MINNEHAHA CREEK
WATERSHED DISTRICT
QUALITY OF WATER, QUALITY OF LIFE

**Meeting: Board of Managers**
**Meeting date: 10/12/2023**
**Agenda Item #: 11.2**
**Request for Board Action**

| | |
|---|---|
| **Title:** | Authorization to Contract with the University of Wisconsin Stout to perform sediment core analysis |
| **Resolution number:** | 23-062 |
| **Prepared by:** | Kailey Cermak<br>952-641-4501<br>kcermak@minnehahacreek.org |
| **Reviewed by:** | Brian Beck, Research and Monitoring Program Manager; Michael Hayman, Project Planning Director |
| **Recommended action:** | Approval of a contract with University of Wisconsin – Stout to analyze Wassermann Lake sediment cores to assess effectiveness of 2021 and 2022 alum treatments. |
| **Schedule:** | October – December 2023: Collection and testing of sediment cores<br>January – February 2024: Assess treatment effectiveness<br>April – June 2024: If necessary, incorporate third alum treatment into 2025 budget<br>Fall 2025: Potential maintenance alum treatment |
| **Budget considerations:** | Fund names and codes: Research and Monitoring Lab Analysis 5-5001-4520<br>Fund budgets: $75,300<br>Expenditures to date: $23,120<br>Requested amount of funding: $14,525 |

**Past Board action:**

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| Resolution 19-072 | Authorization to apply for BWSR Clean Water Funds |
| Resolution 20-050: | Ordering of the Wassermann internal load management project |
| Resolution 20-051: | Approval of Wassermann internal load project agreement |
| Resolution 20-052: | Authorization to contract with UW-Stout to analyze Wassermann Lake sediment for alum treatment engineering design |

**Background:**

Since adoption of the 2017 Water Management Plan (WMP), Minnehaha Creek Watershed District (MCWD or District) has been working to implement high impact capital projects within the SMCHB subwatershed, with particular focus in the city of Victoria and Laketown Township, where current land use pressure presents a unique opportunity to implement projects concurrent with development. Under this plan, MCWD has invested substantially in both watershed and in-lake management activities in the restoration of Wassermann Lake, an impaired waterbody within the city of Victoria.

As MCWD was developing its WMP, it partnered with Lennar Corporation to restore vegetative diversity and predevelopment hydrology in a 22-acre wetland along the upstream segment of Six Mile Creek, improving habitat and nutrient cycling. Since 2018, MCWD has been working on a subwatershed wide carp management program that has effectively reduced the carp population in Wassermann Lake, improving aquatic plant communities and slowing sediment and nutrient resuspension in the water column. In spring 2019 and Spring 2021, MCWD applied alum in the six-acre pond on the Wassermann West property, resulting in a 75 pound per year decrease in phosphorus loading to Wassermann Lake. Finally, in 2021 MCWD and the City completed construction of a 33.5-acre park preserve and habitat

restoration project on the west shore of Lake Wassermann which offers an opportunity to showcase the improvements to Wassermann Lake and the SMCHB Subwatershed while creating a unique recreational asset for Victoria residents.

Internal loading was the last remaining significant source of nutrient pollution in Wassermann Lake. The 2013 SMCHB Diagnostic Study estimated an annual internal release rate of 375 pounds per year, the largest nutrient source identified**.** Alum treatment is projected to reduce internal loading by an estimated 90%, for a reduction of 336 pounds per year.

**Wassermann Lake Alum Treatment**

In January 2020, MCWD was awarded a Clean Water Fund grant from the Board of Water and Soil Resources, positioning the District to conduct an initial alum treatment in spring 2021 and fall 2022. The total budget for the project was $355,900, including $284,720 in grant funds and $71,180 in District match. MCWD's match funds were allocated to feasibility, pre- and post-project sediment analysis, and some of the cost of treatment. The grant dollars were allocated exclusively to the alum treatment. MCWD conducted alum treatments in May 2021 and October 2022. Both treatments used water quality and sediment core data to inform the alum application design and specifications. The data used to design the 2022 application suggested the remaining grant dollars were sufficient to meet the treatment needs in Wassermann Lake. In addition, sediment data collected in 2022 suggested that sediment reacted as expected to the first alum treatment in 2021. Therefore, the best path forward was to first spend the remaining grant dollars on the second treatment, monitor treatment effectiveness, and then evaluate if a third dose is needed.

*Alum Treatment Effectiveness Monitoring*

There are two factors to consider when characterizing the effectiveness of an internal load reduction project, which include monitoring the bottom water (hypolimnion) of Wassermann Lake and characterizing how sediments have changed based on the alum treatment. MCWD has been collecting water quality samples throughout 2023, which are sent to the District's contracted lab for analysis.

MCWD staff plan to collect the sediment cores of Wassermann Lake in fall of 2023 but rely on University of Wisconsin-Stout to analyze the sediment chemistry, as it has done in the past. The results from this data collection effort will be used to determine if a maintenance alum treatment is required to meet the 90% reduction goal outlined in 2021. If necessary, a final alum treatment could be applied in 2025 to ensure that nutrient load reduction goals are being met and bring a close to nutrient reduction efforts on Wassermann Lake.

Staff recommends approval of the contract with University of Wisconsin-Stout to perform sediment core analysis for Wassermann Lake. The cost of the analysis will not exceed $14,525 and is within Research and Monitoring's 2023 available lab analysis budget.

**Supporting documents:**

Attachment 1: UW-Stout Wassermann Lake Proposal

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# RESOLUTION

**Resolution number:** 23-062

**Title:** Authorization to Contract with University of Wisconsin-Stout to Perform Sediment Core Analysis

WHEREAS, pursuant to Resolution 14-047 the MCWD Board of Managers identified the Six Mile Creek-Halsted Bay (SMCHB) subwatershed as a priority area for focusing planning activities and coordination efforts with subwatershed partners;

WHEREAS, in January 2018 the Board of Managers adopted the MCWD Watershed Management Plan (WMP), which incorporated a comprehensive restoration strategy for the SMCHB subwatershed to achieve MCWD's goals of protecting and improving water quality, water quantity, ecological integrity, and thriving communities through land use and water integration. The WMP includes a capital improvement plan, which lists the Wassermann West External Load Reduction and Landscape Restoration as an implementation project;

WHEREAS, in March 2020, the Board of Managers accepted a grant award of $284,720 through the BWSR Clean Water Fund grant program for the implementation of the Wassermann Internal Load Management project;

WHEREAS, on June 23, 2020, the Board of Managers ordered the Wassermann Internal Load Management Project in fulfillment of the MCWD WMP's identification of the project as a planned investment to reduce internal nutrient loading, improve water clarity, and create a more abundant and diverse aquatic vegetation community with alum treatments;

WHEREAS on September 24, 2020, the Board of Managers approved a contract with University of Wisconsin-Stout to perform sediment core analysis and approved a contract with Wenck Associates, now Stantec, to analyze collected water chemistry and sediment data to develop specifications for alum treatment of Wassermann Lake and the Wassermann West Pond and to provide construction oversight of the alum applications;

WHEREAS on March 25, 2021, the Board of Managers awarded the contract for the Wassermann Lake and Wassermann West Pond Alum Treatments to Clark Aquatic Services, and the alum treatments were completed in May 2021;

WHEREAS on April 14, 2022, the Board of Managers approved a contract with Stantec to develop specifications and provide application oversight for the second planned alum treatment of Wassermann Lake; and the scope of work included completing sediment core analysis to inform alum treatment specifications;

WHEREAS, on August 22, 2022, the Board of Managers awarded the contract for Wassermann Lake's second alum treatment to Solitude, and the alum treatment was completed in September 2022;

WHEREAS, the District has continued to monitor effectiveness of the Wassermann Lake's alum treatments, through water quality and sediment sampling, to evaluate whether a third dose is needed to meet internal load reduction goals;

WHEREAS, staff plan to collect sediment cores from Wassermann Lake in October of 2023 but rely on University of Wisconsin-Stout to analyze the cores;

NOW, THEREFORE, BE IT RESOLVED that the Minnehaha Creek Watershed District Board of Managers authorizes the District Administrator, on advice of legal counsel, to execute a contract with the University of Wisconsin-Stout to analyze sediments from Wassermann Lake for an amount not to exceed $14,525.

Resolution Number 23-062 was moved by Manager _____, seconded by Manager _____. Motion to adopt the resolution ___ ayes, ___ nays, ___abstentions. Date: 10/12/2023

_____ Date: _____
Secretary

# Evaluation of sediment characteristics and phosphorus fluxes in Wassermann Lake, Minnesota

PROPOSAL OF RESEARCH

5 October, 2023

University of Wisconsin - Stout
Center for Limnological Research and Rehabilitation
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## 1.0 BACKGROUND.

Wassermann Lake and West Pond, located near Victoria MN, were treated with alum in 2021 and 2022.

## 2.0 PURPOSE.

The objectives of these investigations are to evaluate post-treatment sediment chemistry and phosphorus (P) flux at 5 stations in Wassermann Lake in 2023. Specifically,

1. estimate rates of P release from sediment under anaerobic conditions,
2. determine vertical variations in sediment phosphorus fractions (loosely-bound P, iron-bound P, labile organic P, and aluminum-bound P) and total aluminum

## 3.0 SCOPE OF WORK.

Intact sediment cores will be collected for P flux and sediment characteristics at 5 stations in the lake and transported to the University of Wisconsin – Stout for processing and analysis.

### *Task 1 - Laboratory-derived rates of P release from sediment under anaerobic conditions:*

Triplicate intact sediment cores will be collected each station will be carefully drained of overlying water in the laboratory and the upper 10 cm of sediment will be transferred intact to a smaller acrylic core liner (6.5-cm dia and 20-cm ht) using a core remover tool. Surface water collected from each lake will be filtered through a glass fiber filter (Gelman A-E), with 300 mL then siphoned onto the sediment contained in the small acrylic core liner without causing sediment resuspension. They will be placed in a darkened environmental chamber and incubated at a constant temperature of ~15 to 20 $^{o}$C

to reflect summer conditions. The oxidation-reduction environment in the overlying water will be controlled by gently bubbling nitrogen (anaerobic) through an air stone placed just above the sediment surface in each system. Bubbling action will ensure complete mixing of the water column but not disrupt the sediment.

Water samples for soluble reactive P will be collected from the center of each system using an acid-washed syringe and filtered through a 0.45 µm membrane syringe filter. The water volume removed from each system during sampling will be replaced by addition of filtered lake water preadjusted to the proper oxidation-reduction condition. These volumes are accurately measured for determination of dilution effects. Soluble reactive P is measured colorimetrically using the ascorbic acid method (APHA 2011). Rates of P release from the sediment (mg/$m^2$ d) are calculated as the linear change in mass in the overlying water divided by time (days) and the area ($m^2$) of the incubation core liner. Regression analysis is used to estimate rates over the linear portion of the data.

*Task 2 - Evaluation of sediment P characteristics:*

The objectives of this task are to quantify spatial and vertical variations in sediment P fractions in different areas of the lake. Triplicate sediment cores collected at each station will be sectioned at 2-cm intervals from the sediment-water interface down to 10 cm. Individual sections from each replicate core will be combined into 1 section sample to ensure that there is at least 1 g dry mass available for total aluminum analysis.

Table 1. Textural-physical variables and biologically-labile sediment phosphorus pools.

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| Moisture content (%) |
| Sediment wet and dry bulk density (g/$cm^3$) |
| Organic matter content (%) |
| Loosely-bound P (mg/g) |
| Iron-bound P (mg/g) |
| Labile organic P (mg/g) |
| Aluminum-bound P (mg/g) |
| Total aluminum (mg/g) |

Sediment sections will be analyzed for the variables listed in Table 1. Subsamples will be dried at 105 °C to a constant weight and burned at 550 °C for determination of moisture content, sediment density, and organic matter

content (Håkanson and Jensson 2002, Avnimelech et al. 2001). Phosphorus fractionation will be conducted according to Hieltjes and Lijklema (1980), Psenner and Puckso (1988), and Nürnberg (1988) for the determination of ammonium-chloride-extractable P (1 M $NH_4Cl$; loosely-bound P), bicarbonate-dithionite-extractable P (0.11 M BD; iron-bound P), and sodium hydroxide-extractable P (0.1 N NaOH; aluminum-bound P). A subsample of the sodium hydroxide extract will be digested with potassium persulfate to determine nonreactive sodium hydroxide-extractable P (Psenner and Puckso 1988). Labile organic P is calculated as the difference between reactive and nonreactive sodium hydroxide-extractable P. Remaining sediment will be dried at ~ 105 C, ground with a mortar and pestle, and shipped to Pace Analytical in Minneapolis MN for digestion (EPA 3050) and analyzed for total aluminum via ICP (Inductively Coupled Plasma Atomic Absorption Spectrophotometry, EPA 6010D).

*Task 3 – Reporting:*

A summary report will be provided containing figures and tables that describe P fluxes and sediment characteristics in Wassermann Lake in 2023.

## 4.0 REFERENCES.

APHA (American Public Health Association). 2005. Standard Methods for the Examination of Water and Wastewater. 21th ed. American Public Health Association, American Water Works Association, Water Environment Federation.

Avnimelech Y, Ritvo G, Meijer LE, Kochba M. 2001. Water content, organic carbon and dry bulk density in flooded sediments. Aquacult. Eng. 25:25-33.

Håkanson L, Jansson M. 2002. Principles of lake sedimentology. The Blackburn Press, Caldwell, NJ USA

Hjieltjes AH, Lijklema L. 1980. Fractionation of inorganic phosphorus in calcareous sediments. J. Environ. Qual. 8: 130-132.

Nürnberg GK. 1988. Prediction of phosphorus release rates from total and reductant-soluble phosphorus in anoxic lake sediments. Can. J. Fish. Aquat. Sci. 45:453-462.

Psenner R, Puckso R. 1988. Phosphorus fractionation: Advantages and limits of the method for the study of sediment P origins and interactions. Arch Hydrobiol Biel Erg Limnol 30:43-59.

## 5.0 COST ANALYSIS

| Variable | | Unit | Cost | | |
|---|---|---|---|---|---|
| | | | Each | Quantity | Total |
| Textural and Physical Characteristics | Moisture Content-Bulk Density-LOI | per sediment section | $30 | 25 | $750 |
| | Sediment prep for metals | per sediment section | $5 | 25 | $125 |
| Sediment Phosphorus Extractions | Biologically-labile Phosphorus | per sediment section | $170 | 25 | $4,250 |
| Sediment Flux or Internal Loading | Incubation for rates of soluble reactive P release | per 10 cm core | $560 | 15 | $8,400 |
| Reporting | | per hour | $100 | 10 | $1,000 |
| Total | | | | | $14,525 |