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Project name:
Superior Slips

Project ref:
60685299

From:
AECOM

Date:
June 27, 2023

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Spooner, WI 54801

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Reece Frederick

Memo

Subject: Suitability Evaluation for Construction of a Superior Slips Confined Disposal Facility

1. Introduction

AECOM Technical Services, Inc. (AECOM) prepared this memorandum for evaluating the use of a Confined Disposal Facility (CDF) as a remedial alternative for sediment management per request by the Wisconsin Department of Natural Resources (WDNR). This memorandum was prepared for the WDNR under a United States Environmental Protection Agency (USEPA) Great Lakes Restoration Initiative (GLRI) grant (USEPA GLRI Grant No. GL-00E03068), which includes a 35% nonfederal cost share from WDNR. Remedial alternatives were defined, screened, and selected to address impacted sediment at the General Mills Slip, Oil Barge Dock Slip, and Tower Avenue Slip within the St. Louis River Area of Concern (SLRAOC) in Superior, Wisconsin. Each Slip was evaluated as a potential CDF location that may confine the target dredge volume from, or part thereof, the other two slips not used as a CDF (Figures 1 through 4).

Figure 1. Site Location Map

AECOM was previously tasked with evaluating multiple remedial alternatives including but not limited to hydraulic dredging, mechanical dredging, engineered capping, enhanced natural attenuation and in situ stabilization. The goal of this evaluation was to evaluate CDF(s) as a potential remedial alternative for confining contaminated sediment from General Mills (GM), Oil Barge Dock (OBD), and Tower Avenue (TA) Slips in lieu of ex situ sediment management, transportation and disposal at a commercial landfill as there may be significant cost savings.

AECOM evaluated three potential CDF locations. Water and mass balance calculations were used to conceptualize the turn-key project and approximate capacities of each CDF constructed within the slips. Bench-scale treatability testing was previously performed and used to approximate dewatering efficacy. Stormwater drainage and cofferdam construction are also accounted for in this suitability evaluation. Five site-specific criteria were weighted and scored for comparison of the three potential CDF locations. These criteria include but are not limited to:

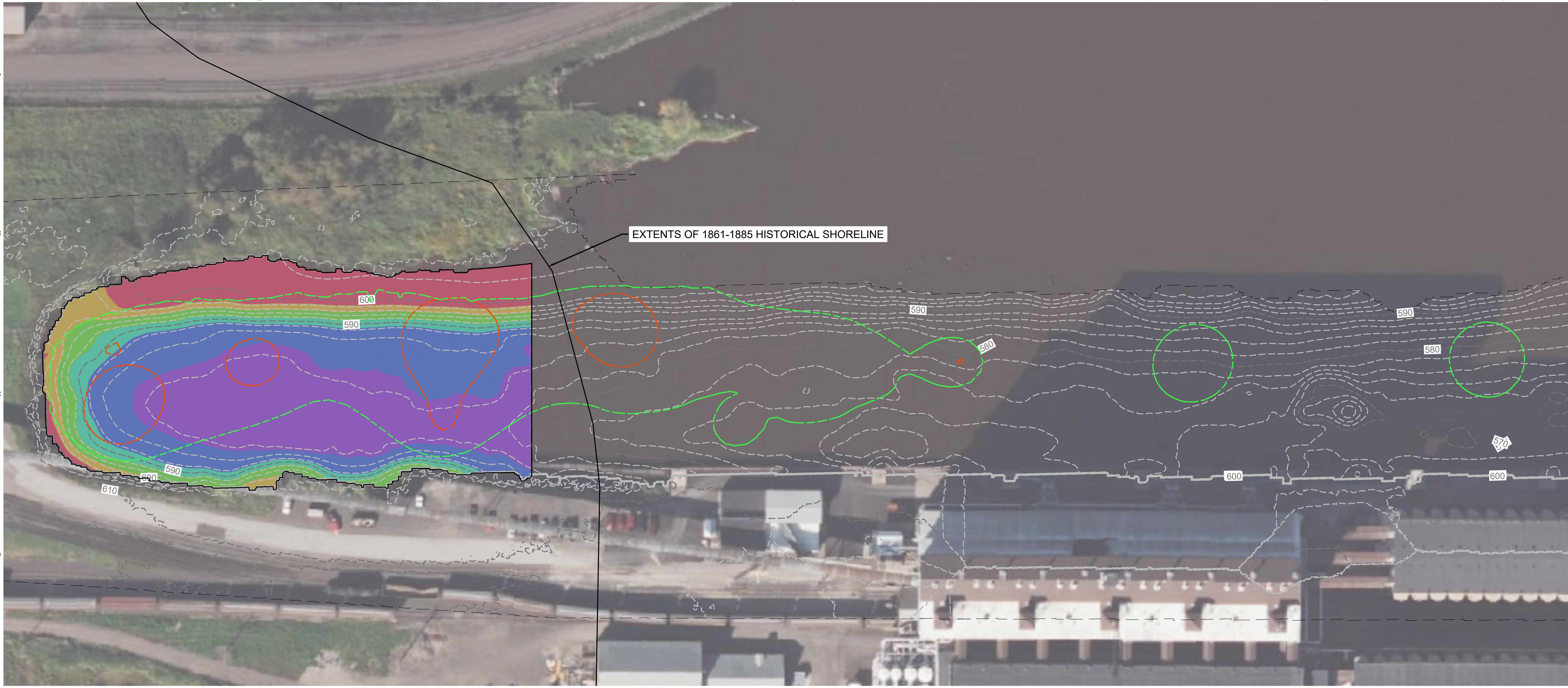
- Engineering and Design Considerations;
- Operational Considerations;
- Impact to Community;
- Estimated Project Costs; and
- Regulatory Acceptability.

Site investigation and remediation of the General Mills, Oil Barge Dock, and Tower Avenue Slips are regulated under Chapters NR 700-799 (collectively referred to as the “NR 700 series” or “NR 700 process”) of the Wisconsin Administration Code administered by the Remediation and Redevelopment (RR) Program of the WDNR. Use of a CDF for sediment management and/or disposal may be added to the process flow of the previously screened remedial alternatives, and results subsequently included as an attachment to the Remedial Action Options Report (ROARs) for these three project sites.

2. Confined Disposal Facility Evaluation

General Mills, Oil Barge Dock, and Tower Avenue Slips were evaluated as potential CDFs for remediation and management of contaminated sediments within these three slips in lieu of off-site commercial landfill disposal. Contaminated sediments isolated within the selected CDF (or CDFs) are assumed to remain within confines of the containment area. Once the site is isolated, overlying water will be pumped off, treated (if necessary) and discharged to allow for more efficient in situ sediment dewatering. Contaminated sediments that fall outside the CDF footprint and within the dredge prisms, will be dredged and placed via hydraulic or mechanical methods into the selected CDF(s). Impacted material that cannot be dredged due to offsets, dredge prism sloping, or access restrictions will either be left in place and capped or potentially dredged in a subsequent phase via divers (based on recommendations provided in the task 10 Remedial Alternatives Analysis Reports).

CDFs were evaluated for their potential capacity (i.e., sediment/water storage volume). CDF footprints were established to maximize capacity potential, limit impact to surrounding infrastructure and slip use, and to be constructable (i.e., linear containment walls and perpendicular to adjacent land). CDF storage capacities were developed by comparing the assumed water surface elevation of 602.5-ft (NAVD-88) to the existing bathymetric and LiDAR survey (collected from previous consultants) using AutoCAD Civil 3D. The distance between the sediment survey elevation and water surface elevation is noted as the “freeboard”. The storage volume of the CDF is termed “capacity”. The in situ dredge prism volumes (based on current dredge prism models) falling outside the respective CDF is termed “target dredge volume” in this memo. Plan views, CDF capacities (in cubic yards), and a freeboard heat map (depicting depth of freeboard, in feet, across the CDF limits) of each CDF can be reviewed in Figures 2 through 4.



Elevations Table

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2	4.00	7.00	6654.51	
3	7.00	11.00	8508.31	
4	11.00	14.00	7850.66	
5	14.00	18.00	27301.89	
6	18.00	22.00	29895.57	

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
GM_CDF EVAL	1.000	1.000	96072.11 Sq. Ft.	0.00 Cu. Yd.	46703.77 Cu. Yd.	46703.77 Cu. Yd.<Fill>
Totals			96072.11 Sq. Ft.	0.00 Cu. Yd.	46703.77 Cu. Yd.	46703.77 Cu. Yd.<Fill>

50 0 100

GRAPHIC SCALE IN FEET

INTERNAL DRAFT

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DATE: 06/27/2023

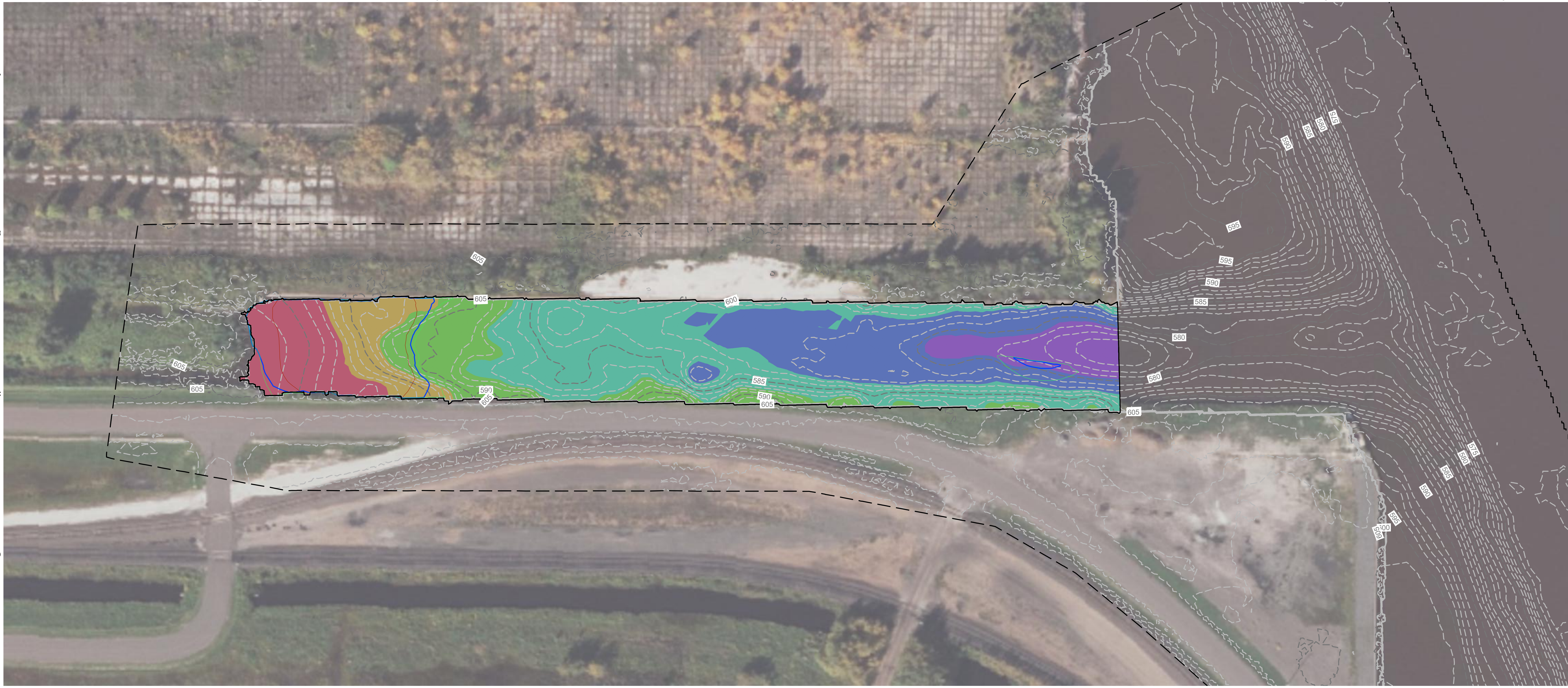
GENERAL MILLS CDF EVALUATION PLAN VIEW (CDF CAPACITY)

SUPERIOR SLIPS DREDGING

DRAWING NUMBER: C-01

SHEET NUMBER: FIG 2

REVISION 0



Elevations Table				
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2	5.00	10.00	6450.19	
3	10.00	15.00	12212.33	
4	15.00	20.00	31193.97	
5	20.00	23.00	20539.73	
6	23.00	27.00	6417.19	

Cut/Fill Summary

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OB_CDF EVAL	1.000	1.000	86202.60 Sq. Ft.	0.00 Cu. Yd.	50943.11 Cu. Yd.	50943.11 Cu. Yd.<Fill>
Totals			86202.60 Sq. Ft.	0.00 Cu. Yd.	50943.11 Cu. Yd.	50943.11 Cu. Yd.<Fill>

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GRAPHIC SCALE IN FEET

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DATE: 06/27/2023

OIL BARGE DOCK CDF EVALUATION PLAN VIEW (CDF CAPACITY)

SUPERIOR SLIPS DREDGING

DRAWING NUMBER: C-01

SHEET NUMBER: FIG 3

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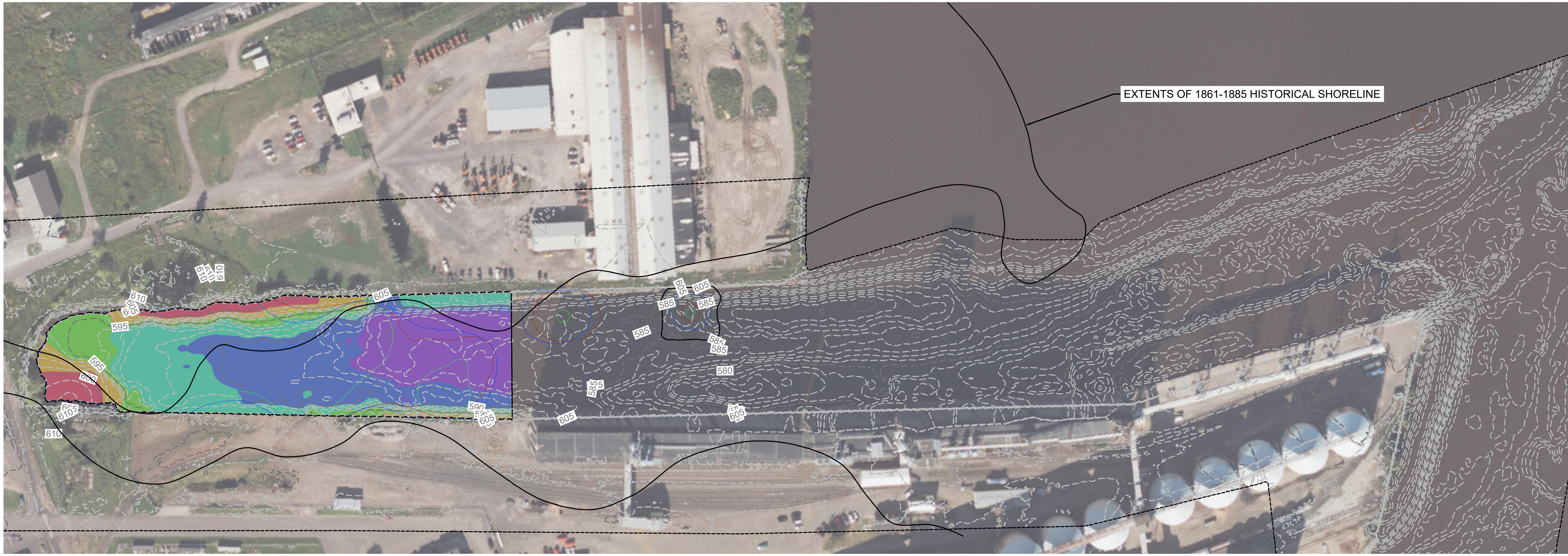

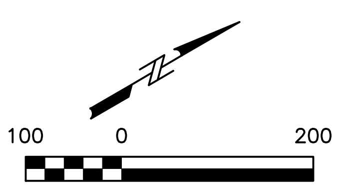

Elevations Table				
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2	3.00	6.00	14850.75	
3	6.00	9.00	21856.18	
4	9.00	12.00	47917.96	
5	12.00	15.00	55854.14	
6	15.00	18.00	41252.90	

Cut/Fill Summary

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TA_CDF EVAL	1.000	1.000	194552.46 Sq. Ft.	0.00 Cu. Yd.	80902.44 Cu. Yd.	80902.44 Cu. Yd.<Fill>
Totals			194552.46 Sq. Ft.	0.00 Cu. Yd.	80902.44 Cu. Yd.	80902.44 Cu. Yd.<Fill>

INTERNAL DRAFT

NO	DRWN	DATE	REVISION	CHKD	DATE	APPVD	DATE
7							
6							
5							
4							
3							
2							
1							
0	JLL	06/06/23	DRAFT				

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TOWER AVENUE CDF EVALUATION PLAN VIEW (CDF CAPACITY)

SUPERIOR SLIPS DREDGING

DRAWING NUMBER: C-01
SHEET NUMBER: FIG 4
REVISION 0

Once CDF capacities were developed, the mass balance was revised based on treatability test results and total consolidated disposal volumes were re-calculated. For purposes of this task evaluation, a polymer additive was assumed to expedite dewatering of the sediment, thus decreasing the overall in situ target dredge volume. Table 1 highlights the mass balance for each CDF including CDF capacity, in situ target dredge volumes and total consolidated disposal volumes for each CDF and the CDF capacity difference.

Table 1. CDF Capacities and Mass Balances

Slip	CDF Capacity[2] (CY)	In Situ Target Dredge Volume[2/4] (CY)	In Situ Solids (%)	7-day Consolidated Solids (with polymer addition) (%)	Total Consolidated Disposal Volume[2] (CY)	+/- CDF Capacity Difference[1] (CY)
General Mills[3]	46,700	121,900	46.6	63.5	65,820	-19,120
Oil Barge Dock	50,900	135,300	34.7	52.8	102,900	-52,000
Tower Avenue	80,900	89,850	36.5	46.6	58,010	+22,900

Notes:

1. Negative (-) indicates not enough capacity in the CDF to store conditioned dredge material from target areas. Positive (+) indicates the amount of excess capacity within the CDF as currently designed.
2. Values are raw and do not include factors of safety (e.g., bulking/swell factors).
3. General Mills has approximately 20,000 CY of clean sediment overlying the contaminated target material. In the calculations of available capacity, this sediment was assumed to be left in place. However, if this volume were to be removed prior to dredged material placement, the General Mills CDF would have enough capacity for all dredged material from the target dredge areas.
4. In Situ Target Dredge Volumes include all dredge prism sediment outside the CDF footprint. Dredge prism volume falling inside the CDF footprint will be left in place.

3. Alternatives Analysis

Hydraulic and mechanical dredging and subsequent placement of dredge material were analyzed for this CDF suitability evaluation. This section highlights key differences between hydraulic and mechanical dredging and placement methods, advantages and disadvantages of each as well as which method is recommended based on the CDF alternatives analysis.

Mechanical dredging typically involves removal of material via an excavator or crane (with a clam shell hooked up to a wireline cable) on adjacent land or a barge. Excavators are typically more efficient compared to a crane but are limited by their reach. A crane and clam shell set up is favorable for deeper waters. For this memorandum, an excavator used for dredging will be used to compare mechanical to hydraulic dredging. Mechanical dredging is favorable for restricted space working areas, smaller sediment removal volumes, and if debris is expected (i.e., wood, tires, metal, etc.). Mechanical dredging for this project would require transportation and rehandling of sediment via scows for subsequent placement of material in the CDF. Mechanical dredging and placement would eliminate the use of polymer treatment and therefore remove the ability to consolidate the in situ target removal volume.

Hydraulic dredging uses pump suction to lift sediment from the river, lake or seabed and transport the slurry (combination of solids and water) via a conveying pipeline to the desired location. Hydraulic methods typically have a higher capital cost but tend to be better suited for longer sediment transport distances between the dredging location and management or disposal area, and projects with larger volumes of sediment compared to mechanical means of sediment removal. Hydraulic dredging also offers the option to condition the slurry with polymer via an injection port in the conveyance pipeline, allowing for better consolidation and dewatering of sediments at an ex situ management or disposal area.

Given the limitation for mechanical dredging to use polymer treatment, this evaluation assumed the method of dredging and placement to be hydraulic. Although, given the slips limited working space and likelihood of debris presence, mechanical dredging with the use of scows and barges paired with other engineering considerations (i.e., off-site disposal, S/S and/or clean material reuse) might be the more favorable construction method for this remedial alternative. Further historical document review and pre-design investigations would need to be completed to determine the extent of debris in the slips prior to a final decision on use of mechanical versus hydraulic dredging.

A table comparing the proposed CDF locations for suitability based on the criteria listed in section 1 is provided in Table 2. A scoring system of 1 through 5 was used for each category with 1 indicating a low score and 5 indicating the highest score relative to the project and the locations being compared. Each category was scored based on the following including but not limited to:

Engineering and Design Considerations

- Amount of contaminated material left in place (target dredge volume within footprint of the CDF stays in place);
- Presence and number of stormwater outfalls;
- Cofferdam size (includes consideration of depth from sediment surface to top of wall and depth the wall needs to be driven into the sediment;
- Overall capacity of CDF to receive sediment;
- Site access via land and water including relative accessibility for construction and transloading; and
- Future use of CDF.

Operational Considerations

- Relative CDF location compared to dredge prism locations;
- Slip and adjacent land use (I.e. navigational/freight);
- O&M of CDF through its life expectancy;
- Project Duration (i.e., construction, filling, dewatering and closure of the CDF; and
- Utilities (i.e., aboveground and below ground water, gas, sewer and electricity).

Impact to Community

- Use of land surrounding slip;
- Roadway congestion/closure due to site access; and
- Monitoring of quality-of-life impacts during construction (e.g., odor, noise, vibration, etc.).

Estimated Project Cost

- Based on Cost Comparison Tables

Regulatory Acceptance

- Higher scores given to CDFs that fall within the shoreline extent of 1861–1885-year limits.

Table 2. Comparison of CDF Sites

CDF Location	Engineering and Design Considerations	Operational Considerations	Impact to Community	Estimated Project Cost	Regulatory Acceptability	Final Scoring
General Mills	2	3	3	3	4	15
Oil Barge Dock	2	2	4	2	2	12
Tower Avenue	4	4	2	4	2	16

AECOM realizes ecological impact is typically a consideration for comparing site locations but in this instance, all sites being compared fall within the same setting and ecological variations do not account for significant differences between the proposed CDF locations.

Additional considerations may be used to assist with constructability assessment of a CDF including but not limited to application of a solidification/stabilization (S/S) agent to facilitate dewatering and compaction strength (ex situ), disposal of a portion of the dredge material off-site, and/or potential for beneficial use of clean material (i.e., restoration or engineered cap material). Arcadis evaluated the use of a Confined Aquatic Disposal (CAD) facility for the Howards Bay Remediation project which was completed in 2022. Ultimately, the CAD was not used, and off-site disposal was chosen as the material disposal alternative. The project removed about 80,000 CY of sediment and hauled material via truck to Wisconsin Point Landfill approximately 8-miles away. The project totaled approximately 21 million dollars (Arcadis 2015).

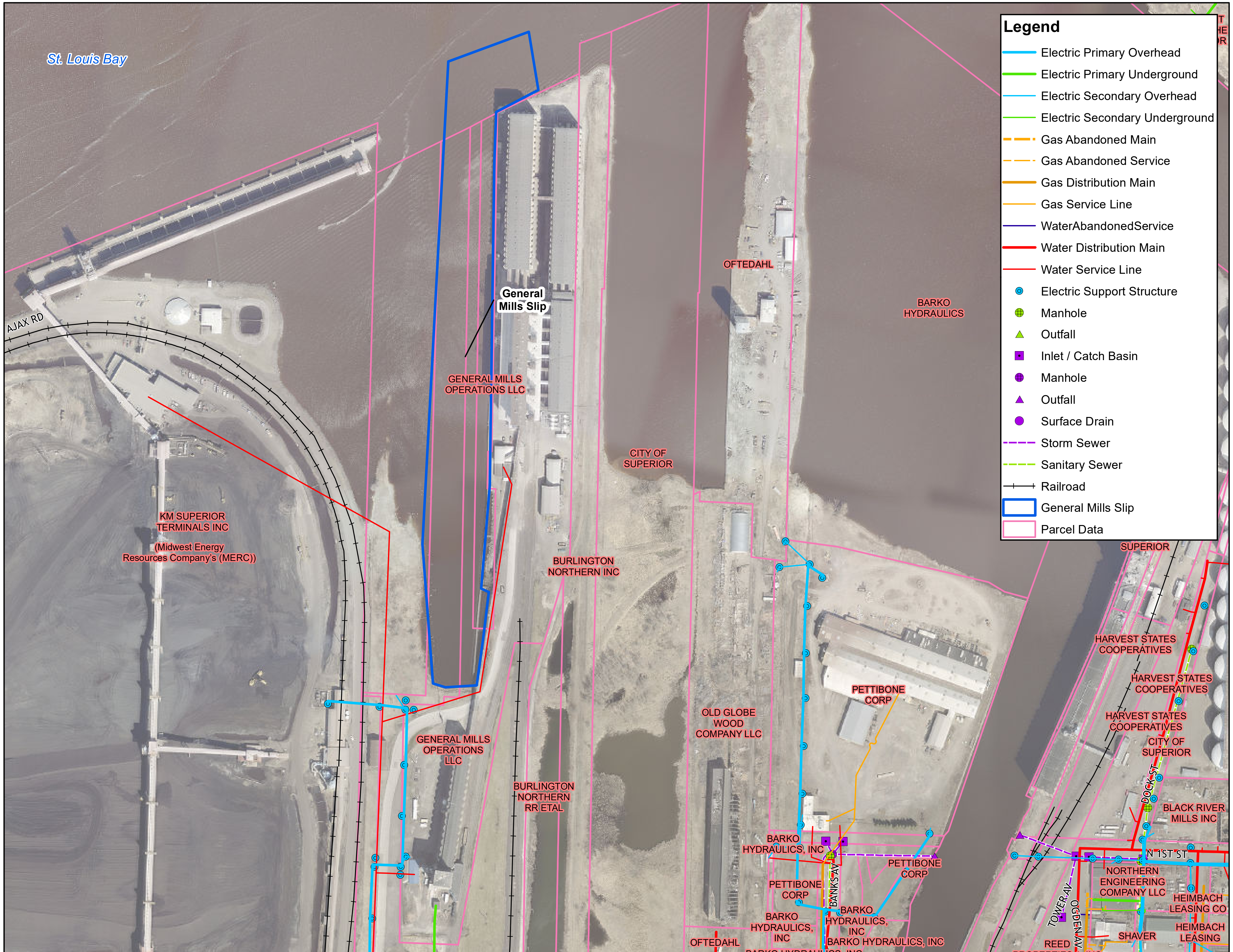
4. Stormwater and Groundwater

Stormwater runoff will need to be monitored and managed based on rainfall frequency and intensity during construction. Storm frequency and intensity were not considered for this level of evaluation but will need to be evaluated during a pre-design investigation (PDI) phase. Stormwater management also depends on the number of stormwater outfalls and runoff catchment areas for each location. Oil Barge Dock Slip has one outfall pipe identified within the footprint of the proposed CDF. The history of this pipe is not known, and it is not assumed to be stormwater related at this time. This pipe is not identified on the site layout figure but is located at the western corner at the head of the slip. The pipe was identified by EA Engineering during field work in July 2020. No stormwater outfalls were identified within General Mills Slip. Tower Avenue has six stormwater outfalls within the footprint of the proposed CDF. See Figures 5 through 7 for stormwater outfalls within each slip.

Anticipated stormwater management during construction for any proposed slip will consist of diverting water from outfalls and runoff around the working CDF(s) and discharging directly into Saint Louis Bay. It is unclear at this time if extending existing outfalls to discharge to the Saint Louis Bay will impact maintenance dredging for any given slip. Sediment loading was not considered in this evaluation but will need to be investigated during the PDI phase. Extension of existing stormwater outfalls may have an impact on sediment loading for any given slip. If stormwater diversion is not possible, other engineering solutions will need to be investigated. Currently, it is not anticipated that any other permits will be required for water management during construction.

Following sediment placement in the CDF, long-term stormwater management measures may be implemented. For example, erosion protected stormwater channels may be constructed to allow existing stormwater outfalls to discharge water directly over the CDF.

Given the location of the proposed CDF sites, it is expected that groundwater seepage to surface water may be a factor in initial CDF dewatering and water management during construction. It is assumed that dewatering measures (i.e., dewatering wells) will not be required for the project based on initial review of existing geotechnical information. At this time, groundwater seepage is not expected to impact sediment dewatering and water process flow of any CDF, but a groundwater investigation is recommended as part of the PDI.



VICINITY MAP

Image Source: Douglas County
Image Date: 2022

Storm and Sanitary Sewer Data
The City of Superior

Utility data from Superior Water, Light & Power

Parcel data from the City of Superior/Douglas County

NAD 1983 State Plane Wisconsin North FIPS 4801 Feet

N

0 150 300 600
Feet

AECOM

Title:	**Current Site Layout General Mills Slip**
Project:	General Mills Remedial Investigation Report Superior, Wisconsin
Client:	Wisconsin DNR
File Name:	Current Site Layout Gen Mills.mxd

Project No.:	Date:	Figure:
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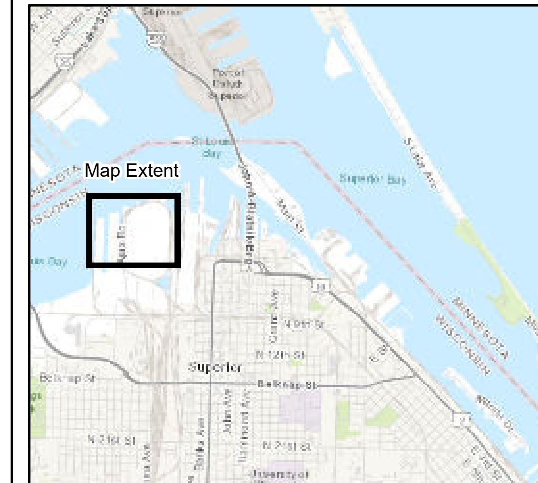
VICINITY MAP



Legend

- Electric Primary Overhead
- Electric Primary Underground
- Electric Secondary Overhead
- Water Service Line
- Electric Support Structure
- Railroad
- Oil Barge Dock Slip
- Parcel Owners

Image Source: Douglas County
Image Date: 2022

Utility data from Superior Water, Light & Power

Parcel data from the City of Superior/Douglas County

NAD 1983 State Plane Wisconsin North FIPS 4801 Feet

N

0 150 300 600
Feet

AECOM

Title: **Current Site Layout**
Oil Barge Dock Slip

Project: Oil Barge Dock Slip
Remedial Investigation Report
Superior, Wisconsin

Client: Wisconsin DNR

File Name: 4-Current Site Layout Oil Barge Slip.mxd

Project No.:	Date:	Figure:
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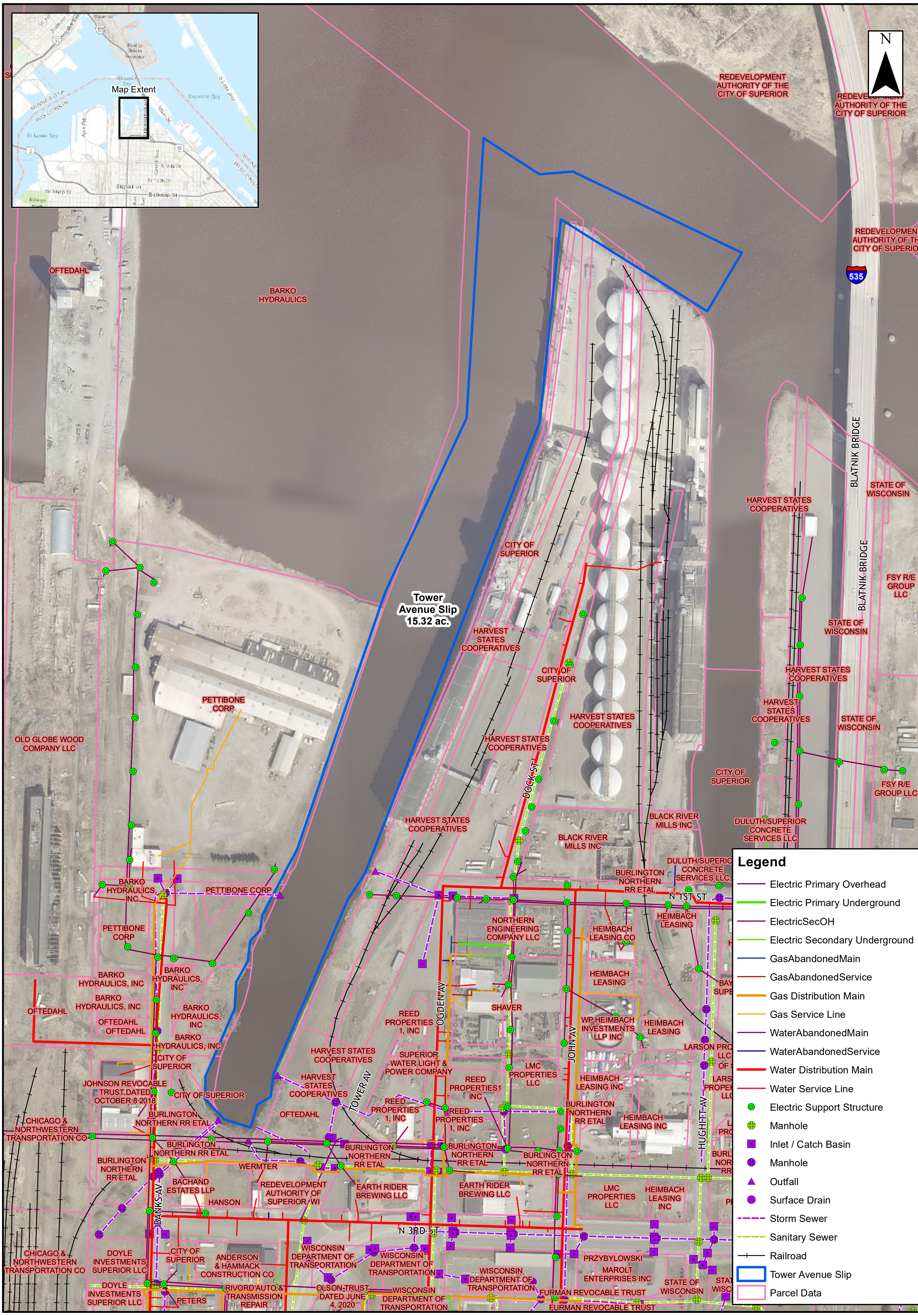

Image Source: Douglas County
Image Date: 2022

Storm and Sanitary Sewer Data from The City of Superior

Utility data from Superior Water, Light & Power

Parcel data from the City of Superior/Douglas County

AECOM

Title: **Current Site Layout Tower Avenue Slip**

Project: Remedial Investigation Report
Tower Avenue Slip
Superior, Wisconsin

Client: **Wisconsin DNR**

Scale:	Drawn by:	Date:	Project No.:	File Name:	Figure:
As Shown	KPL	6/27/2022	60685299	Current Site Layout Tower Avene Slip.mxd	7
	Chk'd by: AO	Date: 6/27/2022			

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5. Water Balance

Water will need to be managed from two sources during construction of the CDF(s). Initially, overlying water currently in the slip will be pumped off following CDF isolation and prior to dredge material placement. Secondly, filtrate water will be generated from the release of interstitial water during dewatering and consolidation of the dredge material placed in the CDF. Stormwater volumes were not included in the suitability evaluation but will need to be considered during pre-design investigation. Total water volume to be pumped and/or treated from each CDF is summarized in Table 3 and 4. Overlying water will be removed following CDF isolation (i.e., sheet pile installation) and prior to filling the CDF with target sediments. Once the overlying water is removed, pore water pressure within the in situ sediment will be reduced and cause sediment in the CDF to passively consolidate. This passive consolidation will release additional water from the in situ sediments. This additional water volume is not estimated within this analysis but is not expected to have a significant impact on the overall water balance and management. In situ passive consolidation will also allow for greater CDF capacity than what was stated earlier in Table 1.

Coarse material and polymer-conditioned solids will settle out and consolidate at the bottom of the CDF as slurry is pumped and deposited. Filtrate water volume depends on the dredge material placement rate, slurry characterization and dewatering efficacy. A water balance evaluation was performed on each slip to calculate the anticipated volume of filtrate water to be generated from target dredge areas. Water volumes were generated based on the 7-day polymer conditioned dewatering efficacy. General Mills, Oil Barge Dock and Tower Avenue slips will produce approximately 51.3 MG, 9.1 MG, and 40.9 MG of filtrate water, respectively. General Mills and Tower Avenue slips have impacted sediment that falls outside their currently designed CDF footprint which account for 27.9 MG and 5.3 MG, respectively. Table 3 highlights the overlying water, filtrate water per slips dredge prism, and total filtrate water volumes to be managed for each CDF.

Table 4 summarizes water balance results for dredged material placement of a 10% solids slurry into the CDF for each location at 2,000 gpm, 3,000 gpm and 5,000 gpm. The duration of water treatment system (WTS) operations for each discharge rate was calculated based on a 12-hr workday and a 24-hr workday. These operational numbers reflect the time it would take to treat all the overlying water and filtrate water in a continuous operation. These operational numbers suggest that a substantial water treatment plant (WTP) is not required since water treatment will be limited to dredging operations and pumping rates. Hydraulic dredging will produce a larger volume of water and therefore will require more detailed design of the water balance. Mechanical dredging will not generate as much filtrate water as hydraulic dredging and therefore a water balance table was not generated.

Table 3. Total Filtrate Water to be Treated from Each CDF (Hydraulic Dredging)

CDF	Overlying Water of CDF (MG)	Filtrate Water Generated from Dredge Material General Mills (MG)	Filtrate Water Generated from Dredge Material Oil Barge Dock (MG)	Filtrate Water Generated from Dredge Material Tower Avenue (MG)	Total Filtrate Water to be Treated (MG)
General Mills	**9.4**	**26.0**	**8.1**	**35.0**	**69.1**
Oil Barge Dock	**10.2**	**47.9**	**N/A**	**35.0**	**82.8**
Tower Avenue	**16.3**	**47.9**	**8.1**	**4.5**	**60.5**

Notes:

1. Overlying water is not included in this table. Overlying water will not be treated and will be directly discharged into Saint Louis Bay.

Table 4. Water Treatment Rate by CDF (2,000, 3,000 and 5,000 gpm Hydraulic Dredging Discharge Rates).

CDF	12-hour WTS Operation Treatment Rate (gpd)	12-hour WTS Operation Duration (days)	24-hour WTS Operation Treatment Rate (gpd)	24-hour WTS Operation Duration (days)
Hydraulic Dredge Rate: 2,000 gpm				
General Mills	1,213,000	57	2,427,000	28
Oil Barge Dock	1,167,000	71	2,335,000	35
Tower Avenue	1,131,000	53	2,262,000	27
Hydraulic Dredge Rate: 3,000 gpm				
General Mills	1,820,000	38	3,640,000	19
Oil Barge Dock	1,751,000	47	3,502,000	24
Tower Avenue	1,697,000	36	3,393,000	18
Hydraulic Dredge Rate: 5,000 gpm				
General Mills	3,033,000	23	6,066,000	11
Oil Barge Dock	2,918,000	28	5,836,000	14
Tower Avenue	2,8280000	21	5,655,000	11

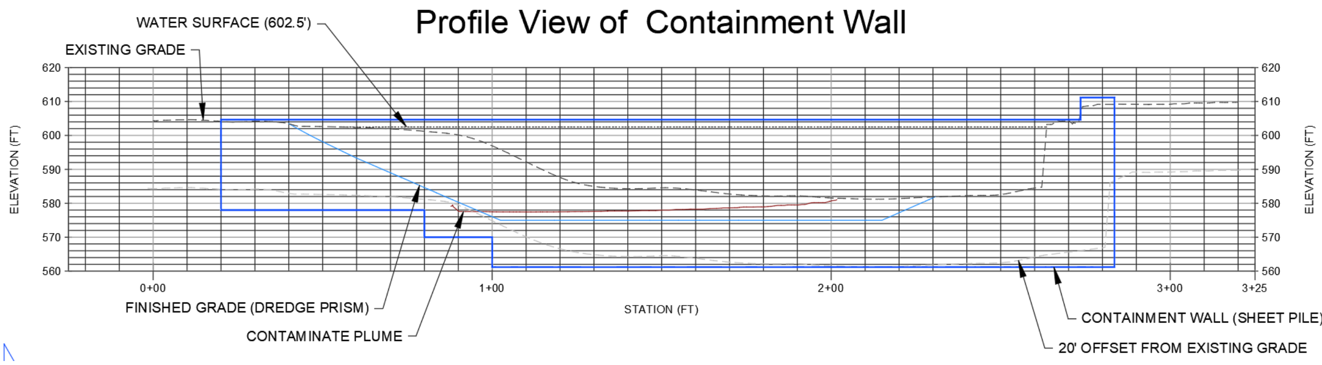
6. CDF Containment Wall

A cofferdam (i.e., sheet pile) will be required to contain the sediments placed in the CDF. A conservative engineering and design principle is a “two times embedment depth to one-time exposed length” (2 to 1) approach. In other words, two thirds of the sheet pile wall is driven into the overburden and one third would act as the load bearing retaining wall. For example, if the overlying water depth was 20-ft, the full sheet pile vertical length would be 60-ft, 40-ft would be driven into the sediment acting as the retaining wall foundation and 20-ft would be the active loading bearing structure. The “2 to 1” design approach is preliminary and would be supplemented by a more detailed design approach based on a geotechnical review and subsequent pre-design investigation.

Initially, a corrosion protected, steel sheet pile is assumed for the containment wall. During the initial stages of construction, the containment wall will act as a retaining structure with water on the bay side acting as a lateral load. Once the CDF gets filled with sediments, static forces will shift with a net force acting from the CDF side. Based on treatability test results, polymer conditioned dredge slurry increased from 5% solids to greater than 52% for Oil Barge Dock, 46% for Tower Avenue and 63% for General Mills after 7 days consolidating.

Based on the geotechnical investigation at General Mills, it is anticipated that a single combination corrosion protected steel sheet pile (type SKZ25) may be used at any given CDF (AECOM PEA 2022). A combination sheet pile consists of a z-sheet pile section and a pipe/H-pile driven sequentially between the wall extents. A combination sheet pile wall may eliminate the need for a ground anchor that was previously used at the existing sheet pile structure at General Mills.

Figure 8. Typical Profile View of a Sheet Pile Containment Wall



Other engineering and design considerations for the containment wall, not included in this evaluation, include ice, earthquake loads, geotechnical properties of the in-situ slip sediment, waves, wind, current, tides, and other dynamic external forces. These considerations will need to be evaluated and included in the final design of the containment wall.

A single combination steel sheet pile wall with a preliminary "2 to 1" design approach will be used to estimate cost for the construction of the CDF containment. See the Cost Comparison section below for total costs of CDF construction compared to off-site disposal.

7. Cost Comparison

A cost comparison was completed for this CDF evaluation. Mechanical and hydraulic dredging methods were initially evaluated for ex situ sediment management and off-site disposal and compared to construction and use of a CDF for on-site management and disposal for each slip. Cost comparison tables used in the Task 10 Alternatives Analysis reports were used as a baseline for this suitability cost comparison. Line items used to develop the total costs highlighted in the cost comparison table below generally included project management and controls, mobilization/demobilization, site preparation (including sediment management area (SMA) construction for off-site disposal), hydraulic/mechanical dredging productivity, and construction quality assurance oversight. Off-site disposal costs accounted for S/S and loadout, transportation and disposal, additional solids waste (disposal of liner for SMA), and restoration of the SMA. The CDF alternative line-specific-items included sheet pile material and installation. Specific costs associated with hydraulic dredging included geotextile tubes (for off-site disposal), conveyance booster pumps, polymer addition, water treatment system and filtrate discharge. Mechanical dredging did not have any specific line-item differences. This cost comparison falls within the Class 3 cost estimating classification category, based on AACE International Standards, indicating a plus 30% or minus 20% accuracy in total costs provided below. Table 5 illustrates the biggest advantage to using a CDF as a remedial alternative is the cost savings.

Table 5 depicts the total cost for both remedial alternatives (off-site disposal versus CDF) and for each proposed CDF location. Mechanical and hydraulic dredging of material into the Tower Avenue CDF is the cheapest approach at $10.6 million and $10.7 million, respectively. Oil Barge Dock CDF is the most expensive CDF for both mechanical and hydraulic dredging at $17.4 and $17.6 million. Altogether, the CDF remedial alternative provides an average cost savings of $20.1 million compared to off-site disposal.

Table 5. CDF versus Off-Site Disposal Cost Comparison (Mechanical versus Hydraulic Dredging)

Remedial Alternative	Cost of GM Slip	Cost of OBD Slip	Cost of TA Slip	Total Cost of Dredging all 3 Slips	Cost Savings
General Mills CDF					
Hydraulic Dredging to SMA for T&D	$13,921,0000	$3,530,000	$17,917,000	**$35,368,000**	$21,192,000
Hydraulic Dredging to CDF	$4,644,000	$2,458,000	$7,074,000	**$14,175,000**	
Mechanical Dredging to SMA for T&D	$14,688,000	$3,182,000	$15,052,000	**$32,922,000**	$19,000,000
Mechanical Dredging to CDF	$4,644,000	$2,374,000	$6,904,000	**$13,922,000**	
Oil Barge Dock CDF					
Remedial Alternative	**Cost of GM Slip**	**Cost of OBD Slip**	**Cost of TA Slip**	**Total Cost of Dredging all 3 Slips**	**Cost Savings**
Hydraulic Dredging to SMA for T&D	$13,921,000	$3,530,000	$17,917,000	**$35,368,000**	**$17,709,000**
Hydraulic Dredging to CDF	$6,948,000	$3,636,000	$7,074,000	**$17,658,000**	
Mechanical Dredging to SMA for T&D	$14,688,000	$3,182,000	$15,052,000	**$32,922,000**	**$15,517,000**
Mechanical Dredging to CDF	$6,948,000	$3,553,000	$6,904,000	**$17,405,000**	
Tower Avenue CDF					
Remedial Alternative	**Cost of GM Slip**	**Cost of OBD Slip**	**Cost of TA Slip**	**Total Cost of Dredging all 3 Slips**	**Cost Savings**
Hydraulic Dredging to SMA for T&D	$13,921,000	$3,530,000	$17,917,000	**$35,368,000**	**$24,683,000**
Hydraulic Dredging to CDF	$6,948,000	$2,458,000	$1,278,000	**$10,684,000**	
Mechanical Dredging to SMA for T&D	$14,688,000	$3,182,000	$15,052,000	**$32,922,000**	**$22,346,000**
Mechanical Dredging to CDF	$6,948,000	$2,374,000	$1,253,000	**$10,576,000**	

Notes:

1. CDF construction using hydraulic dredging method excluded costs associated with geotextile tubes, S/S and loadout, transportation and disposal and additional solids waste management.

2. The cost savings column highlights the difference between the two remedial alternatives, off-site disposal and CDF construction.

The main difference between the use of a CDF and off-site disposal are the cost savings associated with transportation and disposal. Transportation and disposal costs for sediment within the dredge prisms at each of the three slips are $5,500,000 for General Mills, $800,000 for Oil Barge Dock, and $8,500,000 for Tower Avenue. Benefits also come with the elimination of a SMA and affiliated infrastructure, reducing the overall footprint of the project. Operations and maintenance (O&M) of the CDF is not included in the costs depicted in Table 6. O&M costs are expected to be minimal compared to overall construction costs and relatively equal across all three slips. AECOM assumed that the CDF will be designed for a lifespan of 100 years and should not need any significant maintenance other than routine inspections unless an “act of god” (earthquake, flooding, natural catastrophe, etc.) event occurs in which inspection and O&M should be handled on a case-by-case basis.

8. Conclusions

Overall, a CDF offers cost savings and project schedule benefits compared to other remedial options (i.e., off-site disposal). Eliminating the cost of off-site disposal removes a large portion of project cost along with time savings to perform this portion of the project. The responsible party for operation and maintenance (O&M) of the CDF is still to be determined but is not expected to be too cumbersome initially other than general site maintenance (i.e. lawn mowing) and site inspections. Long-term monitoring may be a challenge as inspections of the sheet-pile wall and other construction elements will be required. It is anticipated that monthly inspections of post construction site features, sheet pile, and sediment and erosion (S&E) control measures will be required for the initial year following construction completion. After the first year, quarterly inspections of these features would be the recommended frequency until further information and data can better identify inspection and O&M needs.

Based on the initial CDF evaluation and mass balance, Tower Avenue is the most favorable slip to be used as a CDF due to its available capacity and engineering design advantages. General Mills can potentially be used as a CDF for containment of the three slips but additional measures (i.e., off-site disposal, S/S and/or clean material reuse) would likely need to be considered. Oil Barge Dock Slip alone is not a viable choice based on the initial CDF evaluation without significant engineering and additional considerations listed above. If regulatory acceptance is determined to be the driving factor for the CDF location, General Mills is the recommended slip due to its CDF extents falling entirely within the historical shoreline extents.

Mechanical dredging appears to be a more constructable sediment dredging and placement strategy, but hydraulic dredging may be an option depending on logistics, ability to direct discharge dredge slurry from one slip to the CDF and additional pre-design investigations (PDI). Both mechanical and hydraulic dredging and placement methods are relatively similar in cost and dredging methods will be decided based on ease of implementation and contractor input.

Storm and groundwater, water balance and treatment, and the CDF containment wall will need a PDI to complete engineering and a final design. A PDI for any slip is anticipated to cost between $150,000 and $300,000 depending on the slip and further scope definition and goals of the investigation. PDI activities will include, but are not limited to, geotechnical investigations, hydrologic and hydraulic (H&H) calculations, sediment loading, and preliminary site designs. Once PDI activities are complete, the final design may move forward.

A reasonable factor of safety for CDF capacity should be considered if design is to move forward. Inaccuracies in surveys, bulking/swelling estimates, and variability in material can cause deviations in anticipated removal volumes from target dredge areas. Applying a factor of safety to account for these variables will limit any potential need for field changes encountered during construction. A better understanding of appropriate factors of safety for any given slip would be concluded following PDI activities.

Based on review of historical documents and projects pertaining to CDFs within the Great Lakes Region, permitting through the Clean Water (CWA) and Marine Protection, Research, and Sanctuaries Act’s with review by the United States Army Corps of Engineers (USACE), Environmental Protection Agency (EPA), and relevant state agencies will be required. Local approvals from conservation commissions, board of health, public, and other relevant agencies/communities should be planned for (USACE 1998).

Discussions with appropriate parties and agencies is the recommended next step. This will allow for a better understanding if the CDF remedial alternative will provide a suitable and acceptable option for remediation of contaminated sediments at any or all of the three Superior Slips. Following discussions with appropriate parties, a pre-design investigation is recommended as the first step of the engineering and design of the CDF remedial alternative.

9. Limitations

The data and information presented in this evaluation is primarily based on AECOM's experience on other relevant projects, previous investigations at the site, and online sources. AECOM does not guarantee the performance of the proposed confined disposal facility in any respect, only that our engineering and analysis work meets the standard of care of our profession. AECOM represents that our services were performed within the limits prescribed by the client, in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation to the client, expressed or implied, and no other warranty or guarantee is included or intended at this time.

10. References

AECOM, ‘DRAFT Preliminary Engineering Assessment Summary Report’ (AECOM PEA 2022), dated November 11, 2022

United States Army Corps of Engineers, ‘Confined Disposal Facilities on the Great Lakes’ (USACE 1998), dated October 1998

Arcadis, ‘Howard’s Bay Superior, Wisconsin, Focused Feasibility Study’ (Arcadis 2015), dated January 27, 2015