Minnehaha Creek Watershed District ***REQUEST FOR BOARD ACTION***

MEETING DATE: March 28, 2019

TITLE: Authorization to Execute Contract with University of Wisconsin Stout for Wassermann West Sediment Analysis

RESOLUTION NUMBER: **19-036**

PREPARED BY: Brian Beck

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REVIEWED BY: ☐Administrator ☐ Counsel ☐ Program Mgr. (Name):____________________
☐ Board Committee ☐ Engineer ☐ Other

WORKSHOP ACTION:

☐ Advance to Board mtg. Consent Agenda. ☐ Advance to Board meeting for discussion prior to action.

☐ Refer to a future workshop (date):_______ ☐ Refer to taskforce or committee (date):______________

☐ Return to staff for additional work. ☐ No further action requested.

☒ Other (specify): Approval at the March 28, 2019 Board Meeting

PURPOSE or ACTION REQUESTED:
Authorization to execute contract with University of Wisconsin – Stout to measure phosphorus release rates and sediment characteristics in Wassermann West Pond to inform future alum treatments.

PROJECT/PROGRAM LOCATION:
Wassermann West Property, Victoria, MN

PROJECT/PROGRAM COST:
Fund name and number: Research and Monitoring Department: Water Quality Program (500-5001-4520)
Current Budget: $168,050
Expenditures to date: $5,600
Requested amount of funding: $9,780

PAST BOARD ACTION:

February 23, 2017	Authorization for the District to acquire the Wassermann West property (17-014)
Nov 17, 2017	Approval of design contract for park design and alum feasibility (17-071)
Sept. 27, 2018	Approval of grant agreement with BWSR for Wassermann West alum treatment (18-100)

SUMMARY:

In April 2018, Wenck Associates prepared a technical memorandum and specifications for an alum treatment on the Wassermann West site. The project would reduce phosphorus export to Lake Wassermann by an estimated 35 lbs/year. Wenck Associates specifications proposed two treatments that would occur over three years, with the estimated cost for the first two treatments as $34,100 per treatment. The memo recommends the District plan for a third contingency dose sometime in the following two to five year window, which would be informed by effectiveness monitoring.

On March 28, 2019, under resolution 19-035, the MCWD Board of Managers will consider awarding a contract to HAB Aquatic Solutions for the alum treatment of a six acre pond on the District owned property in Victoria, MN known as Wassermann West. It should be noted that HAB Aquatic Solution's quote exceeded the engineer's estimate developed in April of 2018. After consulting with several vendors, it is staff's understanding that the chemical costs for alum have risen substantially within the last year and may continue to rise.

Staff is recommending a complimentary investigation led by the Research and Monitoring Department that will assess the alum treatment effectiveness at various depths, potentially reducing the amount of alum needed for the second application by half. This investigation will not only improve the cost-benefit analysis for the subsequent treatment at Wasserman West Pond, but will also inform future treatments on water bodies such as Wasserman Lake or Halsted Bay.

Staff are seeking authorization to submit sediment samples to the University of Wisconsin - Stout. Their scope of work includes measuring phosphorus release and chemical characteristics from sediment samples on Wasserman West Pond. The total cost for this activity will not exceed $9,780.

RESOLUTION

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

WHEREAS, in November 2017, the MCWD Board of Managers approved a contract with Wenck Associates for the Wassermann West Park and Natural Resource Improvements, including the development of feasibility and specifications for alum treatment; and

WHEREAS, on March 28, 2019, pursuant to resolution 19-035, the MCWD Board of Managers will consider awarding a contract to HAB aquatic services for alum treatment of the Wassermann West Pond; and

WHEREAS, complimentary to the alum treatment, in order to measure phosphorus release rates and sediment characteristics in Wasserman West Pond, staff are recommending that sediment samples are collected by District staff and submitted to University of Wisconsin – Stout; and

WHEREAS, this assessment will provide information that will allow the staff and engineer to reduce the cost of the subsequent alum treatment on Wasserman West Pond without decreasing the phosphorus load reduction results.

NOW, THEREFORE, BE IT RESOLVED that the Minnehaha Creek Watershed District Board of Managers hereby authorizes the District Administrator to execute contract with University of Wisconsin - Stout for sediment analysis in Wassermann West Pond that is not to exceed $9,780.

Resolution Number 19-036 was moved by Manager _____________, seconded by Manager ____________.
Motion to adopt the resolution ___ ayes, ___ nays, ___abstentions. Date: _______________.

____ Date:____________________________
Secretary

Determination of Rates of Phosphorus Release and Sediment Characteristics in Minnehaha Creek Watershed Lakes, Minnesota

PROPOSAL OF RESEARCH

26 March, 2019

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1.0 BACKGROUND.

Bottom sediments represent an important internal source of phosphorus (P) that can potentially subsidize high algal productivity, even when external P loading from the watershed has been reduced. For sediments containing iron (Fe) compounds, P is usually coupled with Fe dynamics and flux to the water column is regulated by oxidation-reduction (i.e., eH) and pH reactions (Mortimer 1971). A thin oxidized microzone exists in the sediment surface layer when the overlying water column is oxygenated. Under these conditions, Fe is in an oxidized state (i.e., Fe^{+3}) in the microzone as Fe~(OOH) and adsorbs P, thereby controlling its diffusion into the overlying water column. Elevated pH and production of hydroxyl ions (OH^-) during periods of intense photosynthesis can also indirectly enhance rates of P release from sediment under aerobic conditions via ligand exchange (i.e., competition for binding sites by OH^-). Under anoxic conditions at the sediment-water interface, anaerobic bacterial reduction of iron from Fe^{+3} to Fe^{+2} results in P desorption and diffusion into the water column for potential uptake by algae. Internal P loading via these recycling pathways can account for a substantial portion of the P economy of aquatic systems and hinder restoration efforts targeted at reducing algal biomass.

Fe~(OOH)~PO_4 or redox-sensitive P can be quantified via extraction with a strong reducing agent (dithionite-bicarbonate; BD; Nürnberg 1988). Additionally, biologically-labile P in the form of bacterial polyphosphates and labile organic P compounds and can be recycled to the overlying water column via mineralization and metabolic breakdown and is extracted with a basic solution (0.1 to 1.0 N NaOH; Psenner and Puckso 1988). Thus, the size of the biologically-labile P pool (i.e., redox-P and labile organic P; subject to recycling and internal P loading) in surface sediment can be quantified for evaluation and be compared to other systems to assess the potential importance as a source of P recycling in lakes.

2.0 PURPOSE.

The objectives of these investigations are to:

1. measure rates of P release from sediment under anaerobic conditions,
2. examine sediment mobile P fractions that are active in internal P loading for estimation of alum dosage,

3.0 SCOPE OF WORK.

Intact sediment cores will be collected for P flux and sediment characteristics in the deep basin of 5 lakes.

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

Triplicate intact sediment cores will be collected by MCWD personnel from a deep basin station in each lake for the determination of rates of P release from sediment under controlled laboratory conditions. All cores 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 ~ 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 insure complete mixing of the water column but not disrupt the sediment. For each station, duplicate cores will be subjected to anaerobic conditions.

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 2005). 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 sediment physical-textural characteristics and P fractions in the upper 5-cm sediment layer of each lake. 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 500 ºC for determination of moisture content, sediment density, and organic matter content (Håkanson and Jensson 2002). 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.

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

The loosely-bound (Loose-P) and iron-bound P (Fe-P) fractions are readily mobilized at the sediment-water interface under anaerobic conditions that result in desorption of P from bacterially-reduced iron compounds (i.e., Fe^{+3} to Fe^{+2}) in the sediment and diffusion into the overlying water column (Mortimer 1971, Boström 1984, Nürnberg 1988). The sum of the Loose-P and Fe-P fractions are referred to as redox-sensitive P (i.e., redox-P; the P fraction that is active in P release under anaerobic and reducing conditions). In addition, labile organic P (LOP) can be converted to soluble P via bacterial mineralization (Jensen and Andersen 1992) or hydrolysis of bacterial polyphosphates to soluble phosphate under anaerobic conditions (Gächter et al. 1988; Gächter and Meyer 1993; Hupfer et al. 1995). The sum of redox-P and LOP is collectively referred to a biologically-labile P. This fraction is generally active in recycling pathways that result in exchanges of phosphate from the sediment to the overlying water column and potential assimilation by algae.

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.

Boström B. 1984. Potential mobility of phosphorus in different types of lake sediments. Int. Revue. Ges. Hydrobiol. 69:457-474.

Gächter R., Meyer JS, Mares A. 1988. Contribution of bacteria to release and fixation of phosphorus in lake sediments. Limnol. Oceanogr. 33:1542-1558.

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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.

Hupfer M, Gächter R., Giovanoli R. 1995. Transformation of phosphorus species in settling seston and during early sediment diagenesis. Aquat. Sci. 57:305-324.

Mortimer CH. 1971. Chemical exchanges between sediments and water in the Great Lakes – Speculations on probable regulatory mechanisms. Limnol. Oceanogr. 16:387-404.

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.

5.0 COST ANALYSIS

Sediment Chemistry Price List					
Variable		Unit	Cost		
			Each	Quantity	Total
Textural and Physical Characteristics	Moisture Content-Bulk Density-organic matter	per sediment section	$30	20	$600
Sediment Phosphorus Extractions	Biologically-labile Phosphorus	per sediment section	$135	20	$2,700
Sediment Flux or Internal Loading	Incubation for rates of soluble reactive P release	per 10 cm core	$540	12	$6,480
Total					$9,780