LOWER MINNESOTA RIVER
WATERSHED DISTRICT

Executive Summary for Action

Lower Minnesota River Watershed District Board of Managers Meeting
Wednesday, October 19, 2022

Agenda Item
Item 7. K. – MPCA Soil Reference Values

Prepared By
Linda Loomis, Administrator

Summary
In May 2022 the MPCA provided an annual update to their Soil Reference Values (SRVs). The LMRWD engaged Barr Engineering to evaluate the impact the SRVs may have on the LMRWD's role as local sponsor to the US Army Coe of Engineers management of the Minnesota River 9-foot navigation channel. In August 2022, the LMRWD received a Technical Memorandum dated August 25, 2022 from Barr Engineering advising the LMRWD of possible impacts.

Based on the guidance in the Barr Memorandum, Young Environmental Consulting Group reviewed the LMRWD's Dredge Material Management Plan (DMMP) and how the DMMP should be revised based on the new pollutant tolerance levels. Young Environmental's Technical Memorandum – Revised Soil Reference Values and the Dredge Material Management Plan dated October 12, 2022, is attached for the Board's information.

Now that the MPCA has determined SRV's, future reports to the Board of Managers on this item will be included under Dredge Management and the Item listed as "MPCA Soil Reference Values" will be removed from the agenda.

Attachments
Technical Memorandum – Revised Soil Reference Values and the Dredge Material Management Plan dated October 12, 2022

Recommended Action
Motion to authorize staff to proceed with recommendations contained in the Technical Memorandum

Young Environmental Consulting Group, LLC

Technical Memorandum

To: Linda Loomis, Administrator
Lower Minnesota River Watershed District

From: Katy Thompson, PE, CFM
Hannah LeClaire, PE

Date: October 12, 2022

Re: Revised Soil Reference Values and the Dredge Material Management Plan

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As outlined in the Lower Minnesota River Watershed District's (LMRWD's) workplan to the Board of Water and Soil Resources, the LMRWD will implement capital improvement projects and continue the operation and management (O&M) of the Cargill East River (MN—14.2 RMP) Dredge Material Site (Site) located on the Minnesota River in Savage, Minnesota (Figure 1). O&M activities include maintenance of the Site and management of the disposal of the dredged material.

The Minnesota Pollution Control Agency (MPCA) has been in the process of updating its Soil Reference Values (SRVs), which are used as a screening tool to evaluate potential human health risks from exposure to contaminated soil, since 2014 and has recently updated the values in 2021 and 2022. This document provides the history of the dredging activities on the Minnesota River, reviews the impacts of the new SRVs on the LMRWD's current dredged material management, and provides recommendations for updating the LMRWD's Dredged Material Management Plan (DMMP).

Background

The U.S. Army Corps of Engineers (USACE) is required to maintain a nine-foot-deep by 100-foot-wide channel within the Minnesota River for barge navigation from its confluence with the Mississippi River to 14.7 miles upstream. While the USACE provides the needed channel dredging for navigation, the LMRWD serves as the local sponsor and is responsible for providing dredge material placement sites and disposal. In 2007, the LMRWD acquired land from Cargill, and in 2014, it entered into an agreement with LS Marine, which also provides dredging services for the private slips at the nearby Ports of Savage, to operate the Site and identify end users for the USACE dredged material on the LMRWD's behalf. In 2020, the Site was improved to reconfigure the containment berms to segregate the sandy USACE dredged material and the more fine-grained and clayey private dredged material, which requires longer drying times. Since this most recent construction was completed, LS Marine has coordinated the placement and removal of approximately 24,000 cubic yards (CY) of USACE dredged material and 93,000 CY of private dredged materials.

LMRWD's role and responsibilities for dredged material are outlined in the District's *2018–2027 Watershed Management Plan* and its *Cargill East River (MN—14.2 RMP) Dredge Material Site Management Plan* (DMMP) adopted in January 2013. The DMMP included sediment analysis to determine the beneficial reuses available for the dredged material, considering contaminant-specific concentrations from the SRVs. In 2009, samples were screened against the SRVs and determined to be below the MPCA Dredge Material Level 1 values and suitable for residential fill uses around potentially sensitive populations, such as the very young, infirm, and elderly. Contamination below the Level 1 values is considered to represent little to no risk for human exposure (Table 1).

Table 1. 2009 Sediment Analysis and MPCA SRVs from the 2013 DMMP

	2009 Sample	Level 1 SRV (Residential)	Level 2 SRV (Industrial)
Arsenic (mg/kg dry)	2.3	9	20
Cadmium (mg/kg dry)	<0.52	25	200
Chromium Total (mg/kg dry)	5.5	87	650
Copper (mg/kg dry)	2.6	100	9,000
Lead (mg/kg dry)	3.4	300	700
Mercury (mg/kg dry)	<0.018	0.5	1.5
Nickel (mg/kg dry)	5.3	560	2,500
Selenium (mg/kg dry)	<1.0	160	1,300
Zinc (mg/kg dry)	15	8,700	75,000
Total PCBs (mg/kg dry)	<0.11	1.2	8.0

Figure 1: LMRWD Dredge Site Location Map

In 2014, the MPCA developed two reference documents for managing dredged materials: *BMPs for the Management of Dredged Materials* and *Managing Dredged Materials in Minnesota*. These documents superseded the SRV values used in 2009 and provide clearer guidance on how and where dredged materials may be used depending on their chemical composition. In 2021 and 2022, *Managing Dredged Materials in Minnesota* was further updated and expanded to include 21 additional metals and chemicals, notably perfluoroalkyl and polyfluoroalkyl substances, commonly known as PFAS, which are an emerging contaminant of concern for groundwater.

A review of the USACE annual dredging summaries available online as part of its *Channel Maintenance Management Plan* (CMMP) provided the quantities of material dredged from each Minnesota River historic dredge cuts (or reaches) from 1970 through 2020 (Table 2, Figure 2). The estimated volumes to be dredged for 2022 are also included in Table 2. From the USACE data, we were able to determine the percentage of routine and nonroutine dredging activities contributing to the total quantity dredged, as well as the average accumulation rate, in terms of CY per year (yr).

Table 2. Summary of USACE Dredged Quantities, 1970–2022 (CMMP Table 14)

Reach	Number of Times Dredged	Last Date Dredged	Total Quantity Dredged (CY)	% of Routine Dredging Activities	Avg. Accumulation Rate (CY/yr)
MN-1	2	1993	32,234	89%	1,470
MN-2	1	1987	4,389	100%	-
MN-3A	1	1983	36,612	100%	-
MN-3B	2	1982	14,454	100%	1,610
MN-3C	37	2022	611,038	47%	11,980
MN-4	13	2022	39,370	51%	1,640
MN-5	20	2017	261,578	78%	5,940

Next we compared the USACE dredge records from 1999 to 2022 to the 27-year forecasted quantities from 1999 through 2025 in the 2013 DMMP (Table 3). Cells that exceed the forecasted quantities are highlighted in yellow, while cells the are less than for forecasted quantities are highlighted in green.

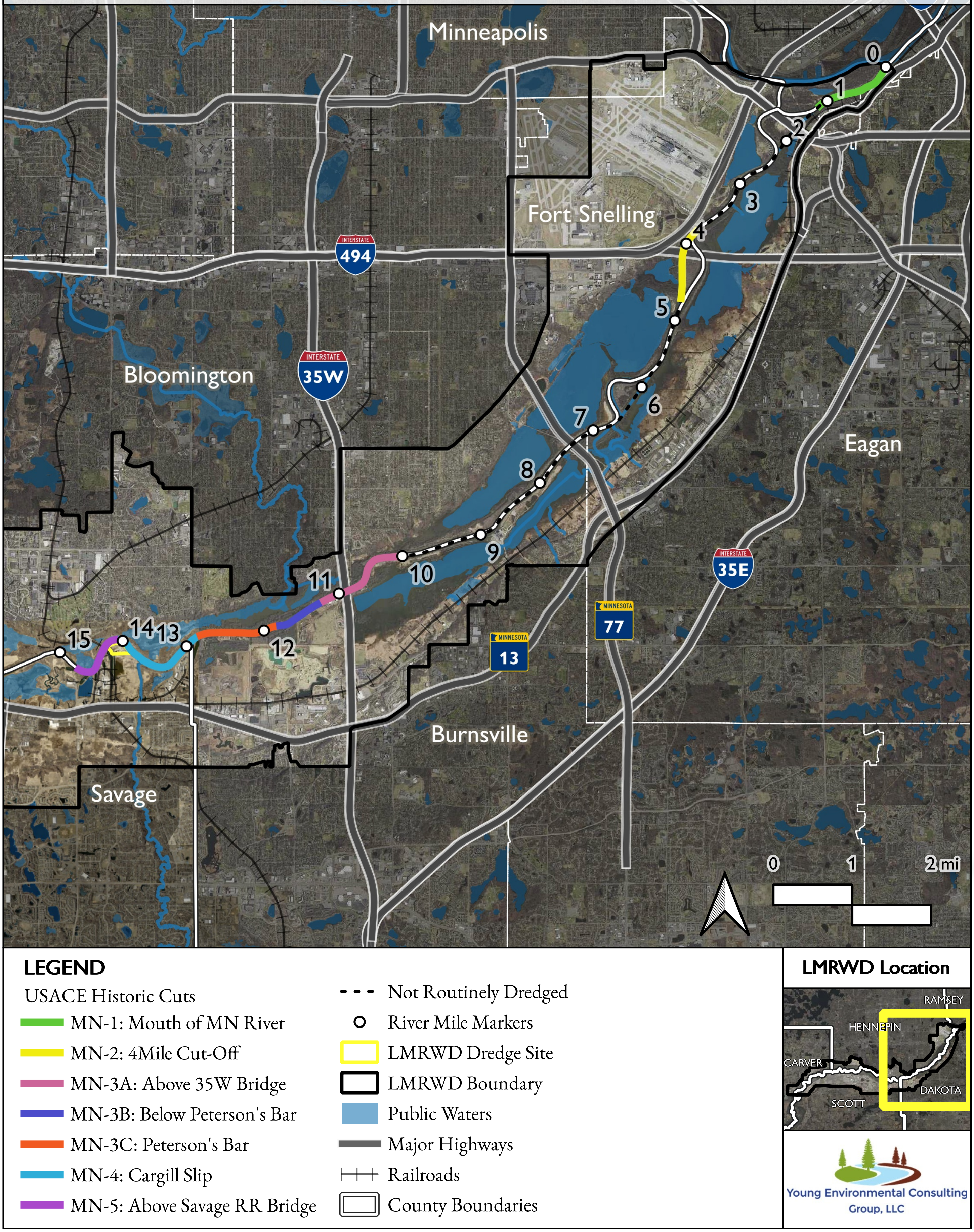
Table 3. DMMP 27-year Forecasted Dredging Quantities (1999–2025) versus USACE Dredge Records (1999–2022)

Reach	27-yr Forecasted Number of Dredge Events	27-yr Forecasted Dredged Quantity (CY)	27-yr Forecasted Accumulation Rate (CY/yr)	USACE Number of Dredge Events, 1999–2022	USACE Dredged Quantity, 1999–2022 (CY)	Avg. Accumulation Rate, 1999-2022 (CY/yr)
MN-1	3	54,000	2,000	0	0	0
MN-2	3	27,000	1,000	0	0	0
MN-3	15	405,000	15,000	19	320,484	13,400
MN-4	3	237,600	8,800	12	35,872	1,500
MN-5	8	432,800	16,030	10	89,698	3,700
TOTAL	**85**	**1,156,400**	**42,830**	**41**	**446,054**	**18,600**

The overall analysis of the forecasted DMMP quantities and USACE dredge records shows that the total annual volume dredged has averaged around 18,600 CY, more than 24,000 CY less than the 2013 DMMP forecasted annual total of 42,830 CY. The two-year running average of the total annual dredged volume (Figure 3) appears to support this lower annual average since the 1990s. The dredged volumes by reach shown in Figure 3 also confirms that over the past 52 years, the most frequently dredged reaches of the Minnesota River were MN-3C, MN-4, and MN-5. Updates to the DMMP should include a review of all historic dredge cuts to update the forecasted quantities for the next 30-year period (2022–2052) and confirm the LMRWD Dredge Site will have adequate storage capacity into the future. This update should also include a review of the forecasted operating costs, especially if the forecasted annual dredge quantities are less than the 2013 DMMP estimates, as this may affect the potential beneficial uses and income generated from the sale of dredge spoils.

Figure 3 includes historic flood events for reference however a brief review of flood and drought records (Figure 4) does not appear to show a correlation between dredged volumes and episodic river events. The impact of weather extremes on dredging operations should be further investigated with any update to the DMMP so that the LMRWD can plan accordingly for the future.

Figure 2: LMRWD Historic Dredge Cuts



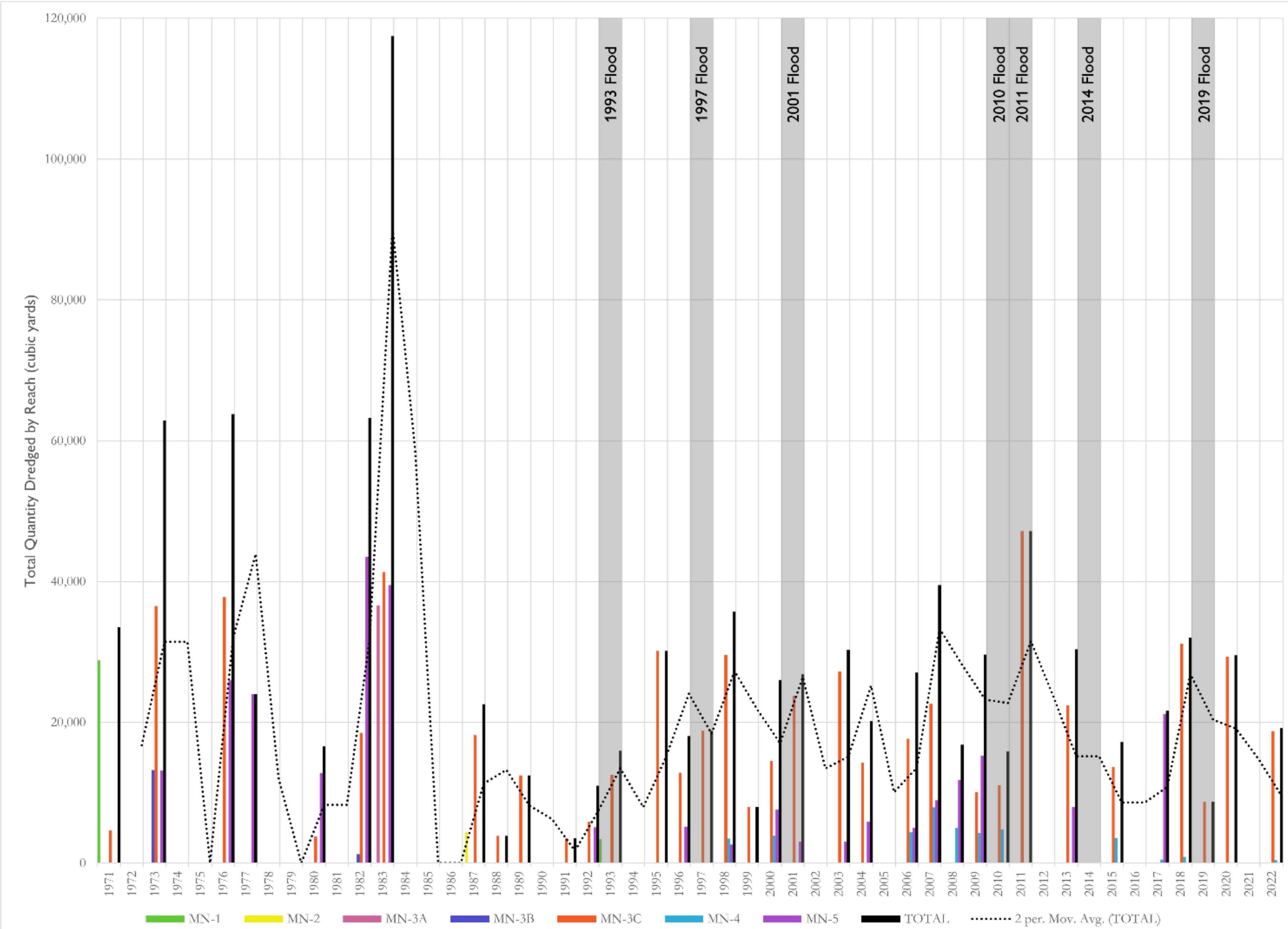


Figure 3. Annual Material Dredged per USACE Minnesota River Reach (USACE 2020); Black dashed line indicates the total dredged volume two-year running average.

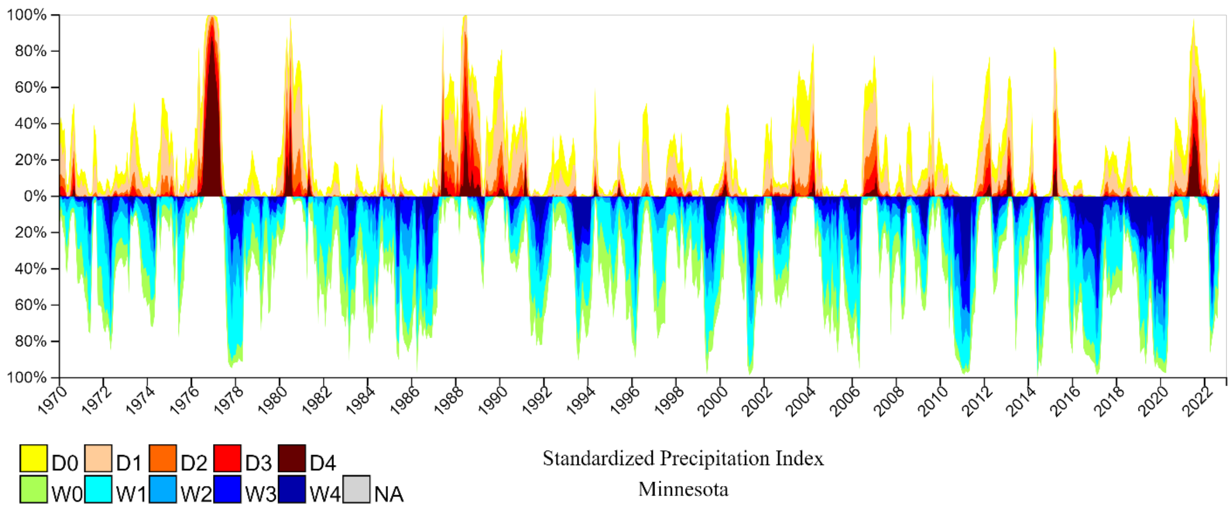


Figure 4. Standardized Precipitation Index from Drought.gov (D0–D4 indicate drought severity, whereas W0–W4 indicate wet conditions over a nine-month average.

Impacts to LMRWD Operations

The LMRWD authorized Barr Engineering Co (Barr) to review the latest SRV values and provide an assessment of the changes and impacts to LMRWD activities and operations (Attachment 1). Barr reviewed the historic sampling data from the USACE CMMP and LMLRWD DMMP and identified that the only chemical parameter that would have exceeded the 2022 MCPA Level 1 SRV was manganese. The manganese Level 1 SRV decreased from 3,600 mg/kg in 2009 to 730 in 2022, and the historic Minnesota River samples show manganese concentrations between 56.8 and 931 mg/kg. The highest concentration was found at River Mile (RM) 14.5 (MN-5, Figure 2), whereas the lowest was at RM 13.2 (MN-4, Figure 2). Barr concluded in their analysis that manganese concentrations in the Minnesota River “are consistent with naturally-occurring background levels in the soil and may be due to the geochemical composition of the sediments themselves.” Regardless, the lowered manganese SRV may limit the ability to sell dredged materials to the private market and could significantly increase the LMRWD’s operation costs if dredged material is required to be landfilled rather than sold. Future updates to the DMMP should validate the levels of manganese that could be expected to be found in the dredge spoils from each reach because the historic data shows MN-5 only exceeded the 2022 SRV the single time in 1999.

Though there does not appear to be an immediate requirement for the LMRWD Dredge Site to address PFAS, it could be a requirement in the future should PFAS be found in the dredge material. Barr preliminary identified potential sources of PFAS in the watershed, including airports, landfills, and wastewater treatment plants that may have historically "used, discharged, emitted, and/or served as conduits for PFAS." Barr noted that while there is no statewide value for PFAS in surface water, it is expected that there will be decreasing tolerance for PFAS in surface and groundwater in the future. Also, given the presence of PFAS found in Pool 2 of the Mississippi River, Barr anticipates that the new PFAS SRVs will eventually affect the dredge material management, which may further limit the ability to sell the dredged material.

Next Steps

The District DMMP was last updated in 2013 and focuses heavily on material placement options, beneficial uses, and estimated quantities through 2025. Given the changes in SRV values and river conditions, we recommend the DMMP be updated to plan for future management of the site, including contingency plans for if dredge materials exceed the manganese and PFAS criteria. The following are specific items that should be considered as part of the DMMP update:

1. Complete a sediment assessment to aid in forecasting the next 30-years of dredging requirements for the Minnesota River, considering changing climate and flow conditions as well as projected changes in barge traffic or dredging practices.
2. Collect sediment core samples at each of the Minnesota River dredge cuts to supplement the data last collected in 2009 and validate the ability to continue sales of dredged materials, if not already available from the USACE or LS Marine.
3. Review the MPCA PFAS Monitoring Plan and identify future improvements necessary for the LMRWD Dredge Site to prevent runoff and soil leaching of PFAS, should PFAS be found in dredged materials.
4. Meet with the USACE to discuss the Mississippi River Pool 2 dredged material management for PFAS and identify joint disposal opportunities should the Minnesota River dredge material exceed the SRVs for PFAS in the future.
5. Develop an adaptable framework for the next 30-years of dredge site management based on the results from items 1 and 2 above and including alternative options for disposal of dredged material should the sediments exceed current SRV thresholds.

Attachments

Attachment 1—Lower Minnesota River Watershed District Soil Criteria Review Technical Memorandum by Barr Engineering, dated August 25, 2022

Technical Memorandum

To: Della Young, Young Environmental Consulting Group
From: Jenni Brekken
Subject: MPCA Soil Criteria Review for LMRWD
Date: August 25, 2022
Project: Lower Minnesota River Watershed District Soil Criteria Review
c: Karen Chandler

The Lower Minnesota River Watershed District (LMRWD) manages dredged sediments from the Minnesota River and from other ponds or surface waters. As part of this activity, an evaluation of the material is needed to determine the appropriate disposal or reuse of the materials based on Minnesota Best Management Practices (BMP) documents and other federal, state or local regulations. Assessment of chemical contamination in dredged sediments is part of the BMPs and impacts whether the material may be reused as fill, may have a restricted reuse, or requires landfill disposal. For this assessment, sediment chemical concentrations are compared to current Minnesota Pollution Control Agency (MPCA) Soil Reference Values (SRVs). The MPCA recently provided a substantive update to their methods for developing SRVs in 2021 and in May 2022 followed with an annual update to their SRVs (MPCA, 2021 and 2022a/b).

The MPCA also recently issued a per-and polyfluoroalkyl substances (PFAS) Monitoring Plan, outlining specific programs and facilities that will incorporate analysis for PFAS as part of the regulatory program. The MPCA's PFAS monitoring programs may also impact decisions regarding reuse of dredged sediments.

This memo describes how the SRVs are typically used in evaluating dredge materials, summarizes the recent SRV updates (in 2021 and 2022), and provides an assessment of how these changes may impact LMRWD activities or operations. In addition, Barr is providing a review of the MPCA PFAS Monitoring Plan including a discussion of whether PFAS analysis of sediments may be required and the potential impacts to LMRWD.

1 Soil Reference Values Overview

The SRVs are a screening tool used to evaluate potential human health risks from exposure to contaminated soils by comparing chemical concentrations in soil to the SRVs. They are derived using USEPA methodology for assessing human health risk and are based on conservative assumptions designed to be protective of the most vulnerable receptors and cover multiple soil exposure pathways, including inhalation of dust, ingestion, dermal contact and inhalation of vapors for both cancer and non-cancer risks. SRVs are developed using exposure assumptions based on different land use categories (e.g., the assumed duration and quantity of exposure to the soil is different for a residential use property versus an industrial use property). Currently, the MPCA has published SRVs for two different land use categories: 1) residential/recreational (e.g., single family homes; multi-family housing; long-term care facilities, hospitals, churches, schools, sports fields, etc.) and 2) commercial/industrial (warehouses, offices, manufacturing facility, restaurants, hotels, etc.)

The MPCA has several programs where SRVs are applied, including brownfields, petroleum leak sites, closed landfills, superfund, management of dredged sediments, management of stormwater pond sediments, and for evaluating offsite reuse of excess fill from a development or construction project. For evaluating whether dredged sediments or soils are suitable for reuse on other sites, the residential/recreations SRVs (formerly referred to as "Tier 1" SRVs), are applied, which are lower and more conservative than commercial/industrial SRVs.

The SRVs are provided by the MPCA in an excel spreadsheet format (https://www.pca.state.mn.us/document/c-r1-06xlsx), which includes detailed background information on how each SRV is calculated and the final SRVs for each chemical. This spreadsheet is updated periodically by the MPCA and the revision year for each chemical is noted within the spreadsheet.

2 Applications of SRVs to LMRWD Projects

The following types of projects or activities undertaken by LMRWD may warrant evaluation of chemical concentrations in soils or sediments using MPCA SRVs:

- Stormwater management or flood mitigation projects involving excavation in areas with contaminated soils or sediments.
- Creek or riverbank erosion control or bank stabilization projects in areas with contaminated soils.
- Management of dredge material from the Minnesota River.

2.1 Soil Excavation Projects

For projects involving excavation of soils, if there is no known or suspected source of contamination, sampling and analysis of this excess soil is generally not needed. During the planning stages of an excavation project, an initial assessment can be considered to help determine whether an investigation and chemical analysis of the soils may be warranted. Depending on the site specifics, the initial assessment could involve a desktop review of the site history and uses such as review of MPCA's website What's in My Neighborhood (MPCA, 2022f) and any available historical aerial imagery. If a property transfer is occurring as part of the project, or if there are potential concerns for environmental releases, then more detailed study could be completed that would involve completion of a Phase I Environmental Site Assessment (ASTM, 2021) that includes broader records review, interviews, a site visit, and a preparation of a report.

If there is documented contamination or recognized environmental conditions indicating contamination is likely present in the soils, soil sampling and chemical analysis can be performed, and the results compared to SRVs. The list of chemical contaminants is selected based on the land use history and suspected type of hazardous substance or petroleum release. In the case where contamination is identified at concentrations above MPCA SRVs for a particular land use, plans for appropriately managing and/or disposing of soils are needed. These projects may be performed under the MPCA's voluntary remediation (Brownfield) program oversight to obtain various MPCA liability assurances or technical review of reports and cleanup plans (MPCA, 2022c).

Offsite reuse of soil is guided by MPCA's Best Management Practices (BMP) for the Off-Site Reuse of Unregulated Fill (MPCA, 2012a) and the BMP for Off-Site Reuse of Regulated Fill (MPCA, 2012b). The classification of Unregulated Fill includes soils that meet MPCA Soil Leaching Values (SLVs; protective of contaminant leaching to groundwater), MPCA Residential SRVs, and are free of debris and other observations of contamination (MPCA, 2012a). Regulated Fill is defined as soil that has chemical concentrations above MPCA residential SRVs but below Industrial SRVs (among other characteristics). However, the BMP for Offsite Reuse of Regulated Fill (MPCA, 2012b) requires identification of a project site to receive the Regulated Fill and approval by local government and MPCA. Because of these restrictions, reuse of Regulated Fill under MPCA's BMP is rare. In most cases, excess soils with chemical concentrations above MPCA residential SRVs are typically disposed of at a landfill.

2.2 Stormwater Pond Dredging Projects

For management of sediments removed from stormwater ponds, work is guided by MPCA's BMP for Managing Stormwater Sediments (MPCA, 2017), typically independent of voluntary brownfield cleanup program review.

Similar to excavated soils, offsite reuse of sediments dredged from stormwater ponds (MPCA, 2017) is based on whether the sediment chemical concentrations meet MPCA's BMP for Unregulated Fill (MPCA, 2012a), which includes residential SRVs and SLVs. The stormwater pond sediment chemical parameter list for laboratory analysis includes analysis of polycyclic aromatic hydrocarbons (PAHs), arsenic and copper, and any other chemicals that would be expected to be present in the sediments based on a known release or site use (e.g., from industrial operations on the site). The same site assessment tools outlined in Section 2.1 could be used to evaluate historical site uses and potential for contamination. Stormwater pond sediments that do not meet Unregulated Fill guidelines are typically drained of free-liquids and disposed at a solid waste landfill.

2.3 River Dredge Material Management

The LMRWD manages Minnesota River sediments dredged by the US Army Corps of Engineers (USACE) to maintain the Minnesota River 9-foot navigation channel from the confluence of the Mississippi River to river mile 14.7 in Savage, Minnesota (LMRWD, 2013). The dredged sediments are stored at the Cargill East River site, located at river mile 14.2 in Shakopee, Minnesota (LMWRD Dredge Facility). The LMRWD Dredge Facility is estimated to potentially store about 190,000 CY of dredged material at one time An estimated 25,000 CY of sandy material is dredged annually by the USACE and managed at the LMRWD Dredge Facility. The USACE dredged material is dewatered prior to being taken offsite for beneficial reuse. Approximately 18,000 CY of mainly fine grained silty and clay sediments dredged from private terminals in this stretch of the river are also dewatered and managed at the LMRWD Dredge Facility for a fee prior to being taken offsite within the year (Burns & McDonnell and Young Environmental, 2017).

As one of the LMRWD's main activities is to manage dredge materials from the Minnesota River, the remainder of this memo focuses on dredge material management.

3 Minnesota Dredge Material Management BMPs

The MPCA has two relevant guidance documents for managing dredge materials: 1) BMPs for the Management of Dredged Material (MPCA, 2014a) and 2) Managing Dredge_Materials in Minnesota (MPCA, 2014b). The guidance indicates the following steps for determining the appropriate management method for dredged materials: perform grain size analysis, evaluate past industrial activities and sources of pollutants, and collect samples for analysis of pollutants likely to be present. If the grain size analysis indicates the material is predominantly sand (only 7 percent is finer than sand and passes the #200 sieve), the material is deemed by the guidance to be unlikely to contain contaminants and does not need chemical analysis. USACE dredge materials from the Minnesota River were previously reported to be predominantly sand (7 percent or less fines) with an average of 1 to 4% silt and clays (USACE, 2007), indicating the material and does not warrant chemical analysis based on the Minnesota BMP (MPCA, 2014a/b). The USACE also reported that materials from private dredging typically tested as having 30% silts and clays, which would warrant chemical analysis (USACE, 2007). Barr did not evaluate grain size data sets from the Minnesota River for this assessment, so we assume for the purposes of this memo that dredge materials are tested for chemical analyses as part of the LMRWD dredge material management plans.

Management of dredge materials originating from the Minnesota River downstream of River Mile 27 (which is approximately two miles upstream of the CSAH 101 crossing at Shakopee) requires a permit under the State Disposal System for disposal or reuse of dredged materials (MPCA, 2014b) if the quantity of dredged material is 3,000 cubic yards or more (MPCA, 2014b).

The Dredge Material BMP defines the following management categories for sediment based on chemical concentrations (MPCA, 2014b):

- Level 1 Dredged Material is suitable for reuse on residential or recreational properties and is characterized as being at or below analyte concentrations for all of the Tier 1 SRVs (a.k.a. Residential/Recreational SRVs).
- Level 2 Dredged Material is suitable for use or reuse on properties with an industrial use category and is characterized as being at or below analyte concentrations for Tier 2 SRVs (a.k.a. commercial/industrial SRVs).
- Level 3 Dredged Material is not suitable for use or reuse and is classified as having one or more analyte concentrations being greater than Tier 2 (commercial/industrial) SRVs.

Dredged material, if not excluded from additional analysis as determined using the grain size analysis described above, is to be analyzed for a baseline list of sediment parameters as well as other pollutants with a reasonable likelihood to be present in the dredged material based on an evaluation of past industrial activities. The lists of baseline sediment parameters and additional sediment parameters for which the MPCA has established SRVs is shown on Table 1.

4 SRV Updates

The SRVs established in 2009 were applied for many years, with only minor updates or additions as information developed regarding toxicity for select, limited chemicals. In 2014, MPCA published draft revised methodology and SRVs for public comment. Several iterations of draft SRVs were provided and new SRVs and technical guidance were finalized and published in January 2021. Updates to the MPCA SRVs and associated technical guidance occurred in 2022

The changes in the SRVs, comparing 2009, 2021 and 2022 values are shown in Table 1 (residential/recreational SRVs) and Table 2 (commercial/industrial SRVs) for those chemicals on the sediment parameter lists for dredge materials (MPCA, 2014b). PFAS, while not on the sediment list, are also included, and discussed further below. In general, most of the residential SRVs decreased from 2009 to 2021 due to changes in toxicity information, assumptions and default values used for the risk-based calculations of these screening levels. Fewer SRVs decreased for the industrial/commercial land use, and some, including naphthalene, benzo(a)pyrene equivalents and copper increased significantly from 2009 to 2022. Between 2021 and 2022, fewer SRVs changed, but those that did decreased.

Notable changes to the SRVs and technical guidance in 2021 and 2022 include the following:

- Prior to 2021, individual SRVs were published for these four land use scenarios: residential, recreational, industrial, and short-term worker. In 2020, the categories were reduced to two: residential/recreational and commercial/industrial. The MPCA updated their SRVs and technical guidance again in 2022 and has indicated they plan to provide annual updates to the SRVs.
- Calculation of some SRVs based on the risk-based equations resulted in very low values, below either naturally-occurring levels (e.g. arsenic) or typical urban anthropogenic background levels (e.g. benzo(a)pyrene) in soil. For these chemicals, the SRVs were set at the background levels, as MPCA has recognized that cleaning up soil to levels below background concentrations is not feasible or practicable. It should be noted that some background concentrations in soil are also higher than SLVs (especially for metals); use of SLVs to assess contaminant levels should also consider background concentrations in decision-making.
- Previous SRVs accounted for both acute (short term) and chronic (long term) exposures. The 2021 revision separated acute from chronic SRVs for the residential exposure scenario for chemicals with acute toxicity risk. For the sediment parameter list, these include arsenic, barium, cadmium, copper, cyanide and nickel. It should be noted that the acute SRVs for barium and copper are more than an order of magnitude lower than the chronic SRVs.
- The technical guidance for assessing risk from carcinogenic PAHs (cPAHs) is assessed by calculating a toxic equivalency to benzo(a)pyrene. There are different cPAH parameter lists published for sediments than there are for soils, but after the 2021 update, both the MPCA soil and sediment guidance documents indicate the benzo(a)pyrene equivalents are to be calculated

using Kaplan Meier statistical methods. When analyzing for PAHs, the correct parameter list, and an understanding of the methods for calculating the cPAH equivalents are required.

5 Impact of Changes in SRVs to Management of Dredge Material

To assist in predicting how changes in the SRVs may impact LMRWD management of dredge material, data from the Minnesota River sediments collected between 1978 and 2007 as reported in the Dredge Material Site Management Plan (LMRWD, 2013) was compared to 2022 MPCA Residential/Recreational SRVs and SLVs to assess whether it meets MPCA Unregulated Fill guidelines (MPCA, 2012) and Level 1 category for dredged material management (MPCA, 2014b). The results are shown on Table 3.

The only parameter above SLVs or the Residential/Recreational SRV was manganese. The manganese Residential SRV decreased from 3,600 mg/kg in 2009 to 730 mg/kg in 2022. Nearly all manganese results were also above the SLV of 130 mg/kg. The manganese concentrations in the Minnesota River sediments are consistent with naturally-occurring background levels in soil (USGS, 2013), and may be partially attributed to the geochemical composition of the sediments or a result of inputs to the river through runoff from soils. While The MPCA recognizes that some naturally-occurring levels of metals in soils are above SRVs or SLVs, the presence of chemical concentrations above these Unregulated Fill screening levels may limit the ability to sell the dredged materials in the private market for beneficial reuse.

A comparison of more recent USACE sediment data, if available, would be useful for assessing the potential for cost impacts to LMWRD for managing dredge material and evaluating if it is suitable for beneficial reuse.

The MPCA has indicated they intend to update the SRVs on an annual basis, so LMRWD should consider potential changes to SRVs in the long term management plan for dredged materials. If sediments are sampled and analyzed for chemical analysis, the data should be compared to the most recent SRVs in determining beneficial reuse. If the material is stored on the site for more than a year, re-evaluation of the sediment data using updated SRVs may be warranted prior to removing the material from the site for offsite reuse. It should be anticipated that projects receiving the dredged soil for reuse will be making comparisons to current SRVs.

Barr is not aware of MPCA revisiting past soil management and reuse decisions at off-site locations based on then-current SRVs/SLVs, but as MPCA continues to adjust their values, there is some risk that past reuse of sediments at off-site locations may come under new scrutiny in the future if testing is conducted as part of a construction or remediation project.

6 PFAS Monitoring Plan

On March 22, 2022, the MPCA published the final version of its PFAS Monitoring Plan (MPCA, 2022). The plan addresses issues identified in Minnesota's PFAS Blueprint (MPCA, 2021), released in February 2021, and responds to public comments submitted to the MPCA. Given the wide-spread use of PFAS over the past 70 years and their persistence, they are considered ubiquitous in the environment. Therefore, to address PFAS broadly and consistently the MPCA is taking a statewide and coordinated approach across their permitting and cleanup programs as document in their PFAS Monitoring Plan.

In general, the MPCA's approach has been to initiate sampling across select industries and sites, and then develop future efforts based on the results. Looking ahead, MPCA's approach is expected to expand PFAS sampling over time and will result in an evolving regulatory approach as more information is developed.

The plan addresses monitoring requirements under five different MPCA programs:

- Air Program. Selected permitted facilities via emissions inventory reporting and stack testing;
- Wastewater Program. Subset of municipal wastewater treatment plants and industrial facilities via influent monitoring;
- Solid Waste/Hazardous Waste Program. Selected facilities via leachate or groundwater sampling;
- Industrial Stormwater Program. Selected airports, chrome plating facilities, and automotive shredding facilities via stormwater sampling; and
- Remediation Program: Phased program with additional specific guidance forthcoming.

The MPCA relied on a set of North American Industry Classification System (NAICS) codes to identify facilities that are likely to have used, emitted or discharged PFAS. The monitoring plan ultimately listed over 400 specific facilities in the "initial" phase of monitoring, including 169 manufacturing/industrial facilities, 8 regional airports, 145 landfills/solid waste management facilities, and 91 municipal wastewater treatment plants. The plan notes a differentiation between facilities that may be a source of PFAS (e.g. industrial facilities that used PFAS) and facilities that are likely "conduits" for PFAS into the environment (e.g., waste management, recycling, etc.)

The MPCA's stated intention is to have the monitoring plan "avoid duplication" for a specific facility (e.g., sampling under multiple MPCA programs or for multiple media). However, the plan clearly states that sampling of other media, under additional programs may be required after the initial phase (e.g., results of stack testing may lead to a request for industrial stormwater sampling). The identified facilities began receiving MPCA letters requesting sampling in mid-2022. While dredge material or sediment sampling for PFAS is not explicitly mentioned it the PFAS Monitoring Plan, such activities may potentially follow findings of PFAS impacts in stormwater or wastewater discharges to the Minnesota River.

The MPCA's PFAS Monitoring Plan leverages existing program and permit structures to require PFAS sampling at facilities. Although there does not appear to be an immediate requirement for LMRWD facilities to sample or address PFAS in the MPCA PFAS Monitoring Plan, this may be a future requirement if, for example, PFAS sources are found to be located near USACE or private dredge sites in the LMRWD. Although Barr has not completed an exhaustive review, the following facilities within the watershed are types of facilities that are likely to have used, discharged, emitted, and/or 'served as conduits' for PFAS: Blue Lake Wastewater Treatment Plant, Seneca Wastewater Treatment Plant, Flying Cloud Airport, Minneapolis/St. Paul International Airport, and numerous dumps and landfills (operating or historical).

Note as precedent, that the MPCA has investigated, and found, PFAS impacts in sediments in the Mississippi River (MPCA, 2013). Additionally, MPCA has listed 25 bodies of water in the state on its impaired waters list due to impacts from PFAS (MPCA, 2022e). While there is currently no statewide value for PFAS chemicals in surface water, MPCA has developed a site-specific water quality criteria (SSWQC) for perfluorooctane sulfonic acid (PFOS) protective of fish consumption in an area around Lake Elmo, Bde Maka Ska, and Pool 2 of the Mississippi River. Specifically, the SSWQC is 0.05 parts per trillion (ppt) PFOS, which is below current laboratory quantitative limits. (https://www.pca.state.mn.us/waste/water-quality-criteria-development-pfas). MPCA has acknowledged that such low values (derived from risk-based calculations and modeling) may be challenging to measure and attain in practice, but MPCA has also indicated that permit conditions for facilities that directly discharge to these impaired waterbodies are being evaluated for additional requirements where necessary.

Current SRVs for PFAS are shown on Tables 1 and 2, but future SRV updates are expected to result in lower SRVs for PFAS given evolving understanding of PFAS toxicity and other regulatory trends in other PFAS screening levels.

Another recent development for monitoring PFAS is the emerging concept of world-wide background concentrations of PFAS which is being monitored in rainfall and surface soils across widely distributed areas and land uses. As this concept advances, it may be another factor in distinguishing PFAS sources from specific industries verses baseline or background concentrations that are more ubiquitous. We are not aware that MPCA has developed a current position on this concept, but Barr believes it will emerge as a topic of interest as more PFAS data is collected across the state and beyond.

Given the airports, wastewater treatment plants and solid waste disposal and recycling facilities in the watershed, there is potential for PFAS to have been discharged to the Minnesota River through overland stormwater flow or direct discharges. The PFAS identified in the Mississippi River sediments is also indicative of potential PFAS presence upstream in the Minnesota River sediments. Given the general decreasing trends in PFAS regulatory criteria and screening levels, and the increase in monitoring across various Minnesota programs, it is likely that sampling of Minnesota River sediments for PFAS analysis may follow other monitoring programs. Due to the ubiquitous nature of PFAS and the persistence of these compounds in the environment, sampling of Minnesota River sediments may identify PFAS, and given the general decreasing trend in PFAS criteria, options for beneficial reuse of dredged materials may become more limited due to difficulty in meeting the increasingly lower PFAS SRVs. Presence of PFAS in dredged materials stored at the LMWRD Dredge Facility may also require controls to address runoff from stockpiles and leachate to the surrounding soil and groundwater and river.

Attachments:

Table 1 – Summary of MPCA Residential/Recreational Soil Reference Value Changes, 2009 – 2022, Sediment Parameter List and PFAS

Table 2 – Summary of MPCA Commercial/Industrial Soil Reference Value Changes, 2009 – 2022, Sediment Parameter List and PFAS

Table 3 – Minnesota River Sediment Chemical Data

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Table 1
Summary of MPCA Residential/Recreational Soil Reference Value Revisions, 2009 - 2022
Sediment Parameter List and PFAS

Chemical	Baseline Sediment Parameter List	Additional Sediment Parameter List	CAS No.	Most Recent SRV Revision Year	2021 Res/Rec Acute SRV* (mg/kg)	2022 Res/Rec Acute SRV (mg/kg)	Comparison Acute SRVs: 2022 to 2021 (% change)	2009 Residential SRV (mg/kg)	2021 Res/Rec Chronic SRV (mg/kg)	2022 Res/Rec Chronic SRV (mg/kg)	Comparison: Chronic SRVs 2022 to 2009 (% change)	Comparison: Chronic SRVs 2022 to 2021 (% change)
Inorganics												
Arsenic	X		7440-38-2	2016	9	9	0%	9	9	9	0%	0%
Barium		X	7440-39-3	2022	250	260	4%	1100	3000	3100	182%	3%
Cadmium	X		7440-43-9	2016	8.8	9.1	3%	25	1.6	1.6	-94%	0%
Chromium III	X		16065-83-1	2016				44000	23000	23000	-48%	0%
Chromium VI	X		18540-29-9	2022				87	11	2.3	-97%	-79%
Copper	X		7440-50-8	2016	110	120	9%	100	2200	2200	2100%	0%
Cyanide		X	57-12-5	2016	7.1	7.3	3%	60	13	13	-78%	0%
Lead	X		7439-92-1	2022				300	300	200	-33%	-33%
Manganese		X	7439-96-5	2022				3600	2100	730	-80%	-65%
Mercury (inorganic)	X		7439-97-6	2022				0.5	3.1	2.7	440%	-13%
Nickel	X		various	2016	250	260	4%	560	170	170	-70%	0%
Selenium	X		7782-49-2	2022				160	77	78	-51%	1%
Zinc (except zinc phosphide)	X		7440-66-6	2022				8700	4600	4700	-46%	2%
Per- and Polyfluoroalkyl Substances												
Perfluorobutanesulfonic acid (PFBS)			375-73-5	2022						1.1		
Perfluorobutanoic acid (PFBA)			375-22-4	2022				77		49	-36%	
Perfluorooctanesulfonic acid (PFOS)			1763-23-1	2019				2.1	0.041	0.041	-98%	0%
Perfluorooctanoic acid (PFOA)			335-67-1	2019				2.1	0.24	0.24	-89%	0%
Perfluorohexanesulfonic acid (PFHxS)			355-46-4	2019					0.13	0.13		0%
Perfluorohexanoic acid (PFHxA)			307-24-4	2022						1.9		
Polycyclic Aromatic Hydrocarbons												
Acenaphthene		X	83-32-9	2022				1200	450	460	-62%	2%
Anthracene		X	120-12-7	2021				7880	2800	2800	-64%	0%
Benzo[a]pyrene (BaP equivalents)		X	50-32-8	2019				2	2	2	0%	0%
Fluorene		X	86-73-7	2021				850	390	390	-54%	0%
Naphthalene		X	91-20-3	2016				81	81	710%	0%	
Pyrene		X	129-00-0	2021				890	220	220	-75%	0%
Quinoline		X	91-22-5	2016				4	1.4	1.4	-65%	0%
Polychlorinated Biphenyls												
PCBs (Polychlorinated Biphenyls)	X		1336-36-3	2022				1.2	0.81	0.82	-32%	1%
Pesticides												
Aldrin		X	309-00-2	2016				1	0.45	0.45	-55%	0%
Chlordane		X	12789-03-6	2022				13	9.5	9.6	-26%	1%
4,4-DDD (Dichlorodiphenyldichloroethane)		X	72-54-8	2016				56	19	19	-66%	0%
4,4-DDE		X	72-55-9	2022				40	22	23	-43%	5%
4,4-DDT		X	50-29-3	2022				15	7.3	7.4	-51%	1%
Dieldrin		X	60-57-1	2016				0.8	0.11	0.11	-86%	0%
Endrin		X	72-20-8	2016				8	4	4	-50%	0%
Heptachlor		X	76-44-8	2016				2	1.6	1.6	-20%	0%
gamma-Hexachlorocyclohexane (gamma-BHC, Lindane)		X	58-89-9	2022				9	4.3	0.15	-98%	-97%
Toxaphene		X	8001-35-2	2022				13	4.1	1.2	-91%	-71%
Dioxins and Furans												
TCDD (2,3,7,8-) (2,3,7,8 TCDD equivalents, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)		X	1746-01-6	2021				0.00002	0.000007	0.000007	-65%	0%

* Acute SRV = Acute SRVs are published for select parameters. No Acute SRVs were established in 2009.
X = Baseline and Additional Sediment Parameter Lists from Managing Dredge Materials in the State of Minnesota. wq-gen2-01. April, 2014. https://www.pca.state.mn.us/sites/default/files/wq-gen2-01.pdf
See the MPCA SRV spreadsheet for a complete list of SRVs and detailed footnotes. https://www.pca.state.mn.us/sites/default/files/c-r1-06.xlsx

Table 2
Summary of MPCA Commercial/Industrial Soil Reference Value Revisions, 2009 - 2022
Sediment Parameter List and PFAS

Chemical	CAS No.	SRV Revision Year	Baseline Sediment Parameter List	Additional Sediment Parameter List	2009 Industrial SRV (mg/kg)	2021 Com/Ind Chronic SRV (mg/kg)	2022 Com/Ind Chronic SRV (mg/kg)	Comparison of 2022 SRV to 2009 SRV (% change)	Comparison of 2022 SRV to 2021 SRV (% change)
Inorganics									
Arsenic	7440-38-2	2016	X		20	9	9	-55%	0%
Barium	7440-39-3	2021		X	18000	41000	41000	128%	0%
Cadmium	7440-43-9	2016	X		200	23	23	-89%	0%
Chromium III	16065-83-1	2016	X		100000	100000	100000	0%	0%
Chromium VI	18540-29-9	2021	X		650	62	62	-90%	0%
Copper	7440-50-8	2016	X		9000	33000	33000	267%	0%
Cyanide	57-12-5	2016		X	5000	190	190	-96%	0%
Lead	7439-92-1	2022	X		700	700	460	-34%	-34%
Manganese	7439-96-5	2022		X	8100	26000	10000	23%	-62%
Mercury (inorganic)	7439-97-6	2016	X		1.5	3.1	3.1	107%	0%
Nickel	various	2016	X		2500	2600	2600	4%	0%
Selenium	7782-49-2	2016	X		1300	1200	1200	-8%	0%
Zinc (except zinc phosphide)	7440-66-6	2016	X		75000	70000	70000	-7%	0%
Per- and Polyfluoroalkyl Substances									
Perfluorobutanesulfonic acid (PFBS)	375-73-5	2022				77	15		-81%
Perfluorobutanoic acid (PFBA)	375-22-4	2022			500	280	250	-50%	-11%
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	2022			14	0.56	0.54	-96%	-4%
Perfluorooctanoic acid (PFOA)	335-67-1	2022			13	3.2	3	-77%	-6%
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	2022				1.7	1.6		-6%
Perfluorohexanoic acid (PFHxA)	307-24-4	2022					24		
Polycyclic Aromatic Hydrocarbons									
Acenaphthene	83-32-9	2021		X	5260	6800	6800	29%	0%
Anthracene	120-12-7	2021		X	45400	42000	42000	-7%	0%
Benzo[a]pyrene (BaP equivalents)	50-32-8	2019		X	3	23	23	667%	0%
Fluorene	86-73-7	2021		X	4120	5800	5800	41%	0%
Naphthalene	91-20-3	2021		X	28	280	280	900%	0%
Pyrene	129-00-0	2021		X	5800	3200	3200	-45%	0%
Quinoline	91-22-5	2016		X	7	7.8	7.8	11%	0%
PCBs (Polychlorinated Biphenyls)	1336-36-3	2016	X		8	10	10	25%	0%
Pesticides									
Aldrin	309-00-2	2021		X	2	2.6	2.6	30%	0%
Carbazole	86-74-8	2016		X	1310	1300	1300	-1%	0%
4,4-DDD (Dichlorodiphenyldichloroethane)	72-54-8	2016		X	125	100	100	-20%	0%
4,4-DDE	72-55-9	2021		X	80	130	130	63%	0%
4,4-DDT	50-29-3	2021		X	88	87	87	-1%	0%
Dieldrin	60-57-1	2016		X	2	1.5	1.5	-25%	0%
Endrin	72-20-8	2016		X	56	54	54	-4%	0%
Heptachlor	76-44-8	2021		X	3.5	8.9	8.9	154%	0%
gamma-Hexachlorocyclohexane (gamma-BHC, Lindane)	58-89-9	2022		X	15	25	2.1	-86%	-92%
Toxaphene	8001-35-2	2022		X		23	16		-30%
Dioxins and Furans									
TCDD (2,3,7,8-) (2,3,7,8 TCDD equivalents, 2,3,7,8-Tetrachlorodibenzo-p-dioxin)	1746-01-6	2021		X	0.000035	0.000028	0.000028	-20%	0%

X = Baseline and Additional Sediment Parameter Lists from Managing Dredge Materials in the State of Minnesota. wq-gen2-01. April, 2014. https://www.pca.state.mn.us/sites/default/files/wq-gen2-01.pdf
See the MPCA SRV spreadsheet for a complete list of SRVs and detailed footnotes. https://www.pca.state.mn.us/sites/default/files/c-r1-06.xlsx

Table 2
Minnesota River Sediment Chemical Data*
Lower Minnesota River Watershed District

			Record #				78507	402	301	302	303	78506	401	404
			River Mile				14.7	14.6	14.52	14.51	14.5	14.5	14.4	13.4
			Location				Above Savage RR Bridge	Above Savage RR Bridge	Above Savage RR Bridge	Above Savage RR Bridge	Above Savage RR Bridge	Above Savage RR Bridge	Above Savage RR Bridge	AB & BLW CARGILL
			Year				1999	1989	1982	1982	1978	1999	1989	1989
				MN Soil Leaching Values (June 2013)	MN Acute Residential/ Recreational SRVs (April 2022)	MN Chronic Residential SRVs (April 2022)								
Criteria Exceedance Key				**Bold**	No Exceedances	Shaded								
CHC's	ug/kg		a-BHC			700	< 0.08	< 0.01				< 0.08	< 0.08	< 0.07
CHC's	ug/kg		b-BHC			2500	< 0.08	< 0.2				< 0.08	< 0.16	< 0.15
CHC's	ug/kg		BHC				< 0.08	< 0.3				< 0.08	< 0.24	< 0.22
CHC's	ug/kg		2,4´-DDD											
CHC's	ug/kg		2,4´-DDE											
CHC's	ug/kg		2,4´-DDT											
CHC's	ug/kg		g-BHC (lindane)			150	< 0.08	< 0.13				< 0.08	< 0.11	< 0.1
CHC's	ug/kg		Heptachlor			1600	< 0.10	< 0.1				< 0.10	< 0.08	< 0.07
CHC's	ug/kg		Anthracene	1300000		2800000								
CHC's	ug/kg		Aldrin			450		< 0.13					< 0.11	< 0.1
CHC's	ug/kg		Acenaphthene	81000		460000								
CHC's	ug/kg		Acenaphthylene											
CHC's	ug/kg		Benz(a)anthracene											
CHC's	ug/kg		Benzo(a)pyrene	1400		2000								
CHC's	ug/kg		Heptachlorepoxide			280	< 0.12	< 0.17				< 0.12	< 0.13	< 0.12
CHC's	ug/kg		Benzo(g,h,i)perylene											
CHC's	ug/kg		Benzo(b)fluoranthene											
CHC's	ug/kg		Benzo(k)fluoranthene											
CHC's	ug/kg		Endosulfan I					< 0.17					< 0.13	< 0.12
CHC's	ug/kg		Dieldrin			110	< 0.04	< 0.17	< 0.1	< 0.1	< 1	< 0.04	< 0.13	< 0.12
CHC's	ug/kg		4,4'-DDE			23000	< 0.04	< 0.13	< 0.1	< 0.1		< 0.04	< 0.11	< 0.1
CHC's	ug/kg		Endrin			4000	< 0.06	< 0.3	< 0.1	< 0.1	< 1	< 0.06	< 0.24	< 0.22
CHC's	ug/kg		Endosulfan II					< 0.33					< 0.26	< 0.25
CHC's	ug/kg		4,4'-DDD			19000	< 0.06	< 0.36	< 0.1	< 0.1		< 0.06	< 0.29	< 0.27
CHC's	ug/kg		Endrinaldehyde					< 0.36					< 0.29	< 0.27
CHC's	ug/kg		Endosulfan sulfate					< 0.36					< 0.29	< 0.27
CHC's	ug/kg		4,4'-DDT			7400	< 0.18	< 0.43	< 0.1	< 0.1	< 4	< 0.18	< 0.34	< 0.32
CHC's	ug/kg		Methoxychlor					< 0.73					< 0.58	< 0.55
CHC's	ug/kg		Endrinketone					< 0.36					< 0.29	< 0.27
CHC's	ug/kg		alpha-Chlordane			9600								
CHC's	ug/kg		Chlorodane			9600	< 0.20	< 1.98	< 1	< 1		< 0.20	< 1.58	< 1.49
CHC's	ug/kg		gamma-Chlordane			9600								
CHC's	ug/kg		Oxychlordane				< 0.20					< 0.20		
CHC's	ug/kg		Fluoranthene	670000		210000								
CHC's	ug/kg		Toxaphene			1200		< 1.98					< 1.58	< 1.49
CHC's	ug/kg		Hexachlorobenzene			220								
CHC's	ug/kg		Pyrene	440000		220000								
METALS	mg/kg		Ag (silver)	7.9		78								
METALS	mg/kg		Al (aluminum)			19000								
METALS	mg/kg		As (arsenic)	5.8	9	9	1.30	< 1.2	1.6	2.2	2.54	1.81	< 1.2	1.6
METALS	mg/kg		B (boron)	62		3100								
METALS	mg/kg		Ba (barium)	1700	260	3100								
METALS	mg/kg		Be (beryllium)	2.7		31								
METALS	mg/kg		Cd (cadmium)	8.8	9.1	1.6	< 0.03	< 1.3	< 0.2	< 0.19	1.18	< 0.03	< 1.3	< 1.3
METALS	mg/kg		Cr (chromium)	36		23000	3.25	3.8	3.9	4.2	28.7	3.82	4.3	5
METALS	mg/kg		Cu (copper)	700	120	2200	1.72	8.7	2.9	3.3	12	2.04	13.3	4.8
METALS	mg/kg		Fe (iron)			29000			4300	5500	10700			
METALS	mg/kg		Hg (mercury)	3.3		2.7	0.0065	< 0.01	0.015	0.0165	0.031	0.0069	< 0.01	< 0.01
METALS	mg/kg		Mg (magnesium)											
METALS	mg/kg		Mn (manganese)	**130**		730	**143**	**254**			**419**	**931**	**263**	**232**
METALS	mg/kg		Mo (molybdenum)	16		78								
METALS	mg/kg		Ni (nickel)	180	260	170	6.14	7.5	7	7	16.7	8.27	< 6.4	7
METALS	mg/kg		Pb (lead)	2700		200	5.0	4.4	4	4.4	44	6.3	4.6	3.6
METALS	mg/kg		Sb (antimony)	5.4		6.3								
METALS	mg/kg		Se (selenium)	2.6		78		< 0.92					< 0.93	< 0.93
METALS	mg/kg		Sn (tin)	20000		4700								
METALS	mg/kg		Sr (strontium)	2800		6700								
METALS	mg/kg		Ti (titanium)			40000								
METALS	mg/kg		Zn (zinc)	3000		4700	9.47					12.3		
METALS	mg/kg		V (vanadium)	4		62								
METALS	mg/kg		Chromium, Hexavalent	36		2.3								
PCB's	ug/kg		Aroclor-1016				< 0.24	< 1.98				< 0.24	< 1.58	< 1.49
PCB's	ug/kg		Aroclor-1221				< 0.28	< 1.98				< 0.28	< 1.58	< 1.49
PCB's	ug/kg		Aroclor-1232				< 0.26	< 1.98				< 0.26	< 1.58	< 1.49
PCB's	ug/kg		Aroclor-1242				< 0.32	< 1.98				< 0.32	< 1.58	< 1.49
PCB's	ug/kg		Aroclor-1248				< 0.22	< 1.98				< 0.22	< 1.58	< 1.49
PCB's	ug/kg		Aroclor-1254				< 0.34	< 4.13				< 0.34	< 3.3	< 3.1
PCB's	ug/kg		Aroclor-1260				< 0.32	< 4.13				< 0.32	< 3.3	< 3.1
PCB's	ug/kg		Total PCB's	130		820								
PARTICLE SIZE %FINER	SAND	coarse	3 in								100			
PARTICLE SIZE %FINER	SAND	coarse	1 1/2						100	100	100			
PARTICLE SIZE %FINER	SAND	coarse	3/4						100	100	100			
PARTICLE SIZE %FINER	SAND	coarse	3/8						100	100	100			
PARTICLE SIZE %FINER	SAND	coarse	4					100.0	100	100	100	100	99.9456	100
PARTICLE SIZE %FINER	SAND	coarse	8						100	100				
PARTICLE SIZE %FINER	SAND	coarse	10					99.8				98	99.7595	99.9211
PARTICLE SIZE %FINER	SAND	medium	16					99.5	100	100		94	99.3005	99.3583
PARTICLE SIZE %FINER	SAND	medium	20											
PARTICLE SIZE %FINER	SAND	medium	30				100	98.5	100	100		88	93.9681	92.8675
PARTICLE SIZE %FINER	SAND	medium	40				98		100	99				
PARTICLE SIZE %FINER	SAND	medium	50					98.5	98	96			93.9681	92.8675
PARTICLE SIZE %FINER	SAND	fine	60				80					48		
PARTICLE SIZE %FINER	SAND	fine	70						87	79				
PARTICLE SIZE %FINER	SAND	fine	80					84.8					83.0929	68.9342
PARTICLE SIZE %FINER	SAND	fine	100				16	13.5	58	50		10	10.3533	14.5539
PARTICLE SIZE %FINER	SAND	fine	140				7	8.5				50	6.36015858	9.9257696
PARTICLE SIZE %FINER	SILT	clay	200				2	4.8	31	36	34	2	4.39382985	7.18111026
PARTICLE SIZE %FINER	SILT	clay	270				1	4.5	25	32		1	2.93210559	5.17041208
PARTICLE SIZE %FINER	SILT	clay	0.20 mm					3.5	11	19			2.14905649	3.62252512
PARTICLE SIZE %FINER	SILT	clay	0.05 mm					2.1	5	8	21		1	2.09050416
MISC	mg/kg		Total Organic Carbon											
MISC	%		Total Organic Carb				0.04	0.4				0.03	0.91	1.13
MISC	mg/kg		Chem Oxy Demand						10000	10580	19700			
MISC	mg/kg		Kjedahl Nitrogen						440	520	740			
MISC	mg/kg		Phosphorus (as P)						290	230	561			
MISC	mg/kg		Oil and Grease											
MISC	mg/kg		Cyanide, Total	20	7.3	13	< 0.20					< 0.20		
MISC	mg/kg		Ammonia											
MISC	mg/l		Ammonia Elutriate											
MISC	%		Moisture				0.2					0.2		
MISC	%		Total Solids				99.8					99.8		
MISC	gVS/gTS		Total Volatile Solids											
MISC	%		Volatile Solids				0.41					0.54		
MISC	mg/kg		Phenolics, Total											

* Data table reproduced from Cargill East River (MN – 14.2 RMP) Dredge Material Site Management Plan, Lower Minnesota River Watershed District, Appendix A: Chemical Analyses Data for the Minnesota River.

Table 3
Minnesota River Sediment Chemical Data*
Lower Minnesota River Watershed District

		Record #				304	305	403		78505	306	405	78504
		River Mile				13.21	13.2	13.2	12.9	12.5&12.6	12.5	12.4	12.3
		Location				AB & BLW CARGILL	AB & BLW CARGILL	AB & BLW CARGILL	Cargill	Cargill Slip	AB&BW PETERSON BAR	AB&BW PETERSON BAR	Peterson's Bar
		Year				1979	1979	1989	10/17/2007	1999	1980	1989	1999
			MN Soil Leaching Values (June 2013)	MN Acute Residential/ Recreational SRVs (April 2022)	MN Chronic Residential SRVs (April 2022)								
Criteria Exceedance Key			**Bold**	No Exceedances	Shaded								
CHC's	ug/kg	a-BHC			700			< 0.11		< 0.08		< 0.07	< 0.08
CHC's	ug/kg	b-BHC			2500			< 0.21		< 0.08		< 0.14	< 0.08
CHC's	ug/kg	BHC						< 0.32		< 0.08		< 0.22	< 0.08
CHC's	ug/kg	2,4´-DDD							< 4				
CHC's	ug/kg	2,4´-DDE							< 4				
CHC's	ug/kg	2,4´-DDT							< 4				
CHC's	ug/kg	g-BHC (lindane)			150			< 0.14		< 0.08		< 0.1	< 0.08
CHC's	ug/kg	Heptachlor			1600			< 0.11		< 0.10		< 0.07	< 0.10
CHC's	ug/kg	Anthracene	1300000		2800000				< 0.79				
CHC's	ug/kg	Aldrin			450			< 0.14				< 0.1	
CHC's	ug/kg	Acenaphthene	81000		460000				< 0.71				
CHC's	ug/kg	Acenaphthylene							< 1.0				
CHC's	ug/kg	Benz(a)anthracene							1.8				
CHC's	ug/kg	Benzo(a)pyrene	1400		2000				1.7				
CHC's	ug/kg	Heptachlorepoxide			280			< 0.18		< 0.12		< 0.12	< 0.12
CHC's	ug/kg	Benzo(g,h,i)perylene							1.6				
CHC's	ug/kg	Benzo(b)fluoranthene							3.1				
CHC's	ug/kg	Benzo(k)fluoranthene							0.94				
CHC's	ug/kg	Endosulfan I						< 0.18				< 0.12	
CHC's	ug/kg	Dieldrin			110	0	0	< 0.18	< 3.2	< 0.04	0	< 0.12	< 0.04
CHC's	ug/kg	4,4'-DDE			23000	0	0	< 0.14	< 3.5	< 0.04	0	< 0.1	< 0.04
CHC's	ug/kg	Endrin			4000	0	0	< 0.32		< 0.06	0	< 0.22	< 0.06
CHC's	ug/kg	Endosulfan II						< 0.35				< 0.24	
CHC's	ug/kg	4,4'-DDD			19000	0	0	< 0.39	< 3.7	< 0.06	0	< 0.26	< 0.06
CHC's	ug/kg	Endrinaldehyde						< 0.39				< 0.26	
CHC's	ug/kg	Endosulfan sulfate						< 0.39				< 0.26	
CHC's	ug/kg	4,4'-DDT			7400	0	0	< 0.46	< 4.2	< 0.18	0	< 4.8	< 0.18
CHC's	ug/kg	Methoxychlor						< 0.77				< 0.53	
CHC's	ug/kg	Endrinketone						< 0.39				< 0.26	
CHC's	ug/kg	alpha-Chlordane			9600				< 1.7				
CHC's	ug/kg	Chlorodane			9600	0	0	< 2.11		< 0.20	0	< 1.44	< 0.20
CHC's	ug/kg	gamma-Chlordane			9600				< 1.6				
CHC's	ug/kg	Oxychlordane								< 0.20			< 0.20
CHC's	ug/kg	Fluoranthene	670000		210000				5				
CHC's	ug/kg	Toxaphene			1200			< 2.11				< 1.44	
CHC's	ug/kg	Hexachlorobenzene			220				< 2				
CHC's	ug/kg	Pyrene	440000		220000				4.3				
METALS	mg/kg	Ag (silver)	7.9		78								
METALS	mg/kg	Al (aluminum)			19000								
METALS	mg/kg	As (arsenic)	5.8	9	9	0	0	2.7	0.97	1.89	0	1.8	1.16
METALS	mg/kg	B (boron)	62		3100								
METALS	mg/kg	Ba (barium)	1700	260	3100	40	80				40		
METALS	mg/kg	Be (beryllium)	2.7		31								
METALS	mg/kg	Cd (cadmium)	8.8	9.1	1.6	< 10	< 10	< 1.6	< 1.0	< 0.03	< 10	< 1.2	< 0.03
METALS	mg/kg	Cr (chromium)	36		23000	< 10	< 10	8.1	4.7	3.81	20	3.4	2.96
METALS	mg/kg	Cu (copper)	700	120	2200	< 10	< 10	15	1.9	2.18	< 10	3.9	1.24
METALS	mg/kg	Fe (iron)			29000	3800	9700				2600		
METALS	mg/kg	Hg (mercury)	3.3		2.7	0	0	< 0.02	< 0.10	0.0052	0	< 0.01	< 0.0048
METALS	mg/kg	Mg (magnesium)											
METALS	mg/kg	Mn (manganese)	**130**		730	**160**	**720**	56.8	**218**	**242**	**170**	**163**	**154**
METALS	mg/kg	Mo (molybdenum)	16		78								
METALS	mg/kg	Ni (nickel)	180	260	170	< 10	20	9.4	< 0.10	7.92	< 10	< 6.2	6.12
METALS	mg/kg	Pb (lead)	2700		200	< 10	20	5.8	2.5	6.3	< 10	3	4.7
METALS	mg/kg	Sb (antimony)	5.4		6.3								
METALS	mg/kg	Se (selenium)	2.6		78			< 1.2				< 0.89	
METALS	mg/kg	Sn (tin)	20000		4700								
METALS	mg/kg	Sr (strontium)	2800		6700								
METALS	mg/kg	Ti (titanium)			40000								
METALS	mg/kg	Zn (zinc)	3000		4700				12.1	11.1			8.12
METALS	mg/kg	V (vanadium)	4		62								
METALS	mg/kg	Chromium, Hexavalent	36		2.3				< 5.9				
PCB's	ug/kg	Aroclor-1016						< 2.11	< 50	< 0.24		< 1.44	< 0.24
PCB's	ug/kg	Aroclor-1221						< 2.11	< 50	< 0.28		< 1.44	< 0.28
PCB's	ug/kg	Aroclor-1232						< 2.11	< 50	< 0.26		< 1.44	< 0.26
PCB's	ug/kg	Aroclor-1242						< 2.11	< 50	< 0.32		< 1.44	< 0.32
PCB's	ug/kg	Aroclor-1248						< 2.11	< 40	< 0.22		< 1.44	< 0.22
PCB's	ug/kg	Aroclor-1254						< 4.4	< 50	< 0.34		< 3	< 0.34
PCB's	ug/kg	Aroclor-1260						< 4.4	< 40	< 0.32		< 3	< 0.32
PCB's	ug/kg	Total PCB's	130		820								
PARTICLE SIZE %FINER	SAND coarse	3 in				100	100				100		
PARTICLE SIZE %FINER	SAND coarse	1 1/2				100	100				100		
PARTICLE SIZE %FINER	SAND coarse	3/4				100	100				100		
PARTICLE SIZE %FINER	SAND coarse	3/8				100	100				100		
PARTICLE SIZE %FINER	SAND coarse	4				100	100	99.4659	99.14	99	100	99.3761	
PARTICLE SIZE %FINER	SAND coarse	8									100		
PARTICLE SIZE %FINER	SAND coarse	10				100	100	99.339	64.29	97		98.6943	
PARTICLE SIZE %FINER	SAND medium	16						98.8504		93	100	96.2073	100
PARTICLE SIZE %FINER	SAND medium	20				100	100		84.45				
PARTICLE SIZE %FINER	SAND medium	30						96.6491		95		83.8046	99
PARTICLE SIZE %FINER	SAND medium	40				100	100		66.31	71	99		95
PARTICLE SIZE %FINER	SAND medium	50						96.6491				83.8046	
PARTICLE SIZE %FINER	SAND fine	60							33.37	37			39
PARTICLE SIZE %FINER	SAND fine	70											
PARTICLE SIZE %FINER	SAND fine	80				92	80	92.6698	6.97			41.9038	
PARTICLE SIZE %FINER	SAND fine	100						42.5172	5.26	6	42	17.4719	4
PARTICLE SIZE %FINER	SAND fine	140						26.39172056		3		10.74500323	2
PARTICLE SIZE %FINER	SILT clay	200				12	46	17.37520712	2.87	1	20	6.81403086	1
PARTICLE SIZE %FINER	SILT clay	270						11.90172384				4.65926604	
PARTICLE SIZE %FINER	SILT clay	0.20 mm				5	35	8.54970672			7	3.29043663	
PARTICLE SIZE %FINER	SILT clay	0.05 mm				2	19	4.54007512			2	2.30048832	
MISC	mg/kg	Total Organic Carbon							< 85				
MISC	%	Total Organic Carb						1.02		0.03		1.11	0.02
MISC	mg/kg	Chem Oxy Demand				8700	29000				5300		
MISC	mg/kg	Kjedahl Nitrogen				1300	4100		170		1600		
MISC	mg/kg	Phosphorus (as P)				400	510		280				
MISC	mg/kg	Oil and Grease											
MISC	mg/kg	Cyanide, Total	20	7.3	13				< 0.20	< 0.20			< 0.20
MISC	mg/kg	Ammonia							6.5				
MISC	mg/l	Ammonia Elutriate											
MISC	%	Moisture							25.57	0.2			0.2
MISC	%	Total Solids							74.43	99.8			99.8
MISC	gVS/gTS	Total Volatile Solids							0.013				
MISC	%	Volatile Solids								0.35			0.25
MISC	mg/kg	Phenolics, Total							1.5				

* Data table reproduced from Cargill East River (MN – 14.2 RMP) Dredge Material Site Management Plan, Lower Minnesota River Watershed District, Appendix A: Chemical Analyses Data for the Minnesota River.

Table 3
Minnesota River Sediment Chemical Data*
Lower Minnesota River Watershed District

			Record #				307	78503	406	78502	308		78501
			River Mile				12	12.0	11.7	11.5	11.4	11.3	11.0
			Location				AB&BW PETERSON BAR	Peterson's Bar	AB&BW PETERSON BAR	Blw Peterson's Bar	AB&BW PETERSON BAR	Above 35W	Blw Perterson's Bar
			Year				1975	1999	1989	1999	1980	10/17/2007	1999
				MN Soil Leaching Values (June 2013)	MN Acute Residential/ Recreational SRVs (April 2022)	MN Chronic Residential SRVs (April 2022)							
Criteria Exceedance Key				**Bold**	No Exceedances	Shaded							
CHC's	ug/kg		a-BHC			700		< 0.08	< 0.09	< 0.08			< 0.08
	ug/kg		b-BHC			2500		< 0.08	< 0.18	< 0.08			< 0.08
	ug/kg		BHC					< 0.08	< 0.27	< 0.08			< 0.08
	ug/kg		2,4´-DDD									< 4	
	ug/kg		2,4´-DDE									< 4	
	ug/kg		2,4´-DDT									< 4	
	ug/kg		g-BHC (lindane)			150		< 0.08	< 0.12	< 0.08			< 0.08
	ug/kg		Heptachlor			1600		< 0.10	< 0.09	< 0.10			< 0.10
	ug/kg		Anthracene	1300000		2800000						1.4	
	ug/kg		Aldrin			450			< 0.12				
	ug/kg		Acenaphthene	81000		460000						< 0.71	
	ug/kg		Acenaphthylene									< 1.0	
	ug/kg		Benz(a)anthracene									8.4	
	ug/kg		Benzo(a)pyrene	1400		2000						9.8	
	ug/kg		Heptachlorepoxide			280		< 0.12	< 0.15	< 0.12			< 0.12
	ug/kg		Benzo(g,h,i)perylene									6.2	
	ug/kg		Benzo(b)fluoranthene									19	
	ug/kg		Benzo(k)fluoranthene									5.6	
	ug/kg		Endosulfan I						< 0.15				
	ug/kg		Dieldrin			110		< 0.04	< 0.15	< 0.04	0.5	< 3.2	< 0.04
	ug/kg		4,4'-DDE			23000		< 0.04	< 0.12	< 0.04	0	< 3.5	< 0.04
	ug/kg		Endrin			4000		< 0.06	< 0.27	< 0.06	0		< 0.06
	ug/kg		Endosulfan II						< 0.3				
	ug/kg		4,4'-DDD			19000		< 0.06	< 0.33	< 0.06	0.8	< 3.7	< 0.06
	ug/kg		Endrinaldehyde						< 0.33				
	ug/kg		Endosulfan sulfate						< 0.33				
	ug/kg		4,4'-DDT			7400		< 0.18	< 0.4	< 0.18	0	< 4.2	< 0.18
	ug/kg		Methoxychlor						< 0.67				
	ug/kg		Endrinketone						< 0.33				
	ug/kg		alpha-Chlordane			9600						< 1.7	
	ug/kg		Chlorodane			9600		< 0.20	< 1.82	< 0.20	1		< 0.20
	ug/kg		gamma-Chlordane			9600						< 1.6	
	ug/kg		Oxychlordane					< 0.20		< 0.20			< 0.20
	ug/kg		Fluoranthene	670000		210000						26	
	ug/kg		Toxaphene			1200			< 1.82				
	ug/kg		Hexachlorobenzene			220						< 2	
	ug/kg		Pyrene	440000		220000						21	
METALS	mg/kg		Ag (silver)	7.9		78							
	mg/kg		Al (aluminum)			19000							
	mg/kg		As (arsenic)	5.8	9	9	0.83	1.43	3.2	1.13	0	1.2	3.44
	mg/kg		B (boron)	62		3100							
	mg/kg		Ba (barium)	1700	260	3100					60		
	mg/kg		Be (beryllium)	2.7		31							
	mg/kg		Cd (cadmium)	8.8	9.1	1.6	< 0.1	< 0.03	< 1.6	< 0.03	< 10	< 1.0	0.17
	mg/kg		Cr (chromium)	36		23000	7	3.30	7.1	3.07	10	5.3	5.60
	mg/kg		Cu (copper)	700	120	2200	2.8	1.67	12.1	2.17	< 10	2.5	3.97
	mg/kg		Fe (iron)			29000					5200		
	mg/kg		Hg (mercury)	3.3		2.7	0.13	< 0.0048	< 0.02	< 0.0048	0	< 0.10	0.0058
	mg/kg		Mg (magnesium)										
	mg/kg		Mn (manganese)	**130**		730		**235**	59.3	**160**	**660**	**203**	**357**
	mg/kg		Mo (molybdenum)	16		78							
	mg/kg		Ni (nickel)	180	260	170		7.32	11.5	6.54	10	4.7	12.3
	mg/kg		Pb (lead)	2700		200	< 0.1	5.8	11.6	6.4	10	2.5	9.2
	mg/kg		Sb (antimony)	5.4		6.3							
	mg/kg		Se (selenium)	2.6		78			2.2				
	mg/kg		Sn (tin)	20000		4700							
	mg/kg		Sr (strontium)	2800		6700							
	mg/kg		Ti (titanium)			40000							
	mg/kg		Zn (zinc)	3000		4700		9.29		8.53		13.6	19.3
	mg/kg		V (vanadium)	4		62							
	mg/kg		Chromium, Hexavalent	36		2.3						< 5.8	
PCB's	ug/kg		Aroclor-1016					< 0.24	< 1.82	< 0.24		< 50	< 0.24
	ug/kg		Aroclor-1221					< 0.28	< 1.82	< 0.28		< 50	< 0.28
	ug/kg		Aroclor-1232					< 0.26	< 1.82	< 0.26		< 50	< 0.26
	ug/kg		Aroclor-1242					< 0.32	< 1.82	< 0.32		< 50	< 0.32
	ug/kg		Aroclor-1248					< 0.22	< 1.82	< 0.22		< 40	< 0.22
	ug/kg		Aroclor-1254					< 0.34	< 3.8	< 0.34		< 50	< 0.34
	ug/kg		Aroclor-1260					< 0.32	< 3.8	< 0.32		< 40	< 0.32
	ug/kg		Total PCB's	130		820							
PARTICLE SIZE %FINER	SAND	coarse	3 in				100				100		
			1 1/2				100				100		
			3/4				100				100		
			3/8				100				100		
			4				99	100	100		100	100	
			8				95				100		
			10					97	99.9173	100		99.89	100
		medium	16				84	92	99.6276	99	100		97
			20									99.04	
			30					84	98.5519	98			84
			40				41	76		94	98	95.1	
			50						98.5519				
		fine	60					37		38		64.79	54
			70										
			80						81.6715			27.25	
			100				6	4	52.1307		83	21.89	31
			140					1	40.47394665	2			21
	SILT	clay	200				2		26.9826311	1	70	13.16	13
			270						17.59732573				7
			0.20 mm						13.27129692		33		
			0.05 mm						9.16528674		18		
MISC	mg/kg		Total Organic Carbon									< 84	
	%		Total Organic Carb					0.01	1.2	0.02			0.18
	mg/kg		Chem Oxy Demand				1950				31000		
	mg/kg		Kjedahl Nitrogen								3700	300	
	mg/kg		Phosphorus (as P)									270	
	mg/kg		Oil and Grease										
	mg/kg		Cyanide, Total	20	7.3	13		< 0.20		< 0.20		< 0.20	< 0.20
	mg/kg		Ammonia									16	
	mg/l		Ammonia Elutriate										
	%		Moisture					0.2		0.1		24.88	0.7
	%		Total Solids					99.8		99.9		75.12	99.3
	gVS/gTS		Total Volatile Solids									0.013	
	%		Volatile Solids					0.49		0.29			0.95
	mg/kg		Phenolics, Total									6.2	

* Data table reproduced from Cargill East River (MN – 14.2 RMP) Dredge Material Site Management Plan, Lower Minnesota River Watershed District, Appendix A: Chemical Analyses Data for the Minnesota River.