MINNEHAHA CREEK
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Meeting date: 10/6/2022
Agenda Item #: 12.1
Item type: Discussion

Title: East Auburn Wetland Assessment Findings

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Purpose:
During 2022, Research and Monitoring staff have worked, in partnership with Stantec, to conduct further diagnostic monitoring of the East Auburn Wetland complex, which had previously been identified as a source of phosphorus export to the downstream receiving waterbody, Auburn Lake. This memorandum serves as a summary of the findings to date and marks a transition point between Research and Monitoring's effort to characterize the underlying drivers causing phosphorus export and Projects and Planning's effort to identify and implement a project to improve water quality in the Six Mile Creek Halsted Bay Subwatershed (SMCHB).

Background:
Since adoption of the 2017 Water Resources Management Plan (WRMP), MCWD 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 high impacts capital projects concurrent with development. Under this plan, MCWD has invested substantially in the restoration of Wassermann Lake through both watershed and in-lake management activities.

In January 2020, MCWD was awarded a Clean Water Fund grant from the Board of Water and Soil Resources to conduct in-lake alum treatments of Wassermann Lake. The first treatment took place in spring of 2021 with the second in September of 2022. That project, in addition to upstream watershed projects, positions Wassermann Lake to meet water quality standards and ultimately be removed from the Impaired Waters List.

The next logical step is to address impairments downstream of Wassermann Lake by identifying drivers of poor water quality in East Auburn Lake, which also receives drainage from Steiger and Sunny Lake. The 2017 WRMP identifies that the impairments in East Auburn Lake are driven primarily by wetland phosphorus export. The WRMP also identifies the wetland that lies between Wassermann Lake and East Auburn Lake as a potential restoration opportunity (now referred to as the East Auburn Wetland).

MCWD staff analyzed historic water quality data to identify if, and to what extent, the East Auburn Wetland is exporting phosphorus. This analysis revealed that the wetland is exporting on average 135 pounds of phosphorus per year to East Auburn Lake. In comparison, the total watershed load reduction needed for East Auburn Lake to meet water quality standards is 341 pounds per year as noted in the Six Mile Creek Diagnostic Study. Therefore, a wetland restoration focused on phosphorus reduction could achieve nearly half of the total watershed load reduction needed for East Auburn Lake.

In 2019 and 2020, MCWD staff conducted more refined water quality sampling, hydrology, and vegetation analysis, in cooperation with Stantec, in the East Auburn Wetland to identify if there was a specific area responsible for much of the phosphorus export. The analyses indicated that a relatively small portion of the wetland was the primary source of phosphorus export. With a characterization of the location and magnitude of the phosphorus export, identifying a range of engineering solutions was the next step.

Summary:
In July 2021, The Board authorized a contract with Stantec to support 2022 monitoring efforts that will inform high-level project concepts. The first step was to conduct a site visit and familiarize with data collected to date. MCWD staff and Stantec worked collaboratively to design a monitoring plan for 2022 that would ultimately help understand if a project would reduce phosphorus loading from the East Auburn Wetland, refine potential project ideas, and inform future project design. The two key questions that the monitoring plan for the East Auburn Wetland were designed to answer include:

1. Is there high phosphorus throughout the soil of the wetland?
2. Are there areas of high phosphorus that can mobilize and move downstream into East Auburn Lake?

The results from the 2022 soil analysis confirmed that phosphorus soil concentrations were relatively high throughout the 11-acre wetland cell at depths between 0 and 2 feet. Soil phosphorus concentrations were lower between 4-5 feet relative to surface soil phosphorus concentrations.

District Staff also installed 40 monitoring wells to assess groundwater phosphorus concentrations and water levels at varying depths and locations throughout the wetland to understand if the elevated soil phosphorus could be mobilized and transported downstream to East Auburn Lake. The groundwater phosphorus concentrations and water level data collected in these wells clearly showed that phosphorus-rich groundwater was being transported to the channel.

These findings, along with past monitoring conclusions, all support that this area of the east auburn wetland and specifically its soils are a primary source of phosphorus export. A perception remains that all wetlands should clean and filter the water as it passes through. However, in the case of East Auburn and many others like it, the wetland has experienced decades of high phosphorus loading from the upstream impaired Wassermann Lake. This legacy phosphorus has deposited over time and pushed the wetland's natural ability, to effectively cycle nutrients, past its limits. Now the primary question is how to mitigate the impacts of this legacy loading.

<u>Next Steps</u>
Stantec is working to develop a comprehensive technical memorandum that will summarize the results from the 2022 monitoring effort. As part of Stantec's technical memorandum, they will also include an appendix to outline the high-level project options, range of associated costs, and the risks and uncertainties relating to each approach. While it's important to note that wetland restorations focused on phosphorus reduction are relatively novel endeavors, many parallels can be drawn to an entire established field of sediment contamination. The range of options fall under the same three categories:

1. Trap legacy phosphorus within the wetland
2. Remove legacy phosphorus within the wetland
3. Treat legacy phosphorus within the wetland

At the October 20, 2022 Board of Managers meeting, Project-Planning staff will be bringing forward a Request for Proposals (RFP) to contract for project feasibility to identify cost effective projects to reduce legacy phosphorus export from the East Auburn Wetland.

Supporting documents:
2022 East Auburn Wetland Targeted Monitoring Plan

Stantec

Memo

To:	Kailey Cermak and Brian Beck	From:	Dendy Lofton, PhD Joel Thompson, PG
	Minnehaha Creek Watershed District		Stantec
File:	227704313	Date:	January 19, 2022

Reference: Auburn Wetland Targeted Monitoring Plan – FINAL

Stantec Consulting Services Inc (Stantec) is supporting the Minnehaha Creek Watershed District (MCWD) with development of a targeted monitoring plan for the Auburn Wetland (site). Previous investigations into water quality through the wetland found that dissolved phosphorus (DP) concentrations increased from upstream to downstream through the system resulting in a net export of DP to East Auburn Lake. This memo provides the targeted monitoring plan designed to assess the hydrology and phosphorus dynamics at the site to evaluate the mechanisms and sources of DP export from the wetland complex.

The following investigation tasks are described for this scope of work:

- Installation of multilevel piezometers and collection of groundwater level measurements and water quality samples;
- Installation of stilling wells within Six Mile Creek and collection of surface water level measurements, flow measurements, and water quality samples; and
- In-channel sediment and wetland soil chemistry sampling.

Field installation of monitoring equipment will be initiated in December 2021 before the ground freezes with any remaining equipment to be installed in April 2022 , or as soon as thawed ground conditions persist following ice-out. The recommended field installation and monitoring schedule is further described at the end of this memo.

DESCRIPTION OF FIELD INVESTIGATION METHODS

Hydrologic and Water Quality Monitoring Network

An understanding of wetland hydrology is vital in understanding wetland behavior and flux of nutrients. Hydrologic monitoring provides a direct measurement of water elevation (groundwater and surface water). Water elevations over time may be used to understand the seasonal variability of saturation level, groundwater flow direction, recharge/discharge rates, and relative importance of sheet flow versus subsurface pore flow. Piezometers are recommended to provide depth-specific measurements to support characterization of the vertical variability in phosphorus, geochemical environment, and vertical and horizontal components of groundwater flow. In conjunction with the piezometers, stilling wells are recommended to be installed within the channel of Six Mile Creek within the site to support evaluation of groundwater/surface water interaction.

Water quality sampling will be conducted at locations throughout the site to evaluate distribution of DP and potential pathways for flux of DP to Six Mile Creek.

Reference: **Auburn Wetland Targeted Monitoring Plan – FINAL**

Piezometers

Stantec recommends installation of up to 15 multi-level nested piezometer locations to facilitate measurement of groundwater elevation and collection of water quality samples (Figure 1). Each nested location within the wetland complex will consist of 3 piezometers (surface, shallow and deep) installed at progressively deeper intervals for a total of 45 piezometers.

The piezometers are planned to be oriented in four east-west oriented transects across the wetland (perpendicular to the channel) to provide sufficient areal coverage to support characterization of site hydrology and characterize the horizontal and vertical distribution of DP in groundwater and surface water.

The uppermost piezometer (surface) location will be fitted with a 1 ft screen from +0.5 to -0.5 feet relative to the ground surface. The shallow piezometer is designed to monitor saturation and water quality in the dynamically variable saturated zone of the wetland complex. It is anticipated that this zone is variably saturated depending upon short-term and seasonal precipitation patterns and is key to understanding the nutrient contribution from the wetland. The next deepest piezometer (shallow) will be installed with a screened depth of 1 to 2 feet below ground surface (bgs). This shallow location is targeted to monitor the uppermost consistently saturated zone. The deep piezometer locations are proposed to be constructed with a screen located from approximately 4 to 5 feet bgs and are designed to monitor conditions at depth within the wetland complex.

Note that one piezometer location will be located east of the wetland complex in the upland soils. This location would consist of a single piezometer (not a nested group) with a screen interval below the seasonal low water elevation. The purpose of this piezometer is to monitor local groundwater elevations outside of the wetland complex and facilitate evaluation of the interaction between groundwater within upland soils groundwater within the wetland organic soils.

Piezometers will be installed within pilot holes which will be advanced using a hand auger. One groundwater piezometer will be installed within each soil boring. Each piezometer is proposed to be constructed of 2-inch diameter, schedule 40 polyvinyl chloride (PVC) casing, and 0.010-inch slotted screen. It is anticipated that the surface piezometers will need to be secured to a T-post for additional stabilization.

Stilling Wells

Stantec recommends installing 4 stilling wells within the wetland channel of Six Mile Creek that bisects the Auburn Wetland. Stilling wells will be constructed to provide a stable location for measurement of surface water elevations to provide data to evaluate surface water/ groundwater interaction.

The stilling wells should be constructed of 2-inch, schedule 40 PVC, 10-slot secured to T-posts to provide stability.

Surveying

Surveying of the installed piezometers and stilling wells should be completed to document horizontal coordinates, elevations of ground surface and top of riser casing. Wells installed in December 2021 will need to be re-surveyed

Groundwater and Surface Water Elevation Monitoring

Install up to 16 pressure transducers within the piezometers and stilling wells. Manual water level measurements will be collected periodically from each of the piezometers and stilling wells following installation. In addition, we recommend installation of pressure and temperature logging transducers in each of the locations within the south central transect: four nested piezometers (3 piezometers at each location [12 piezometers], one upland piezometer, and one surface water stilling well. The pressure transducers will facilitate evaluation of short-term variations in water levels and wetland hydraulics in response to precipitation events.

In addition to surface water elevation measurements, measurements of flow rate and water quality samples will be collected at the collocated surface water sampling locations.

Water Quality Sampling

Water samples will be collected periodically from piezometers and surface water stilling wells supplies to characterize distribution of DP and evaluate site geochemistry. Water quality samples will be analyzed for total phosphorus, dissolved phosphorus, total nitrogen, and total iron. In addition, the following parameters will be measured in the field: temperature, pH, dissolved oxygen, specific conductance, and oxidation-reduction potential.

In-channel Sediment and Wetland Soil Chemistry Sampling

Stantec recommends collection of 28 in-channel sediment and wetland soil samples for phosphorus chemistry analyses at the up to 16 locations shown in Figure 1. These samples will quantify the phosphorus fractions that can be mobilized and the pool considered to be permanent and non-mobile (Table 1). These data will be compared to the hydrological data to assess potential load from various locations across the site. Sediment and soil chemistry samples only need to be collected during one event in late spring/early summer. One single sediment sample will be collected from each of the four in-channel sites (indicated by red circles in Figure 1). Sediment samples from within the channel should be collected from an approximate depth of 0-3 inches using a sediment coring device (Figure 1).

In the 12 wetland soil sampling locations (noted by pink box in Figure 1), vertical soil samples will be collected to a total depth of 12 inches. The collected wetland soil sample will be split into two segments representing the 0-6 and 6-12 inch depth intervals. Wetland soil samples should be collected during the same sampling event as the in-channel samples. The deeper soil interval (6-12 in) is expected to remain inundated with water while the uppermost portion is expected to dry out and rewet at some unknown temporal frequency which will differentially impact the biogeochemical and geochemical nutrient cycling compared to the deeper portion that remains wetted and likely anoxic. These data will be compared to hydrological data collected in the piezometers to evaluate potential load from sampled areas within the site. The locations, depth intervals and chemistry parameters are shown in Table 2.

The soil and sediment samples (n=28) will be sent to the UW-Stout for analysis of moisture content-bulk density, loss on ignition organic matter, total phosphorus, total aluminum, total iron, and biologically-labile and refractory phosphorus.

Table 1. Operational grouping and recycling potential of phosphorus fractions.

Reference: **Auburn Wetland Targeted Monitoring Plan – FINAL**

Operational Grouping	P Fraction	Recycling Potential
Mobile P pool	Iron-bound P	Biologically-labile and may be recycling through biogeochemical and geochemical reactions
	Loosely-bound P	
	Labile organic P	
Permanent P pool	Aluminum-bound P	Biologically-refractory and subject to burial
	Calcium-bound P	
	Refractory organic P	

Table 2. Summary of in-channel and wetland soil sampling.

Sampling Location	Depth Intervals	Total number of samples for analyses	Parameters	Basis
In-channel	0 – 3 inches	4	Moisture content-bulk density, loss on ignition organic matter, total phosphorus, total aluminum, total iron, and the mobile and permanent pools of P.	Quantifies pools of phosphorus with potential for mobilization and fractions considered to be permanent and non-mobile. Measures potential for DP mobilization from surficial sediments within the channel, surficial reactive layers of wetland soils and the deeper wetted layers of wetland soils to evaluate potential for P transport. Data will be evaluated in conjunction with hydrologic monitoring.
Wetland soils	One vertical soil profile segmented into two sections: 0-6 and 6-12 inch depth intervals	24		

Reference: **Auburn Wetland Targeted Monitoring Plan – FINAL**

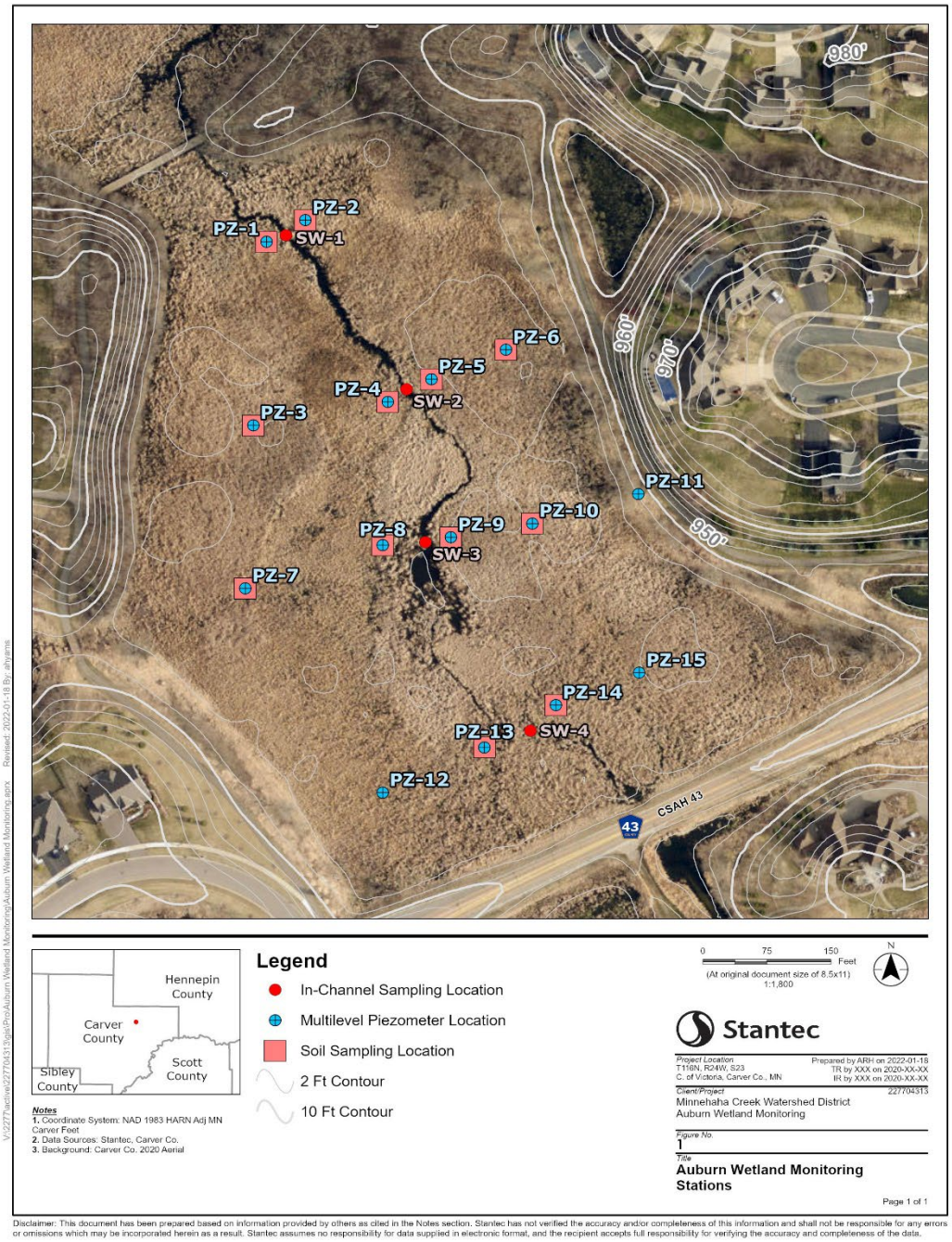

Figure 1. Monitoring locations within the Auburn Wetland.

Reference: **Auburn Wetland Targeted Monitoring Plan – FINAL**

Schedule and Frequency

Target dates and sampling frequency for monitoring components are shown in Table 3. Deep piezometers will be installed in December 2021 prior to the onset of ice with installation of remaining piezometers and stilling wells in April 2022, when thawed conditions allow.

The first water quality sampling event can proceed within a few days of piezometer installation which will allow time particulate settling prior to sample collection. We recommend taking an adaptive management approach to the sampling frequency by collecting samples approximately every two weeks through May, and then evaluating the data to determine the appropriate frequency of collection needed for adequate temporal resolution through summer 2022.

Table 3. Field installation and monitoring schedule and frequency.

Component	Target Date	Frequency
Installation of piezometers and stilling wells	December 2021	Initial installation of deep piezometers
Installation of piezometers and stilling wells	April 2022	Installation of remaining piezometers and wells
Hydrology and water quality monitoring	Begins in following installation of monitoring equipment.	Up to 10 events, schedule based on timing of ice-out. Collect samples every two weeks in April to May, then evaluate data to determine frequency of subsequent sampling events. Aim for baseflow and post-storm event flow conditions Water level measurements and water quality samples should be collected in parallel in each sampling event
Sediment and soil P chemistry samples	Early June	Single event. Should coincide with a monitoring event.

Reference: **Auburn Wetland Targeted Monitoring Plan – FINAL**

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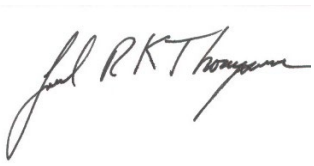

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