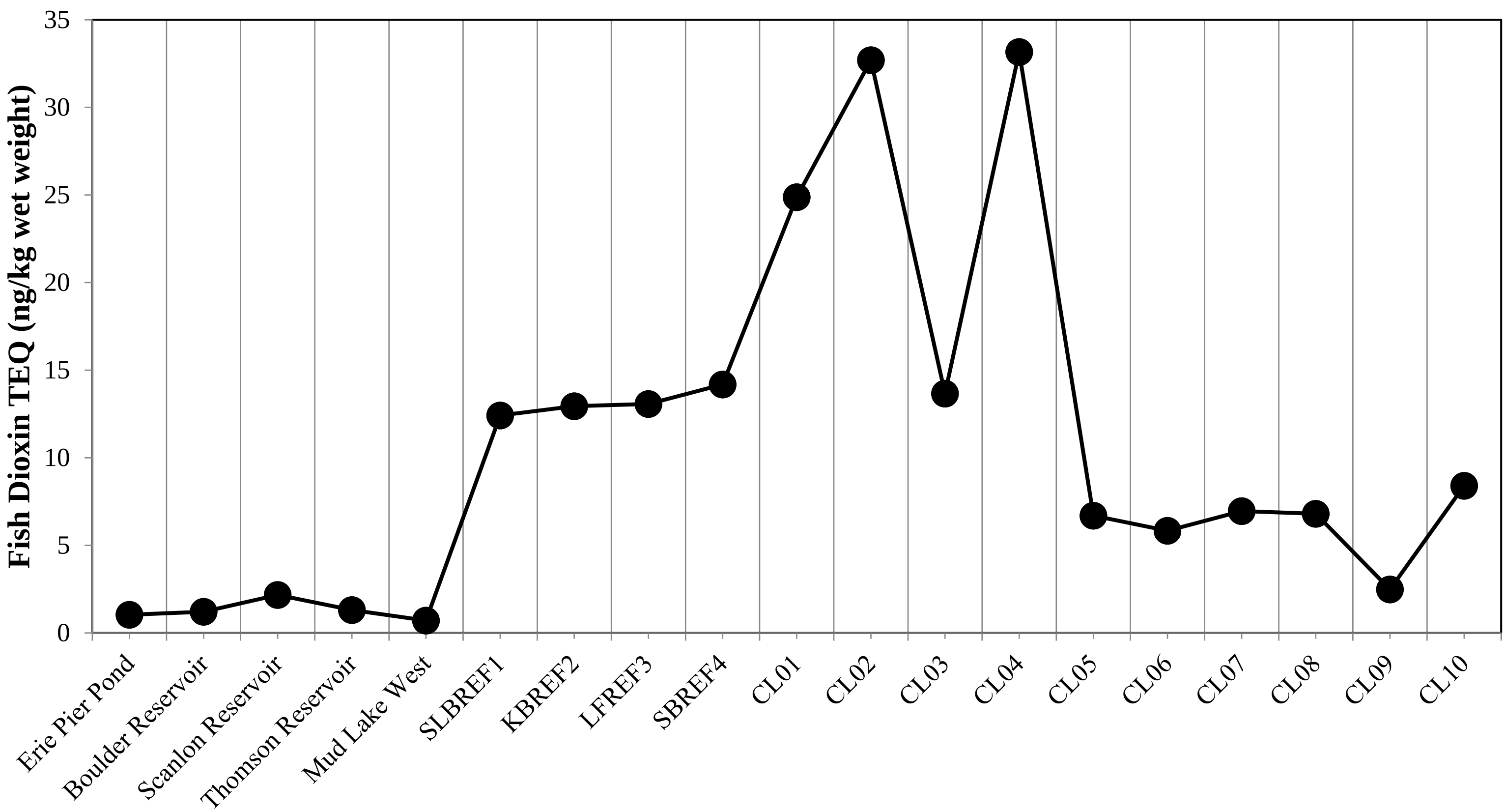
Figure 5-12: Mean Plot for Fish Dioxin TEQ (ND=DL) in *Lumbriculus variegatus* Tissue
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin



Regional results are included with 2020 samples for comparison. Erie Pier Pond data is based on 5 samples (each with 5 replicates) collected in 2019. Boulder Reservoir data is based on 1 sample from 2016, 5 samples from 2017, and 5 samples from 2019. Scanlon Reservoir data is based on 2 samples from 2016, 5 samples from 2017, and 5 samples from 2019. Thomson Reservoir data is based on 4 samples from 2016, 5 samples from 2017, and 5 samples from 2019. The 2017 and 2019 reservoir data had 5 replicates per sample, except for two replicates (one from Scanlon Station 4 and one from Boulder Station 4) that were excluded after outlier analysis and in 2016 the resevoir sample tissue from the 5 replicates was homogenized before analysis due to low tissue volume. Mud Lake West data is based on 3 samples (each with 5 replicates) from 2016. The regional data were analyzed for dioxins/furans but reporting of the dioxin TEQ varies based on the site. 40th Avenue Project and Munger Landing dioxin TEQs were not calculated via Fish Dioxin TEQ (ND=DL) and are not included.

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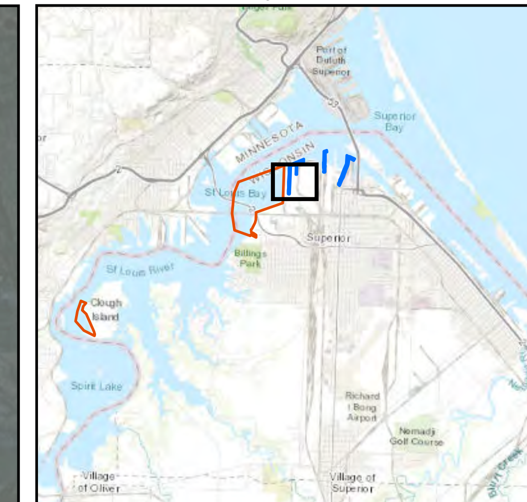
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 200 400
Feet

Figure 6-1
Summary of SQG Exceedance for Surface and Subsurface Organics
Hallet Dock 8 Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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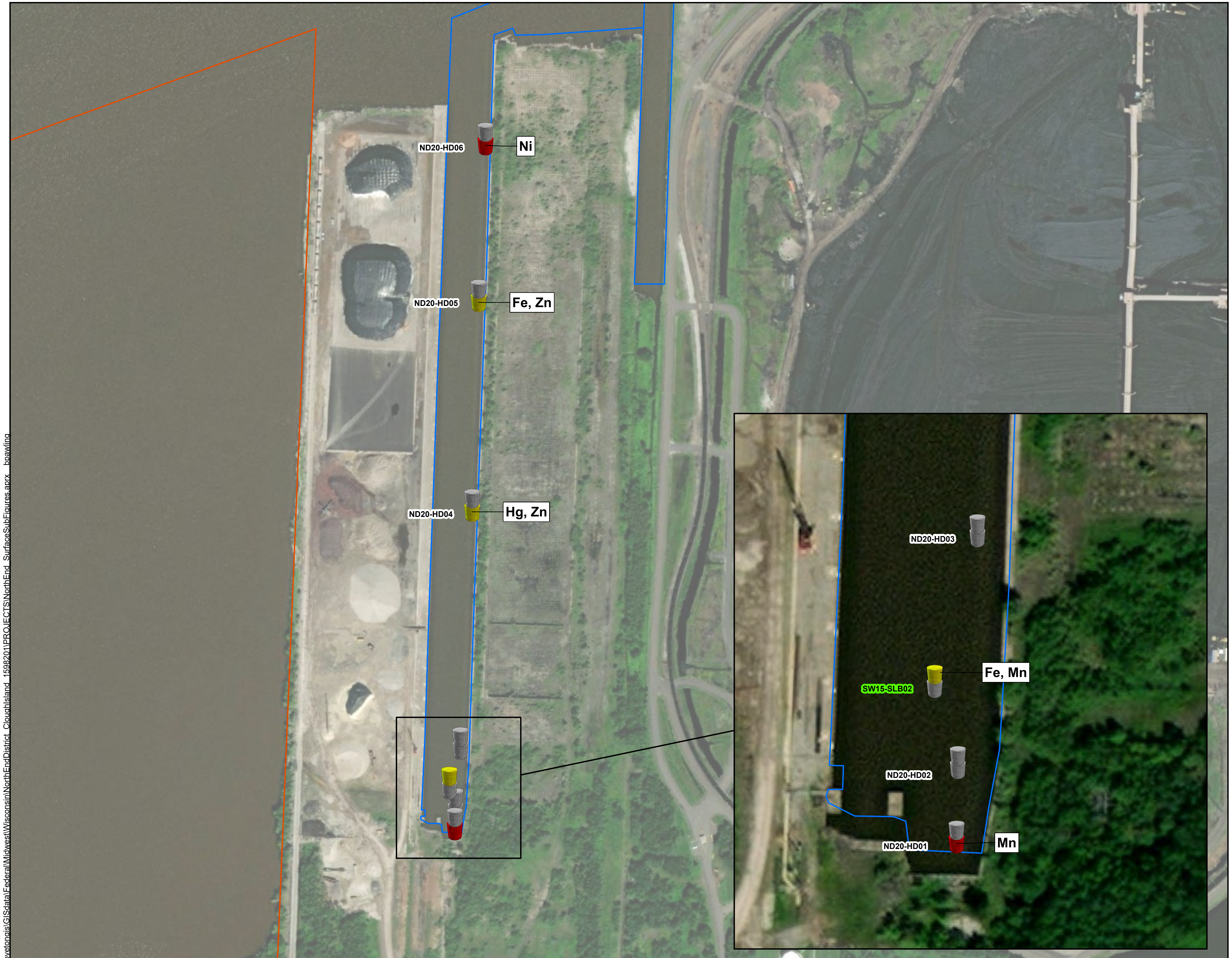
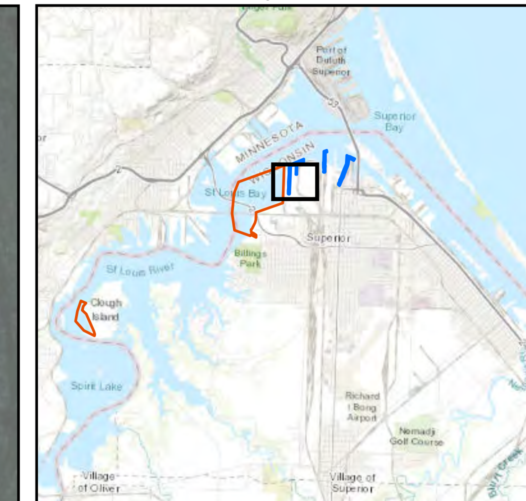


VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 200 400
Feet

Figure 6-2
Summary of SQG Exceedance for Surface and Subsurface Metals
Hallet Dock 8 Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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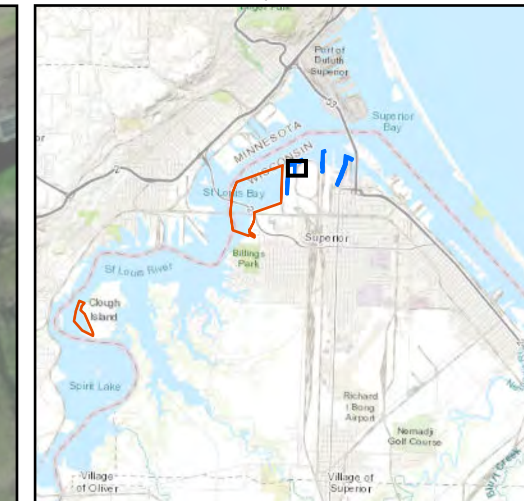
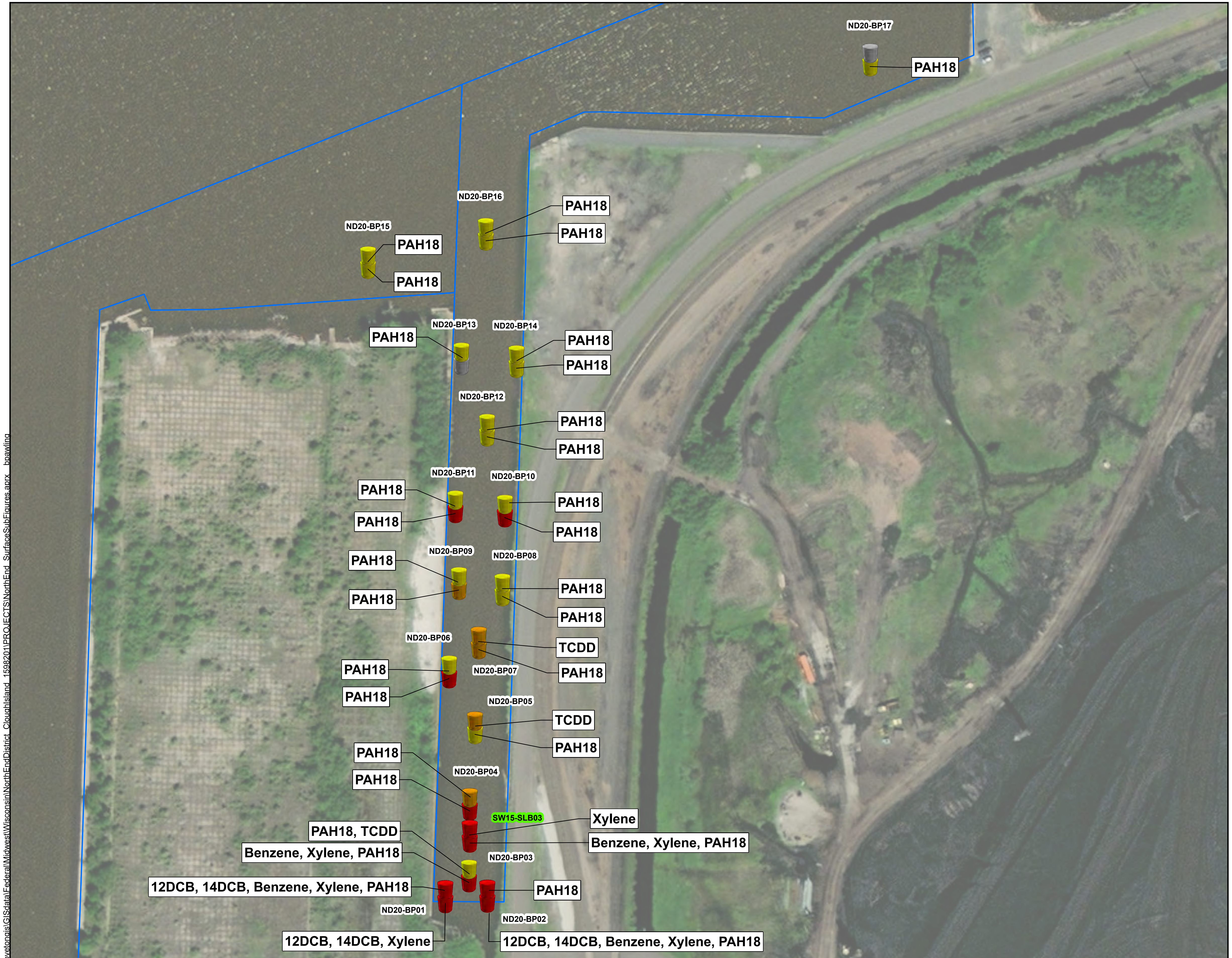
VICINITY MAP





Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 150 300
Feet

Figure 6-3
Summary of SQG Exceedance for Surface and Subsurface Organics
Oil Barge Dock Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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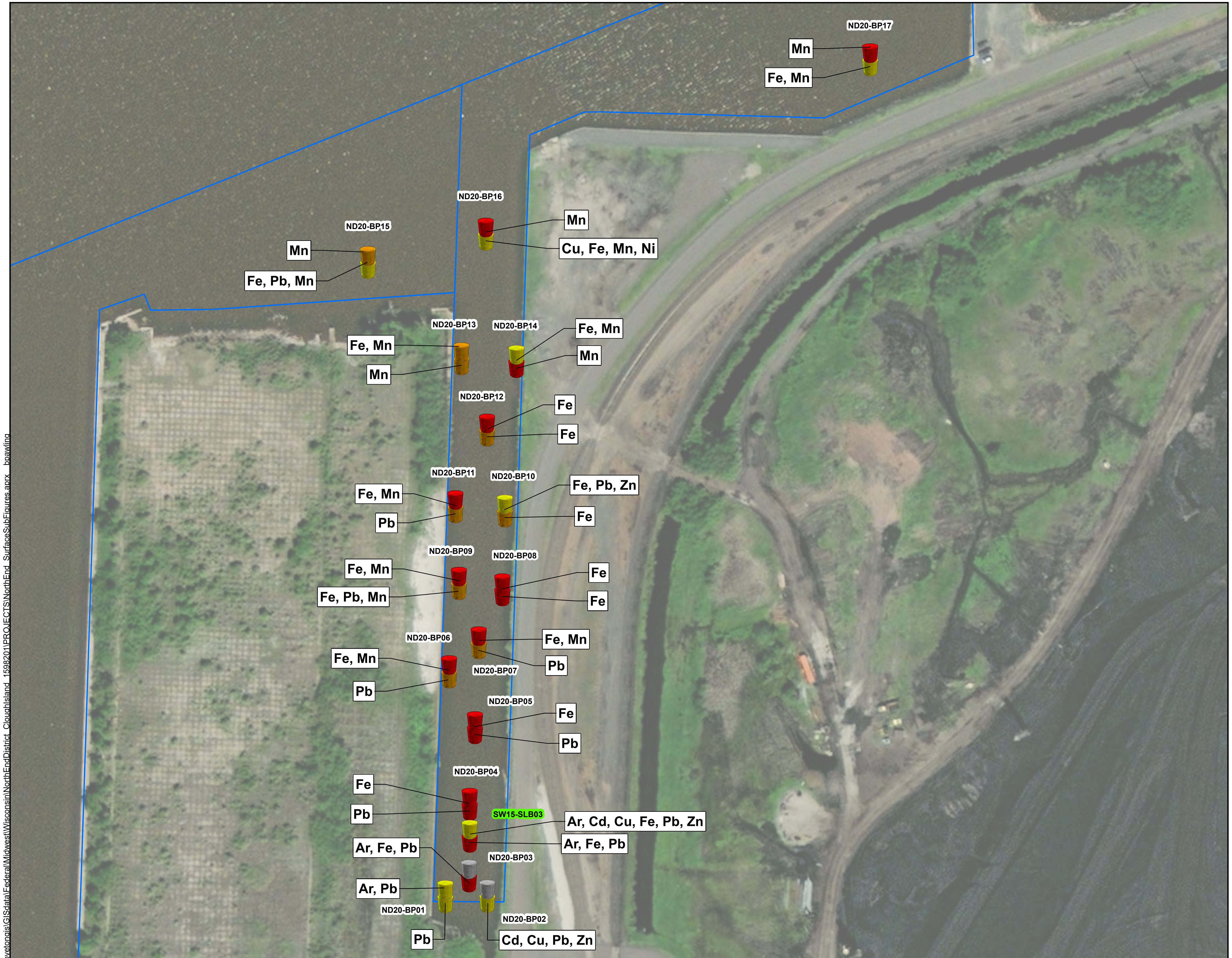
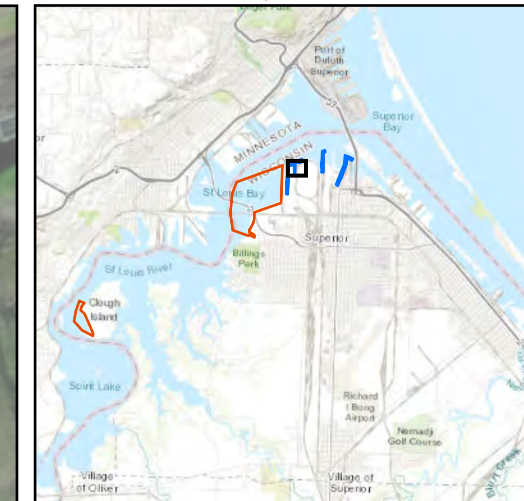


VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 150 300
Feet

Figure 6-4
Summary of SQG Exceedance for Surface and Subsurface Metals
Oil Barge Dock Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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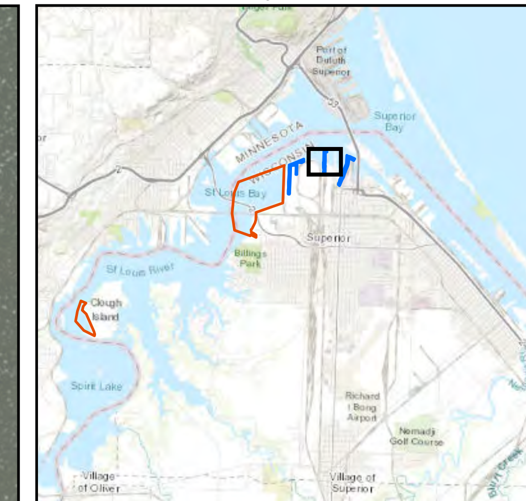
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 150 300
Feet

Figure 6-5
Summary of SQG Exceedance for Surface and Subsurface Organics
General Mills Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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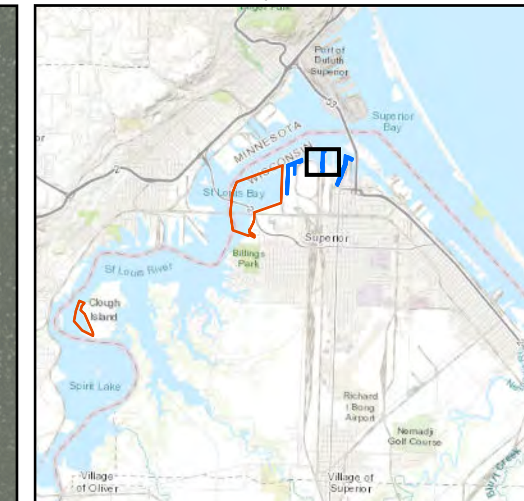
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 150 300
Feet

Figure 6-6
Summary of SQG Exceedance for Surface and Subsurface Metals
General Mills Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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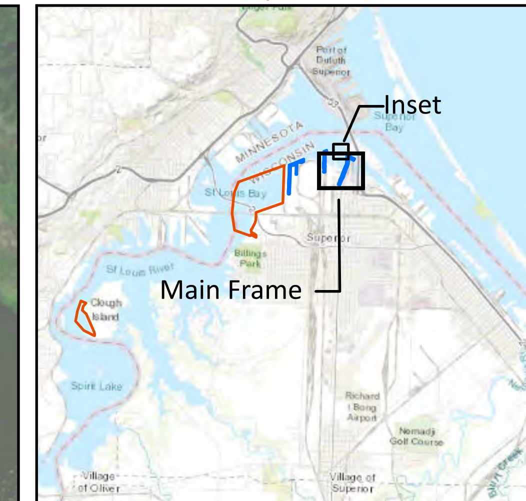
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 250 500
Feet

Figure 6-7
Summary of SQG Exceedance for Surface and Subsurface Organics
Tower Avenue Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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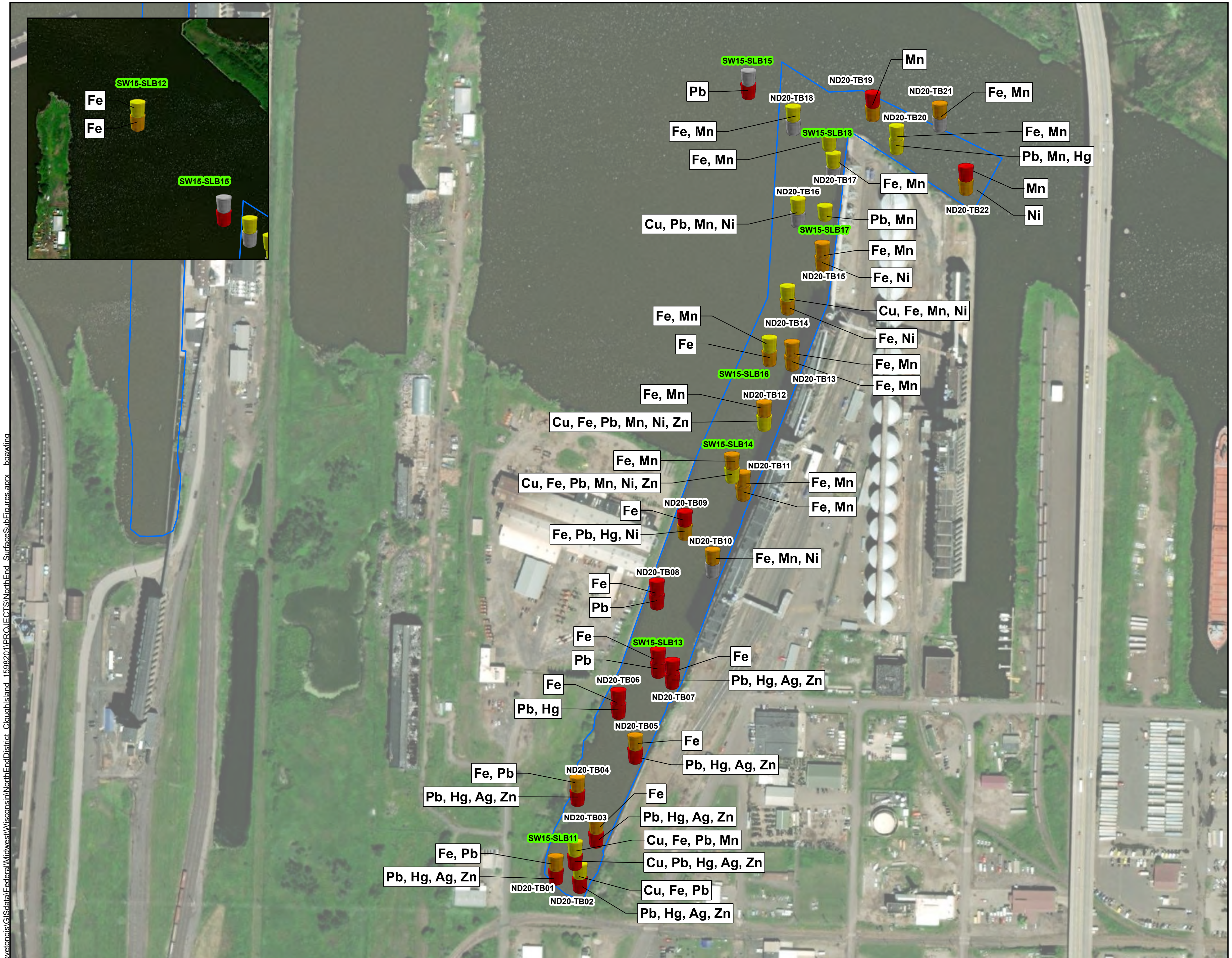

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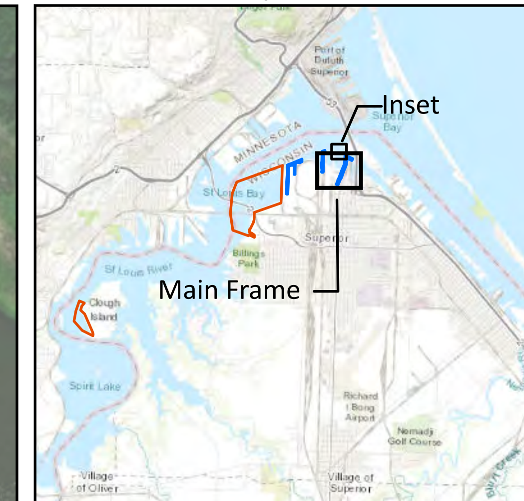
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 250 500
Feet

Figure 6-8
Summary of SQG Exceedance for Surface and Subsurface Metals
Tower Avenue Slip
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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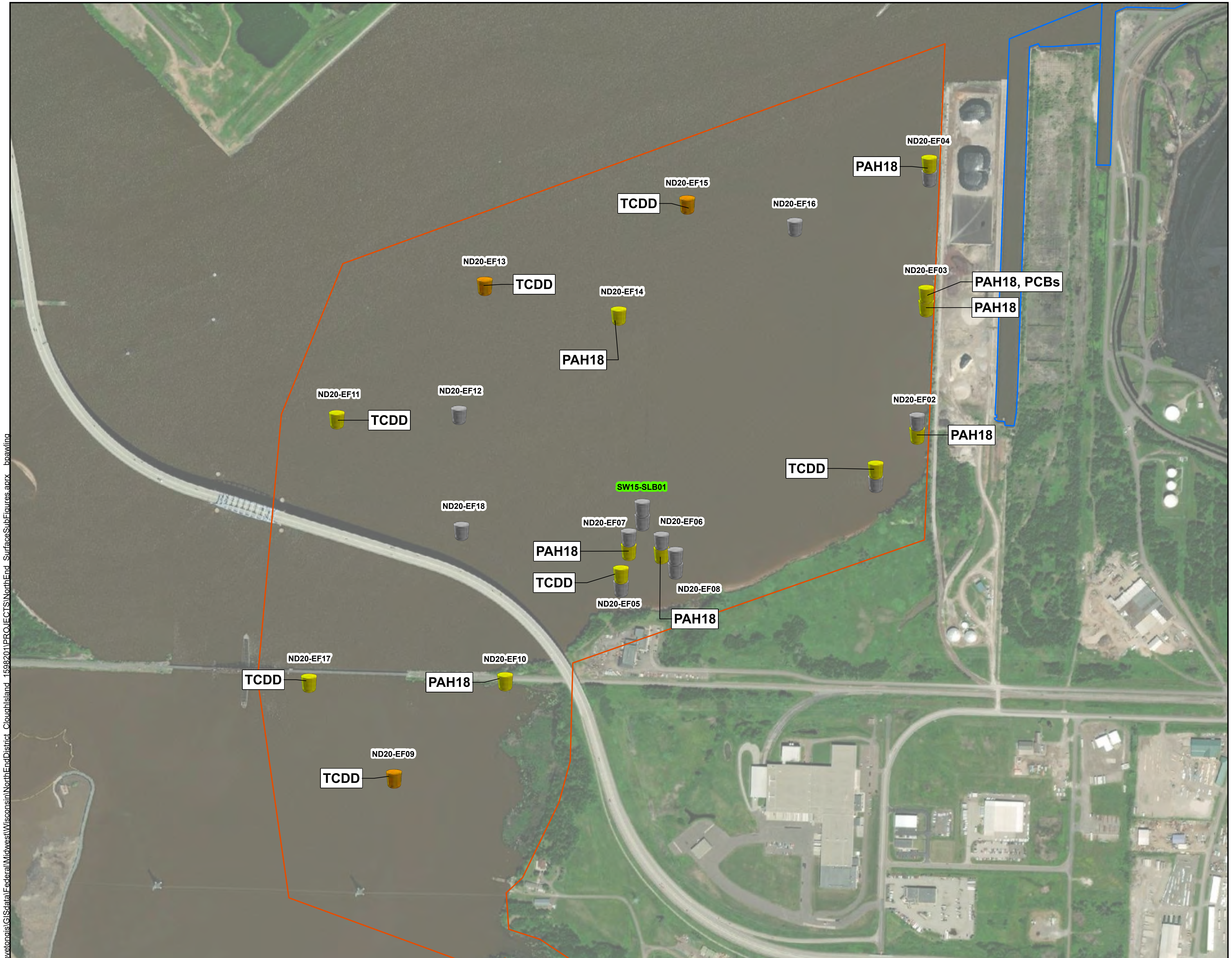

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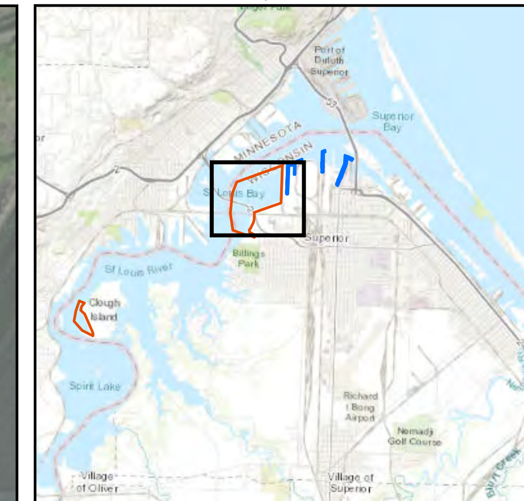

Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 500 1,000
Feet

Figure 6-9
Summary of SQG Exceedance for Surface and Subsurface Organics
Estuary Flats
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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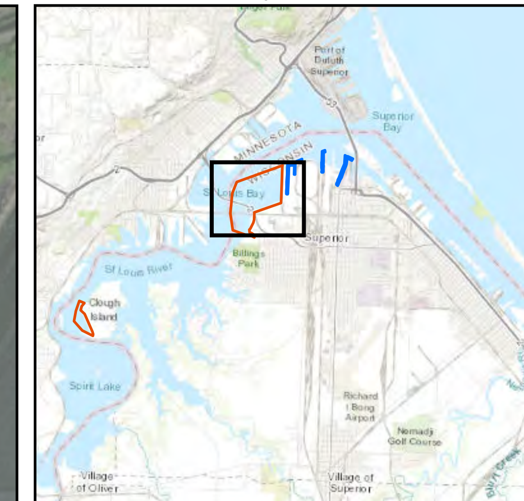

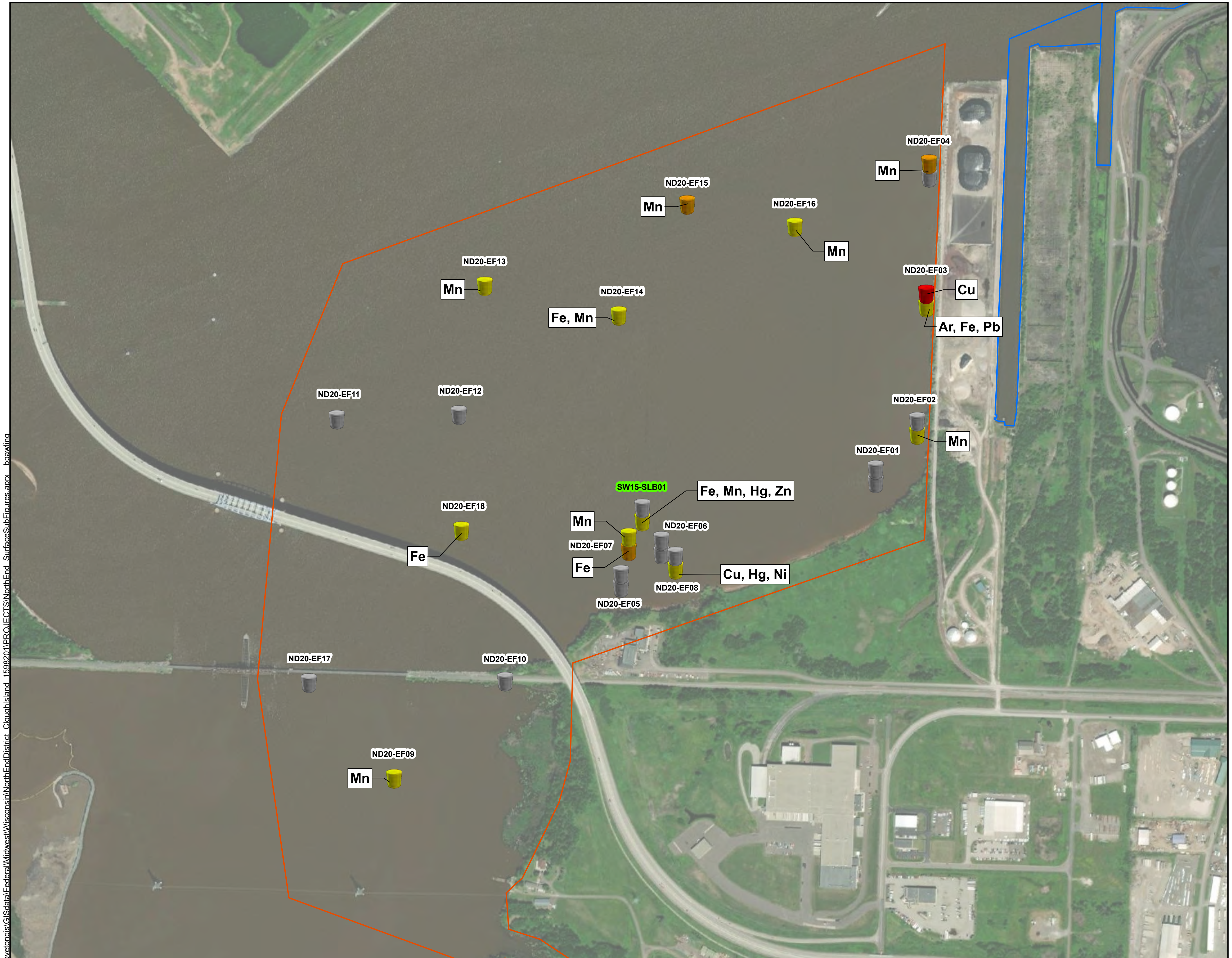

Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 500 1,000
Feet

EA

Figure 6-10
Summary of SQG Exceedance for Surface and Subsurface Metals
Estuary Flats
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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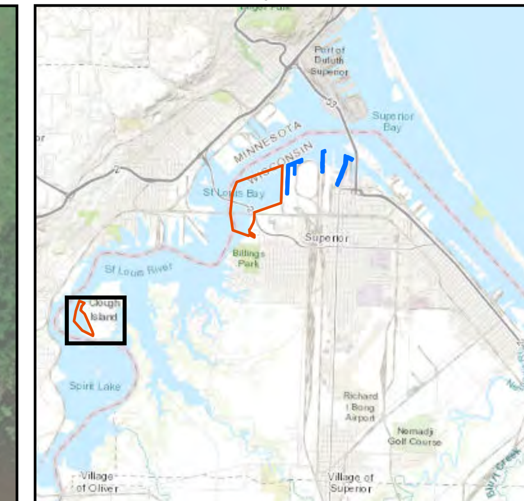
VICINITY MAP



Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 500 1,000
Feet

Figure 6-11
Summary of SQG Exceedance for Surface and Subsurface Organics
Clough Island
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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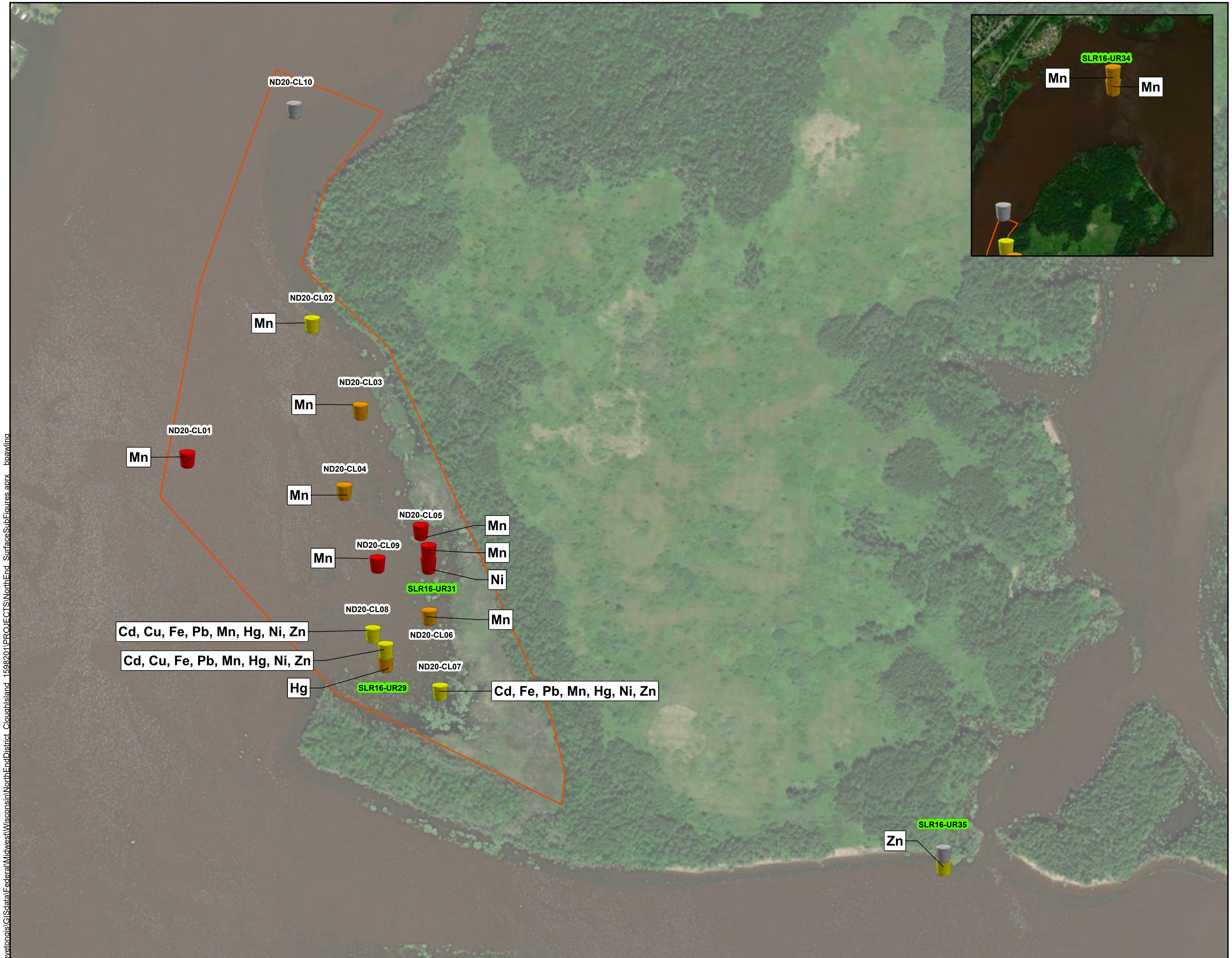

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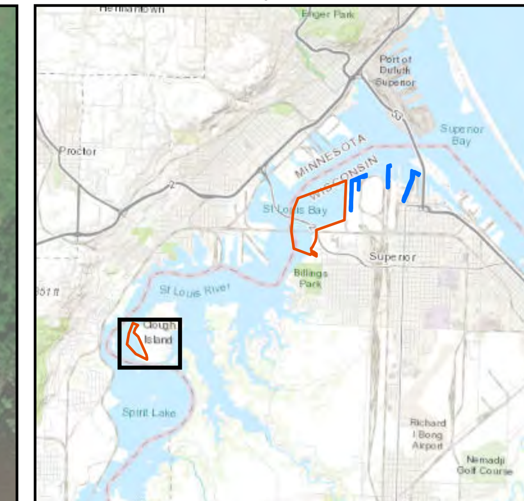

Legend

Exceedance

- No Exceedance
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Top tier symbol indicates surface sample exceedance (0-0.3 ft).
Lower tier symbol indicates subsurface exceedance.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.
Green halo on location tag indicates historical sample.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 500 1,000
Feet

Figure 6-12
Summary of SQG Exceedance for Surface and Subsurface Metals
Clough Island
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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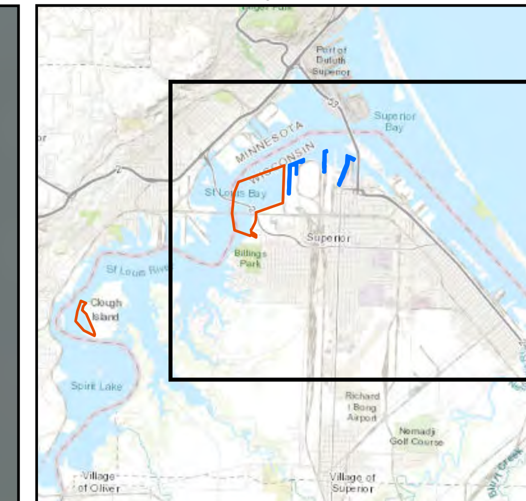
VICINITY MAP



Legend

Exceedance

≥ TEC

≥ PEC

Sediment Characterization Area

Sediment Characterization and Survey Area

Notes:
Symbol indicates surface sample exceedance (0-0.3 ft).
No subsurface sample collected.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 2,000 4,000
Feet

Figure 6-13
Summary of SQG Exceedance for Surface and Subsurface Organics
Reference Sites
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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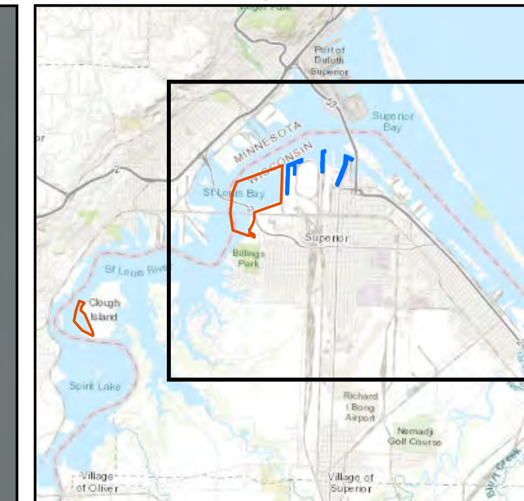
VICINITY MAP



Legend

Exceedance

- NA
- ≥ TEC
- ≥ MEC
- ≥ PEC
- Sediment Characterization Area
- Sediment Characterization and Survey Area

Notes:
Symbol indicates surface sample exceedance (0-0.3 ft).
No subsurface sample collected.
Compounds indicated in text box exceed either the TEC, MEC, or PEC.

Map Date: 3/4/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 2,000 4,000
Feet

Figure 6-14
Summary of SQG Exceedance for Surface and Subsurface Metals
Reference Sites
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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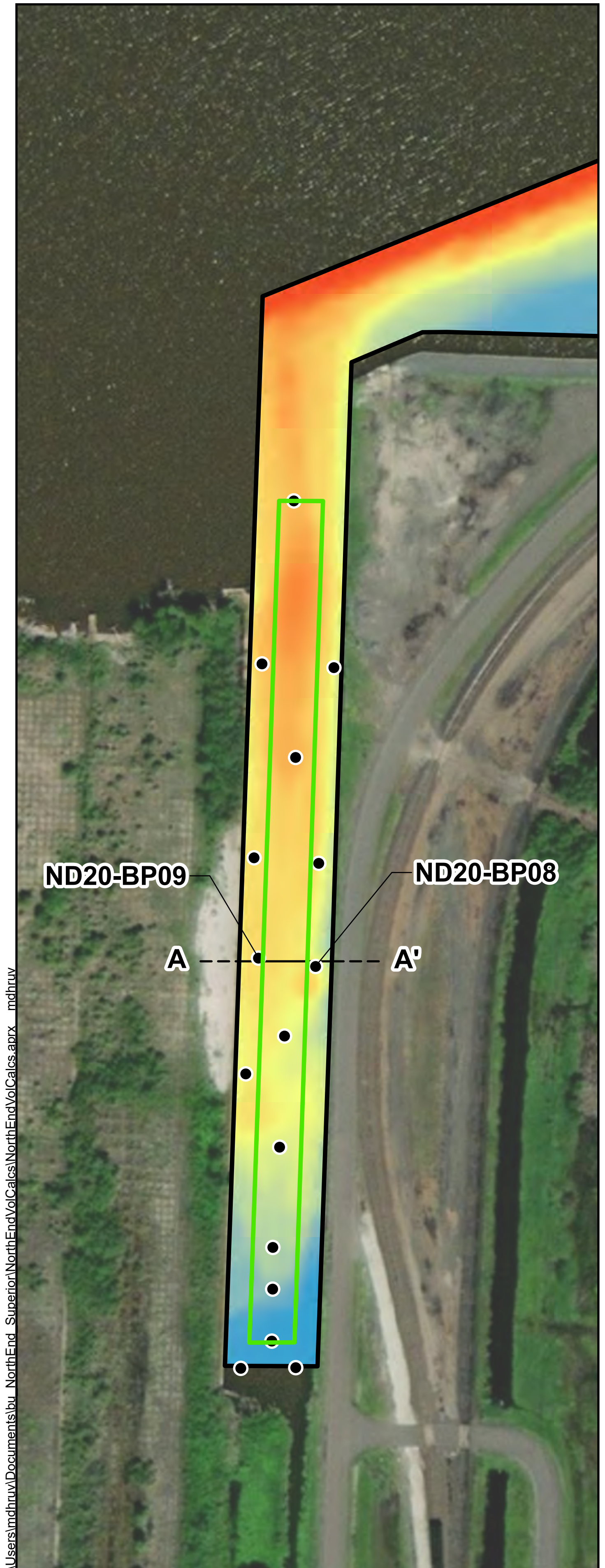
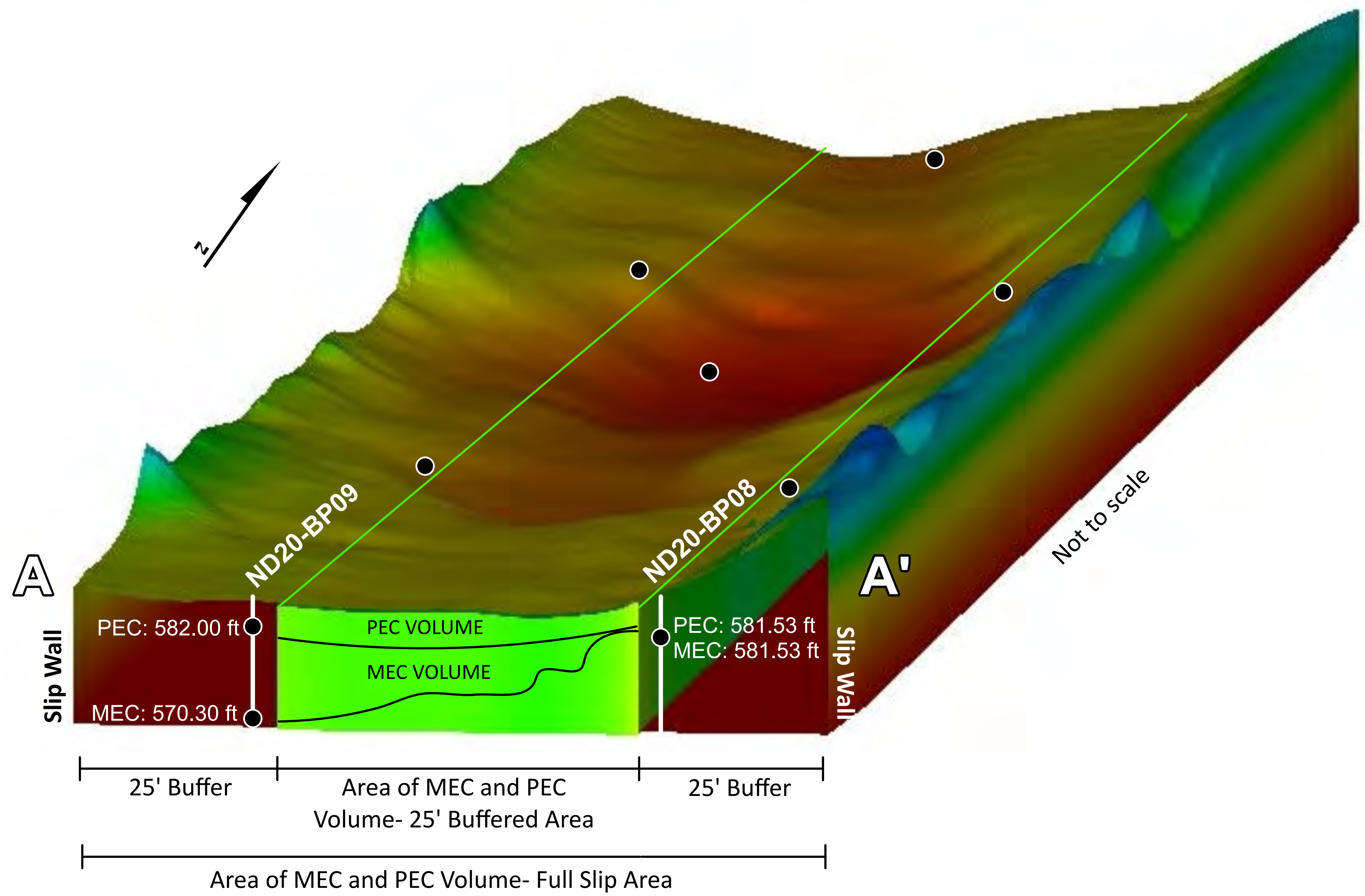


Oil Barge Slip Conceptual Model for Volume Estimates

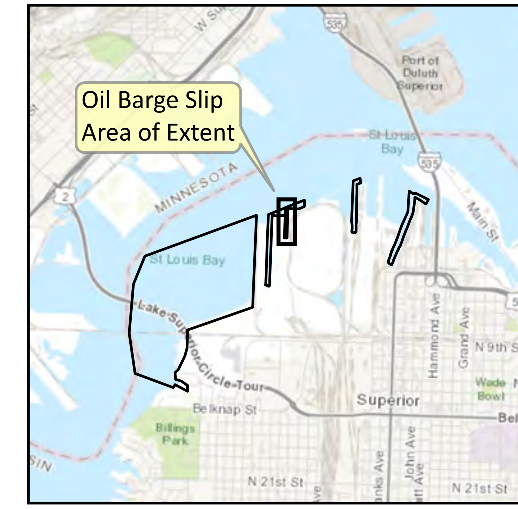


MEC and PEC Volumes were calculated based on the difference in the kriged surface from the bathymetric sediment surface. The figure above is a representative conceptual model of the Oil Barge Slip with the cross section at borings ND20-BP08 and ND20-BP09. The surface of the model represents the sediment surface based on bathymetric data. The green area represents the area in which the MEC and PEC volumes were calculated which is the central portion of the slip constrained by a 25 foot buffer from the slip walls.

The PEC and MEC values indicate the depths at which the maximum exceedance occurred at that location.

The above image was created in C-Tech's EVS three-dimensional volumetric Earth Science software. A 2.5x vertical exaggeration was employed for visualization purposes.

VICINITY MAP



Legend

- Sediment Sample Location
- Area of Volume Estimates- 25' Buffered Area
- Sediment Characterization and Survey Area

Elevation

598 ft

570 ft

Map Date: 6/2/2021
Source: Esri Aerial 2019
Projection: NAD83 StatePlane WI North

N

0 200 400
Feet

Figure 6-15
MEC and PEC Volume Estimate Conceptual Site Model
North End District and Clough Island
Sediment Characterization
St. Louis River Area of Concern
Superior, Wisconsin

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Tables

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**TABLE 2-1 MANUAL PROBING RESULTS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN**

Location Identification	Date Sampled	Time Sampled (local)	Water Depth (ft)	Probe Depth (ft)	Field Notes
Hallet Dock 8 Slip					
HD-01	4/29/2020	14:55	5.2	1.0	Coarse sand gravel packed penetration less than 1 ft with repeated pushes.
HD-02	4/29/2020	15:00	16.6	6.0	Layers of sand and clay. Repeated pushes to reach penetration depth.
HD-03	4/29/2020	15:05	22.7	--	Water depth greater than 20 ft
HD-04	4/29/2020	15:05	21.5	--	Water depth greater than 20 ft
HD-05	4/29/2020	15:05	26.3	--	Water depth greater than 20 ft
HD-06	4/29/2020	15:05	24.2	--	Water depth greater than 20 ft
Oil Barge Dock					
BP-01	4/29/2020	9:55	< 2.0	2.0	Behind old pilings and bulkhead. Random debris. Penetration between debris. Heavy timber in the area. Sheen observed. Dry swash discharge
BP-02	4/29/2020	9:55	2.5-3	1.0	May be accessible by Mudpuppy. Located at end of discharge canal. Hard bottom. Likely rock placed at end discharge canal. Less rock to the west. 1-ft penetration to north of location
BP-03	4/29/2020	9:55	3.5	2.0	Sandy material. Woody debris including boards from bulkhead.
BP-04	4/29/2020	11:00	13.0	> 8.0	Soft sediments
BP-05	4/29/2020	11:17	18.5	> 5.0	Firm on top, soft/sand underlying material.
BP-06	4/29/2020	11:27	20.5	--	Water depth greater than 20 ft
BP-07	4/30/2020	14:15	19.0	> 6.0	Soft
BP-08	4/30/2020	13:54	20.2	>4.5	Hard debris closer to wall. Gravel coarse at distance. Needed to probe multiple times to find unconsolidated material. May need to shift toward center.
BP-09	4/29/2020	11:27	22.0	--	Water depth greater than 20 ft
BP-10	4/29/2020	11:27	21.0	--	Water depth greater than 20 ft
BP-11	4/29/2020	11:27	22.2	--	Water depth greater than 20 ft
BP-12	4/29/2020	11:27	24.5	--	Water depth greater than 20 ft
BP-13	4/29/2020	11:27	24.5	--	Water depth greater than 20 ft
BP-14	4/29/2020	11:27	21.2	--	Water depth greater than 20 ft
BP-15	4/29/2020	11:44	7.5	2.0	Firm sand on surface 2 ft of penetration
BP-16	4/29/2020	11:27	24.8	--	Water depth greater than 20 ft
General Mills Slip					
GM-01	4/30/2020	14:45	14.4	7.5	Soft. Station close to old piling field from former pier. Consider shifting east by 10 ft.
GM-02	4/30/2020	14:58	18.2	> 7.0	Soft brown slit and clay
GM-03	4/30/2020	15:40	17.7	3.7	Soft silt/clay over gravel
GM-04	4/30/2020	14:58	20.4	--	Water depth greater than 20 ft
GM-05	4/30/2020	14:58	26.7	--	Water depth greater than 20 ft
GM-06	4/30/2020	15:50	20.1	> 5.0	Soft sediments, brown silt/clay
GM-07	4/30/2020	14:58	29.0	--	Water depth greater than 20 ft
GM-08	4/30/2020	14:58	24.5	--	Water depth greater than 20 ft
GM-09	4/30/2020	14:58	--	--	Not accessible-vessel in slip
GM-10	4/30/2020	14:58	21.3	--	Water depth greater than 20 ft
GM-11	4/30/2020	14:58	--	--	Not accessible-vessel in slip
GM-12	4/30/2020	14:58	28.3	--	Water depth greater than 20 ft
GM-13	4/30/2020	14:58	--	--	Not accessible-vessel in slip
GM-14	4/30/2020	14:58	23.5	--	Water depth greater than 20 ft
Tower Avenue Slip					
TB-01	4/29/2020	12:21	8.0	7.5	Very shallow. Coarse sand over clay. Multiple outfalls. 1 active, 1 relic near TB-02.
TB-02	4/29/2020	12:17	< 2.0	> 8.0	Very shallow. Coarse sand over clay.
TB-03	4/29/2020	12:26	12.3	> 8.0	Soft brown clay with limited sand. Outfall south of location.
TB-04	4/29/2020	12:30	13.0	> 7.0	Soft brown clay bricks or other debris at depth
TB-05	4/29/2020	12:11	13.7	> 7.0	Soft brown clay obstruction at depth, but worked through
TB-06	4/29/2020	12:52	16.9	> 8.0	Soft brown clay
TB-07	4/30/2020	13:15	14.9	9.0	Mixed soft material and hard fill (bricks). Outfall.
TB-08	4/30/2020	13:36	17.4	> 8.0	Soft throughout brown clay
TB-09	4/29/2020	13:20	20.5	--	Water depth greater than 20 ft
TB-10	4/29/2020	13:20	22.5	--	Water depth greater than 20 ft
TB-11	4/29/2020	13:20	25.0	--	Water depth greater than 20 ft
TB-12	4/29/2020	13:20	25.2	--	Water depth greater than 20 ft
TB-13	4/29/2020	13:20	29.5	--	Water depth greater than 20 ft
TB-14	4/29/2020	13:20	28.9	--	Water depth greater than 20 ft
TB-15	4/29/2020	13:20	37.0	--	Water depth greater than 20 ft
TB-16	4/29/2020	13:20	29.9	--	Water depth greater than 20 ft
TB-17	4/29/2020	13:20	36.9	--	Water depth greater than 20 ft
TB-18	4/29/2020	13:20	34.2	--	Water depth greater than 20 ft
TB-19	4/29/2020	13:20	30.0	--	Water depth greater than 20 ft
TB-20	4/29/2020	13:50	13.5	1.0	One foot of soft silts over hard concrete rubble. Relocated 10 ft toward channel. Water depth 15 ft, penetration 5 ft, dense brown clay.
TB-21	4/29/2020	13:20	34.0	--	Water depth greater than 20 ft. Falls with in Nav channel, consider shifting.
TB-22	4/29/2020	13:20	31.5	--	Water depth greater than 20 ft

NOTE: ft = Foot (feet).

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TABLE 2-2 SURFACE SAMPLE COLLECTION
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Sample Collection Date	Sample Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Surface Grab Sample			
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Percent Recovery	Field Notes
HALLET DOCK											
ND20-HD01	1436299.59	578448.64	6/30/2020	15:35	8.1	603.29	595.19	0.3	0.2	66%	Light brown silts over medium brown clays with trace fine sands. Pockets of medium/coarse black sands with sheen in clay layer. Large sheen appeared on surface of water as ponar was collected. No odor in sediments. Subsequent grabs pulled up part of a large tarp, that when pulled on released a large (10 ft x 10 ft) sheen on surface of water. Tarp could not be removed, was buried in sediments.
ND20-HD02	1436300.64	578520.46	6/25/2020	9:15	20.8	602.87	582.07	0.3	0.3	100%	Loose brown silts over brown fine-grained sands. Some coal chunks. No odor, no sheen.
ND20-HD03	1436312.00	578718.16	6/30/2020	16:50	21.9	603.14	581.24	0.3	0.3	100%	Light brown silts with trace clays and loose cohesion. High density of coal chunks in sample. No odor, slight sheen.
ND20-HD04	1436352.88	579503.11	6/30/2020	17:35	21.6	603.25	581.65	0.3	0.3	100%	Light brown silts over medium brown silty-clays with loose/medium cohesion. Coa chunks throughout. Petroleum odor and sheen noted in sample.
ND20-HD05	1436372.67	580188.42	6/25/2020	8:55	23.8	602.93	579.13	0.3	0.2	66%	Medium brown sands with coal chunks throughout. No odor, no sheen.
ND20-HD06	1436393.21	580704.72	6/25/2020	8:30	23.4	602.98	579.58	0.3	0.2	66%	Loose brown silts and fine sands, over compacted fine sands. Coal chunks in sample. No odor, no sheen
OIL BARGE DOCK											
ND20-BP01	1436912.94	580306.26	6/26/2020	--	--	--	--	0.3	0.0	0%	Due to dense woody debris, a surface grab sample could not be collected at this location. The surface interval (0.0 to 0.3 ft) was collected from the core collected instead.
ND20-BP02	1436953.62	580233.08	7/2/2020	17:42	2.5	603.13	600.63	0.3	0.2	66%	Black silty fine sands with vegetative and woody debris. A decontaminated stainless-steel shovel was used to collect surficial sediments due to debris. Both odor and sheen observed.
ND20-BP03	1436910.31	580229.55	7/2/2020	19:05	2.0	603.07	601.07	0.3	0.3	100%	Due to dense woody debris at the target location, the sampling location was shifted and the sediments were collected with a stainless steel shovel, per direction of J. Graham (DNR). Sediment comprised of fine black sands, with woody debris. Petroleum sheen arose in water at collection, and odor was noted in sediments.
ND20-BP04	1436934.82	580377.66	6/25/2020	15:42	13.2	603.03	589.83	0.3	0.3	100%	Medium brown silts over medium brown clays with vegetative matter and medium cohesion. No odor, no sheen.
ND20-BP05	1436940.35	580482.52	7/1/2020	17:05	17.3	603.22	585.92	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-BP06	1436903.33	580559.19	6/25/2020	15:05	18.9	603.04	584.14	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clay with medium cohesion. No odor, no sheen.
ND20-BP07	1436946.99	580598.17	7/1/2020	17:55	19.0	603.07	584.07	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-BP08	1436980.95	580674.57	6/25/2020	14:45	18.2	603.00	584.80	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clay with medium cohesion. No odor, no sheen.
ND20-BP09	1436912.10	580682.13	6/25/2020	14:25	20.7	602.98	582.28	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clay with medium cohesion. No odor, no sheen.
ND20-BP10	1436989.12	580782.78	6/25/2020	13:40	18.0	603.04	585.04	0.3	0.3	100%	Light brown fine sands and silts with loose cohesion over medium brown sandy-clays with medium cohesion. No odor, no sheen.
ND20-BP11	1436915.47	580784.42	6/25/2020	13:20	20.7	602.99	582.29	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-BP12	1436960.33	580889.67	6/25/2020	12:55	23.8	602.91	579.11	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.

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TABLE 2-2 SURFACE SAMPLE COLLECTION
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Sample Collection Date	Sample Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Surface Grab Sample			
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Percent Recovery	Field Notes
ND20-BP13	1436921.92	580991.74	6/25/2020	10:35	22.7	602.78	580.08	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-BP14	1436992.89	580989.81	6/25/2020	11:30	19.9	602.29	582.39	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown sandy-clay with low/medium cohesion. No odor, no sheen
ND20-BP15	1436791.85	581123.98	6/25/2020	12:10	7.9	602.86	594.96	0.3	0.3	100%	Light brown silts with loose cohesion and coal chunks over clays with trace fine sands.
ND20-BP16	1436954.41	581163.08	6/25/2020	10:15	23.3	602.83	579.53	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-BP17	1437488.57	581402.31	6/25/2020	9:45	20.8	602.86	582.06	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, no sheen.
GENERAL MILLS SLIP											
ND20-GM01	1439427.48	580487.69	6/28/2020	14:15	14.4	603.16	588.76	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM02	1439500.13	580485.29	7/1/2020	8:30	17.9	603.08	585.18	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM03	1439441.83	580812.96	6/28/2020	14:35	17.3	603.25	585.95	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM04	1439517.47	580811.19	6/30/2020	18:20	19.4	603.06	583.66	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM05	1439516.98	580978.24	6/28/2020	14:50	26.2	603.31	577.11	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM06	1439434.08	580984.47	6/28/2020	15:05	18.7	603.21	584.51	0.3	0.3	100%	Medium brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM07	1439525.88	581096.72	6/28/2020	15:20	28.7	603.15	574.45	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM08	1439470.31	581321.42	6/29/2020	18:00	24.8	603.09	578.29	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM09	1439534.68	581441.04	6/28/2020	15:35	28.8	603.09	574.29	0.3	0.3	100%	Light brown silts over medium brown silty-clay with loose/medium cohesion. No odor, no sheen.
ND20-GM10	1439478.39	581549.51	6/28/2020	15:48	24.5	603.03	578.53	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-GM11	1439541.20	581688.69	6/28/2020	16:00	33.5	603.04	569.54	0.3	0.3	100%	Light brown silty-clays with low/medium cohesion. No odor, no sheen.
ND20-GM12	1439476.18	581840.47	6/28/2020	16:25	26.8	603.13	576.33	0.3	0.3	100%	Light brown silts over medium brown silty-clay with medium cohesion. A few chunks of coal. No odor, no sheen.
ND20-GM13	1439511.22	582076.28	7/1/2020	9:25	31.7	603.09	571.39	0.3	0.2	66%	Light brown silts over medium brown clays with trace fine sands. Small pockets of black sands in clay layer. No odor, no sheen
ND20-GM14	1439628.17	582333.09	6/30/2020	19:00	22.8	603.13	580.33	0.3	0.2	66%	Loose brown silts over medium brown fine sands, loosely packed. No odor, no sheen
TOWER AVENUE SLIP											
ND20-TB01	1440799.04	579323.06	6/29/2020	14:10	8.6	603.28	594.68	0.3	0.3	100%	Light brown silty-clays with low/medium cohesion. Small sheens, no odor. Vegetative debris.
ND20-TB02	1440875.15	579286.80	6/28/2020	10:35	1.9	603.15	601.25	0.3	0.1	33%	Light brown reddish silty fine sand. No odor, no sheen.
ND20-TB03	1440931.26	579450.04	6/29/2020	15:05	12.2	603.27	591.07	0.3	0.3	100%	Light brown silty-clays with low/medium cohesion. No odor, no sheen. Lots of woody/vegetative debris.
ND20-TB04	1440875.21	579584.46	6/28/2020	10:55	10.1	603.28	593.18	0.3	0.3	100%	Light brown silty-clay with medium cohesion. Some sheen. Trace vegetative debris. No odor.
ND20-TB05	1441060.69	579722.33	6/28/2020	11:35	13.5	603.27	589.77	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clay with medium cohesion. No odor, sheen at surface of sediments.

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TABLE 2-2 SURFACE SAMPLE COLLECTION
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Sample Collection Date	Sample Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Surface Grab Sample			
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Percent Recovery	Field Notes
ND20-TB06	1440993.42	579872.16	6/29/2020	16:00	16.1	603.16	587.06	0.3	0.3	100%	Medium brown silts over medium brown silty-clay with medium cohesion. Slight petroleum odor, sheen present.
ND20-TB07	1441185.39	579962.96	6/29/2020	12:25	15.0	603.43	588.43	0.3	0.3	100%	Light brown silts over light brown silty-clays with low/medium cohesion. Sheens a surface of sediments, no odor.
ND20-TB08	1441131.19	580227.81	6/28/2020	10:15	16.0	603.16	587.16	0.3	0.3	100%	Light brown silty-clays with medium cohesion. No odor, no sheen.
ND20-TB09	1441216.76	580458.38	6/28/2020	9:37	21.1	603.20	582.10	0.3	0.3	100%	Light brown silts over medium brown silty-clays with medium cohesion. No odor, no sheen.
ND20-TB10	1441314.29	580331.36	6/29/2020	13:20	21.5	603.42	581.92	0.3	0.3	100%	Light brown silts over light brown silty-clays with low/medium cohesion. No odor, slight sheen.
ND20-TB11	1441415.51	580583.92	6/28/2020	9:10	26.7	603.13	576.43	0.3	0.3	100%	Light brown silty-clays with medium cohesion. No odor, no sheen.
ND20-TB12	1441485.58	580813.78	6/28/2020	9:00	23.7	603.15	579.45	0.3	0.3	100%	Light brown silts over medium brown silty-clays with medium cohesion. No odor, no sheen.
ND20-TB13	1441580.60	581007.74	6/28/2020	8:45	27.5	603.05	575.55	0.3	0.3	100%	Thin layer of loose light brown silts over medium brown silty-clay with medium cohesion. No odor, no sheen.
ND20-TB14	1441558.60	581195.93	6/28/2020	8:30	26.3	602.96	576.66	0.3	0.2	66%	Light brown silts with loose cohesion with small (1 inch diameter) dense clay chunks throughout. Slight Sheen. No odor.
ND20-TB15	1441670.77	581361.43	6/29/2020	16:40	35.0	603.01	568.01	0.3	0.2	66%	Medium brown silty-clays with medium cohesion. No odor. Sheen present. Some small chunks of coal.
ND20-TB16	1441594.02	581477.06	6/28/2020	8:10	27.8	602.99	575.19	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clays with medium cohesion. Trace chunks of dense clay. Shell hash.
ND20-TB17	1441707.83	581633.23	6/28/2020	7:55	34.3	603.03	568.73	0.3	0.2	66%	Light brown silty-clays with loose cohesion. Trace medium sands. Shell shash. No odor. Some sheens.
ND20-TB18	1441583.47	581780.25	7/1/2020	9:45	26.6	603.05	576.45	0.3	0.2	66%	Light brown silts over medium brown clays with trace fine sands. No odor, no sheen.
ND20-TB19	1441837.24	581832.69	6/28/2020	13:30	28.1	603.19	575.09	0.3	0.3	100%	Light brown silts over medium brown silty-clay. No odor, no sheen. Some sort of ore/metallic chunks, photo taken.
ND20-TB20	1441915.57	581719.42	7/1/2020	10:05	13.4	603.07	589.67	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clays with medium cohesion. Slight organic odor, no sheen.
ND20-TB21	1442054.46	581771.15	7/3/2020	16:30	31.3	603.26	571.96	0.3	0.3	100%	Medium brown silts over medium brown silty-clays with low/medium cohesion. N odor, no sheen.
ND20-TB22	1442147.48	581591.06	6/28/2020	13:15	29.5	603.21	573.71	0.3	0.3	100%	Light brown silty-clays with loose cohesion. Sheen present. No odor.
ESTUARY FLATS											
ND20-EF01	1435360.75	578053.21	6/24/2020	9:25	3.1	602.82	599.72	0.3	0.2	66%	Light brown fine grained sands with trace silts. No odor, no sheen.
ND20-EF02	1435652.15	578383.97	6/24/2020	8:50	3.2	602.85	599.65	0.3	0.2	66%	Light brown medium and fine grained sands with trace silts. No odor, no sheen.
ND20-EF03	1435706.36	579260.96	6/24/2020	8:30	9.0	602.93	593.93	0.3	0.1	33%	Brown silty-coarse grained sands with some fine sands. Coal chunks throughout sample. No odor, no sheen.
ND20-EF04	1435729.22	580161.63	6/24/2020	7:55	6.1	603.04	596.94	0.3	0.1	33%	Brown silts with trace coarse sands and loose cohesion. Coal chunks throughout sample. Trace gravel and woody debris. No odor, no sheen.
ND20-EF05	1433594.26	577330.19	6/25/2020	7:45	2.4	603.00	600.60	0.3	0.2	66%	Light brown fine sands. No odor, no sheen.
ND20-EF06	1433974.41	577454.02	6/24/2020	13:00	3.3	602.86	599.56	0.3	0.1	33%	Light brown fine sands. No odor, no sheen.
ND20-EF07	1433653.04	577583.79	6/24/2020	13:40	6.6	602.98	596.38	0.3	0.2	66%	Light brown silts with fine grained sands with loose cohesion over medium brown fine sands with some clays. No odor, no sheen.

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TABLE 2-2 SURFACE SAMPLE COLLECTION
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Sample Collection Date	Sample Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Surface Grab Sample			
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Percent Recovery	Field Notes
ND20-EF08	1433872.89	577563.99	6/24/2020	13:20	3.7	602.93	599.23	0.3	0.1	33%	Light brown sands. No odor, no sheen.
ND20-EF09	1432031.30	575915.46	6/24/2020	14:25	6.0	603.01	597.01	0.3	0.2	66%	Light brown silts over medium brown clays with medium cohesion. No odor, no sheen.
ND20-EF10	1432798.70	576586.64	6/24/2020	14:50	4.2	603.03	598.83	0.3	0.3	100%	Brown silts with loose cohesion over brown clays. Some woody debris throughout clay portion of sample.
ND20-EF11	1431635.87	578398.03	6/24/2020	11:15	6.4	602.79	596.39	0.3	0.1	33%	Light brown fine sands. No odor, no sheen.
ND20-EF12	1432479.49	578429.60	6/24/2020	11:00	6.8	602.79	595.99	0.3	0.2	66%	Light brown fine sands. No odor, no sheen.
ND20-EF13	1432657.02	579320.77	6/24/2020	10:40	8.0	602.76	594.76	0.3	0.2	66%	Light brown silts over medium brown clays with fine sands with medium cohesion. Shell hash. No odor, no sheen.
ND20-EF14	1433582.72	579114.44	6/24/2020	10:20	8.0	602.77	594.77	0.3	0.2	66%	Light brown silts over medium brown clay with fine sands, medium cohesion. No odor, no sheen.
ND20-EF15	1434056.56	579883.02	6/24/2020	10:00	9.9	602.80	592.90	0.3	0.3	100%	Light brown silts over medium brown clays with some fine sands, medium cohesion. No odor, no sheen.
ND20-EF16	1434800.41	579727.71	6/24/2020	9:45	6.2	602.79	596.59	0.3	0.2	66%	Light brown silty-sands over medium brown clays with sand and woody debris, medium cohesion. No odor, no sheen.
ND20-EF17	1431442.79	576576.47	6/24/2020	14:10	11.2	603.03	591.83	0.3	0.2	66%	Light brown silts over medium brown clays with fine sands, medium/firm cohesion. No odor, no sheen.
ND20-EF18	1432496.98	577626.59	6/24/2020	11:35	5.0	602.81	597.81	0.3	0.1	33%	Light brown fine sands with some clay. No odor, no sheen.
CLOUGH ISLAND											
ND20-CL01	1416928.86	566992.04	6/30/2020	8:00	5.5	603.04	597.54	0.3	0.3	100%	Light brown silts over medium brown silty-clays with loose/medium cohesion. Woody debris throughout. No odor, no sheen.
ND20-CL02	1417467.13	567573.21	6/30/2020	12:25	5.2	603.26	598.06	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clays with medium/firm cohesion. No odor, no sheen.
ND20-CL03	1417675.38	567198.65	6/30/2020	11:35	4.6	603.26	598.66	0.3	0.3	100%	Medium brown silts with lots of vegetative matter and SAV. Slight organic odor. No sheen.
ND20-CL04	1417605.84	566852.21	6/30/2020	8:40	5.5	603.12	597.62	0.3	0.3	100%	Light brown silts over medium brown silty-clays with loose/medium cohesion. Woody debris throughout. No odor, no sheen.
ND20-CL05	1417937.24	566679.39	6/30/2020	9:10	4.4	603.26	598.86	0.3	0.3	100%	Medium brown silty-clays with loose cohesion. Some SAV, vegetative detritus. Organic odor, no sheen.
ND20-CL06	1417973.75	566311.43	6/30/2020	11:05	4.3	603.02	598.72	0.3	0.3	100%	Medium brown silts over medium brown silty-clay with medium cohesion. Lots of vegetative matter. SAV present. No odor, no sheen.
ND20-CL07	1418020.64	565985.76	6/30/2020	10:30	4.1	603.08	598.98	0.3	0.2	66%	Medium brown silts, trace clays. Lots of vegetative debris. Organic odor, no sheen
ND20-CL08	1417729.70	566234.56	6/30/2020	10:05	5.3	603.31	598.01	0.3	0.3	100%	Medium brown silts over medium brown silty-clays with medium cohesion. Trace vegetative debris in clay layer. No odor, no sheen.
ND20-CL09	1417750.00	566538.50	6/30/2020	9:40	5.6	603.54	597.94	0.3	0.3	100%	Light brown silts over medium brown silty-clays with medium cohesion. No odor, no sheen.
ND20-CL10	1417390.40	568501.33	6/30/2020	13:00	4.0	603.45	599.45	0.3	0.2	66%	Light brown silts with loose cohesion over medium brown silty-fine sands. SAV present in abundance.

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TABLE 2-2 SURFACE SAMPLE COLLECTION
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Sample Collection Date	Sample Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Surface Grab Sample			
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Percent Recovery	Field Notes
REFERENCE											
ND20-SLBREF1	1438553.42	583747.05	7/1/2020	7:45	23.2	603.11	579.91	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown clays with medium cohesion. No odor, no sheen.
ND20-KBREF2	1427328.73	569074.70	6/30/2020	14:00	10.5	603.45	592.95	0.3	0.3	100%	Light brown silts with loose cohesion over medium brown silty-clays with medium cohesion. No odor, no sheen.
ND20-LREF3	1457850.09	566511.62	7/3/2020	0.7	2.7	603.28	600.58	0.3	0.2	66%	Medium brown silts with loose cohesion over dense clays with strong cohesion. SAV abundant. No sheen, organic odor.
ND20-SBREF4	1454913.55	569521.37	7/1/2020	18:55	19.2	603.14	583.94	0.3	0.3	100%	Light brown silts over medium brown dense clays with strong cohesion. Slight sheen, no odor.

NOTES:
IGLD85 = International Great Lakes Datum of 1985.
NAD83 = North American Datum of 1983.
ft = Foot (feet).
CDT = Central daylight time.
SAV = Submerged aquatic vegetation.

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TABLE 2-3 VIBRACORE COLLECTION DATA
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Core Collection Date	Core Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Sediment Core				
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Sediment Recovery (ft)	Percent Recovery	Refusal Met (Y/N)
HALLET DOCK												
ND20-HD01	1436294.45	578455.64	6/23/2020	15:18	8.7	603.08	594.38	4	6.5	5.8	89.23%	N
ND20-HD02	1436295.54	578519.92	6/23/2020	15:51	22.5	603.14	580.64	4	6.5	6.1	93.85%	N
ND20-HD03	1436312.58	578720.23	6/23/2020	13:04	22.4	602.84	580.44	4	6.5	5.6	86.15%	N
ND20-HD04	1436350.65	579501.76	6/23/2020	11:26	20.8	602.69	581.89	4	6.5	5.9	90.77%	N
ND20-HD05	1436372.64	580189.60	6/23/2020	10:48	22.4	602.63	580.23	4	6.50	5.9	90.77%	N
ND20-HD06	1436394.84	580704.93	6/23/2020	10:03	22.1	602.67	580.57	4	6.5	6.4	98.46%	N
OIL BARGE DOCK												
ND20-BP01	1436900.58	580247.36	6/26/2020	9:21	2.6	602.99	600.39	20	20.5	20.4	99.51%	N
ND20-BP02	1436958.57	580248.06	6/26/2020	11:50	2.3	603.05	600.75	20	20.5	20.3	99.02%	N
ND20-BP03	1436933.32	580276.10	6/26/2020	10:33	3.4	603.04	599.64	20	20.5	20.0	97.56%	N
ND20-BP04	1436934.39	580375.00	6/27/2020	8:33	12.4	602.87	590.47	20	20.5	20.3	99.02%	N
ND20-BP05	1436941.52	580480.84	6/27/2020	9:48	16.0	602.91	586.91	20	20.5	20.1	98.05%	N
ND20-BP06	1436905.81	580558.20	6/26/2020	13:30	18.6	603.01	584.41	20	20.5	20.3	99.02%	N
ND20-BP07	1436946.73	580598.16	6/27/2020	11:20	18.5	603.11	584.61	20	20.5	19.8	96.59%	N
ND20-BP08	1436979.51	580671.60	6/26/2020	15:28	18.5	602.84	584.34	20	20.0	19.4	97.00%	N
ND20-BP09	1436919.22	580680.40	6/26/2020	14:21	20.4	603.02	582.62	20	20.5	20.3	99.02%	N
ND20-BP10	1436982.85	580780.50	6/24/2020	15:41	19.1	603.05	583.95	10	10.2	9.4	92.16%	N
ND20-BP11	1436914.56	580786.35	6/24/2020	15:05	20.5	603.06	582.56	10	10.2	10.0	98.04%	N
ND20-BP12	1436958.40	580892.28	6/27/2020	13:12	23.3	603.04	579.74	10	10.2	10.0	98.04%	N
ND20-BP13	1436922.95	580991.06	6/24/2020	14:21	22.5	602.91	580.41	10	10.2	10.1	99.02%	N
ND20-BP14	1436998.83	580987.10	6/24/2020	13:01	19.2	602.88	583.68	10	10.2	10.0	98.04%	N
ND20-BP15	1436793.81	581124.03	6/25/2020	8:40	7.3	602.94	595.64	10	10.2	9.8	96.08%	N
ND20-BP16	1436956.58	581163.11	6/25/2020	15:56	22.9	603.04	580.14	10	10.2	9.7	95.10%	N
ND20-BP17	1437487.64	581404.09	6/27/2020	14:38	20.5	602.99	582.49	10	10.0	8.6	86.00%	N
GENERAL MILLS SLIP												
ND20-GM01	1439438.81	580486.08	7/1/2020	9:02	14.3	603.1	588.80	10	6.6	4.2	63.64%	Y
ND20-GM02	1439501.73	580488.27	7/1/2020	9:42	17.0	603.05	586.05	10	10.0	9.6	96.00%	N
ND20-GM03	1439446.40	580814.34	7/1/2020	15:58	17.0	603.35	586.35	10	10.0	9.4	94.00%	N
ND20-GM04	1439519.96	580810.85	6/28/2020	15:42	18.8	603.03	584.23	10	10.2	9.2	90.20%	N
ND20-GM05	1439520.58	580980.04	7/1/2020	14:08	25.4	603.26	577.86	10	7.6	7.6	100.00%	Y
ND20-GM06	1439443.31	580988.57	7/1/2020	15:32	19.4	603.35	583.95	10	10.0	9.6	96.00%	N
ND20-GM07	1439526.81	581092.05	7/1/2020	13:24	28.1	603.16	575.06	10	10.0	9.9	99.00%	N
ND20-GM08	1439469.30	581321.88	7/1/2020	12:21	24.6	603.4	578.80	10	9.5	9.1	95.79%	N
ND20-GM09	1439533.06	581442.91	7/1/2020	11:24	28.1	603.26	575.16	10	9.0	8.7	96.67%	N
ND20-GM10	1439477.15	581550.07	7/1/2020	9:48	24.0	603.05	579.05	6	10.0	9.9	99.00%	N
ND20-GM11	1439541.97	581688.21	7/1/2020	8:48	31.5	603.07	571.57	6	10.2	9.8	96.08%	N
ND20-GM12	1439477.91	581843.69	7/2/2020	10:44	26.5	603.07	576.57	6	7.3	7.3	100.00%	Y
ND20-GM13[1]	1439515.06	582081.59	7/2/2020	11:55	30.9	603.06	572.16	6	1.1	1.1	100.00%	Y
ND20-GM14	1439630.38	582329.41	7/2/2020	13:12	21.6	603.15	581.55	6	10.2	10.0	98.04%	N

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TABLE 2-3 VIBRACORE COLLECTION DATA
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	State Plane Wisconsin North, US Survey Feet (NAD83)		Core Collection Date	Core Collection Time (CDT)	Water Depth (ft)	Water Surface Elevation IGLD85 (ft)	Sediment Surface Elevation IGLD85 (ft)	Sediment Core				
	Easting	Northing						Target Penetration Depth (ft)	Actual Penetration Depth (ft)	Sediment Recovery (ft)	Percent Recovery	Refusal Met (Y/N)
TOWER AVENUE SLIP												
ND20-TB01	1440799.09	579324.92	6/30/2020	8:57	7.9	603.2	595.30	20	20.5	20.1	98.05%	N
ND20-TB02	1440877.28	579298.45	6/30/2020	12:37	1.9	603.4	601.50	20	20.0	18.1	90.50%	N
ND20-TB03	1440930.79	579446.81	6/30/2020	14:23	11.4	603.16	591.76	20	20.0	19.2	96.00%	N
ND20-TB04	1440870.01	579583.57	6/30/2020	15:31	9.4	603.29	593.89	20	19.2	18.7	97.40%	N
ND20-TB05	1441059.56	579721.67	6/28/2020	8:44	12.6	602.99	590.39	10	10.2	9.7	95.10%	N
ND20-TB06	1441004.26	579869.96	6/28/2020	10:34	15.6	603.2	587.60	10	10.2	9.7	95.10%	N
ND20-TB07	1441181.08	579968.02	6/28/2020	12:07	14.4	603.13	588.73	10	9.1	9.1	100.00%	Y
ND20-TB08	1441131.07	580228.44	6/28/2020	13:13	15.8	603.21	587.41	10	10.2	10.0	98.04%	N
ND20-TB09	1441222.06	580456.79	6/28/2020	14:13	20.4	603.16	582.76	10	10.2	9.8	96.08%	N
ND20-TB10	1441313.53	580331.38	6/27/2020	15:39	20.6	602.85	582.25	10	10.2	10.0	98.04%	N
ND20-TB11	1441413.69	580585.41	7/2/2020	15:16	26.0	603.19	577.19	6	6.5	5.9	90.77%	N
ND20-TB12	1441483.20	580814.97	7/2/2020	15:59	23.2	603.19	579.99	6	6.5	6.4	98.46%	N
ND20-TB13	1441574.45	581012.84	7/3/2020	8:38	26.9	603.03	576.13	6	3.2	3.2	100.00%	Y
ND20-TB14	1441559.49	581196.40	7/4/2020	9:45	25.5	602.95	577.45	6	1.0	0.8	80.00%	Y
ND20-TB15	1441674.39	581338.37	7/4/2020	8:48	34.2	603.0	568.80	6	2.3	2.3	100.00%	Y
ND20-TB16	1441593.72	581482.84	7/4/2020	10:55	26.1	602.89	576.79	6	1.0	1.0	100.00%	Y
ND20-TB17	1441709.61	581632.20	7/3/2020	15:28	33.7	603.22	569.52	6	3.0	2.6	86.67%	Y
ND20-TB18	1441577.54	581785.64	7/3/2020	14:52	26.4	603.19	576.79	6	2.0	1.9	95.00%	N
ND20-TB19	1441838.74	581831.29	7/3/2020	13:18	28.1	603.16	575.06	6	6.5	6.2	95.38%	N
ND20-TB20	1441917.05	581722.26	7/3/2020	12:18	13.4	603.12	589.72	6	6.6	6.6	100.00%	N
ND20-TB21	1442058.87	581796.01	7/3/2020	10:38	29.4	603.03	573.63	6	5.7	5.7	100.00%	Y
ND20-TB22	1442145.14	581589.16	7/3/2020	9:38	29.0	603.06	574.06	6	6.3	6.3	100.00%	N
ESTUARY FLATS												
ND20-EF01	1435358.26	578051.24	6/24/2020	11:05	2.6	602.77	600.17	6	6.0	5.4	90.00%	N
ND20-EF02	1435645.79	578384.42	6/22/2020	15:45	2.9	603.16	600.26	6	6.4	6.4	100.00%	N
ND20-EF03	1435707.91	579264.45	6/22/2020	14:25	4.4	603.08	598.68	6	6.5	6.3	96.92%	N
ND20-EF04	1435728.92	580162.88	6/22/2020	12:46	5.8	602.95	597.15	6	6.5	6.4	98.46%	N
ND20-EF05	1433598.50	577327.20	6/24/2020	9:09	1.8	602.81	601.01	6	6.5	6.2	95.38%	N
ND20-EF06	1433975.70	577453.02	6/24/2020	9:50	2.5	602.81	600.31	6	6.5	6.3	96.92%	N
ND20-EF07	1433652.04	577581.67	6/24/2020	8:27	6.3	602.93	596.63	6	6.5	6.5	100.00%	N
ND20-EF08	1433877.46	577559.18	6/23/2020	8:53	3.2	602.89	599.69	6	6.5	6.0	92.31%	N

NOTES:
IGLD85 = International Great Lakes Datum of 1985.
NAD83 = North American Datum of 1983.
ft = Foot (feet).
CDT = Central daylight time.
1. A sample was not collected at this location due to poor recovery at the location with shallow refusal.

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TABLE 2-4 ACTUAL ANALYTICAL PROGRAM—HALLET DOCK 8 SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-HD01	surf		1	1	1	1	1	1	1	1	1		1	1	1						0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1		1				1		1		1								1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
ND20-HD02	surf		1	1	1				1	1	1										0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1		1				1		1										1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
ND20-HD03	surf		1	1	1	1	1	1	1	1	1		1	1	1						0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1		1				1		1		1								1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
ND20-HD04	surf		1	1	1	1	1	1	1	1	1			1	1						0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1		1				1		1										1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
ND20-HD05	surf		1	1	1				1	1	1		1								0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1	1	1				1		1		1								1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
	*4.0-5.0***		1		1				1		1										4.0	5.0
ND20-HD06	surf		1	1	1				1	1	1										0	0.3
	0.3-1.0		1	1	1				1		1										0.3	1.0
	1.0-2.0		1		1				1		1										1.0	2.0
	2.0-3.0		1		1				1		1										2.0	3.0
	3.0-4.0		1		1				1		1										3.0	4.0
Total Sediment Samples		**0**	**31**	**13**	**31**	**3**	**3**	**3**	**31**	**6**	**31**	**0**	**6**	**3**	**3**	**0**	**0**	**0**	**0**	**0**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		0	3	2	3	1	1	1	3	0	3	0	1	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		0	2	1	2	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**0**	**5**	**3**	**5**	**2**	**2**	**1**	**5**	**0**	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**0**	**36**	**16**	**36**	**5**	**5**	**4**	**36**	**6**	**34**	**0**	**7**	**3**	**3**	**0**	**0**	**0**	**0**	**0**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List
*** Sample added during field effort*

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume submitted for analysis.

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TABLE 2-5 ACTUAL ANALYTICAL PROGRAM—OIL BARGE DOCK SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-BP01	surf	1	1	1	1				1												0	0.3
	0.3-2.0	1	1	1	1				1		1	1	1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1	1	1								2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
	10.0-12.0	1	1	1	1				1		1										10.0	12.0
	12.0-14.0	1	1	1	1				1		1										12.0	14.0
ND20-BP02	surf	1	1	1	1	1			1												0	0.3
	*surftox***	1	1	1	1	1	1	1	1	1	1	1	1	1	1						0	0.3
	0.3-2.0	1	1	1	1				1		1		1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1		1								2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
	10.0-12.0		1	1	1				1		1										10.0	12.0
	12.0-14.0		1	1	1				1		1										12.0	14.0
ND20-BP03	surf	1	1	1	1	1			1												0	0.3
	*surftox***	1	1	1	1	1	1	1	1	1	1	1	1	1	1						0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1	1	1								2.0	4.0
	4.0-6.0	1	1	1	1				1		1	1	1								4.0	6.0
	6.0-8.0	1	1	1	1				1		1	1	1								6.0	8.0
	8.0-10.0	1	1	1	1				1		1	1	1								8.0	10.0
	10.0-12.0	1	1	1	1				1		1	1	1								10.0	12.0
	12.0-14.0	1	1	1	1				1		1	1	1								12.0	14.0
	*14.0-16.0***	1	1	1	1				1		1										14.0	16.0
	*16.0-18.0***	1	1	1	1				1		1		1								16.0	18.0
	*18.0-20.0***	1	1	1	1				1		1										18.0	20.0
ND20-BP04	surf	1	1	1	1				1	1	1										0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
	10.0-12.0		1	1	1				1		1										10.0	12.0
	12.0-14.0		1	1	1				1		1										12.0	14.0
ND20-BP05	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1						0	0.3
	0.3-2.0	1	1	1	1				1		1	1	1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1	1	1								2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
	10.0-12.0	1	1	1	1				1		1										10.0	12.0
	12.0-14.0	1	1	1	1				1		1										12.0	14.0
ND20-BP06	surf	1	1	1	1				1	1	1		1								0	0.3
	0.3-2.0	1	1	1	1				1		1		1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1		1								2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
	10.0-12.0		1	1	1				1		1										10.0	12.0
	12.0-14.0		1	1	1				1		1										12.0	14.0

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**TABLE 2-5 ACTUAL ANALYTICAL PROGRAM—OIL BARGE DOCK SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN**

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	Sample Depth Interval (ft)	Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM	TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG	TCL VOCs EPA SW846 8260D	TCL SVOCs[2] EPA SW846 8270D	PCBs - Aroclors EPA CLP SOM02.4/PCB	Organotin GC/MS SIM	Dioxins/Furans EPA Method 1613B	Total Organic Carbon Lloyd Kahn	Grain Size (with hydrometer) ASTM D422	Moisture Content ASTM D2216	Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan	Microscopic Analysis of Coal Particles Method OPT.023.3	Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706	Toxicity Testing (10-day *Chironomus*) EPA 100.2	Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3	Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4	Organotins (*Lumbriculus* tissue) GC/MS SIM	Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613	Percent Lipids Gravimetric Method	Start of Interval Below Sediment Surface (ft)	End of Interval Below Sediment Surface (ft)
ND20-BP07	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1						0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
	10.0-12.0	1	1	1	1				1		1										10.0	12.0
	12.0-14.0	1	1	1	1				1		1										12.0	14.0
ND20-BP08	surf	1	1	1	1				1	1	1										0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
	10.0-12.0		1	1	1				1		1										10.0	12.0
	12.0-14.0		1	1	1				1		1										12.0	14.0
ND20-BP09	surf	1	1	1	1				1	1	1										0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
	10.0-12.0	1	1	1	1				1		1										10.0	12.0
	12.0-14.0	1	1	1	1				1		1										12.0	14.0
ND20-BP10	surf	1	1	1	1				1	1	1	1	1								0	0.3
	0.3-2.0	1	1	1	1				1		1	1	1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
ND20-BP11	surf	1	1	1	1				1	1	1		1								0	0.3
	0.3-2.0	1	1	1	1				1		1		1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
ND20-BP12	surf	1	1	1	1				1	1	1	1	1								0	0.3
	0.3-2.0	1	1	1	1				1		1	1	1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
ND20-BP13	surf	1	1	1	1				1	1	1										0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
ND20-BP14	surf	1	1	1	1				1	1	1										0	0.3
	0.3-2.0	1	1	1	1				1		1										0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0

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TABLE 2-5 ACTUAL ANALYTICAL PROGRAM—OIL BARGE DOCK SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-BP15	surf	1	1	1	1				1	1	1	1	1								0	0.3
	0.3-2.0	1	1	1	1				1		1	1	1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
ND20-BP16	surf	1	1	1	1				1	1	1		1								0	0.3
	0.3-2.0	1	1	1	1				1		1		1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
	6.0-8.0		1	1	1				1		1										6.0	8.0
	8.0-10.0		1	1	1				1		1										8.0	10.0
ND20-BP17	surf	1	1	1	1				1	1	1		1								0	0.3
	0.3-2.0	1	1	1	1				1		1		1								0.3	2.0
	2.0-4.0	1	1	1	1				1		1										2.0	4.0
	4.0-6.0	1	1	1	1				1		1										4.0	6.0
	6.0-8.0	1	1	1	1				1		1										6.0	8.0
	8.0-10.0	1	1	1	1				1		1										8.0	10.0
Total Sediment Samples		**97**	**125**	**125**	**125**	**6**	**4**	**4**	**125**	**16**	**122**	**20**	**32**	**4**	**4**	**0**	**0**	**0**	**0**	**0**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		11	13	13	13	2	2	2	13	0	13	3	4	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		5	7	7	7	1	1	0	7	0	1	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**16**	**20**	**20**	**20**	**3**	**3**	**2**	**20**	**0**	**14**	**3**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**113**	**145**	**145**	**145**	**9**	**7**	**6**	**145**	**16**	**136**	**23**	**36**	**4**	**4**	**0**	**0**	**0**	**0**	**0**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List
*** Sample added during field effort*

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume submitted for analysis.

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**TABLE 2-6 ACTUAL ANALYTICAL PROGRAM—GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN**

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	Sample Depth Interval (ft)	Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM	TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG	TCL VOCs EPA SW846 8260D	TCL SVOCs[2] EPA SW846 8270D	PCBs - Aroclors EPA CLP SOM02.4/PCB	Organotin GC/MS SIM	Dioxins/Furans EPA Method 1613B	Total Organic Carbon Lloyd Kahn	Grain Size (with hydrometer) ASTM D422	Moisture Content ASTM D2216	Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan	Microscopic Analysis of Coal Particles Method OPT.023.3	Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706	Toxicity Testing (10-day *Chironomus*) EPA 100.2	Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3	Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4	Organotins (*Lumbriculus* tissue) GC/MS SIM	Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613	Percent Lipids Gravimetric Method	Start of Interval Below Sediment Surface (ft)	End of Interval Below Sediment Surface (ft)
ND20-GM01	surf		1		1	1	1		1	1	1		1								0	0.3
	0.3-2.0		1		1	1	1		1		1		1								0.3	2.0
	2.0-4.0		1		1	1	1		1		1		1								2.0	4.0
ND20-GM02	surf		1	1	1	1	1	1	1	1	1		1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1		1		1		1		1								0.3	2.0
	2.0-4.0		1		1		1		1		1		1								2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
	6.0-8.0		1		1		1		1		1										6.0	8.0
	8.0-10.0		1		1		1		1		1										8.0	10.0
ND20-GM03	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
	6.0-8.0		1		1				1		1										6.0	8.0
	8.0-10.0		1		1				1		1										8.0	10.0
ND20-GM04	surf		1	1	1	1	1	1	1	1	1		1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
	6.0-8.0		1		1				1		1										6.0	8.0
	8.0-10.0		1		1				1		1										8.0	10.0
ND20-GM05	surf		1		1	1	1		1	1	1		1								0	0.3
	0.3-2.0		1		1	1	1		1		1		1								0.3	2.0
	2.0-4.0		1		1	1	1		1		1		1								2.0	4.0
	4.0-6.0		1		1	1	1		1		1										4.0	6.0
	6.0-8.0		1		1	1	1		1		1										6.0	8.0
ND20-GM06	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
	6.0-8.0		1		1				1		1										6.0	8.0
	8.0-10.0		1		1				1		1										8.0	10.0
ND20-GM07	surf		1		1		1		1	1	1		1								0	0.3
	0.3-2.0		1		1		1		1		1		1								0.3	2.0
	2.0-4.0		1		1		1		1		1		1								2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
	6.0-8.0		1		1		1		1		1										6.0	8.0
	8.0-10.0		1		1		1		1		1										8.0	10.0
ND20-GM08	surf		1	1	1		1	1	1	1	1		1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
	6.0-8.0		1		1				1		1										6.0	8.0
	8.0-10.0		1		1				1		1										8.0	10.0
ND20-GM09	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
	6.0-8.0		1		1		1		1		1										6.0	8.0
	8.0-10.0		1		1		1		1		1										8.0	10.0

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**TABLE 2-6 ACTUAL ANALYTICAL PROGRAM—GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN**

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-GM10	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
ND20-GM11	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
ND20-GM12	surf		1		1	1			1	1	1		1								0	0.3
	0.3-2.0		1		1	1			1		1		1								0.3	2.0
	2.0-4.0		1		1	1			1		1										2.0	4.0
	4.0-6.0		1		1	1			1		1										4.0	6.0
ND20-GM13	surf		1		1		1		1	1	1										0	0.3
ND20-GM14	surf		1		1		1		1	1	1		1								0	0.3
	0.3-2.0		1		1		1		1		1		1								0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
Total Sediment Samples		**0**	**67**	**3**	**67**	**14**	**37**	**3**	**67**	**14**	**67**	**0**	**18**	**3**	**3**	**3**	**15**	**15**	**0**	**0**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		0	8	1	8	2	5	1	8	0	8	0	4	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		0	4	1	4	2	3	0	4	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**0**	**12**	**2**	**12**	**4**	**8**	**1**	**12**	**0**	**8**	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**0**	**79**	**5**	**79**	**18**	**45**	**4**	**79**	**14**	**75**	**0**	**22**	**3**	**3**	**3**	**15**	**15**	**0**	**0**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List
** Sample added during field effort

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume submitted for analysis.

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TABLE 2-7 ACTUAL ANALYTICAL PROGRAM—TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-TB01	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1	1	1	1	1	1	1		1	1									0.3	2.0
	2.0-4.0		1	1	1	1	1		1		1	1	1								2.0	4.0
	4.0-6.0		1		1	1	1		1		1										4.0	6.0
	6.0-8.0		1		1	1	1		1		1										6.0	8.0
	8.0-10.0		1		1	1	1		1		1										8.0	10.0
	*10.0-12.0***		1		1	1			1		1										10.0	12.0
	*12.0-14.0***		1		1	1			1		1										12.0	14.0
	*14.0-16.0***		1		1	1			1		1										14.0	16.0
ND20-TB02	surf		1	1	1	1			1	1	1		1								0	0.3
	0.3-2.0		1		1	1			1		1										0.3	2.0
	2.0-4.0		1		1																2.0	4.0
	4.0-6.0		1		1																4.0	6.0
	6.0-8.0		1		1																6.0	8.0
	8.0-10.0		1	1	1	1			1		1		1								8.0	10.0
	*10.0-12.0***		1		1	1			1		1										10.0	12.0
	*12.0-14.0***		1	1	1	1			1		1										12.0	14.0
	*14.0-16.0***		1		1	1			1		1										14.0	16.0
ND20-TB03	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1	1	1		1		1										0.3	2.0
	2.0-4.0		1		1	1	1		1		1										2.0	4.0
	4.0-6.0		1		1	1	1		1		1										4.0	6.0
	6.0-8.0		1	1	1	1	1		1		1	1									6.0	8.0
	8.0-10.0		1	1	1	1	1	1	1		1	1	1								8.0	10.0
ND20-TB04	surf		1	1	1	1			1	1	1		1								0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1		1								2.0	4.0
	4.0-6.0		1		1	1			1		1										4.0	6.0
	6.0-8.0		1		1	1			1		1										6.0	8.0
	8.0-10.0		1		1	1			1		1										8.0	10.0
	*10.0-12.0***		1		1																10.0	12.0
	*12.0-14.0***		1		1																12.0	14.0
	*14.0-16.0***		1		1																14.0	16.0
ND20-TB05	surf		1	1	1	1	1		1	1	1	1	1								0	0.3
	0.3-2.0		1	1	1	1	1		1		1	1									0.3	2.0
	2.0-4.0		1	1	1	1	1		1		1	1	1								2.0	4.0
	4.0-6.0		1		1	1	1		1		1										4.0	6.0
	6.0-8.0		1		1	1	1		1		1										6.0	8.0
	8.0-10.0		1		1	1	1		1		1										8.0	10.0
ND20-TB06	surf	1	1	1	1	1			1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1		1								2.0	4.0
	4.0-6.0		1		1	1			1		1										4.0	6.0
	6.0-8.0		1		1	1			1		1										6.0	8.0
	8.0-10.0		1		1	1			1		1										8.0	10.0
ND20-TB07	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1	1	1	1	1	1	1		1	1									0.3	2.0
	2.0-4.0		1	1	1	1	1		1		1	1	1								2.0	4.0
	4.0-6.0		1		1	1	1		1		1										4.0	6.0
	6.0-8.0		1		1	1	1		1		1										6.0	8.0
	8.0-10.0		1		1	1	1		1		1										8.0	10.0

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TABLE 2-7 ACTUAL ANALYTICAL PROGRAM—TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	Sample Depth Interval (ft)	Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM	TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG	TCL VOCs EPA SW846 8260D	TCL SVOCs[2] EPA SW846 8270D	PCBs - Aroclors EPA CLP SOM02.4/PCB	Organotin GC/MS SIM	Dioxins/Furans EPA Method 1613B	Total Organic Carbon Lloyd Kahn	Grain Size (with hydrometer) ASTM D422	Moisture Content ASTM D2216	Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan	Microscopic Analysis of Coal Particles Method OPT.023.3	Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706	Toxicity Testing (10-day *Chironomus*) EPA 100.2	Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3	Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4	Organotins (*Lumbriculus* tissue) GC/MS SIM	Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613	Percent Lipids Gravimetric Method	Start of Interval Below Sediment Surface (ft)	End of Interval Below Sediment Surface (ft)
ND20-TB08	surf		1		1				1	1	1		1								0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1		1								2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
	6.0-8.0		1		1				1		1										6.0	8.0
	8.0-10.0		1		1				1		1										8.0	10.0
ND20-TB09	surf		1		1		1		1	1	1		1								0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1		1								2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
	6.0-8.0		1		1		1		1		1										6.0	8.0
	8.0-10.0		1		1		1		1		1										8.0	10.0
ND20-TB10	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1		1	1	1		1	1									0.3	2.0
	2.0-4.0		1		1		1		1		1	1	1								2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
	6.0-8.0		1		1		1		1		1										6.0	8.0
	8.0-10.0		1		1		1		1		1										8.0	10.0
ND20-TB11	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
ND20-TB12	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
	4.0-6.0		1		1				1		1										4.0	6.0
ND20-TB13	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
	*2.0-3.0***		1		1				1		1										2.0	3.0
	*3.0-3.5***				1																3.0	3.5
ND20-TB14	surf		1		1				1	1	1										0	0.3
	0.3-2.0		1		1				1		1										0.3	2.0
ND20-TB15	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	*0.3-1.7***		1		1		1		1		1										0.3	1.7
	*1.7-2.3***		1		1				1		1										1.7	2.3
ND20-TB16	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
ND20-TB17	surf		1		1				1	1	1	1									0	0.3
	0.3-2.0		1		1				1		1	1									0.3	2.0
	2.0-4.0		1		1				1		1										2.0	4.0
ND20-TB18	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
ND20-TB19	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
ND20-TB20	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5			0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0

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TABLE 2-7 ACTUAL ANALYTICAL PROGRAM—TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-TB21	surf	1	1		1	1	1		1	1	1										0	0.3
	0.3-2.0		1		1		1	1	1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
ND20-TB22	surf		1		1		1		1	1	1										0	0.3
	0.3-2.0		1		1		1		1		1										0.3	2.0
	2.0-4.0		1		1		1		1		1										2.0	4.0
	4.0-6.0		1		1		1		1		1										4.0	6.0
Total Sediment Samples		**8**	**108**	**24**	**109**	**49**	**58**	**11**	**102**	**22**	**102**	**20**	**22**	**7**	**7**	**7**	**35**	**35**	**0**	**0**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		8	11	5	11	7	7	3	11	0	11	3	5	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		2	6	3	6	3	4	0	6	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**10**	**17**	**8**	**17**	**10**	**11**	**3**	**17**	**0**	**11**	**3**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**18**	**125**	**32**	**126**	**59**	**69**	**14**	**119**	**22**	**113**	**23**	**27**	**7**	**7**	**7**	**35**	**35**	**0**	**0**		

NOTES:

AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List
*** Sample added during field effort*

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume submitted for analysis.

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TABLE 2-8 ACTUAL ANALYTICAL PROGRAM—ESTUARY FLATS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-EF01	surf		1	1	1	1		1	1	1	1										0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1										2.0	4.0
	4.0-6.0		1	1	1	1			1		1										4.0	6.0
ND20-EF02	surf		1	1	1	1			1	1	1										0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1										2.0	4.0
	4.0-6.0		1	1	1	1			1		1										4.0	6.0
ND20-EF03	surf		1	1	1	1			1	1	1										0	0.3
	*0.3-1.0***		1	1	1	1			1		1										0.3	1.0
	*1.0-3.5***		1	1	1	1			1		1										1.0	3.5
	*3.5-5.0***		1	1	1	1			1		1										3.5	5.0
	*5.0-6.3***		1	1	1	1			1		1										5.0	6.3
ND20-EF04	surf		1	1	1				1	1	1										0	0.3
	0.3-2.0		1	1	1				1		1										0.3	2.0
	2.0-4.0		1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
ND20-EF05	surf		1	1	1	1		1	1	1	1										0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1										2.0	4.0
	4.0-6.0		1	1	1	1			1		1										4.0	6.0
ND20-EF06	surf		1	1	1				1	1	1										0	0.3
	0.3-2.0		1	1	1				1		1										0.3	2.0
	2.0-4.0		1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
ND20-EF07	surf		1	1	1	1			1	1	1										0	0.3
	0.3-2.0		1	1	1	1			1		1										0.3	2.0
	2.0-4.0		1	1	1	1			1		1										2.0	4.0
	4.0-6.0		1	1	1	1			1		1										4.0	6.0
ND20-EF08	surf		1	1	1				1	1	1										0	0.3
	0.3-2.0		1	1	1				1		1										0.3	2.0
	2.0-4.0		1	1	1				1		1										2.0	4.0
	4.0-6.0		1	1	1				1		1										4.0	6.0
ND20-EF09	surf		1	1	1	1		1	1	1	1										0	0.3
ND20-EF10	surf		1		1	1			1	1	1										0	0.3
ND20-EF11	surf		1		1	1		1	1	1	1										0	0.3
ND20-EF12	surf		1		1	1			1	1	1										0	0.3
ND20-EF13	surf		1		1	1		1	1	1	1										0	0.3
ND20-EF14	surf		1		1	1			1	1	1										0	0.3
ND20-EF15	surf		1		1	1		1	1	1	1										0	0.3
ND20-EF16	surf		1		1	1			1	1	1										0	0.3
ND20-EF17	surf		1		1	1		1	1	1	1										0	0.3
ND20-EF18	surf		1		1	1			1	1	1										0	0.3
Total Sediment Samples		**0**	**43**	**34**	**43**	**31**	**0**	**7**	**43**	**18**	**43**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		

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TABLE 2-8 ACTUAL ANALYTICAL PROGRAM—ESTUARY FLATS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		0	5	4	5	3	0	1	5	2	4	0	0	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		0	2	2	2	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**0**	**7**	**6**	**7**	**5**	**0**	**1**	**7**	**2**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**0**	**50**	**40**	**50**	**36**	**0**	**8**	**50**	**20**	**47**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List
** Sample added during field effort

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume submitted for analysis.

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**TABLE 2-9 ACTUAL ANALYTICAL PROGRAM—CLOUGH ISLAND
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN**

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**	**Start of Interval Below Sediment Surface (ft)**	**End of Interval Below Sediment Surface (ft)**
ND20-CL01	surf		1		1	1		1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL02	surf		1		1			1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL03	surf		1		1	1		1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL04	surf		1		1			1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL05	surf		1		1	1		1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL06	surf		1		1			1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL07	surf		1		1	1		1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL08	surf		1		1			1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL09	surf		1		1	1		1	1	1	1			1	1	1	5		5	5	0	0.3
ND20-CL10	surf		1		1			1	1	1	1			1	1	1	5		5	5	0	0.3
Total Sediment Samples		**0**	**10**	**0**	**10**	**5**	**0**	**10**	**10**	**10**	**10**	**0**	**0**	**10**	**10**	**10**	**50**	**0**	**50**	**50**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		0	2	0	2	2	0	2	2	0	2	0	0	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**0**	**3**	**0**	**3**	**3**	**0**	**2**	**3**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**0**	**13**	**0**	**13**	**8**	**0**	**12**	**13**	**10**	**12**	**0**	**0**	**10**	**10**	**10**	**50**	**0**	**50**	**50**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
TAL = Target Analyte List

1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike duplicate samples, double volume should be submitted for analysis

TABLE 2-10 ACTUAL ANALYTICAL PROGRAM—REFERENCE SITES
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																			Analytical Interval	
		Chemistry												Bioassay								
Sample Location/ Sample ID	Sample Depth Interval (ft)	Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM	TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG	TCL VOCs EPA SW846 8260D	TCL SVOCs[2] EPA SW846 8270D	PCBs - Aroclors EPA CLP SOM02.4/PCB	Organotin GC/MS SIM	Dioxins/Furans EPA Method 1613B	Total Organic Carbon Lloyd Kahn	Grain Size (with hydrometer) ASTM D422	Moisture Content ASTM D2216	Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan	Microscopic Analysis of Coal Particles Method OPT.023.3	Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706	Toxicity Testing (10-day *Chironomus*) EPA 100.2	Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3	Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4	Organotins (*Lumbriculus* tissue) GC/MS SIM	Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613	Percent Lipids Gravimetric Method	Start of Interval Below Sediment Surface (ft)	End of Interval Below Sediment Surface (ft)
ND20-SLBREF1	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	0	0.3
ND20-KBREF2	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	0	0.3
ND20-LFREF3	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	0	0.3
ND20-SBREF4	surf	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	5	5	5	5	0	0.3
Total Sediment Samples		**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**20**	**20**	**20**	**20**		
Field Quality Control Samples																						
Field Split / Duplicates (10% of samples)		1	0	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0		
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total Field Quality Control Samples		**2**	**0**	**2**	**2**	**0**	**2**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
Total Samples		**6**	**4**	**6**	**6**	**4**	**6**	**4**	**4**	**4**	**5**	**5**	**5**	**4**	**4**	**4**	**20**	**20**	**20**	**20**		

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
ICP = Inductively-coupled plasma
PAH = Polycyclic aromatic hydrocarbon
PCB = Polychlorinated biphenyl
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1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For matrix spike/matrix spike dupcliate samples, double volume should be submitted for analysis

TABLE 2-11 SUMMARY ACTUAL ANALYTICAL PROGRAM
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AOC, SUPERIOR, WISCONSIN

		Field Sample Count and Required QC																		
		Chemistry												Bioassay						
Area	**Number of sample locations**	**Alkylated PAHs[1] (34) EPA CLP SOM02.4/SVOCS SIM**	**TAL Metals + Mercury EPA CLP ISM02.4/ICP-AES + HG**	**TCL VOCs EPA SW846 8260D**	**TCL SVOCs[2] EPA SW846 8270D**	**PCBs - Aroclors EPA CLP SOM02.4/PCB**	**Organotin GC/MS SIM**	**Dioxins/Furans EPA Method 1613B**	**Total Organic Carbon Lloyd Kahn**	**Grain Size (with hydrometer) ASTM D422**	**Moisture Content ASTM D2216**	**Aliphatic Hydrocarbons (C8-C40) - GC/MS Full Scan**	**Microscopic Analysis of Coal Particles Method OPT.023.3**	**Toxicity Testing (28-day + 4 hr UV light *Hyalella*) EPA 100.4/ ASTM E1706**	**Toxicity Testing (10-day *Chironomus*) EPA 100.2**	**Bioaccumulation Testing (28-day *Lumbriculus*) EPA 100.3**	**Mercury (*Lumbriculus* tissue) EPA CLP ISM02.4**	**Organotins (*Lumbriculus* tissue) GC/MS SIM**	**Dioxin/Furans (*Lumbriculus* tissue) EPA Method 1613**	**Percent Lipids Gravimetric Method**
Hallet Dock 8 Slip	6	0	31	13	31	3	3	3	31	6	31	0	6	3	3	0	0	0	0	0
Oil Barge Dock Slip	17	97	125	125	125	6	4	4	125	16	122	20	32	4	4	0	0	0	0	0
General Mills Slip	14	0	67	3	67	14	37	3	67	14	67	0	18	3	3	3	15	15	0	0
Tower Avenue Slip	22	8	108	24	109	49	58	11	102	22	102	20	22	7	7	7	35	35	0	0
Estuary Flats	18	0	43	34	43	31	0	7	43	18	43	0	0	0	0	0	0	0	0	0
Clough Island	14	0	10	0	10	5	0	10	10	10	10	0	0	10	10	10	50	0	50	50
Reference Sites	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	20	20	20	20
Total Sediment Samples		**109**	**388**	**203**	**389**	**112**	**106**	**42**	**382**	**90**	**379**	**44**	**82**	**31**	**31**	**24**	**120**	**70**	**70**	**70**
Field Quality Control Samples																				
Field Split / Duplicates (10% of samples)		20	42	26	43	17	16	10	42	2	42	7	15	0	0	0	0	0	0	0
Matrix Spike / Matrix Spike Duplicates[3] (5% of samples)		8	22	15	23	10	10	0	22	0	1	0	0	0	0	0	0	0	0	0
Total Field Quality Control Samples		**28**	**64**	**41**	**66**	**27**	**26**	**10**	**64**	**2**	**43**	**7**	**15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Samples		**137**	**452**	**244**	**455**	**139**	**132**	**52**	**446**	**92**	**422**	**51**	**97**	**31**	**31**	**24**	**120**	**70**	**70**	**70**

NOTES:
AES = Atomic emission spectroscopy
ASTM = ASTM International
C8-C40 = 8 carbon-chain to 40 carbon-chain
CLP = Contract Laboratory Program
EPA = U.S. Environmental Protection Agency
GC/MS = Gas chromatography/mass spectrometry
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1. 34 PAHs include: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(g,h,i)perylene, benzo(k)fluoranthene, c1 chrysenes, c1 fluorenes, c1-fluoranthenes/pyrenes, c1-naphthalenes, c1-phenanthrenes/anthracenes, c2 chrysenes, c2 fluorenes, c2-naphthalenes, c2-phenanthrenes/anthracenes, c3 chrysenes, c3 fluorenes, c3-naphthalenes, c3-phenanthrenes/anthracenes, c4 chrysenes, c4-naphthalenes, c4-phenanthrenes/anthracenes, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, perylene, phenanthrene, pyrene.

2. SVOCs include 18 PAHS: 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(e)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-c,d)pyrene, naphthalene, phenanthrene, pyrene.

3. For MS/MSD samples, double volume was submitted for analysis

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TABLE 4-1 SUMMARY OF SEDIMENT RESULTS - HALLET DOCK 8 SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	16	0	160	ug/kg	SW15-SLB02-SURF	8	13	18				0	0	0		7
1,2-Dichlorobenzene	16	0	120	ug/kg	SW15-SLB02-SURF	23		23				0	0	0		7
1,4-Dichlorobenzene	16	0	120	ug/kg	SW15-SLB02-SURF	31	61	90				0	0	0		7
Benzene	16	0	110	ug/kg	SW15-SLB02-SURF	57	84	110				0	0	0		7
Toluene	16	1	650	ug/kg	SW15-SLB02-SURF	890	1,345	1,800				0	0	0		7
Xylenes, total	16	0	240	ug/kg	SW15-SLB02-SURF	25	38	50				0	0	0		7
SVOCS																
2,4-Dimethylphenol	36	25	520	ug/kg	ND20-HD04-2030	290		290	3		3	8	0	8	2	7
2-Methylnaphthalene	36	31	2,400	ug/kg	ND20-HD04-2030	20	111	201	21	18	15	58	50	42	7	7
2-Methylphenol	36	23	320	ug/kg	ND20-HD04-2030	6700		6,700				0	0	0		7
Acenaphthene	36	28	370	ug/kg	ND20-HD03-0310	6.7	48	89	20	11	9	56	31	25	7	7
Acenaphthylene	36	24	300	ug/kg	ND20-HD04-0310	5.9	67	128	16	4	1	44	11	3	6	7
Anthracene	36	30	690	ug/kg	ND20-HD03-0310	57.2	451	845	15	5		42	14	0	6	7
Benzo(a)anthracene	36	29	1,600	ug/kg	ND20-HD03-0310	108	579	1,050	15	7	3	42	19	8	7	7
Benzo(a)pyrene	36	29	1,400	ug/kg	ND20-HD03-0310	150	800	1,450	12	4		33	11	0	5	7
Benzo(b)fluoranthene	36	29	1,500	ug/kg	ND20-HD01-SURF	240	6,820	13,400	12			33	0	0	5	7
Benzo(e)pyrene	31	28	1,200	ug/kg	ND20-HD03-0310	150	800	1,450	11	2		35	6	0	4	6
Benzo(g,h,I)perylene	36	29	940	ug/kg	ND20-HD03-0310	170	1,685	3,200	12			33	0	0	5	7
Benzo(k)fluoranthene	36	29	500	ug/kg	ND20-HD01-SURF	240	6,820	13,400	6			17	0	0	4	7
Chrysene	36	29	2,200	ug/kg	ND20-HD03-0310	166	728	1,290	12	7	3	33	19	8	5	7
Dibenz(a,h)anthracene	36	26	440	ug/kg	ND20-HD03-0310	33	84	135	13	10	5	36	28	14	6	7
Dibenzofuran	36	31	540	ug/kg	ND20-HD04-2030	150	365	580	7	2		19	6	0	3	7
Diethyl phthalate	36	7	360	ug/kg	ND20-HD04-3040	610	885	1,000				0	0	0		7
Dimethyl phthalate	36	0	75	ug/kg	ND20-HD04-3040	530		530				0	0	0		7
Di-n-butyl phthalate	36	6	450	ug/kg	ND20-HD04-3040	2200	9,600	17,000				0	0	0		7
Di-n-octyl phthalate	36	0	590	ug/kg	ND20-HD04-3040	580	22,790	45,000				0	0	0		7
Fluoranthene	36	32	3,200	ug/kg	ND20-HD01-SURF	423	1,327	2,230	11	6	2	31	17	6	5	7
Fluorene	36	30	620	ug/kg	ND20-HD03-0310	77.4	307	536	12	5	1	33	14	3	5	7
Indeno(1,2,3-c,d)pyrene	36	29	720	ug/kg	ND20-HD01-SURF	200	1,700	3,200	10			28	0	0	4	7
Naphthalene	36	29	1,700	ug/kg	ND20-HD04-2030	176	369	561	14	8	6	39	22	17	6	7
Pentachlorophenol	36	0	1,600	ug/kg	ND20-HD04-3040	150	175	200				0	0	0		7
Phenanthrene	36	32	2,900	ug/kg	ND20-HD04-0310	204	687	1,170	12	9	6	33	25	17	5	7
Phenol	36	18	190	ug/kg	ND20-HD04-2030	4200	8,100	12,000				0	0	0		7
Pyrene	36	29	2,800	ug/kg	ND20-HD04-0310	195	858	1,520	14	8	4	39	22	11	6	7
Total PAH18 ND=1/2MDL	36	36	22,090	ug/kg	ND20-HD03-0310	1610	12,205	22,800	15	6		42	17	0	7	7
PCB AROCLORS																
Total PCBs ND=0	6	4	47	ug/kg	ND20-HD01-SURF	60	368	676				0	0	0		4
METALS																
Antimony	36	0	1	mg/kg	ND20-HD05-2030	2	14	25				0	0	0		7
Arsenic	36	36	7	mg/kg	ND20-HD04-3040	9.8	21	33				0	0	0		7
Cadmium	36	27	1	mg/kg	SW15-SLB02-SURF	0.99	3	5				0	0	0		7
Chromium	36	36	50	mg/kg	ND20-HD01-0310	43	77	110	1			3	0	0	1	7
Copper	36	36	25	mg/kg	ND20-HD05-2030	32	91	150				0	0	0		7
Iron	36	36	28,700	mg/kg	SW15-SLB02-SURF	20000	30,000	40,000	2			6	0	0	2	7
Lead	36	36	106	mg/kg	ND20-HD06-3040	36	83	130	1	1		3	3	0	1	7
Manganese	36	36	1,420	mg/kg	ND20-HD01-0310	460	780	1,100	2	1	1	6	3	3	2	7
Mercury	36	17	0	mg/kg	ND20-HD04-3040	0.18	1	1	1			3	0	0	1	7
Nickel	36	36	50	mg/kg	ND20-HD06-2030	23	36	49	2	2	1	6	6	3	1	7
Silver	36	0	0	mg/kg	ND20-HD05-2030	1.6	2	2				0	0	0		7
Zinc	36	36	141	mg/kg	ND20-HD05-2030	120	290	460	2			6	0	0	2	7

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TABLE 4-1 SUMMARY OF SEDIMENT RESULTS - HALLET DOCK 8 SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	3	3	1	pg/g	ND20-HD01-SURF	1	11	22				0	0	0		3
FISH TEQ (ND=1/2RL)	3	3	5.89	pg/g	ND20-HD01-SURF	0.85	11	22	3			100	0	0	3	3
BUTYLTINS																
Tributyltin	3	0	3	ug/kg	ND20-HD01-SURF	0.52	2	3				0	0	0		3

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

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TABLE 4-2 SUMMARY OF SEDIMENT RESULTS - OIL BARGE DOCK
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	131	4	560	ug/kg	ND20-BP03-1012	8	13	18				0	0	0		18
1,2-Dichlorobenzene	131	8	320	ug/kg	SW15-SLB03-SURF	23		23	7		7	5	0	5	3	18
1,4-Dichlorobenzene	131	8	330	ug/kg	SW15-SLB03-SURF	31	61	90	7	7	6	5	5	5	3	18
Benzene	131	12	850	ug/kg	ND20-BP03-6080	57	84	110	7	6	6	5	5	5	4	18
Toluene	131	22	810	ug/kg	ND20-BP03-6080, SW15-SLB03-0520	890	1,345	1,800				0	0	0		18
Xylenes, total	131	26	2,100	ug/kg	ND20-BP03-8010	25	38	50	18	18	17	14	14	13	4	18
SVOCS																
2,4-Dimethylphenol	132	20	730	ug/kg	ND20-BP10-0320	290		290	3		3	2	0	2	2	18
2-Methylnaphthalene	132	119	42,000	ug/kg	ND20-BP03-1012	20	111	201	91	72	64	69	55	48	18	18
2-Methylphenol	132	47	860	ug/kg	ND20-BP03-4060	6700		6,700				0	0	0		18
Acenaphthene	132	81	3,500	ug/kg	ND20-BP03-0320	6.7	48	89	69	40	32	52	30	24	18	18
Acenaphthylene	132	57	230	ug/kg	ND20-BP02-SURFTOX, ND20-BP04-SURF, ND20-BP09-2040	5.9	67	128	39	7	3	30	5	2	17	18
Anthracene	132	101	1,200	ug/kg	ND20-BP03-0320	57.2	451	845	57	13	4	43	10	3	16	18
Benzo(a)anthracene	132	105	3,200	ug/kg	ND20-BP03-SURF	108	579	1,050	66	22	11	50	17	8	17	18
Benzo(a)pyrene	132	103	2,900	ug/kg	ND20-BP03-SURF	150	800	1,450	58	16	3	44	12	2	16	18
Benzo(b)fluoranthene	132	104	2,600	ug/kg	ND20-BP11-0320	240	6,820	13,400	49			37	0	0	16	18
Benzo(e)pyrene	125	96	3,800	ug/kg	ND20-BP03-SURF	150	800	1,450	44	16	6	35	13	5	14	17
Benzo(g,h,I)perylene	131	103	3,000	ug/kg	ND20-BP03-SURF	170	1,685	3,200	49	4		37	3	0	15	18
Benzo(k)fluoranthene	132	104	910	ug/kg	ND20-BP11-0320	240	6,820	13,400	18			14	0	0	8	18
Chrysene	132	106	5,100	ug/kg	ND20-BP03-SURF	166	728	1,290	62	25	17	47	19	13	17	18
Dibenz(a,h)anthracene	132	78	1,200	ug/kg	ND20-BP03-SURF	33	84	135	61	41	29	46	31	22	18	18
Dibenzofuran	132	99	4,100	ug/kg	ND20-BP03-1012	150	365	580	38	27	19	29	20	14	12	18
Diethyl phthalate	132	21	1,100	ug/kg	ND20-BP03-4060	610	885	1,000				0	0	0		18
Dimethyl phthalate	132	0	220	ug/kg	ND20-BP03-4060	530		530				0	0	0		18
Di-n-butyl phthalate	132	9	1,300	ug/kg	ND20-BP03-4060	2200	9,600	17,000				0	0	0		18
Di-n-octyl phthalate	132	0	1,800	ug/kg	ND20-BP03-4060	580	22,790	45,000				0	0	0		18
Fluoranthene	132	119	4,500	ug/kg	ND20-BP11-0320	423	1327	2230	46	15	6	35	11	5	15	18
Fluorene	132	109	4,900	ug/kg	ND20-BP03-0320	77.4	307	536	52	33	28	39	25	21	15	18
Indeno(1,2,3-c,d)pyrene	132	102	1,300	ug/kg	ND20-BP04-8010, ND20-BP11-0320	200	1700	3200	31			23	0	0	14	18
Naphthalene	132	119	12,000	ug/kg	ND20-BP03-1012	176	369	561	62	46	38	47	35	29	16	18
Pentachlorophenol	132	0	4,800	ug/kg	ND20-BP03-4060	150	175	200				0	0	0		18
Phenanthrene	132	119	12,000	ug/kg	ND20-BP03-0320, ND20-BP03-SURF	204	687	1,170	59	39	33	45	30	25	16	18
Phenol	132	18	910	ug/kg	ND20-BP03-4060	4200	8100	12,000				0	0	0		18
Pyrene	132	110	5,000	ug/kg	ND20-BP03-1012, ND20-BP03-SURF	195	858	1,520	67	30	19	51	23	14	17	18
Total PAH18 ND=1/2MDL	132	132	93,410	ug/kg	ND20-BP03-1012	1610	12205	22800	72	30	19	55	23	14	18	18
PCB AROCLORS																
Total PCBs ND=0	13	11	112	ug/kg	SW15-SLB03-6080	60	368	676	2			15	0	0	2	5
METALS																
Antimony	132	22	2	mg/kg	ND20-BP03-8010	2	13.5	25	1			1	0	0	1	18
Arsenic	132	132	132	mg/kg	ND20-BP03-8010	9.8	21.4	33	27	10	7	20	8	5	12	18
Cadmium	132	123	2	mg/kg	SW15-SLB03-0520, SW15-SLB03-2040	1	3.0	5	9			7	0	0	4	18
Chromium	132	132	56	mg/kg	ND20-BP06-SURF	43	76.5	110	7			5	0	0	6	18
Copper	132	132	70	mg/kg	ND20-BP16-4060	32	91	150	26			20	0	0	13	18
Iron	132	132	75,000	mg/kg	ND20-BP03-8010	20000	30000	40000	54	21	12	41	16	9	16	18
Lead	132	132	1,610	mg/kg	ND20-BP05-0320	36	83	130	41	18	8	31	14	6	14	18
Manganese	132	132	1,870	mg/kg	ND20-BP14-0320	460	780	1100	40	15	7	30	11	5	13	18
Mercury	132	56	0	mg/kg	ND20-BP06-SURF, ND20-BP09-0320	0.18	0.64	1.1				0	0	0		18
Nickel	132	132	44	mg/kg	ND20-BP06-SURF	23	36	49	28	3		21	2	0	13	18
Silver	132	14	0	mg/kg	ND20-BP11-0320	1.6	1.9	2.2				0	0	0		18
Zinc	132	132	289	mg/kg	ND20-BP14-2040	120	290	460	33			25	0	0	15	18

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TABLE 4-2 SUMMARY OF SEDIMENT RESULTS - OIL BARGE DOCK
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	4	2	1	pg/g	ND20-BP07-SURF	0.85	11.2	21.5	2			50	0	0	2	4
FISH TEQ (ND=1/2RL)	4	4	13.6	pg/g	ND20-BP07-SURF	0.85	11	22	4	2		100	50	0	4	4
BUTYLTINS																
Tributyltin	4	0	5	ug/kg	ND20-BP05-SURF	0.52	1.73	2.94				0	0	0		4

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

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TABLE 4-3 SUMMARY OF SEDIMENT RESULTS - GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	3	0	11	ug/kg	ND20-GM02-SURF, ND20-GM04-SURF	8	13	18				0	0	0		3
1,2-Dichlorobenzene	3	0	6	ug/kg	ND20-GM02-SURF	23		23				0	0	0		3
1,4-Dichlorobenzene	3	0	3	ug/kg	ND20-GM02-SURF	31	61	90				0	0	0		3
Benzene	3	0	6	ug/kg	ND20-GM02-SURF	57	84	110				0	0	0		3
Toluene	3	0	5	ug/kg	ND20-GM02-SURF	890	1,345	1,800				0	0	0		3
Xylenes, total	3	0	13	ug/kg	ND20-GM02-SURF, ND20-GM04-SURF	25	37.5	50				0	0	0		3
SVOCS																
2,4-Dimethylphenol	67	5	79	ug/kg	ND20-GM01-2040	290		290				0	0	0		14
2-Methylnaphthalene	67	62	3,800	ug/kg	ND20-GM07-4060	20.2	111	201	55	34	24	82	51	36	14	14
2-Methylphenol	67	4	360	ug/kg	ND20-GM01-2040	6,700		6,700				0	0	0		14
Acenaphthene	67	60	4,300	ug/kg	ND20-GM07-4060	6.7	48	89	57	50	47	85	75	70	14	14
Acenaphthylene	67	56	690	ug/kg	ND20-GM04-4060	5.9	67	128	54	26	17	81	39	25	14	14
Anthracene	67	59	5,900	ug/kg	ND20-GM07-4060	57.2	451	845	53	29	20	79	43	30	13	14
Benzo(a)anthracene	67	58	9,400	ug/kg	ND20-GM07-4060	108	579	1,050	53	34	21	79	51	31	13	14
Benzo(a)pyrene	67	58	8,000	ug/kg	ND20-GM07-4060	150	800	1,450	50	20	16	75	30	24	13	14
Benzo(b)fluoranthene	67	58	8,600	ug/kg	ND20-GM07-4060	240	6,820	13,400	48	1		72	1	0	13	14
Benzo(e)pyrene	67	58	4,600	ug/kg	ND20-GM07-4060	150	800	1,450	46	16	7	69	24	10	13	14
Benzo(g,h,I)perylene	67	57	5,200	ug/kg	ND20-GM07-4060	170	1,685	3,200	44	4	1	66	6	1	13	14
Benzo(k)fluoranthene	67	58	2,100	ug/kg	ND20-GM07-4060	240	6,820	13,400	30			45	0	0	10	14
Chrysene	67	58	9,600	ug/kg	ND20-GM07-4060	166	728	1,290	51	31	20	76	46	30	13	14
Dibenz(a,h)anthracene	67	56	1,300	ug/kg	ND20-GM07-4060	33	84	135	52	44	28	78	66	42	13	14
Dibenzofuran	67	61	2,000	ug/kg	ND20-GM07-4060	150	365	580	34	17	8	51	25	12	12	14
Diethyl phthalate	67	6	440	ug/kg	ND20-GM01-2040	610	885	1,000				0	0	0		14
Dimethyl phthalate	67	0	94	ug/kg	ND20-GM01-2040	530		530				0	0	0		14
Di-n-butyl phthalate	67	10	550	ug/kg	ND20-GM01-2040	2,200	9,600	17,000				0	0	0		14
Di-n-octyl phthalate	67	0	740	ug/kg	ND20-GM01-2040	580	22,790	45,000				0	0	0		14
Fluoranthene	67	64	19000	ug/kg	ND20-GM07-4060	423	1,327	2,230	50	37	26	75	55	39	13	14
Fluorene	67	62	4700	ug/kg	ND20-GM07-4060	77.4	307	536	49	31	21	73	46	31	13	14
Indeno(1,2,3-c,d)pyrene	67	57	4100	ug/kg	ND20-GM07-4060	200	1,700	3,200	42	3	1	63	4	1	13	14
Naphthalene	67	58	5100	ug/kg	ND20-GM07-4060	176	369	561	37	23	15	55	34	22	13	14
Pentachlorophenol	67	0	2,000	ug/kg	ND20-GM01-2040, ND20-GM02-4060, ND20-GM03-2040	150	175	200				0	0	0		14
Phenanthrene	67	67	26000	ug/kg	ND20-GM07-4060	204	687	1,170	53	40	32	79	60	48	13	14
Phenol	67	2	380	ug/kg	ND20-GM01-2040	4,200	8,100	12,000				0	0	0		14
Pyrene	67	61	24000	ug/kg	ND20-GM07-4060	195	858	1,520	55	42	33	82	63	49	13	14
Total PAH18 ND=1/2MDL	67	67	146140	ug/kg	ND20-GM07-4060	1,610	12,205	22,800	53	28	18	79	42	27	13	14
PCB AROCLORS																
Total PCBs ND=0	22	20	650	ug/kg	ND20-GM05-2040	60	368	676	3	1		14	5	0	2	8
METALS																
Antimony	77	20	2.2	mg/kg	SW15-SLB06-4060	2	13.5	25	1			1	0	0	1	17
Arsenic	77	77	7	mg/kg	ND20-GM02-0320	9.8	21.4	33				0	0	0		17
Cadmium	77	77	1.4	mg/kg	SW15-SLB06-4060	0.99	3	5	8			10	0	0	5	17
Chromium	77	77	41.5	mg/kg	ND20-GM04-SURF	43	76.5	110				0	0	0		17
Copper	77	77	129	mg/kg	ND20-GM08-0320	32	91	150	44	3		57	4	0	12	17
Iron	77	77	36000	mg/kg	ND20-GM02-SURF, ND20-GM04-SURF	20,000	30,000.0	40,000	37	7		48	9	0	14	17
Lead	77	77	345	mg/kg	ND20-GM02-6080	36	83	130	33	10	5	43	13	6	12	17
Manganese	77	77	1130	mg/kg	ND20-GM05-SURF	460	780	1,100	22	3	1	29	4	1	16	17
Mercury	77	40	0.54	mg/kg	ND20-GM02-4060	0.18	0.64	1.1	18			23	0	0	9	17
Nickel	77	77	32.2	mg/kg	ND20-GM02-SURF	23	36	49	17			22	0	0	10	17
Silver	77	22	0.46	mg/kg	ND20-GM08-2040	1.6	1.9	2.2				0	0	0		17
Zinc	77	77	408	mg/kg	SW15-SLB06-4060	120	290	460	37	2		48	3	0	11	17

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TABLE 4-3 SUMMARY OF SEDIMENT RESULTS - GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	3	3	2	pg/g	ND20-GM02-SURF	0.85	11.2	21.5	2			67	0	0	2	3
FISH TEQ (ND=1/2RL)	3	3	65.4	pg/g	ND20-GM02-SURF	0.85	11	22	3	2	2	100	67	67	3	3
BUTYLTINS																
Tributyltin	39	9	81	ug/kg	ND20-GM09-4060	0.52	1.73	2.94	9	8	7	23	21	18	5	11

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

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TABLE 4-4 SUMMARY OF SEDIMENT RESULTS - TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	29	1	320	ug/kg	SW15-SLB14-SURF	8	13	18				0	0	0		12
1,2-Dichlorobenzene	29	1	240	ug/kg	SW15-SLB14-SURF	23		23				0	0	0		12
1,4-Dichlorobenzene	29	0	250	ug/kg	SW15-SLB14-SURF	31	61	90				0	0	0		12
Benzene	29	0	230	ug/kg	SW15-SLB14-SURF	57	84	110				0	0	0		12
Toluene	29	4	290	ug/kg	SW15-SLB14-SURF	890	1,345	1,800				0	0	0		12
Xylenes, total	29	3	500	ug/kg	SW15-SLB14-SURF	25	37.5	50				0	0	0		12
SVOCS																
2,4-Dimethylphenol	116	3	410	ug/kg	ND20-TB01-4060	290		290				0	0	0		25
2-Methylnaphthalene	116	106	16,000	ug/kg	ND20-TB03-6080	20.2	111	201	93	71	59	80	61	51	25	25
2-Methylphenol	116	4	1,900	ug/kg	ND20-TB01-4060	6,700		6,700				0	0	0		25
Acenaphthene	116	100	6,500	ug/kg	ND20-TB09-2040	6.7	48	89	92	71	59	79	61	51	25	25
Acenaphthylene	116	85	950	ug/kg	ND20-TB01-6080	5.9	67	128	81	46	25	70	40	22	23	25
Anthracene	116	103	9,100	ug/kg	ND20-TB09-2040	57.2	451	845	88	37	27	76	32	23	24	25
Benzo(a)anthracene	116	103	15,000	ug/kg	ND20-TB09-2040	108	579	1,050	92	57	41	79	49	35	24	25
Benzo(a)pyrene	116	101	13,000	ug/kg	ND20-TB09-2040	150	800	1,450	89	47	35	77	41	30	23	25
Benzo(b)fluoranthene	116	101	14,000	ug/kg	ND20-TB09-2040	240	6,820	13,400	84	8	1	72	7	1	22	25
Benzo(e)pyrene	109	94	6,900	ug/kg	ND20-TB09-2040	150	800	1,450	77	35	23	71	32	21	19	22
Benzo(g,h,I)perylene	116	101	8,100	ug/kg	ND20-TB09-2040	170	1,685	3,200	83	24	11	72	21	9	22	25
Benzo(k)fluoranthene	116	101	5,500	ug/kg	ND20-TB09-2040	240	6,820	13,400	59			51	0	0	17	25
Chrysene	116	104	14,000	ug/kg	ND20-TB09-2040	166	728	1,290	91	57	39	78	49	34	24	25
Dibenz(a,h)anthracene	116	93	2,200	ug/kg	ND20-TB09-2040	33	84	135	86	68	58	74	59	50	24	25
Dibenzofuran	116	88	5,300	ug/kg	ND20-TB09-2040	150	365	580	30	19	12	26	16	10	11	25
Diethyl phthalate	116	7	2,300	ug/kg	ND20-TB01-4060	610	885	1,000				0	0	0		25
Dimethyl phthalate	116	2	480	ug/kg	ND20-TB01-4060	530		530				0	0	0		25
Di-n-butyl phthalate	116	18	2,900	ug/kg	ND20-TB01-4060	2,200	9,600	17,000				0	0	0		25
Di-n-octyl phthalate	116	1	3,800	ug/kg	ND20-TB01-4060	580	22,790	45,000				0	0	0		25
Fluoranthene	116	106	45000	ug/kg	ND20-TB09-2040	423	1,327	2,230	83	54	40	72	47	34	21	25
Fluorene	116	102	6700	ug/kg	ND20-TB09-2040	77.4	307	536	72	38	30	62	33	26	18	25
Indeno(1,2,3-c,d)pyrene	116	101	7300	ug/kg	ND20-TB09-2040	200	1,700	3,200	73	16	10	63	14	9	20	25
Naphthalene	116	103	5500	ug/kg	ND20-TB09-2040	176	369	561	62	32	21	53	28	18	15	25
Pentachlorophenol	116	0	10,000	ug/kg	ND20-TB01-4060	150	175	200				0	0	0		25
Phenanthrene	116	114	51000	ug/kg	ND20-TB09-2040	204	687	1,170	83	62	44	72	53	38	21	25
Phenol	116	5	2000	ug/kg	ND20-TB01-4060	4,200	8,100	12,000				0	0	0		25
Pyrene	116	105	28000	ug/kg	ND20-TB09-2040	195	858	1,520	93	63	46	80	54	40	24	25
Total PAH18 ND=1/2MDL	116	116	239790	ug/kg	ND20-TB09-2040	1,610	12,205	22,800	92	45	31	79	39	27	24	25
PCB AROCLORS																
Total PCBs ND=0	72	58	4,140	ug/kg	ND20-TB03-0320	60	368	676	39	1	1	54	1	1	13	19
METALS																
Antimony	133	61	2.9	mg/kg	ND20-TB01-6080	2	13.5	25	4			3	0	0	4	30
Arsenic	133	133	11	mg/kg	SW15-SLB13-SURF	9.8	21.4	33	2			2	0	0	2	30
Cadmium	133	130	3.3	mg/kg	ND20-TB02-1416	0.99	3	5	29	1		22	1	0	12	30
Chromium	133	133	51.1	mg/kg	ND20-TB01-0320	43	76.5	110	20			15	0	0	13	30
Copper	133	133	151	mg/kg	SW15-SLB11-6080	32	91	150	94	15	1	71	11	1	23	30
Iron	133	133	46200	mg/kg	ND20-TB07-SURF	20,000	30,000.0	40,000	94	32	5	71	24	4	29	30
Lead	133	133	2070	mg/kg	ND20-TB02-1416	36	83	130	85	44	27	64	33	20	23	30
Manganese	133	133	1190	mg/kg	ND20-TB19-SURF	460	780	1,100	67	17	2	50	13	2	30	30
Mercury	133	88	11.3	mg/kg	ND20-TB01-8010	0.18	0.64	1.1	53	28	18	40	21	14	14	30
Nickel	133	133	43.7	mg/kg	ND20-TB15-1723	23	36	49	77	14		58	11	0	25	30
Silver	133	55	5.5	mg/kg	ND20-TB01-4060, ND20-TB03-6080	1.6	1.9	2.2	14	9	8	11	7	6	8	30
Zinc	133	133	732	mg/kg	SW15-SLB11-6080	120	290	460	76	18	8	57	14	6	23	30

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TABLE 4-4 SUMMARY OF SEDIMENT RESULTS - TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	11	10	3	pg/g	ND20-TB07-0320	0.85	11.2	21.5	7			64	0	0	5	7
FISH TEQ (ND=1/2RL)	11	11	20.6	pg/g	ND20-TB07-SURF	0.85	11	22	11	7		100	64	0	7	7
BUTYLTINS																
Tributyltin	54	17	64	ug/kg	ND20-TB16-0320	0.52	1.73	2.94	17	14	12	31	26	22	10	18

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

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TABLE 4-5 SUMMARY OF SEDIMENT RESULTS - ESTUARY FLATS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	34	0	16	ug/kg	ND20-EF06-4060	8	13	18				0	0	0		9
1,2-Dichlorobenzene	34	0	9	ug/kg	ND20-EF06-4060	23		23				0	0	0		9
1,4-Dichlorobenzene	34	0	5	ug/kg	ND20-EF06-4060	31	61	90				0	0	0		9
Benzene	34	0	9	ug/kg	ND20-EF06-4060	57	84	110				0	0	0		9
Toluene	34	0	7	ug/kg	ND20-EF06-4060	890	1,345	1,800				0	0	0		9
Xylenes, total	34	0	19	ug/kg	ND20-EF06-4060	25	37.5	50				0	0	0		9
SVOCS																
2,4-Dimethylphenol	43	16	100	ug/kg	ND20-EF06-4060	290		290				0	0	0		18
2-Methylnaphthalene	43	35	820	ug/kg	ND20-EF04-SURF	20.2	111	201	22	10	7	51	23	16	12	18
2-Methylphenol	43	9	460	ug/kg	ND20-EF06-4060	6,700		6,700				0	0	0		18
Acenaphthene	43	30	230	ug/kg	ND20-EF03-3550	6.7	48	89	20	4	1	47	9	2	12	18
Acenaphthylene	43	29	110	ug/kg	ND20-EF07-4060	5.9	67	128	17	1		40	2	0	12	18
Anthracene	43	33	420	ug/kg	ND20-EF03-3550	57.2	451	845	8			19	0	0	5	18
Benzo(a)anthracene	43	34	650	ug/kg	ND20-EF07-4060	108	579	1,050	17	1		40	2	0	11	18
Benzo(a)pyrene	43	33	610	ug/kg	ND20-EF07-4060	150	800	1,450	10			23	0	0	6	18
Benzo(b)fluoranthene	43	34	670	ug/kg	ND20-EF07-4060	240	6,820	13,400	6			14	0	0	3	18
Benzo(e)pyrene	43	34	450	ug/kg	ND20-EF04-SURF	150	800	1,450	7			16	0	0	4	18
Benzo(g,h,I)perylene	43	30	480	ug/kg	ND20-EF08-4060	170	1,685	3,200	7			16	0	0	4	18
Benzo(k)fluoranthene	43	34	230	ug/kg	ND20-EF07-4060	240	6,820	13,400				0	0	0	5	18
Chrysene	43	34	630	ug/kg	ND20-EF07-4060	166	728	1,290	9			21	0	0	8	18
Dibenz(a,h)anthracene	43	28	200	ug/kg	ND20-EF06-4060	33	84	135	13	4	1	30	9	2	2	18
Dibenzofuran	43	35	310	ug/kg	ND20-EF03-3550	150	365	580	2			5	0	0		18
Diethyl phthalate	43	18	220	ug/kg	ND20-EF07-4060	610	885	1,000				0	0	0		18
Dimethyl phthalate	43	0	120	ug/kg	ND20-EF06-4060	530		530				0	0	0		18
Di-n-butyl phthalate	43	10	700	ug/kg	ND20-EF06-4060	2,200	9,600	17,000				0	0	0		18
Di-n-octyl phthalate	43	0	930	ug/kg	ND20-EF06-4060	580	22,790	45,000				0	0	0		18
Fluoranthene	43	36	1000	ug/kg	ND20-EF07-4060	423	1,327	2,230	5			12	0	0	3	18
Fluorene	43	33	390	ug/kg	ND20-EF03-3550	77.4	307	536	6	1		14	2	0	4	18
Indeno(1,2,3-c,d)pyrene	43	33	330	ug/kg	ND20-EF07-4060	200	1,700	3,200	2			5	0	0	2	18
Naphthalene	43	35	680	ug/kg	ND20-EF03-3550	176	369	561	9	6	3	21	14	7	6	18
Pentachlorophenol	43	0	2,600	ug/kg	ND20-EF06-4060	150	175	200				0	0	0		18
Phenanthrene	43	39	1200	ug/kg	ND20-EF03-3550	204	687	1,170	9	1	1	21	2	2	6	18
Phenol	43	4	190	ug/kg	ND20-EF07-4060	4,200	8,100	12,000				0	0	0		18
Pyrene	43	36	1300	ug/kg	ND20-EF03-3550	195	858	1,520	12	2		28	5	0	6	18
Total PAH18 ND=1/2MDL	43	43	8850	ug/kg	ND20-EF03-3550	1,610	12,205	22,800	12			28	0	0	7	18
PCB AROCLORS																
Total PCBs ND=0	35	18	170	ug/kg	ND20-EF03-SURF	60	368	676	1			3	0	0	1	16
METALS																
Antimony	50	3	1.3	mg/kg	ND20-EF03-3550	2	13.5	25				0	0	0		19
Arsenic	50	50	14	mg/kg	ND20-EF03-0310	9.8	21.4	33	1			2	0	0	1	19
Cadmium	50	43	1	mg/kg	ND20-EF07-4060	0.99	3	5	1			2	0	0	1	19
Chromium	50	50	42.8	mg/kg	ND20-EF07-4060	43	76.5	110				0	0	0		19
Copper	50	50	260	mg/kg	ND20-EF03-SURF	32	91	150	3	1	1	6	2	2	3	19
Iron	50	50	36800	mg/kg	ND20-EF07-4060	20,000	30,000.0	40,000	13	1		26	2	0	7	19
Lead	50	50	43.5	mg/kg	ND20-EF07-4060	36	83	130	3			6	0	0	2	19
Manganese	50	50	1020	mg/kg	ND20-EF15-SURF	460	780	1,100	12	2		24	4	0	9	19
Mercury	50	29	0.28	mg/kg	ND20-EF06-2040, ND20-EF07-4060	0.18	0.64	1.1	3			6	0	0	3	19
Nickel	50	50	33.1	mg/kg	ND20-EF07-4060	23	36	49	3			6	0	0	3	19
Silver	50	2	0.21	mg/kg	ND20-EF15-SURF	1.6	1.9	2.2				0	0	0		19
Zinc	50	50	215	mg/kg	ND20-EF07-4060	120	290	460	4			8	0	0	2	19

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TABLE 4-5 SUMMARY OF SEDIMENT RESULTS - ESTUARY FLATS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	7	6	2.22	pg/g	ND20-EF15-SURF	0.85	11.2	21.5	1			14	0	0	1	7
FISH TEQ (ND=1/2RL)	7	7	14.4	pg/g	ND20-EF09-SURF	0.85	11.2	21.5	7	3		100	43	0	7	7

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

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TABLE 4-6 SUMMARY OF SEDIMENT RESULTS - CLOUGH ISLAND
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
SVOCS																
2,4-Dimethylphenol	10	0	58	ug/kg	ND20-CL06-SURF	290		290				0	0	0		10
2-Methylnaphthalene	10	10	60	ug/kg	ND20-CL08-SURF	20.2	111	201	6			60	0	0	6	10
2-Methylphenol	10	0	270	ug/kg	ND20-CL06-SURF	6,700		6,700				0	0	0		10
Acenaphthene	10	6	52	ug/kg	ND20-CL07-SURF	6.7	48	89	6			60	0	0	6	10
Acenaphthylene	10	9	180	ug/kg	ND20-CL09-SURF	5.9	67	128	8	5	1	80	50	10	8	10
Anthracene	10	10	520	ug/kg	ND20-CL02-SURF	57.2	451	845	6	1		60	10	0	6	10
Benzo(a)anthracene	10	10	1,300	ug/kg	ND20-CL02-SURF	108	579	1,050	7	3	1	70	30	10	7	10
Benzo(a)pyrene	10	10	1,200	ug/kg	ND20-CL02-SURF	150	800	1,450	6	1		60	10	0	6	10
Benzo(b)fluoranthene	10	10	1,300	ug/kg	ND20-CL02-SURF	240	6,820	13,400	6			60	0	0	6	10
Benzo(e)pyrene	10	10	670	ug/kg	ND20-CL02-SURF	150	800	1,450	6			60	0	0	6	10
Benzo(g,h,I)perylene	10	10	840	ug/kg	ND20-CL02-SURF	170	1,685	3,200	6			60	0	0	6	10
Benzo(k)fluoranthene	10	10	480	ug/kg	ND20-CL02-SURF	240	6,820	13,400	3			30	0	0	3	10
Chrysene	10	10	1,100	ug/kg	ND20-CL02-SURF	166	728	1,290	6	1		60	10	0	6	10
Dibenz(a,h)anthracene	10	8	220	ug/kg	ND20-CL02-SURF	33	84	135	7	5	1	70	50	10	7	10
Dibenzofuran	10	10	52	ug/kg	ND20-CL09-SURF	150	365	580				0	0	0		10
Diethyl phthalate	10	1	330	ug/kg	ND20-CL06-SURF	610	885	1,000				0	0	0		10
Dimethyl phthalate	10	0	69	ug/kg	ND20-CL06-SURF	530		530				0	0	0		10
Di-n-butyl phthalate	10	1	410	ug/kg	ND20-CL06-SURF	2,200	9,600	17,000				0	0	0		10
Di-n-octyl phthalate	10	0	540	ug/kg	ND20-CL06-SURF	580	22,790	45,000				0	0	0		10
Fluoranthene	10	10	2,800	ug/kg	ND20-CL02-SURF	423	1,327	2,230	6	2	1	60	20	10	6	10
Fluorene	10	10	120	ug/kg	ND20-CL09-SURF	77.4	307	536	1			10	0	0	1	10
Indeno(1,2,3-c,d)pyrene	10	10	760	ug/kg	ND20-CL02-SURF	200	1,700	3,200	5			50	0	0	5	10
Naphthalene	10	10	100	ug/kg	ND20-CL05-SURF, ND20-CL06-SURF, ND20-CL08-SURF	176	369	561				0	0	0		10
Pentachlorophenol	10	0	1,500	ug/kg	ND20-CL06-SURF, ND20-CL07-SURF	150	175	200				0	0	0		10
Phenanthrene	10	10	630	ug/kg	ND20-CL09-SURF	204	687	1,170	5			50	0	0	5	10
Phenol	10	0	280	ug/kg	ND20-CL06-SURF, ND20-CL07-SURF	4,200	8,100	12,000				0	0	0		10
Pyrene	10	10	1900	ug/kg	ND20-CL02-SURF	195	858	1,520	7	2	1	70	20	10	7	10
Total PAH18 ND=1/2MDL	10	10	13832	ug/kg	ND20-CL02-SURF	1,610	12,205	22,800	7	1		70	10	0	7	10
PCB AROCLORS																
Total PCBs ND=0	19	13	63	ug/kg	SLR16-UR34-2040	60	368	676	1			5	0	0	1	9
METALS																
Antimony	24	7	2.6	mg/kg	SLR16-UR31-0520	2	13.5	25				0	0	0		14
Arsenic	24	24	15	mg/kg	SLR16-UR31-0520	9.8	21.4	33	3			13	0	0	2	14
Cadmium	24	23	1.5	mg/kg	SLR16-UR31-0520	0.99	3	5	7			29	0	0	6	14
Chromium	24	24	83.2	mg/kg	SLR16-UR31-2040	43	76.5	110	2	1		8	4	0	1	14
Copper	24	24	54.3	mg/kg	SLR16-UR31-2040	32	91	150	5			21	0	0	3	14
Iron	24	24	37000	mg/kg	SLR16-UR31-0520	20,000	30,000.0	40,000	15	2		63	8	0	10	14
Lead	24	24	56.6	mg/kg	SLR16-UR29-0520	36	83	130	4			17	0	0	3	14
Manganese	24	24	1390	mg/kg	ND20-CL09-SURF	460	780	1,100	17	10	4	71	42	17	12	14
Mercury	24	21	1.1	mg/kg	SLR16-UR29-0520	0	1	1	9	1		38	4	0	7	14
Nickel	24	24	51.1	mg/kg	SLR16-UR31-2040	23	36	49	11	1	1	46	4	4	8	14
Silver	24	6	0.51	mg/kg	SLR16-UR31-0520	2	2	2				0	0	0		14
Zinc	24	24	236	mg/kg	SLR16-UR29-0520	120	290	460	11			46	0	0	8	14

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TABLE 4-6 SUMMARY OF SEDIMENT RESULTS - CLOUGH ISLAND
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	19	16	2.6	pg/g	ND20-CL05-SURF, ND20-CL08-SURF	1	11	22	10			53	0	0	9	14
FISH TEQ (ND=1/2RL)	18	18	33.0	pg/g	ND20-CL06-SURF	1	11	22	18	10	4	100	56	22	14	14

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

TABLE 4-7 SUMMARY OF SEDIMENT RESULTS - REFERENCE LOCATIONS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
VOCS																
1,2,4-Trichlorobenzene	4	0	13	ug/kg	ND20-SBREF4-SURF	8	13	18				0	0	0		4
1,2-Dichlorobenzene	4	0	7	ug/kg	ND20-SBREF4-SURF	23		23				0	0	0		4
1,4-Dichlorobenzene	4	0	4	ug/kg	ND20-SBREF4-SURF	31	61	90				0	0	0		4
Benzene	4	0	7	ug/kg	ND20-SBREF4-SURF	57	84	110				0	0	0		4
Toluene	4	0	6	ug/kg	ND20-SBREF4-SURF	890	1345	1800				0	0	0		4
Xylenes, total	4	0	16	ug/kg	ND20-SBREF4-SURF	25	37.5	50				0	0	0		4
SVOCS																
2,4-Dimethylphenol	4	0	33	ug/kg	ND20-LFREF3-SURF	290		290				0	0	0		4
2-Methylnaphthalene	4	4	100	ug/kg	ND20-SBREF4-SURF	20.2	111	201	4			100	0	0	4	4
2-Methylphenol	4	0	150	ug/kg	ND20-LFREF3-SURF	6700		6700				0	0	0		4
Acenaphthene	4	4	58	ug/kg	ND20-SBREF4-SURF	6.7	48	89	4	1		100	25	0	4	4
Acenaphthylene	4	4	60	ug/kg	ND20-SBREF4-SURF	5.9	67	128	4			100	0	0	4	4
Anthracene	4	4	140	ug/kg	ND20-SBREF4-SURF	57.2	451	845	1			25	0	0	1	4
Benzo(a)anthracene	4	4	390	ug/kg	ND20-SBREF4-SURF	108	579	1050	3			75	0	0	3	4
Benzo(a)pyrene	4	4	370	ug/kg	ND20-SBREF4-SURF	150	800	1450	1			25	0	0	1	4
Benzo(b)fluoranthene	4	4	450	ug/kg	ND20-SBREF4-SURF	240	6820	13400	1			25	0	0	1	4
Benzo(e)pyrene	4	4	260	ug/kg	ND20-SBREF4-SURF	150	800	1450	1			25	0	0	1	4
Benzo(g,h,I)perylene	4	4	280	ug/kg	ND20-SBREF4-SURF	170	1685	3200	1			25	0	0	1	4
Benzo(k)fluoranthene	4	4	150	ug/kg	ND20-SBREF4-SURF	240	6820	13400				0	0	0		4
Chrysene	4	4	430	ug/kg	ND20-SBREF4-SURF	166	728	1290	1			25	0	0	1	4
Dibenz(a,h)anthracene	4	4	130	ug/kg	ND20-SBREF4-SURF	33	84	135	3	2		75	50	0	3	4
Dibenzofuran	4	4	68	ug/kg	ND20-SBREF4-SURF	150	365	580				0	0	0		4
Diethyl phthalate	4	0	190	ug/kg	ND20-LFREF3-SURF	610	885	1000				0	0	0		4
Dimethyl phthalate	4	0	39	ug/kg	ND20-LFREF3-SURF	530		530				0	0	0		4
Di-n-butyl phthalate	4	1	230	ug/kg	ND20-LFREF3-SURF	2200	9600	17000				0	0	0		4
Di-n-octyl phthalate	4	0	310	ug/kg	ND20-LFREF3-SURF	580	22790	45000				0	0	0		4
Fluoranthene	4	4	820	ug/kg	ND20-SBREF4-SURF	423	1327	2230	1			25	0	0	1	4
Fluorene	4	4	89	ug/kg	ND20-SBREF4-SURF	77.4	307	536	1			25	0	0	1	4
Indeno(1,2,3-c,d)pyrene	4	4	260	ug/kg	ND20-SBREF4-SURF	200	1700	3200	1			25	0	0	1	4
Naphthalene	4	4	140	ug/kg	ND20-SBREF4-SURF	176	369	561				0	0	0		4
Pentachlorophenol	4	0	860	ug/kg	ND20-LFREF3-SURF	150	175	200				0	0	0		4
Phenanthrene	4	4	460	ug/kg	ND20-SBREF4-SURF	204	687	1,170	1			25	0	0	1	4
Phenol	4	0	160	ug/kg	ND20-LFREF3-SURF	4,200	8,100	12,000				0	0	0		4
Pyrene	4	4	730	ug/kg	ND20-SBREF4-SURF	195	858	1,520	2			50	0	0	2	4
Total PAH18 ND=1/2MDL	4	4	5317	ug/kg	ND20-SBREF4-SURF	1,610	12,205	22,800	2			50	0	0	2	4
PCB AROCLORS																
Total PCBs ND=0	4	4	53	ug/kg	ND20-SBREF4-SURF	60	368	676				0	0	0		4
METALS																
Antimony	4	0	1	mg/kg	ND20-KBREF2-SURF, ND20-SLBREF1-SURF	2	13.5	25				0	0	0		4
Arsenic	4	4	7	mg/kg	ND20-SLBREF1-SURF	9.8	21.4	33				0	0	0		4
Cadmium	4	4	0.85	mg/kg	ND20-SBREF4-SURF	0.99	3	5				0	0	0		4
Chromium	4	4	46.9	mg/kg	ND20-SLBREF1-SURF	43	76.5	110	1			25	0	0	1	4
Copper	4	4	35.1	mg/kg	ND20-SBREF4-SURF	32	91	150	2			50	0	0	2	4
Iron	4	4	40000	mg/kg	ND20-SLBREF1-SURF	20,000	30,000.0	40,000	3	1		75	25	0	3	4
Lead	4	4	42.9	mg/kg	ND20-SBREF4-SURF	36	83	130	1			25	0	0	1	4
Manganese	4	4	1490	mg/kg	ND20-SLBREF1-SURF	460	780	1,100	2	2	1	50	50	25	2	4
Mercury	4	3	0.41	mg/kg	ND20-SBREF4-SURF	0.18	0.64	1.1	1			25	0	0	1	4
Nickel	4	4	38.6	mg/kg	ND20-SLBREF1-SURF	23	36	49	3	1		75	25	0	3	4
Silver	4	3	0.36	mg/kg	ND20-SBREF4-SURF	1.6	1.9	2.2				0	0	0		4
Zinc	4	4	170	mg/kg	ND20-SBREF4-SURF	120	290	460	2			50	0	0	2	4

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TABLE 4-7 SUMMARY OF SEDIMENT RESULTS - REFERENCE LOCATIONS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Analyte	Total Number of Submitted Samples	Number of Detects	Maximum Detected Concentration	Units	Maximum Location	TEC[a]	MEC[a]	PEC[a]	Number of Samples Exceeding TEC	Number of Samples Exceeding MEC	Number of Samples Exceeding PEC	Percentage of Samples that Exceed TEC	Percentage of Samples that Exceed MEC	Percentage of Samples That Exceed PEC	Number of Sampling Locations with Exceedances	Total Number of Locations Sampled
DIOXINS																
2,3,7,8-TCDD	4	4	2.4	pg/g	ND20-SBREF4-SURF	0.85	11.2	21.5	2			50	0	0	2	4
FISH TEQ (ND=1/2RL)	4	4	32.3	pg/g	ND20-SBREF4-SURF	0.85	11.2	21.5	4	1	1	100	25	25	4	4
BUTYLTINS																
Tributyltin	4	0	4	ug/kg	ND20-SBREF4-SURF	0.52	1.73	2.94								4

NOTES:
a = Source: Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
MEC = Midpoint Effect Concentration
MDL = Method detection limit
mg/kg = Milligrams per kilogram
NA = Not applicable
ND = Non-detect
NSL = No screening level
pg/g = Picograms per gram
PAH = Polycyclic Aromatic Hydrocarbon
PCB = Polychlorinated Biphenyl
PEC = Probable Effect Concentration
RL = Reporting limit
SVOC = Semivolatile Organic Compound
TCDD = Tetrachlorodibenzo-p-dioxin
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
TOC = Total organic carbon
ug/kg = Micrograms per kilogram
VOC = Volatile Organic Compound

TABLE 4-8 MICROSCOPIC COAL RESULTS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Location Identification	Depth Interval (ft)	Date Sampled	Time Sampled (local)	Result (%)	Units
Hallet Dock 8 Slip					
ND20-HD01-SURF	surf	6/30/2020	15:35	11.0	%
ND20-HD01-1020	1.0-2.0	6/24/2020	10:00	ND	%
ND20-HD03-SURF	surf	6/30/2020	16:50	25.0	%
ND20-HD03-1020	1.0-2.0	6/24/2020	7:45	32.0	%
ND20-HD05-SURF	surf	6/25/2020	8:55	27.0	%
ND20-HD05-1020	1.0-2.0	6/23/2020	15:25	8.0	%
Oil Barge Dock					
ND20-BP01-0320	0.3-2.0	6/27/2020	7:50	72.0	%
ND20-BP01-2040	2.0-4.0	6/27/2020	7:50	4.0	%
ND20-BP02-SURFTOX	surf	7/2/2020	17:42	85.0	%
ND20-BP02-0320	0.3-2.0	6/27/2020	9:30	69.0	%
ND20-BP02-2040	2.0-4.0	6/27/2020	9:30	74.0	%
ND20-BP03-SURFTOX	surf	7/2/2020	19:05	88.0	%
ND20-BP03-2040	2.0-4.0	6/26/2020	13:35	79.0	%
ND20-BP03-4060	4.0-6.0	6/26/2020	13:35	87.0	%
ND20-BP03-6080	6.0-8.0	6/26/2020	13:35	70.0	%
ND20-BP03-8010	8.0-10.0	6/26/2020	13:35	80.0	%
ND20-BP03-1012	10.0-12.0	6/26/2020	13:35	69.0	%
ND20-BP03-1214	12.0-14.0	6/26/2020	13:35	60.0	%
ND20-BP03-1618	16.0-18.0	6/26/2020	13:35	14.0	%
ND20-BP05-SURF	surf	7/1/2020	17:05	6.0	%
ND20-BP05-0320	0.3-2.0	6/27/2020	16:40	47.0	%
ND20-BP05-2040	2.0-4.0	6/27/2020	16:40	23.0	%
ND20-BP06-SURF	surf	6/25/2020	15:05	9.0	%
ND20-BP06-0320	0.3-2.0	6/27/2020	15:00	15.0	%
ND20-BP06-2040	2.0-4.0	6/27/2020	15:00	2.0	%
ND20-BP07-SURF	surf	7/1/2020	17:55	3.0	%
ND20-BP10-SURF	surf	6/25/2020	13:40	9.0	%
ND20-BP10-0320	0.3-2.0	6/25/2020	10:20	61.0	%
ND20-BP11-SURF	surf	6/25/2020	13:20	3.0	%
ND20-BP11-0320	0.3-2.0	6/25/2020	13:20	20.0	%
ND20-BP12-SURF	surf	6/25/2020	12:55	5.0	%
ND20-BP12-0320	0.3-2.0	6/28/2020	13:40	5.0	%
ND20-BP15-SURF	surf	6/25/2020	12:10	3.0	%
ND20-BP15-0320	0.3-2.0	6/25/2020	15:40	17.0	%

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**TABLE 4-8 MICROSCOPIC COAL RESULTS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN**

Location Identification	Depth Interval (ft)	Date Sampled	Time Sampled (local)	Result (%)	Units
ND20-BP16-SURF	surf	6/25/2020	10:15	4.0	%
ND20-BP16-0320	0.3-2.0	6/26/2020	8:55	3.0	%
ND20-BP17-SURF	surf	6/25/2020	9:45	4.0	%
ND20-BP17-0320	0.3-2.0	6/28/2020	15:30	5.0	%
General Mills Slip					
ND20-GM01-SURF	surf	6/28/2020	14:15	6.0	%
ND20-GM01-0320	0.3-2.0	7/2/2020	16:00	8.0	%
ND20-GM01-2040	2.0-4.0	7/2/2020	16:00	3.0	%
ND20-GM02-SURF	surf	7/1/2020	8:30	7.0	%
ND20-GM02-0320	0.3-2.0	7/2/2020	16:40	5.0	%
ND20-GM02-2040	2.0-4.0	7/2/2020	16:40	3.0	%
ND20-GM04-SURF	surf	6/30/2020	18:20	4.0	%
ND20-GM05-SURF	surf	6/28/2020	14:50	4.0	%
ND20-GM05-0320	0.3-2.0	7/2/2020	10:40	3.0	%
ND20-GM05-2040	2.0-4.0	7/2/2020	10:40	4.0	%
ND20-GM07-SURF	surf	6/28/2020	15:20	12.0	%
ND20-GM07-0320	0.3-2.0	7/2/2020	9:45	2.0	%
ND20-GM07-2040	2.0-4.0	7/2/2020	9:45	1.0	%
ND20-GM08-SURF	surf	6/29/2020	18:00	5.0	%
ND20-GM12-SURF	surf	6/28/2020	16:25	4.0	%
ND20-GM12-0320	0.3-2.0	7/2/2020	14:20	2.0	%
ND20-GM14-SURF	surf	6/30/2020	19:00	2.0	%
ND20-GM14-0320	0.3-2.0	7/2/2020	15:10	2.0	%
Tower Avenue Slip					
ND20-TB01-SURF	surf	6/29/2020	14:10	2.0	%
ND20-TB01-2040	2.0-4.0	6/30/2020	14:00	2.0	%
ND20-TB02-SURF	surf	6/28/2020	10:35	9.0	%
ND20-TB02-8010	8.0-10.0	6/30/2020	17:25	9.0	%
ND20-TB03-SURF	surf	6/29/2020	15:05	2.0	%
ND20-TB03-8010	8.0-10.0	7/1/2020	8:00	5.0	%
ND20-TB04-SURF	surf	6/28/2020	10:55	2.0	%
ND20-TB04-2040	2.0-4.0	7/1/2020	10:30	7.0	%
ND20-TB05-SURF	surf	6/28/2020	11:35	2.0	%
ND20-TB05-2040	2.0-4.0	6/29/2020	8:20	1.0	%

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**TABLE 4-8 MICROSCOPIC COAL RESULTS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN**

Location Identification	Depth Interval (ft)	Date Sampled	Time Sampled (local)	Result (%)	Units
ND20-TB06-SURF	surf	6/29/2020	16:00	5.0	%
ND20-TB06-2040	2.0-4.0	6/29/2020	9:30	5.0	%
ND20-TB07-SURF	surf	6/29/2020	12:25	4.0	%
ND20-TB07-2040	2.0-4.0	6/29/2020	11:00	4.0	%
ND20-TB08-SURF	surf	6/28/2020	10:15	5.0	%
ND20-TB08-2040	2.0-4.0	6/29/2020	12:30	3.0	%
ND20-TB09-SURF	surf	6/28/2020	9:37	6.0	%
ND20-TB09-2040	2.0-4.0	6/29/2020	14:20	4.0	%
ND20-TB10-SURF	surf	6/29/2020	13:20	1.0	%
ND20-TB10-2040	2.0-4.0	6/29/2020	7:45	1.0	%
ND20-TB15-SURF	surf	6/29/2020	16:40	2.0	%
ND20-TB20-SURF	surf	7/1/2020	10:05	2.0	%
Reference Areas					
ND20-SLBREF1-SURF	surf	7/1/2020	7:45	ND	%
ND20-KBREF2-SURF	surf	6/30/2020	14:00	ND	%
ND20-LFREF3-SURF	surf	7/3/2020	17:35	1.0	%
ND20-SBREF4-SURF	surf	7/1/2020	18:55	ND	%

NOTE: ft = Foot (feet).
ND = Result not detected

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TABLE 4-9 ALIPHATIC HYDROCARBON SUMMARY
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

		Ion 85 n-Alkanes (C8-C40)				Ion 113 Iso-Alkanes and Isoprenoids			
Sample Location/ Sample ID	**Sample Depth Interval (ft)**	**Compounds Identified (key provided below)**	**Retention Time**	**Peak**		**Compounds Identified (key provided below)**	**Retention Time**	**Peak**	
ND20-BP01	0.3-2.0	C14-C19	37.5-51.6	C15	32.7%	I15-Ph	33.9-49.6	Pr	34.4%
	2.0-4.0	C14-C19	37.5-51.4	C17	32.2%	I13, I15-Ph	33.2-49.3	Pr	35.0%
ND20-BP02	*surftox***	C12-C27	30.5-68.3	C14	19.8%	I13-Ph	33.1-49.4	Pr	35.8%
ND20-BP03	*surftox***	C13-C27,C29	33.3-68.3,71.7	C25	24.9%	I13-Ph	33.3-49.4	Pr	31.2%
	2.0-4.0	C13-C19	32.6-50.0	C19	28.3%	I14, I16-Ph	34.8-50	Pr	33.9%
	4.0-6.0	C11,C12,C15-C21	25.7-56.0	C17	28.8%	I15-Ph	37.5-49.8	Pr	38.8%
	6.0-8.0	C13-C19	33.7-51.5	C14	41.9%	I14-Ph	33.7-49.4	I16	23.7%
	8.0-10.0	C11-C19	25.9-51.8	C17	20.3%	I15-Ph	37.6-49.8	Pr	33.5%
	10.0-12.0	C9, C11-C19	17.0-51.7	C17	18.6%	I10,I11,I15-Ph	20.9-49.8	Pr	33.5%
	12.0-14.0	C12-C19	29.9-51.7	C15	25.60%	I10,I11,I16-Ph	20.4-49.7	Pr	37.6%
ND20-BP05	surf	C12,C17-C23,C25	30.4-64.6	C17	27.0%	I15-Ph	37.5-49.3	Pr	38.8%
	surf (FS)	C14,C17,C18	36.7-49.0	C14	36.4%	I15-Ph	37.6-49.4	Pr	42.3%
	0.3-2.0	C10-C19	24.4-51.5	C17	25.3%	I14-Ph	33.4-49.5	Pr	30.0%
	2.0-4.0	C12-C14, C16-C19	31.2-51.5	C14	23.0%	I14-Ph	33.4-49.4	I14	29.8%
	2.0-4.0 (FS)	C12-C20	31.2-54.0	C14	19.1%	I13-Ph	33.4-49.4	I13	28.7%
ND20-BP07	surf	ND				I18-Pr	44.8-47.1	Pr	78.3%
	surf (FD)	C17,C18	46.3-49.0	C17	59.2%	I18-Ph	45.0-49.3	I18	37.3%
ND20-BP10	surf	ND				I18-Ph	44.8-50.5	Pr	39.2%
	0.3-2.0	C12-C17	30.2-46.6	C16	28.80%	I15-I18	37.1-44.3	I18	37.3%
ND20-BP12	surf	ND				ND			
	0.3-2.0	C15-C18	1.0-8.9	C17	40.0%	I16-Ph	4.9-9.4	Pr	52.4%
ND20-BP15	surf	ND				ND			
	0.3-2.0	C14-C15, C17-C20	37.6-53.9	C17	40.0%	I13, I15-Ph	33.2-49.4	Pr	37.0%
ND20-TB01	surf	C14-C18, C23, C25,C27	37.4-68.3	C25	16.8%	I15-Ph	36.8-49.4	Pr	45.9%
	surf (FS)	C13-C19,C21, C25-C27,C29, C31	34.1-75.0	C25	15.0%	I15-Ph	36.8-49.4	Pr	47.1%
	0.3-2.0	C17-C20	46.6-54.0	C18	40.5%	I18,Ph	44.8-49.4	I18	50.5%
	0.3-2.0 (FD)	C20	53.9	C20	100.0%	I18-Ph	44.8-49.4	I18	49.3%
	2.0-4.0	C14-C23	36.7-61.2	ND	ND	I16-Ph	39.5-49.4	Ph	45.8
ND20-TB03	surf	C14-C21,C23,C25,C27,C29,C31	37.6-75.0	C17	14.9%	I18-Ph	45.0-49.4	Pr	41.3%
	6.0-8.0	C13-C20	33.3-54.0	ND	ND	I13-Ph	33.1-49.4	I18	40.5%
	8.0-10.0	C14,C15,C17-C19	36.8-51.5	C17	28.9%	I13,I15-Ph	33.3-49.4	I18	31.7%
ND20-TB05	surf	C17-C18	47.1-49.4	C17	76.1%	I18-Ph	44.8-49.4	Pr	71.8%
	surf (FS)	C13,C15,C17-C20	34.8-53.7	C17	25.8%	I16-Ph	39.5-49.4	Pr	55.1%
	0.3-2.0	C14-C26	37.6-66.7	C18	33.2%	I13,I15-I18,Ph	33.2-50.0	I18	40.1%
	2.0-4.0	C14-C25	37.6-64.7	C18	31.4%	I13,I15-Ph	33.3-49.4	Ph	28.9%
ND20-TB06	surf	C13-C20,C25,C27	34.5-68.3	C17	18.6%	I15-Ph	37.5-49.4	Ph	37.3%
ND20-TB07	surf	C14-C21,C23,C25,C27,C28	37.3-70.1	C17	13.1%	I15-Ph	37.3-49.4	Pr	56.6%
	0.3-2.0	C13-C25	34.8-64.7	C18	32.50%	I13-Ph	33.3-49.4	Ph	31.4%
	2.0-4.0	C14-C23	37.7-61.2	C18	37.8%	I13,I15-Ph	33.3-49.5	Ph	37.7%
ND20-TB10	surf	C14-C20,C25,C27	37.3-68.3	C17	18.3%	I13,I15-Ph	32.9-49.4	Ph	31.5%
	0.3-2.0	C14-C23	37.7-61.2	C18	37.8%	I13,I15-Ph	33.3-49.5	Ph	37.7%
	2.0-4.0	ND				I18,Ph	44.8-50.5	Ph	75.9%
ND20-TB15	surf	C14-C21,C23,C25-C27	37.3-68.3	C17	15.0%	I15-Ph	37.3-49.4	Ph	35.9%
ND20-TB17	surf	C15-C23	40.6-60.6	C17	15.5%	I18-Ph	44.8-49.4	Pr	59.4%
	0.3-2.0	ND				I18-Ph	44.4-49.4	Pr	58.0%
ND20-TB20	surf	ND				I18-Pr	44.8-47.1	Pr	65.7%
ND20-SLBREF1	surf	C21	55.5	C21	100.0%	I18-Pr	44.8-47.1	I18	50.5%
ND20-KBREF2	surf	C17,C18,C21	47.1-55.5	C21	53.6%	I18-Pr	44.8-47.1	Pr	51.5%
	surf (FS)	C15-C18,C21	40.5-55.5	C21	30.7%	I18-Pr	44.8-47.1	Pr	54.4%
ND20-LFREF3	surf	ND				I18-Pr	44.8-47.1	Pr	53.4%
ND20-SBREF4	surf	C17-C22	46.6-57.1	C18	36.2%	I16-Ph	39.4-49.3	Pr	43.4%

Notes:
ND-Not Detected

n-Alkanes (C8-C40)		
n-Octane nC8	n-Nonadecane nC19	n-Triacontane nC30
n-Nonane nC9	n-icosane nC20	n-Hentriacontane nC31
n-Decane nC10	n-Henicosane nC21	n-Dotriacontane nC32
n-Undecane nC11	n-Docosane nC22	n-Tritriacontane nC33
n-Dodecane nC12	n-Tricosane nC23	n-Tetratriacontane nC34
n-Tridecane nC13	n-Tetracosane nC24	n-Pentatriacontane nC35
n-Tetradecane nC14	n-Pentacosane nC25	n-Hexatriacontane nC36
n-Pentadecane nC15	n-Hexacosane nC26	n -Heptatriacontane nC37
n-Hexadecane nC16	n-Heptacosane nC27	n -Octatriacontane nC38
n-Heptadecane nC17	n-Octacosane nC28	n -Nonatriacontane nC39
n-Octadecane nC18	n-Nonacosane nC29	n-Tetracontane nC40

Iso-Alkanes and Isoprenoids (I9-Ph)
Iso-alkane w/ 9 Carbon Atoms I-9
Iso-alkane w/ 10 Carbon Atoms I-10
Iso-alkane w/ 11 Carbon Atoms I-11
Iso-alkane w/ 12 Carbon Atoms I-12
Iso-alkane w/ 13 Carbon Atoms I-13
Iso-alkane w/ 14 Carbon Atoms I-14
Farnesane (Isoprenoid - C15) I-15
Iso-alkane w/ 16 Carbon Atoms I-16
Iso-alkane w/ 18 Carbon Atoms I-18
Pristane (Isoprenoid - C19) Pr
Phytane (Isoprenoid - C20) Ph

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TABLE 5-1: SUMMARY OF SURVIVAL AND GROWTH RESULTS FOR *CHIRONOMOUS DILUTUS,* NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Sample Identification	EA Accession Number	10-Day Survival (percent)	Mean Ash Free Dry Weight as mg/Organism (±SD)
Control Sediments			
Laboratory Control	AT0-593	86	1.184 (±0.174)
Laboratory Control	AT0-593	96	1.229 (±0.254)
Laboratory Control	AT0-593	91	1.125 (±0.370)
Reference Sediments			
ND20-KBREF2-SURFTOX	AT0-537	81	0.630 (±0.193)
ND20-LFREF3-SURFTOX	AT0-538	74	0.925 (±0.198)
ND20-SBREF4-SURFTOX	AT0-539	78	0.580 (±0.240)
ND20-SLBREF1-SURFTOX	AT0-540	83	0.816 (±0.124)
Site Sediments			
ND20-BP02-SURFTOX	AT0-517	74[abe]	1.325 (±0.106)
ND20-BP03-SURFTOX	AT0-518	70[abde]	1.206 (±0.247)
ND20-BP05-SURFTOX	AT0-519	66[abde]	1.236 (±0.178)
ND20-BP07-SURFTOX	AT0-520	80[a]	1.162 (±0.149)
ND20-CL01-SURFTOX	AT0-521	81	0.991 (±0.249)[a]
ND20-CL02-SURFTOX	AT0-522	83	0.982 (±0.200)[a]
ND20-CL03-SURFTOX	AT0-523	75[abe]	1.189 (±0.156)
ND20-CL04-SURFTOX	AT0-524	81[a]	1.078 (±0.171)
ND20-CL05-SURFTOX	AT0-525	68[abde]	1.104 (±0.215)
ND20-CL06-SURFTOX	AT0-526	64[abcde]	0.689 (±0.185)[ac]
ND20-CL07-SURFTOX	AT0-527	65[abde]	1.218 (±0.284)
ND20-CL08-SURFTOX	AT0-528	93	1.163 (±0.136)
ND20-CL09-SURFTOX	AT0-529	71[abe]	1.218 (±0.361)
ND20-CL10-SURFTOX	AT0-530	75[abe]	1.008 (±0.179)[a]
ND20-GM02-SURFTOX	AT0-531	89[a]	0.773 (±0.168)[a]
ND20-GM04-SURFTOX	AT0-532	91[a]	1.005 (±0.190)[a]
ND20-GM08-SURFTOX	AT0-533	80[a]	1.268 (±0.240)
ND20-HD01-SURFTOX	AT0-534	63[abcde]	0.764 (±0.191)[a]
ND20-HD03-SURFTOX	AT0-535	36[abcde]	0.826 (±0.443)[a]
ND20-HD04-SURFTOX	AT0-536	26[abcde]	0.587 (±0.314)[ace]
ND20-TB01-SURFTOX	AT0-541	20[abcde]	0.504 (±0.198)[ace]
ND20-TB03-SURFTOX	AT0-542	41[abcde]	0.861 (±0.424)[a]
ND20-TB06-SURFTOX	AT0-543	55[abcde]	0.714 (±0.259)[ac]

Sample Identification	EA Accession Number	10-Day Survival (percent)	Mean Ash Free Dry Weight as mg/Organism (±SD)
Site Sediments (Cont.)			
ND20-TB07-SURFTOX	AT0-544	41[abcde]	1.031 (±0.312)
ND20-TB10-SURFTOX	AT0-545	53[abcde]	0.802 (±0.421)
ND20-TB15-SURFTOX	AT0-546	61[abcde]	0.791 (±0.274)[a]
ND20-TB20-SURFTOX	AT0-570	86	0.940 (±0.274)

(a) Significantly different (p=0.05) from laboratory control.
(b) Significantly different (p=0.05) from ND20-KBREF2-SURFTOX (AT0-537).
(c) Significantly different (p=0.05) from ND20-LBREF3-SURFTOX (AT0-538).
(d) Significantly different (p=0.05) from ND20-SBREF4-SURFTOX (AT0-539).
(e) Significantly different (p=0.05) from ND20-SLBREF1-SURFTOX (AT0-540).

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TABLE 5-2: SUMMARY OF SURVIVAL, GROWTH AND FECUNDITY RESULTS FOR *HYALELLA AZTECA,* NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Sample Identification	EA Accession Number	28-Day Survival (percent)	Post UV Survival (percent)	Fecundity as Percent Females with Eggs	Mean Dry Weight as mg/Organism (±SD)
Laboratory Control	AT9-730	94	94	71	0.282 (±0.041)
Reference Sediments					
ND20-KBREF2-SURFTOX	AT0-537	86	86	71	0.278 (±0.061)
ND20-LFREF3-SURFTOX	AT0-538	85	85	70	0.279 (±0.045)
ND20-SBREF4-SURFTOX	AT0-539	89	89	76	0.301 (±0.020)
ND20-SLBREF1-SURFTOX	AT0-540	84	84	70	0.293 (±0.063)
Site Sediments					
ND20-BP02-SURFTOX	AT0-517	91	91	67	0.399 (±0.040)
ND20-BP03-SURFTOX	AT0-518	80[a]	80[a]	70	0.449 (±0.098)
ND20-BP05-SURFTOX	AT0-519	83[a]	83[a]	72	0.284 (±0.036)
ND20-BP07-SURFTOX	AT0-520	90	90	63[abcd]	0.258 (±0.061)[d]
ND20-CL01-SURFTOX	AT0-521	79[a]	79[a]	50[abcde]	0.282 (±0.023)[d]
ND20-CL02-SURFTOX	AT0-522	71[abcde]	71[abcde]	51[abcde]	0.252 (±0.055)[d]
ND20-CL03-SURFTOX	AT0-523	79[a]	79[a]	73	0.327 (±0.086)
ND20-CL04-SURFTOX	AT0-524	84[a]	81[ad]	67	0.288 (±0.054)
ND20-CL05-SURFTOX	AT0-525	86[a]	86[a]	63[d]	0.334 (±0.051)
ND20-CL06-SURFTOX	AT0-526	73[abcde]	73[abcde]	64[abcd]	0.464 (±0.106)
ND20-CL07-SURFTOX	AT0-527	74[abcd]	74[abcd]	74	0.371 (±0.090)
ND20-CL08-SURFTOX	AT0-528	86	86	67	0.316 (±0.025)
ND20-CL09-SURFTOX	AT0-529	76[ad]	76[ad]	64[d]	0.286 (±0.065)
ND20-CL10-SURFTOX	AT0-530	90	90	66[d]	0.335 (±0.024)
ND20-GM02-SURFTOX	AT0-531	78[abd]	78[abd]	68	0.305 (±0.084)
ND20-GM04-SURFTOX	AT0-532	68[abcde]	68[abcde]	71	0.398 (±0.071)
ND20-GM08-SURFTOX	AT0-533	76[abcd]	76[abcd]	71	0.351 (±0.028)
ND20-HD01-SURFTOX	AT0-534	85[a]	85[a]	63[abcd]	0.304 (±0.043)
ND20-HD03-SURFTOX	AT0-535	65[abcde]	65[abcde]	62[d]	0.285 (±0.066)
ND20-HD04-SURFTOX	AT0-536	71[abcde]	71[abcde]	42[abcde]	0.364 (±0.091)
ND20-TB01-SURFTOX	AT0-541	63[abcde]	63[abcde]	36[abcde]	0.225 (±0.051)[abcde]
ND20-TB03-SURFTOX	AT0-542	76[abcd]	76[abd]	74	0.255 (±0.088)[d]
ND20-TB06-SURFTOX	AT0-543	81[a]	81[a]	55[abcde]	0.214 (±0.045)[abcde]

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Sample Identification	EA Accession Number	28-Day Survival (percent)	Post UV Survival (percent)	Fecundity as Percent Females with Eggs	Mean Dry Weight as mg/Organism (±SD)
ND20-TB07-SURFTOX	AT0-544	78[abd]	76[abcd]	50[abcde]	0.234 (±0.044)[abcde]
Site Sediments (Cont.)					
ND20-TB10-SURFTOX	AT0-545	61[abcde]	59[abcde]	45[abcde]	0.249 (± 0.049)[d]
ND20-TB15-SURFTOX	AT0-546	90	89	68	0.285 (±0.049)
ND20-TB20-SURFTOX	AT0-570	84[a]	81[a]	72	0.305 (±0.072)

(a) Significantly different (p=0.05) from laboratory control.
(b) Significantly different (p=0.05) from ND20-KBREF2-SURFTOX (AT0-537).
(c) Significantly different (p=0.05) from ND20-LBREF3-SURFTOX (AT0-538).
(d) Significantly different (p=0.05) from ND20-SBREF4-SURFTOX (AT0-539).
(e) Significantly different (p=0.05) from ND20-SLBREF1-SURFTOX (AT0-540)

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TABLE 5-3: MEAN LIPID CONCENTRATIONS (PERCENT OF TOTAL BODY WET WEIGHT) IN *LUMBRICULUS VARIEGATUS* NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

Sample Identification	Worms
Pre-test	0.68
ND20-SLBREF1-SURFTOX	0.3
ND20-KBREF2-SURFTOX	0.348
ND20-LFREF3-SURFTOX	0.303
ND20-SBREF4-SURFTOX	0.42
ND20-GM02-SURFTOX	0.159
ND20-GM04-SURFTOX	0.121
ND20-GM08-SURFTOX	0.093
ND20-TB01-SURFTOX	0.277
ND20-TB03-SURFTOX	0.34
ND20-TB06-SURFTOX	0.297
ND20-TB07-SURFTOX	0.186
ND20-TB10-SURFTOX	0.213
ND20-TB15-SURFTOX	0.13
ND20-TB20-SURFTOX	0.113
ND20-CL01-SURFTOX	0.2
ND20-CL02-SURFTOX	0.244
ND20-CL03-SURFTOX	0.274
ND20-CL04-SURFTOX	0.272
ND20-CL05-SURFTOX	0.205
ND20-CL06-SURFTOX	0.215
ND20-CL07-SURFTOX	0.233
ND20-CL08-SURFTOX	0.218
ND20-CL09-SURFTOX	0.238
ND20-CL10-SURFTOX	0.24

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TABLE 5-4A MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations		
		Pre-test	ND20-SLBREF1-SURFTOX	ND20-KBREF2-SURFTOX	ND20-LFREF3-SURFTOX	ND20-SBREF4-SURFTOX	ND20-GM02-SURFTOX	ND20-GM04-SURFTOX	ND20-GM08-SURFTOX
Analyte	**Units**	**%Lipids = 0.68**	**%Lipids = 0.3**	**%Lipids = 0.348**	**%Lipids = 0.303**	**%Lipids = 0.42**	**%Lipids = 0.159**	**%Lipids = 0.121**	**%Lipids = 0.093**
METALS									
MERCURY	mg/kg	<0.0197	<0.02	<0.0205	**0.029**	**0.027**	<0.0198	<0.0202	<0.0206
ORGANOTINS									
MONOBUTYLTIN	µg/kg	R	**6.97**	**56.0**	**44.0**	**11.0**	**17.2**	**15.2**	**12.4**
DIBUTYLTIN	µg/kg	**0.97**	**1.13**	**3,125**	**1,501**	**4.37**	**2,060** [1]	**1,980** [1,4]	**864**
TRIBUTYLTIN	µg/kg	<0.6	<0.533	**4.85**	**2.63**	<0.817	**2.88**	**2.71** [1,4]	**10.8**
TETRA-N-BUTYLTIN	µg/kg	<0.763	<0.677	<0.953	<0.72	<1.04	<0.632	**1.84**	<0.492

NOTES:

The mean concentrations presented on the table are not lipid-normalized.

RL = Reporting limit

pg/g = Picogram(s) per gram

mg/kg = Milligram(s) per kilogram

µg/kg = Microgram(s) per kilogram

R = Analyte may or may not be present; result is unusable and was not included in statistical analysis.

[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)

[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)

[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)

[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)

Analyte concentration is significantly higher than the pre-test tissue concentration ($p<0.05$)

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TABLE 5-4B LIPID-NORMALIZED MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - GENERAL MILLS SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LUOIS RIVER AREA OF CONCEERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations		
		Pre-test	**ND20-SLBREF1-SURFTOX**	**ND20-KBREF2-SURFTOX**	**ND20-LFREF3-SURFTOX**	**ND20-SBREF4-SURFTOX**	**ND20-GM02-SURFTOX**	**ND20-GM04-SURFTOX**	**ND20-GM08-SURFTOX**
Analyte	**Units**	**%Lipids = 0.68**	**%Lipids = 0.3**	**%Lipids = 0.348**	**%Lipids = 0.303**	**%Lipids = 0.42**	**%Lipids = 0.159**	**%Lipids = 0.121**	**%Lipids = 0.093**
ORGANOTINS									
MONOBUTYLTIN	µg/kg	R	**19.8**	**164**	**135**	**25.6**	**120**	**153** [1,4]	**143** [1,4]
DIBUTYLTIN	µg/kg	**1.76**	**4.29**	**9,610**	**4,880**	**10.5**	**15,700** [1,4]	**20,400** [1,3,4]	**10,100** [1]
TRIBUTYLTIN	µg/kg	<1.73	<1.86	**14.8**	**8.26**	<1.95	**22.0**	**28.7** [1,4]	**79.1** [1,4]
TETRA-N-BUTYLTIN	µg/kg	<2.19	<2.36	<2.75	<2.43	<2.48	<4.57	**20.0**	<5.92

NOTES:

The mean concentrations presented on the table are lipid-normalized.

RL = Reporting limit

pg/g = Picogram(s) per gram

mg/kg = Milligram(s) per kilogram

µg/kg = Microgram(s) per kilogram

R = Analyte may or may not be present; result is unusable and was not included in statistical analysis.

[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)

[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)

[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)

[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)

Analyte concentration is significantly higher than the pre-test tissue concentration ($p<0.05$)

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TABLE 5-5A MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - TOWER AVENUE SLIP NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations						
		Pre-test	ND20-SLBREF1-SURFTOX	ND20-KBREF2-SURFTOX	ND20-LFREF3-SURFTOX	ND20-SBREF4-SURFTOX	ND20-TB01-SURFTOX	ND20-TB03-SURFTOX	ND20-TB06-SURFTOX	ND20-TB07-SURFTOX	ND20-TB10-SURFTOX	ND20-TB15-SURFTOX	ND20-TB20-SURFTOX
Analyte	Units	%Lipids = 0.68	%Lipids = 0.3	%Lipids = 0.348	%Lipids = 0.303	%Lipids = 0.42	%Lipids = 0.277	%Lipids = 0.34	%Lipids = 0.297	%Lipids = 0.186	%Lipids = 0.213	%Lipids = 0.13	%Lipids = 0.113
METALS													
MERCURY	mg/kg	<0.0197	<0.02	<0.0205	**0.029**	**0.027**	<0.0197	**0.043**	<0.02	<0.0206	<0.0208	<0.021	<0.0203
ORGANOTINS													
MONOBUTYLTIN	µg/kg	R	**6.97**	**56.0**	**44.0**	**11.0**	**8.77**	**15.0**	**6.25**	**6.2**	**3.5**	**11.6**	**25.7**
DIBUTYLTIN	µg/kg	**0.97**	**1.13**	**3,130**	**1,500**	**4.37**	**2.73**	**2.91**	**2.53**	**1.77**	**1.93**	**405**	**2,370** [1]
TRIBUTYLTIN	µg/kg	<0.6	<0.533	**4.85**	**2.63**	<0.817	<0.497	<0.477	<0.44	<0.512	<0.545	**2.33**	**4.2** [1,4]
TETRA-N-BUTYLTIN	µg/kg	<0.763	<0.677	<0.953	<0.72	<1.04	<0.623	<0.6	<0.553	<0.65	<0.69	<0.793	<0.623

NOTES:

The mean concentrations presented on the table are not lipid-normalized.

RL = Reporting limit

pg/g = Picogram(s) per gram

mg/kg = Milligram(s) per kilogram

µg/kg = Microgram(s) per kilogram

R = Analyte may or may not be present; result is unusable and was not included in statistical analysis.

[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)

[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)

[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)

[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)

Analyte concentration is significantly higher than the pre-test tissue concentration ($p<0.05$)

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TABLE 5-5B LIPID-NORMALIZED MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - TOWER AVENUE SLIP
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations						
		Pre-test	**ND20-SLBREF1-SURFTOX**	**ND20-KBREF2-SURFTOX**	**ND20-LFREF3-SURFTOX**	**ND20-SBREF4-SURFTOX**	**ND20-TB01-SURFTOX**	**ND20-TB03-SURFTOX**	**ND20-TB06-SURFTOX**	**ND20-TB07-SURFTOX**	**ND20-TB10-SURFTOX**	**ND20-TB15-SURFTOX**	**ND20-TB20-SURFTOX**
Analyte	**Units**	**%Lipids = 0.68**	**%Lipids = 0.3**	**%Lipids = 0.348**	**%Lipids = 0.303**	**%Lipids = 0.42**	**%Lipids = 0.277**	**%Lipids = 0.34**	**%Lipids = 0.297**	**%Lipids = 0.186**	**%Lipids = 0.213**	**%Lipids = 0.13**	**%Lipids = 0.113**
ORGANOTINS													
MONOBUTYLTIN	µg/kg	R	**19.8**	**164**	**135**	**25.6**	**31.8**	**36.2**	**16.3**	**56.4**	**26.9**	**113**	**221** [1,4]
DIBUTYLTIN	µg/kg	**1.76**	**4.29**	**9,610**	**4,880**	**10.5**	**10.2**	**8.47**	**9.03**	**12.6**	**10.7**	**3,950**	**20,500** [1,4]
TRIBUTYLTIN	µg/kg	<1.73	<1.86	**14.8**	**8.26**	<1.95	<1.78	<1.76	<2.11	<3.15	<2.94	**21.3**	**38.1** [1,4]
TETRA-N-BUTYLTIN	µg/kg	<2.19	<2.36	<2.75	<2.43	<2.48	<2.24	<2.22	<2.66	<3.99	<3.71	<7.05	<6.08

NOTES:
The mean concentrations presented on the table are lipid-normalized.
RL = Reporting limit
pg/g = Picogram(s) per gram
mg/kg = Milligram(s) per kilogram
µg/kg = Microgram(s) per kilogram
R = Analyte may or may not be present; result is unusable and was not included in statistical analysis.
[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)
[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)
[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)
[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)
Analyte concentration is significantly higher than the pre-test tissue concentration (p<0.05)

TABLE 5-6A MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - CLOUGH ISLAND
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations									
		Pre-test	**ND20-SLBREF1-SURFTOX**	**ND20-KBREF2-SURFTOX**	**ND20-LFREF3-SURFTOX**	**ND20-SBREF4-SURFTOX**	**ND20-CL01-SURFTOX**	**ND20-CL02-SURFTOX**	**ND20-CL03-SURFTOX**	**ND20-CL04-SURFTOX**	**ND20-CL05-SURFTOX**	**ND20-CL06-SURFTOX**	**ND20-CL07-SURFTOX**	**ND20-CL08-SURFTOX**	**ND20-CL09-SURFTOX**	**ND20-CL10-SURFTOX**
Analyte	**Units**	**%Lipids = 0.68**	**%Lipids = 0.3**	**%Lipids = 0.348**	**%Lipids = 0.303**	**%Lipids = 0.42**	**%Lipids = 0.2**	**%Lipids = 0.244**	**%Lipids = 0.274**	**%Lipids = 0.272**	**%Lipids = 0.205**	**%Lipids = 0.215**	**%Lipids = 0.233**	**%Lipids = 0.218**	**%Lipids = 0.238**	**%Lipids = 0.24**
METALS																
MERCURY	mg/kg	<0.0197	<0.02	<0.0205	**0.029**	**0.027**	<0.02	<0.0198	<0.0202	<0.021	<0.0205	<0.0203	<0.0205	**0.0254**	<0.0208	<0.0207
DIOXINS																
2,3,7,8-TCDD	pg/g	<1.2	**0.103**	**0.12**	**0.112**	**0.12**	**0.093**	**0.153**	**0.13**	**0.115**	<0.92	**0.18 [1,2,4]**	**0.127**	**0.157**	**0.138**	<1.07
1,2,3,7,8-PECDD	pg/g	<6.03	<6.73	**0.437**	**0.3**	**0.65**	**0.22**	**0.257**	<6.16	**0.273**	**0.247**	**0.272**	**0.27**	**0.362 [1]**	**0.23**	**0.205**
1,2,3,4,7,8-HXCDD	pg/g	<6.03	<6.73	**0.27**	<6.8	**0.42**	**0.19**	**0.24**	**0.12**	<15.2	<4.6	<4.83	<5.2	<4.88	**0.206**	<5.43
1,2,3,6,7,8-HXCDD	pg/g	<6.03	**0.637**	**0.603**	**0.618**	**0.983**	**0.71**	**0.977**	**0.5**	**0.86**	**0.47**	**0.503**	**0.49**	**0.642**	**0.61**	**0.36**
1,2,3,7,8,9-HXCDD	pg/g	<6.03	**0.38**	**0.385**	**0.38**	**0.693**	**0.21**	**1.4**	**0.22**	**0.26**	**0.31**	**0.36**	**0.32**	**0.247**	**0.28**	**0.18**
1,2,3,4,6,7,8-HPCDD	pg/g	**0.167**	**4.17**	**11.8**	**6.85**	**5.0**	**2.54**	**6.25**	**2.06**	**4.15**	**3.18**	**3.1**	**3.5**	**5.42**	**3.66**	**1.9**
OCDD	pg/g	<12	**32.6**	**141**	**56.3**	**28.5**	**14.7**	**45.3**	**12.8**	**30.9**	**21.1**	**19.5**	**21.3**	**43.5**	**26.5**	**9.93**
2,3,7,8-TCDF	pg/g	**0.149**	**0.387**	**0.423**	**0.493**	**0.7**	**0.18**	**0.35**	**0.233**	**0.25**	**0.257**	**0.353**	**0.31**	**0.48**	**0.476**	**0.19**
1,2,3,7,8-PECDF	pg/g	<6.03	<6.73	<7.83	<6.8	<9.4	<15.4	<17.3	<6.16	**0.088**	<4.6	**0.215**	**0.21**	**0.27**	<5.4	<5.43
2,3,4,7,8-PECDF	pg/g	<6.03	**0.293**	**0.28**	**0.29**	**0.583**	**0.197**	**0.12**	**0.088**	**0.155**	**0.16**	**0.205**	**0.21**	**0.247**	**0.179**	**0.13**
1,2,3,4,7,8-HXCDF	pg/g	<6.03	**0.483**	**0.425**	**0.377**	**0.655**	**0.303**	**0.29**	<6.16	**0.407**	**0.283**	**0.318**	**0.33**	**0.458**	**0.323**	**0.22**
1,2,3,6,7,8-HXCDF	pg/g	**0.2**	**3.13**	**2.55**	**3.9**	**5.17**	**1.27**	**1.75**	**0.978**	**1.35**	**1.43**	**1.63**	**1.8**	**2.44**	**1.96**	**1.17**
2,3,4,6,7,8-HXCDF	pg/g	<6.03	**0.15**	<7.83	<6.8	**0.31**	<15.4	<17.3	<6.16	<15.2	<4.6	<4.83	<5.2	<4.88	<5.4	<5.43
1,2,3,7,8,9-HXCDF	pg/g	<6.03	<6.73	<7.82	<6.8	<9.4	<15.4	<17.3	<6.16	<15.1	<4.6	<4.82	<5.2	<4.88	<5.4	<5.43
1,2,3,4,6,7,8-HPCDF	pg/g	<6.03	**9.16**	**5.55**	**8.33**	**15.0**	**6.56**	**9.67**	**4.43**	**9.11**	**5.42**	**5.75**	**5.83**	**7.92**	**5.9**	**3.6**
1,2,3,4,7,8,9-HPCDF	pg/g	<6.03	<6.73	**0.25**	**0.19**	**0.31**	<15.4	**0.27**	<6.16	**0.2**	<4.6	<4.83	<5.2	<4.88	**0.14**	<5.43
OCDF	pg/g	<12	**3.59**	**4.48**	**4.15**	**4.3**	<30.6	**3.6**	<12.4	**8.32**	**3.76**	**2.63**	**4.16**	**3.9**	**2.54**	<10.7
BIRD TEQ (ND=0)	pg/g	**0.106**	**1.29**	**1.13**	**1.18**	**2.12**	**0.647**	**0.93**	**0.455**	**0.716**	**0.796**	**1.11**	**1.03**	**1.43**	**1.35**	**0.521**
BIRD TEQ (ND=1/2RL)	pg/g	**8.89**	**5.78**	**7.93**	**7.13**	**7.57**	**13.4**	**18.7**	**7.51**	**18.8**	**3.94**	**3.31**	**4.04**	**3.88**	**2.29**	**4.28**
FISH TEQ (ND=0)	pg/g	**0.012**	**0.746**	**0.807**	**0.744**	**1.39**	**0.499**	**0.573**	**0.268**	**0.537**	**0.517**	**0.7**	**0.678**	**0.875**	**0.874**	**0.352**
FISH TEQ (ND=1/2RL)	pg/g	**8.04**	**6.58**	**6.88**	**6.91**	**7.79**	**12.7**	**16.6**	**6.96**	**16.9**	**3.61**	**3.27**	**3.82**	**3.84**	**1.68**	**4.38**
WHO TEQ_2005 (ND=0)	pg/g	**0.018**	**0.842**	**0.975**	**0.871**	**1.44**	**0.546**	**0.782**	**0.33**	**0.626**	**0.611**	**0.789**	**0.791**	**1.0**	**0.898**	**0.387**
WHO TEQ_2005 (ND=1/2RL)	pg/g	**6.73**	**5.26**	**5.37**	**5.59**	**6.37**	**9.67**	**12.5**	**5.81**	**13.7**	**2.49**	**2.25**	**2.47**	**2.82**	**1.65**	**3.38**
WHO TEQ_2005 (ND=RL)	pg/g	**13.4**	**9.69**	**9.77**	**10.3**	**11.3**	**18.8**	**24.2**	**11.3**	**26.8**	**4.37**	**3.7**	**4.15**	**4.63**	**2.4**	**6.38**

NOTES:
The mean concentrations presented on the table are not lipid-normalized.
RL = Reporting limit
pg/g = Picogram(s) per gram
mg/kg = Milligram(s) per kilogram
µg/kg = Microgram(s) per kilogram
[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)
[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)
[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)
[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)
Analyte concentration is significantly higher than the pre-test tissue concentration (p<0.05)

TABLE 5-6B LIPID-NORMALIZED MEAN CONCENTRATIONS IN *LUMBRICULUS VARIEGATUS* TISSUES - CLOUGH ISLAND
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

			Reference Areas				Sample Locations									
		Pre-test	**ND20-SLBREF1-SURFTOX**	**ND20-KBREF2-SURFTOX**	**ND20-LFREF3-SURFTOX**	**ND20-SBREF4-SURFTOX**	**ND20-CL01-SURFTOX**	**ND20-CL02-SURFTOX**	**ND20-CL03-SURFTOX**	**ND20-CL04-SURFTOX**	**ND20-CL05-SURFTOX**	**ND20-CL06-SURFTOX**	**ND20-CL07-SURFTOX**	**ND20-CL08-SURFTOX**	**ND20-CL09-SURFTOX**	**ND20-CL10-SURFTOX**
Analyte	**Units**	**%Lipids = 0.68**	**%Lipids = 0.3**	**%Lipids = 0.348**	**%Lipids = 0.303**	**%Lipids = 0.42**	**%Lipids = 0.2**	**%Lipids = 0.244**	**%Lipids = 0.274**	**%Lipids = 0.272**	**%Lipids = 0.205**	**%Lipids = 0.215**	**%Lipids = 0.233**	**%Lipids = 0.218**	**%Lipids = 0.238**	**%Lipids = 0.24**
DIOXINS																
2,3,7,8-TCDD	pg/g	<3.23	**0.367**	**0.429**	**0.448**	**0.364**	**0.465**	**0.656**	**0.489**	**0.407**	<4.49	**0.789** [1,2,4]	**0.517**	**0.725** [1,2,4]	**0.587**	<4.46
1,2,3,7,8-PECDD	pg/g	<16.4	<22.4	**1.27**	**0.811**	**1.23**	**1.10**	**1.28**	<22.5	**0.959**	**1.21**	**1.270**	**1.17**	**1.66** [1,2,3,4]	**1.02**	**0.797**
1,2,3,4,7,8-HXCDD	pg/g	<16.4	<22.4	**0.964**	<22.5	**1.27**	**0.950**	**1.20**	**0.444**	<59.4	<22.4	<22.4	<22.4	<22.4	**0.893**	<22.7
1,2,3,6,7,8-HXCDD	pg/g	<16.4	**2.29**	**1.81**	**2.02**	**2.52**	**3.55**	**4.07**	**1.82**	**3.07**	**2.31**	**2.30**	**2.09**	**2.92**	**2.64**	**1.69**
1,2,3,7,8,9-HXCDD	pg/g	<16.4	**1.36**	**1.24**	**1.81**	**1.66**	**1.05**	**6.76**	**0.815**	**0.813**	**1.55**	**1.57**	**1.33**	**1.12**	**1.23**	**0.90**
1,2,3,4,6,7,8-HPCDD	pg/g	**0.405**	**15.6**	**39.1**	**23.7**	**12.4**	**12.7**	**27.3** [4]	**7.72**	**14.9**	**15.6**	**14.1**	**14.7**	**24.7** [4]	**15.9**	**7.92**
OCDD	pg/g	<32.3	**121**	**478**	**196**	**72.2**	**73.4**	**197** [4]	**47.1**	**114**	**104**	**88.5**	**89.2**	**198** [4]	**115**	**42.1**
2,3,7,8-TCDF	pg/g	**0.218**	**1.38**	**1.27**	**1.82**	**1.92**	**0.9**	**1.6**	**0.9**	**0.9**	**1.3**	**1.6**	**1.3**	**2.19**	**2.10**	**0.9**
1,2,3,7,8-PECDF	pg/g	<16.4	<22.4	<22.5	<22.5	<22.3	<77	<76.3	<22.5	**0.28**	<22.4	**0.93**	**0.84**	**1.2** [1,2,3,4]	<22.7	<22.7
2,3,4,7,8-PECDF	pg/g	<16.4	**0.976**	**1.000**	**0.820**	**1.410**	**0.98**	**0.60**	**0.36**	**0.56**	**0.80**	**0.87**	**0.84**	**1.10**	**0.78**	**0.55**
1,2,3,4,7,8-HXCDF	pg/g	<16.4	**1.77**	**1.3**	**1.36**	**1.64**	**1.52**	**1.31**	<22.5	**1.41**	**1.38**	**1.45**	**1.44**	**2.09** [2,3,4]	**1.42**	**0.96**
1,2,3,6,7,8-HXCDF	pg/g	**0.133**	**11.4**	**7.47**	**13.5**	**12.9**	**6.33**	**7.46**	**3.62**	**4.90**	**6.98**	**7.42**	**7.75**	**11.2**	**8.56**	**4.90**
2,3,4,6,7,8-HXCDF	pg/g	<16.4	**0.625**	<22.5	<22.5	**0.939**	<77	<76.3	<22.5	<59.4	<22.4	<22.4	<22.4	<22.4	<22.7	<22.7
1,2,3,7,8,9-HXCDF	pg/g	<16.3	<22.4	<22.5	<22.4	<22.3	<77	<76.3	<22.4	<59.4	<22.4	<22.4	<22.3	<22.3	<22.6	<22.6
1,2,3,4,6,7,8-HPCDF	pg/g	<16.4	**33.7**	**16.6**	**29.1**	**37.3**	**32.8**	**42.1** [2]	**16.3**	**32.4**	**26.7**	**26.2**	**24.5**	**36** [2]	**26.5**	**15.0**
1,2,3,4,7,8,9-HPCDF	pg/g	<16.4	<22.4	**0.893**	**0.655**	**0.939**	<77	**1.4**	<22.5	**0.7**	<22.4	<22.4	<22.4	<22.4	**0.7**	<22.7
OCDF	pg/g	<32.3	**13.5**	**14.3**	**14.8**	**10.7**	<153	**15.1**	<45.1	**27.7**	**18.8**	**11.4**	**16.6**	**17.5**	**11.7**	<44.6
BIRD TEQ (ND=0)	pg/g	**0.15**	**4.59**	**3.42**	**4.06**	**5.26**	**3.23**	**4.27**	**1.70**	**2.54**	**3.90**	**4.98**	**4.40**	**6.52**	**5.92**	**2.21**
BIRD TEQ (ND=1/2RL)	pg/g	**24.4**	**19.5**	**22.1**	**24.9**	**18.7**	**66.9**	**78.8**	**27.0**	**75.40**	**19.2**	**15.8**	**17.7**	**17.9**	**9.86**	**18.4**
FISH TEQ (ND=0)	pg/g	**0.012**	**2.67**	**2.44**	**2.51**	**3.38**	**2.49**	**2.61**	**1.0**	**1.91**	**2.53**	**3.18**	**2.89**	**4.0**	**3.82**	**1.44**
FISH TEQ (ND=1/2RL)	pg/g	**22.0**	**22.0**	**19.0**	**23.8**	**18.9**	**63.4**	**70.3**	**25.2**	**67.4**	**17.6**	**15.40**	**16.6**	**17.6**	**7.20**	**18.9**
WHO TEQ_2005 (ND=0)	pg/g	**0.023**	**3.04**	**2.97**	**2.98**	**3.50**	**2.73**	**3.54**	**1.23**	**2.23**	**3.0**	**3.59**	**3.37**	**4.57**	**3.93**	**1.61**
WHO TEQ_2005 (ND=1/2RL)	pg/g	**18.4**	**17.7**	**15.0**	**19.2**	**15.9**	**48.4**	**52.1**	**21.1**	**55.0**	**12.1**	**10.6**	**10.7**	**12.9**	**7.08**	**14.6**
WHO TEQ_2005 (ND=RL)	pg/g	**36.9**	**32.3**	**27.1**	**35.4**	**28.2**	**94.0**	**101**	**40.9**	**108**	**21.3**	**17.6**	**18.1**	**21.3**	**10.2**	**27.6**

NOTES:
The mean concentrations presented on the table are lipid-normalized.
RL = Reporting limit
pg/g = Picogram(s) per gram
mg/kg = Milligram(s) per kilogram
µg/kg = Microgram(s) per kilogram
[1] = Analyte concentration is significantly higher than the St. Louis Bay Reference (SLBREF1)
[2] = Analyte concentration is significantly higher than the Kimballs Bay Reference (KBREF2)
[3] = Analyte concentration is significantly higher than the Loons Foot Landing Reference (LFREF3)
[4] = Analyte concentration is significantly higher than the Superior Bay Reference (SBREF4)
Analyte concentration is significantly higher than the pre-test tissue concentration ($p<0.05$)

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TABLE 6-1 SUMMARY OF FINDINGS
NORTH END DISTRICT AND CLOUGH ISLAND SEDIMENT CHARACTERIZATION
ST. LOUIS RIVER AREA OF CONCERN, SUPERIOR, WISCONSIN

	Chironomus dilutus 10-DAY TOXICITY TESTING		*Hyalella azteca* 28-DAY TOXICITY TESTING				SQG Exceedance (Surface)[2]						*Lumbriculus variegatus* 28-DAY BIOACCUMULATION TEST			Microscopic Coal Results
							Metals			Organics			Significance[1]			
Sample Identification	Significant[1] for SURVIVAL	Significant[1] for GROWTH	Significant[1] for SURVIVAL	Significant[1] for UV SURVIVAL	Significant[1] for FECUNDITY	Significant[1] for GROWTH	TEC	MEC	PEC	TEC	MEC	PEC	Mercury	Dioxins[3]	Organotin[5]	%
ND20-SLBREF1-SURFTOX	Reference	Reference	Reference	Reference	Reference	Reference	X	X	X	X			No	No	No	Not detected
ND20-KBREF2-SURFTOX	Reference	Reference	Reference	Reference	Reference	Reference	X	X		X	X	X	No	No	No	Not detected
ND20-LFREF3-SURFTOX	Reference	Reference	Reference	Reference	Reference	Reference				X			No	No	No	1
ND20-SBREF4-SURFTOX	Reference	Reference	Reference	Reference	Reference	Reference	X			X	X	X	No	No	No	Not detected
Hallet Dock Slip																
ND20-HD01-SURFTOX	Yes	No	No	No	Yes	No				X	X		Not tested	Not tested	Not tested	11
ND20-HD03-SURFTOX	Yes	No	Yes	Yes	Yes	No				X			Not tested	Not tested	Not tested	25
ND20-HD04-SURFTOX	Yes	Yes	Yes	Yes	Yes	No				X			Not tested	Not tested	Not tested	Not tested
Oil Barge Dock																
ND20-BP02-SURFTOX	Yes	No	No	No	No	No				X	X	X	Not tested	Not tested	Not tested	85
ND20-BP03-SURFTOX	Yes	No	No	No	No	No				X	X	X	Not tested	Not tested	Not tested	88
ND20-BP05-SURFTOX	Yes	No	No	No	No	No	X	X	X	X	X		Not tested	Not tested	Not tested	6
ND20-BP07-SURFTOX	No	No	No	No	Yes	Yes							Not tested	Not tested	Not tested	3
General Mills Slip																
ND20-GM02-SURFTOX	No	No	Yes	Yes	No	No	X	X		X	X	X	No	Not tested	Yes	7
ND20-GM04-SURFTOX	No	No	Yes	Yes	No	No	X	X		X	X	X	No	Not tested	Yes	4
ND20-GM08-SURFTOX	No	No	Yes	Yes	No	No	X			X			No	Not tested	Yes	5
Tower Avenue Slip																
ND20-TB01-SURFTOX	Yes	Yes	Yes	Yes	Yes	Yes	X	X		X	X		No	Not tested	No	2
ND20-TB03-SURFTOX	Yes	Yes	Yes	Yes	No	Yes	X			X	X		No	Not tested	No	2
ND20-TB06-SURFTOX	Yes	Yes	No	No	Yes	Yes	X	X	X	X			No	Not tested	No	5
ND20-TB07-SURFTOX	Yes	No	Yes	Yes	Yes	Yes	X	X	X	X	X		No	Not tested	No	4
ND20-TB10-SURFTOX	Yes	No	Yes	Yes	Yes	Yes	X	X		X	X		No	Not tested	No	1
ND20-TB15-SURFTOX	Yes	No	No	No	No	No	X	X		X			No	Not tested	No	2
ND20-TB20-SURFTOX	No	No	No	No	No	No	X			X			No	Not tested	Yes	2
Clough Island																
ND20-CL01-SURFTOX	No	No	No	No	Yes	Yes	X	X	X	X			No	No	Not tested	Not tested
ND20-CL02-SURFTOX	No	No	Yes	Yes	Yes	Yes	X			X	X		No	Some individual dioxin congeners	Not tested	Not tested
ND20-CL03-SURFTOX	Yes	No	No	No	No	No	X	X		X	X		No	No	Not tested	Not tested
ND20-CL04-SURFTOX	No	No	No	Yes	No	No	X	X		X	X		No	Some individual dioxin congeners[4]	Not tested	Not tested
ND20-CL05-SURFTOX	Yes	No	No	No	Yes	No	X	X	X				No	No	Not tested	Not tested
ND20-CL06-SURFTOX	Yes	Yes	Yes	Yes	Yes	No	X	X		X	X	X	No	Some individual dioxin congeners	Not tested	Not tested
ND20-CL07-SURFTOX	Yes	No	Yes	Yes	No	No	X			X	X	X	No	No	Not tested	Not tested
ND20-CL08-SURFTOX	No	No	No	No	No	No	X			X	X	X	No	Some individual dioxin congeners	Not tested	Not tested
ND20-CL09-SURFTOX	Yes	No	Yes	Yes	Yes	No	X	X	X	X	X		No	Some individual dioxin congeners	Not tested	Not tested
ND20-CL10-SURFTOX	Yes	No	No	No	Yes	No				X			No	No	Not tested	Not tested

Notes:
1. Statistically different from one or more reference locations.
2. Exceeds Consensus-Based Sediment Quality Guidelines (SQG), Recommendations for Use and Application, Publication No. WT-732 2003, WDNR December 2003
3. Bird, fish and WHO TEQ considered as well as individual dioxin compounds.
4. Non-lipid normalized results.
5. Yes if one or more organotins (monobutyltin, dibutyltin, tributyltin, tetra-n-butyltin) showed significance.
Shading indicates significant result or result exceeding screening criteria.
MEC = Midpoint Effect Concentration
PEC = Probable Effect Concentration
TEC = Threshold Effect Concentration
TEQ = Toxicity Equivalency Quotient
WHO = World Health Organization

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Table 6-2 Maximum Depth of PEC and MEC Exceedance Elevations for Volume Calculations
North End District and Clough Island Sediment Characterization
St. Louis River Area of Concern, Superior, Wisconsin

Sample Identification	PEC Exceedance Elevation (IGLD85 feet)	MEC Exceedance Elevation (IGLD85 feet)
Hallet Dock 8		
ND20-HD01	593.38	593.38
ND20-HD02	582.60	582.60
ND20-HD03	580.15	578.15
ND20-HD04	581.61	578.61
ND20-HD05	579.35	579.35
ND20-HD06	576.60	575.60
Oil Barge Dock		
ND20-BP01	601.00	587.00
ND20-BP02	587.00	587.00
ND20-BP03	585.00	583.00
ND20-BP04	578.32	578.32
ND20-BP05	584.53	584.53
ND20-BP06	581.76	581.76
ND20-BP07	583.92	582.22
ND20-BP08	581.53	581.53
ND20-BP09	582.00	570.30
ND20-BP10	581.36	581.36
ND20-BP11	580.40	580.40
ND20-BP12	579.00	577.30
ND20-BP13	580.30	574.30
ND20-BP14	582.90	582.90
ND20-BP15	595.28	594.98
ND20-BP16	579.59	579.59
ND20-BP17	581.87	581.87
SW15-SLB03	583.73	583.73
General Mills Slip		
ND20-GM01	584.75	584.75
ND20-GM02	577.24	577.24
ND20-GM03	575.99	575.99
ND20-GM04	577.82	577.82
ND20-GM05	577.70	574.00
ND20-GM06	574.15	574.15
ND20-GM07	575.00	575.00
ND20-GM08	579.15	573.15
ND20-GM09	568.83	568.83
ND20-GM10	575.44	575.44
ND20-GM11	565.00	565.00
ND20-GM12	571.20	571.20
ND20-GM13	571.61	571.61
ND20-GM14	580.56	578.56

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Sample Identification	PEC Exceedance Elevation (IGLD85 feet)	MEC Exceedance Elevation (IGLD85 feet)
SW15-SLB05	578.67	578.67
SW15-SLB06	583.46	577.46
Tower Avenue		
ND20-TB01	579.00	579.00
ND20-TB02	585.00	585.00
ND20-TB03	581.47	581.47
ND20-TB04	585.75	585.75
ND20-TB05	581.51	581.51
ND20-TB06	580.98	578.98
ND20-TB07	580.34	580.34
ND20-TB08	577.19	577.19
ND20-TB09	578.40	574.40
ND20-TB10	582.11	581.81
ND20-TB11	577.07	573.07
ND20-TB12	580.14	579.84
ND20-TB13	575.86	572.86
ND20-TB14	576.88	574.88
ND20-TB15	567.82	565.52
ND20-TB16	574.58	574.58
ND20-TB17	569.38	569.38
ND20-TB18	576.84	574.84
ND20-TB19	572.05	572.05
ND20-TB20	585.62	585.62
ND20-TB21	568.31	568.31
ND20-TB22	570.57	570.57