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Memorandum

To: Bassett Creek Watershed Management Commission

From: Barr Engineering

Subject: Impacts of Proposed Schaper Pond Diversion Project on the Water Quality and Wetland Functions and Values of Schaper Pond

Date: November 6, 2013

Project: 23270051.34 2013 627

This memo discusses the potential effects of diverting flow within Schaper Pond on the water quality and wetland functions and values of Schaper Pond. Figure 1 shows the proposed diversion and redirection of flow to a region of the pond referred to in this memorandum as the northwest lobe. Overall, it is not expected that there will be any notable water quality or wetland effects in Schaper Pond with the construction of the proposed diversion and redirection of flow within Schaper Pond.

1. Summary

A. Water Quality Impacts

It is not expected that there will be any notable water quality effects in Schaper Pond with the construction of the proposed diversion and redirection of flow within Schaper Pond. The basis of this conclusion is as follows:

- Large particles are currently being removed in the shallow upstream wetland areas of Schaper Pond and in the northwest lobe of Schaper Pond. The diversion will direct small particles to the northwest lobe of Schaper Pond for settling. Hence, additional sediment accumulation will be minimal and less than 1 inch per year over a pond bottom area of 1 acre.
- Higher flows will be diverted to the northwest lobe of Schaper Pond, which will:
  - Potentially disrupt the thermal stratification of the pond during the summer months which will likely improve the oxygen levels in the northwest lobe,
  - Increase oxygen supply in this area of Schaper Pond because flows will be greater, and
  - Reduce the residence time of the northwest lobe and hence reduce the opportunity for algae to grow in the pond.
- Some sediment that normally accumulates in the north east arm of the pond may be directed to the northwest lobe and will spread out over a large surface area with the construction of the proposed diversion. This may improve the northeast arm of the pond by preventing sediment accumulation in this relatively small area.

- Implementation of a 10 year dredging schedule for the northwest lobe of Schaper Pond will maintain performance of the pond and prevent potential sediment oxygen demand effects with the expected additional sediment accumulation.

Section 3 provides more details regarding the evaluation of the water quality effects.

B. Wetland Impacts

It is also expected that there will not be any wetland impacts in Schaper Pond with the construction of the proposed diversion and redirection of flow within Schaper Pond. This conclusion is based on the results of using the Minnesota Routine Assessment Method (MNRAM) for Evaluating Wetland Functions to analyze the impacts of the proposed Schaper Pond diversion project on the wetland functions and values of Schaper Pond. MNRAM was used to calculate the wetland functions and values of Schaper Pond under current and post-modification (i.e., post-project) conditions. Scoring of the post-modification MNRAM assumes the removal of 6 inches of additional accumulated sediment in the northwest lobe of the pond.

MNRAM calculated the overall wetland management classification of Schaper Pond to be Manage 1 for both current and post-modification conditions. The quality ratings and numeric score also remain the same for both current conditions and post-modification conditions. This means that the functions and values of Schaper Pond are not expected to change from their current conditions after modifications are made. Section 4 provides more details regarding MNRAM and the scoring of each category.

2. Basis for Need of Project and Project Specifications

The Sweeney Lake TMDL identified a necessary 99 pounds of total phosphorus external load reduction during the July through September summer period to meet the Minnesota water quality standard for phosphorus in Sweeney Lake. The Implementation Plan for the Sweeney Lake TMDL includes several options for reducing phosphorus loads to Sweeney Lake (see attached Table 8.2 from the Sweeney Lake TMDL). Because of the fully-developed nature of the tributary watershed and the existing in-place BMPs, there are limited opportunities to install significant new BMPs in the upstream watershed. The best opportunities for installing such BMPs will come with redevelopment in the tributary watershed. Another primary option in the Sweeney Lake Implementation Plan was modification of Schaper Pond to improve the pond's ability to remove phosphorus. The Bassett Creek Watershed Management Commission (BCWMC) selected this alternative for further study because it could be implemented in the immediate future; the other alternatives in the TMDL implementation plan would require a much longer timeframe (decades) to see the same phosphorus removal results, as they are dependent on redevelopment in the watershed.

The BCWMC completed a feasibility study for the Schaper Pond modification in 2012 (*Feasibility Report for the Schaper Pond Improvement Project*) that investigated alternatives for modifying the pond. The feasibility study recommended construction of a diversion structure within Schaper Pond to direct

more of the stormwater from the south to the northwest (larger, deeper) lobe of Schaper Pond where more treatment could be provided. Monitoring data collected in 2011 for the feasibility study demonstrated that much of the phosphorus entering Schaper Pond is in the particulate form and if more time is provided for settling, the phosphorus removal performance of Schaper Pond could be increased. It was estimated that 81 to 156 additional pounds of phosphorus could be removed with the redirection of water in Schaper Pond as indicated in Figure 1. As a result, the feasibility study found that the project would be a feasible approach to improve the total phosphorus removal performance of the pond and meet the external load reduction required by the TMDL.

Although 90 percent of the flow and over 90 percent of the phosphorus load to Schaper Pond comes from the south inlet to the pond at Highway 55, only 35 percent of the pond volume is provided to settle solids and phosphorus from the stormwater that enters Schaper pond at Highway 55. The diversion enables 100 percent of the pond volume to treat the stormwater entering Schaper Pond at Highway 55.

The proposed modification is envisioned to be a floating/movable structure that would direct the water to the northwest side of Schaper Pond and toward the bottom of the pond, to significantly improve phosphorus removal. The attached Figure 8 from the feasibility study and attached schematic illustrate the proposed modification.

3. Evaluation of Water Quality Effects

The proposed project does not include any additional flow, solids, or phosphorus loads to Schaper Pond. The primary goal of the diversion is to improve settling of particles in stormwater that have a size of around 100 micrometers (um) or smaller. Hence, the sediment accumulation effect is also expected to be small. For example, 200 um particles have four times greater volume than 100 um particles and the volume of 300 um particles are nine times greater. The pond is currently removing 200 and 300 um particles in the upper reaches of the shallow wetland system, however, greater detention time is needed to settle the small particles, which also have comparatively less volume. The smaller particles will be settling in the northwest lobe of Schaper Pond.

It is expected that less than one inch of additional sediment will accumulate in the northwest lobe of Schaper Pond each year (a total of approximately 160 cubic yards of sediment each year). It is recommended that maintenance dredging be conducted every 10 years. The intent of the maintenance dredging is to maintain the performance of the pond and to minimize the accumulation of organic-rich sediments in the bottom of the pond, which may reduce oxygen in the water column of the pond during mid-summer months (e.g., sediment oxygen demand). Monitoring work conducted by Gary Oberts (Technical Note #102 from Watershed Protection Techniques. 3(1): 597-600) demonstrated that the performance of a wetland treatment system (McCarrons wetland/pond system), with a similar watershed size to Schaper Pond, can decline notably with 10 years of operation. Hence, maintenance dredging of

the northwest lobe every 10 years will not only reduce sediment accumulation in the northwest lobe of Schaper Pond, it will also maintain performance.

Dredging will also minimize the accumulation of organic-rich sediments in the bottom of Schaper Pond. Although some studies suggest that ponds can experience thermal stratification in the mid-summer at depths greater than 4 feet (Saint Anthony Falls Hydraulic Laboratory Project Report #479), it is expected that the relatively high flows that will pass through the northwest lobe of Schaper Pond (with the proposed diversion) will frequently disrupt thermal stratification. In addition, the residence time of the northwest lobe will be reduced by a factor of 9 with the proposed diversion. This reduced residence time will also increase oxygen transport to this area of the pond—i.e., the ratio of oxygen consumed by bottom sediment to the volume of water that passes over these sediments will decline notably.

The proposed diversion will not add sediment load to Schaper Pond. It will redirect some sediment load that typically accumulates in the northeast arm of Schaper Pond to the northwest lobe of Schaper Pond. Solids typically accumulate to some depth in the relatively small area of the northeast arm. The proposed diversion may provide some relief from excessive sediment accumulation in this area of the pond.

Based upon flow monitoring conducted in 2011, inflows to Schaper Pond at the south, near Highway 55, are nine times greater than the flows that currently enter the northwest lobe of Schaper Pond. Flow from the south inlet (at Highway 55) does not currently enter the northwest lobe. Once diverted to the northwest lobe, the residence time of the northwest lobe will decline by a factor of 9. At low summer flows (approximately 2 cubic feet per second-both inlets), the current residence time of water in the northwest lobe is 7 days. This provides adequate time for algae to grow in the northwest lobe during the summer. During the summer low flows and with the diversion of water from the south inlet to the northwest lobe, the residence time will decline to approximately 0.7 days. Using a reasonable doubling time for green algae of 0.5 days, there is significantly reduced opportunity for an algal bloom and hence a significant decline in water quality in the northwest lobe with the proposed diversion (e.g., an improvement in water quality with the proposed diversion). Under higher flow conditions (e.g., 25 cubic feet per second) and with the diversion, the residence time of the northwest lobe will be approximately 0.06 days. Under these flow conditions there will be a very low opportunity for algal growth.

Algal growth is also dependent upon dissolved phosphorus concentrations. The total dissolved phosphorus concentration in the northwest lobe of Schaper pond is expected to decline with the proposed diversion. The 2011 flow monitoring found the flow entering the pond from the northwest inlet had an average concentration of 0.050 mg/L dissolved phosphorus, while the concentration from the south inlet at Highway 55 was 0.025 mg/L. Diversion of the south inlet water to the northwest lobe will lead to a dilution of the higher total dissolved phosphorus water coming from the north inlet. Given that algal growth is dependent upon dissolved phosphorus concentrations, a decrease in dissolved phosphorus with diversion will also likely reduce algae growth.

4. Evaluation of Wetland Impacts

A. MNRAM Overview

The Minnesota Routine Assessment Method (MNRAM) for Evaluating Wetland Functions was used to analyze the impacts of the proposed Schaper Pond diversion project on the wetland functions and values of Schaper Pond. The MNRAM was developed as a way to regulate and protect wetlands based on wetland functions. The MNRAM assesses wetlands based on the answers to 72 questions to determine how well the functions and values are performed within each wetland. It is intended to provide detailed wetland resource data to guide future development and redevelopment, with the goal of protecting and managing wetland resources for overall public benefit.

The MNRAM evaluates the following 15 functions/values characteristics:

Ecological Wetland Functions

1. Vegetative Diversity/Integrity
2. Maintenance of Hydrologic Regime
3. Maintenance of Wetland Water Quality
4. Maintenance of Characteristic Wildlife Habitat Structure
5. Maintenance of Characteristic Fish Habitat
6. Maintenance of Characteristic Amphibian Habitat

Wetland Values

7. Flood/Stormwater Attenuation
8. Downstream Water Quality Protection
9. Aesthetics/Recreation/Education/Cultural
10. Ground Water Interaction
11. Commercial Uses
12. Shoreline Protection

Additional Evaluation Information

13. Wetland Restoration Potential
14. Wetland Sensitivity to Stormwater & Urban Development
15. Additional Stormwater Treatment Needs

Numeric scores are computed for each wetland function/value based on established formulas in the methodology. Those numeric scores are then converted to quality ratings – exceptional, high, medium, and low – which are entered into the Wetland Management Classification System to determine the overall management class. The corresponding wetland management standards and guidelines govern future activities that would affect wetlands.

The MNRAM wetland management classification system was developed by the Minnesota Board of Water and Soil Resources (BWSR) for standard wetland protection. The wetland management classification system determines the class into which each wetland will be placed, based on the assessed wetland functions/values. The wetland management classification system includes the following four categories with the general goals:

Preserve

Maintain wetland and existing functions, values and wildlife habitat. There may be a need for active management of the wetland to protect unique features. The application of more strict avoidance standard may be appropriate to develop a conservation easement.

Manage 1

Maintain wetland without degrading existing functions, values and wildlife habitat. Apply sequencing process.

Manage 2

Maintain wetland footprint. Improve wetland biological and plant community diversity/integrity or enhance other functions if possible. Apply sequencing process. Consider for restoration.

Manage 3

Allow for relaxed sequencing and replacement plan flexibility. Consider for restoration/enhancement.

B. Schaper Pond MNRAM Analysis and Results

A MNRAM was completed at the Schaper Pond site on October 4, 2013. The results of that MNRAM reflect the current conditions on the ground on the assessment date and do not reflect speculation on future or past conditions. A post-modification MNRAM was completed on October 23, 2013 that reflects conditions expected to be present after the proposed modifications are made to divert and redirect flows within Schaper Pond. Post-modification MNRAM scoring is also based on the removal of six inches of additional accumulated sediment in the northwest lobe of the pond every 10 years. The attached summaries of the current and post-modification conditions are based on the MNRAM assessments and are generated by the MNRAM access database.

MNRAM was used to evaluate current conditions and post-modification conditions of Schaper Pond. These evaluations yielded a management classification of **Manage 1** for both current conditions evaluated in the field and for post-modification conditions. Quality ratings and numeric scores also did not change when the post-modification conditions were evaluated. This means that the functions and values of Schaper Pond are not expected to change from their current conditions after modifications are made. Table 1 below summarizes the ratings of the current and post modification conditions.

Table 1. Comparison Summary of Wetland Functions and Values

Evaluated Functions and Values	Current Conditions Rating (numeric score)	Post Modification Rating (numeric score)	Type of Change
Vegetative Diversity/Integrity	Low (0.14)	Low (0.14)	none
Maintenance of the Hydrologic Regime	Low (0.30)	Low (0.30)	none
Maintenance of Wetland Water Quality	Moderate (0.33)	Moderate (0.33)	none
Maintenance of Characteristic Wildlife Habitat	Moderate (0.45)	Moderate (0.45)	none
Maintenance of Characteristic Fish Habitat	Moderate (0.50)	Moderate (0.50)	none
Maintenance of Characteristic Amphibian Habitat	Low (0.22)	Low (0.22)	none
Flood/Stormwater Attenuation	Moderate (0.56)	Moderate (0.56)	none
Downstream Water Quality Protection	Moderate (0.49)	Moderate (0.49)	none
Aesthetics, Recreation, Education and Cultural Opportunities	High (0.70)	High (0.70)	none
Ground Water Interaction	Discharge	Discharge	none
Wetland Sensitivity to Stormwater and Urban Development	Moderate (0.50)	Moderate (0.50)	none
Additional Stormwater Treatment Needs	Moderate (0.33)	Moderate (0.33)	none

The narrative below, in Sections C and D, provides more detail on the scoring of each category.

C. Overview of Vegetative Diversity and Integrity for Schaper Pond

A major function and value assessed by MNRAM is the vegetative diversity and integrity of the wetland. Three vegetative communities currently comprise Schaper Pond, as described below:

1. Approximately 70 percent of the pond is shallow open water community (Type 5; PUBH), with little emergent vegetation, and no submergent vegetation observed. Water depth was estimated to be 3 to 4 feet within open water areas. The shallow open water community had a vegetative index of **Low**.

2. Approximately 20 percent of the pond is deep marsh community (Type 4; PEMF) dominated by narrow-leaf cattail and reed canary grass. Deep marsh communities are located along the periphery of the pond but are not contiguous. They are irregularly shaped, giving them a more natural appearance. The deep marsh community had a vegetative index of **Low**.
3. A floodplain forest community (Type 1; PFO1A) is located at the north and northwest sides of the pond. This area is dominated by eastern cottonwood and glossy false buckthorn. The floodplain forest had a vegetative index of **Moderate,** which is the highest rated vegetative community associated with Schaper Pond.

There will be no alteration of the three vegetative communities or the plants within them as a result of the proposed modification. The upland plant communities surrounding Schaper Pond and the pond morphology will also remain unaltered.

When all three communities are averaged together, the vegetative diversity and integrity of this wetland is **Low**, based on the presence of native wetland plant species and the presence of substantial non-native or invasive species. Since there will be no change to the vegetative communities or the plants within them, the post-modification vegetative diversity and integrity is also rated as **Low**.

Much of the edge of the open water community is directly adjacent to the surrounding upland edge. But the floodplain forest community typically does not abut open water. It maintains adjacency to the deep marsh community.

The majority of vegetation at this site does not contribute to wetland functions beyond water retention and flow resistance. However, there were small patches of high-quality species, such as arrowhead and blue flag iris, which were observed on the southwest side of Schaper Pond.

Naturalized upland plant communities surrounding Schaper Pond average 65 feet in width. Dominant species observed along the upland areas on the eastern side and part of the southern side of the wetland were big bluestem, a species of aster, and a species of coneflower. Upland areas at the south and west sides of the wetland have steep slopes and are forested with eastern cottonwood, boxelder and green ash. Common buckthorn was present in the understory as a shrub.

D. Overview of the Remaining Functions and Values for Schaper Pond

In addition to vegetative diversity and integrity, MNRAM assesses fourteen other wetland functions and values. The following paragraphs summarize the results of the MNRAM assessment for these remaining functions and values.

1. Additional stormwater treatment needs was rated as **Moderate** for both the current and the post-modification evaluations. Sediment removal would improve the ability of this site to maintain water quality.

2. Maintenance of the hydrologic regime was rated as **Low** for both the current and the post-modification evaluations because of the extensive alteration that may be impacting the natural hydrologic function.

3. Flood and stormwater attenuation was rated as **Moderate** for both the current and the post-modification evaluations. This wetland provides some flood storage and/or flood wave attenuation. Below is a list of the attributes affecting flood and stormwater attenuation that resulted in a moderate rating.

    - Disturbed wetland soils.
    - Loamy upland soils.
    - Altered outlet.
    - Majority of this community was open water, so emergent vegetation was lacking.
    - Other wetlands present within the sub-watershed.
    - Moderate runoff volumes from park area.

4. Downstream water quality was rated as **Moderate** for both the current and the post-modification evaluations. Schaper Pond has some ability and opportunity to protect downstream resources. The ability of the wetland to remove sediment from stormwater is determined by emergent vegetation and overland flow characteristics. A high nutrient removal rating indicates dense vegetation and sheet flow to maximize nutrient uptake and residence time within the wetland. The opportunity for a wetland to protect a valuable water resource diminishes with distance from the wetland so wetlands with valuable waters within 0.5 miles downstream have the greatest opportunity to provide protection, as do those that receive more (and less-treated) runoff.

5. Maintenance of wetland water quality was rated as **Moderate** for both the current and the post-modification evaluations. Wetland water quality is average. Sediment removal from incoming water would benefit the site and reducing the amount of stormwater directed to the site would also be beneficial. Sustaining a diverse wetland may require additional control over upland land use and the buffer.

6. Maintenance of characteristic wildlife habitat structure was rated as **Moderate** for both the current and the post-modification evaluations. The site provides good habitat and is relatively accessible to wildlife, although it may be somewhat isolated on the landscape and lack the rich vegetative community and complex structure that would support a wider range of wildlife.

7. Maintenance of characteristic fish habitat was rated as **Moderate** for both the current and the post- modification evaluations given that shallow open water wetland communities can support native populations of minnows and some deep marsh communities have intermittent populations

of sunfish and northern pike after flood events. Diminished water quality from runoff and insufficient buffer and vegetation, likely affects the sustainability of current fish populations if they exist. Sediment removal technologies will allow fish eggs to avoid being completely smothered, however.

8. Maintenance of characteristic amphibian habitat was rated as **Low** for both the current and the post-modification evaluations. Predatory fish are likely present and winter habitat is unsuitable for amphibians given that this site often freezes to the bottom. Untreated stormwater or unfiltered runoff contributes to diminished water quality and consequently poor reproductive conditions.

9. Aesthetics, recreation, education and cultural opportunities were rated as **High** for both the current and the post-modification evaluations. Regardless of actual integrity, the site is accessible and likely valued by significant populations of people. Its value is enhanced by not being visibly altered by human influences such as trash or roads. There is high evidence it is used for multiple recreational activities.

10. Wetland sensitivity to stormwater and urban development was rated as **Moderate** for both the current and the post-modification evaluations. This wetland is moderately sensitive to stormwater inputs given that the vegetative community of the deep marsh has a dominance of cattails and reed canary grass, and the shallow open water community has low vegetative diversity.

11. Ground water interactions for this wetland indicate that it is a **Discharge** wetland and will remain a discharge wetland after the proposed modification. Schaper Pond is found lower in the sub-watershed with predominantly organic soils, a semi-permanently flooded water regime and a perennial outlet that is surrounded by moderate residential development. These attributes promote more water discharge from this basin than recharge.

12. Commercial uses do not exist for this wetland.

13. Wetland restoration potential was not evaluated.

14. Shoreline protection was not evaluated.

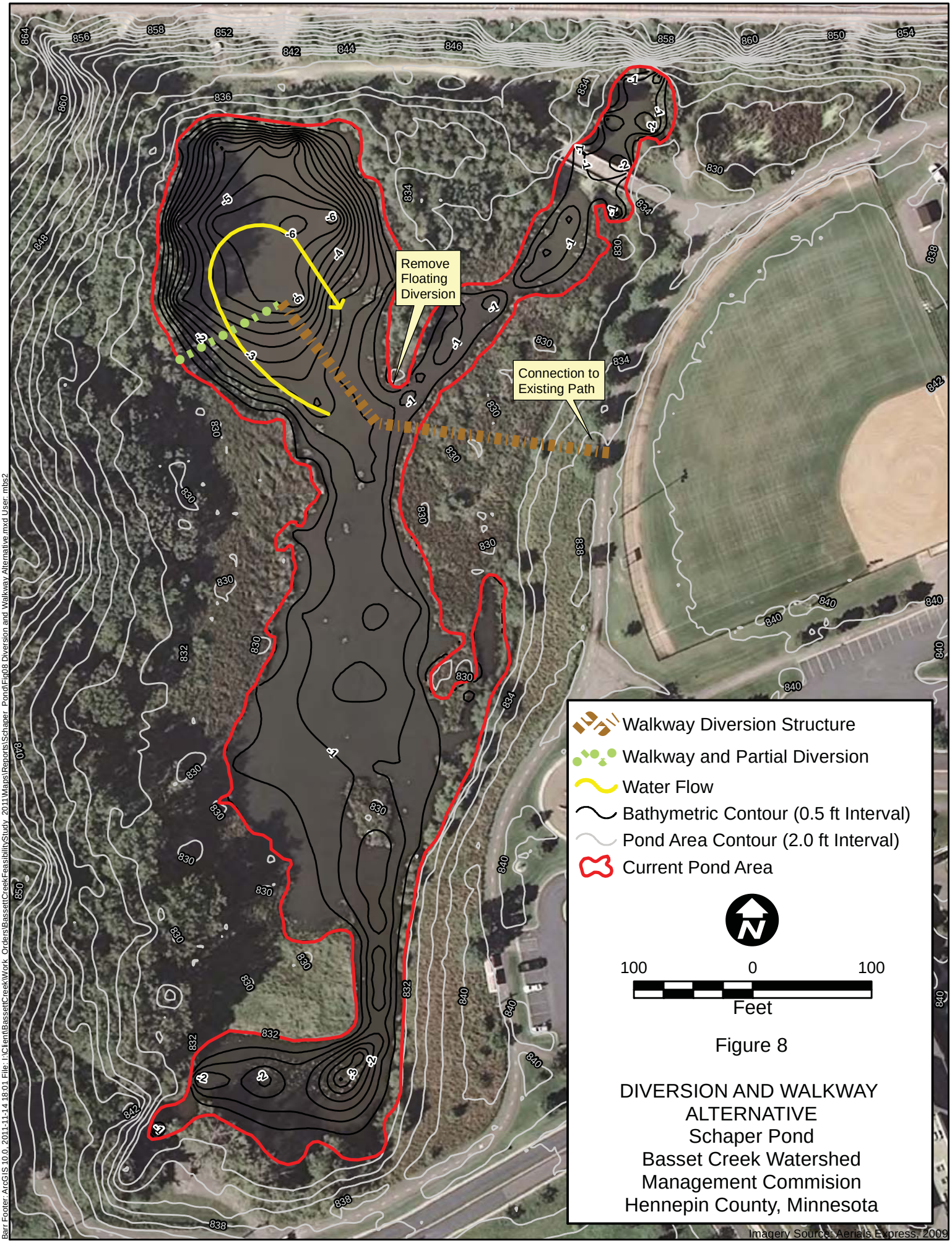
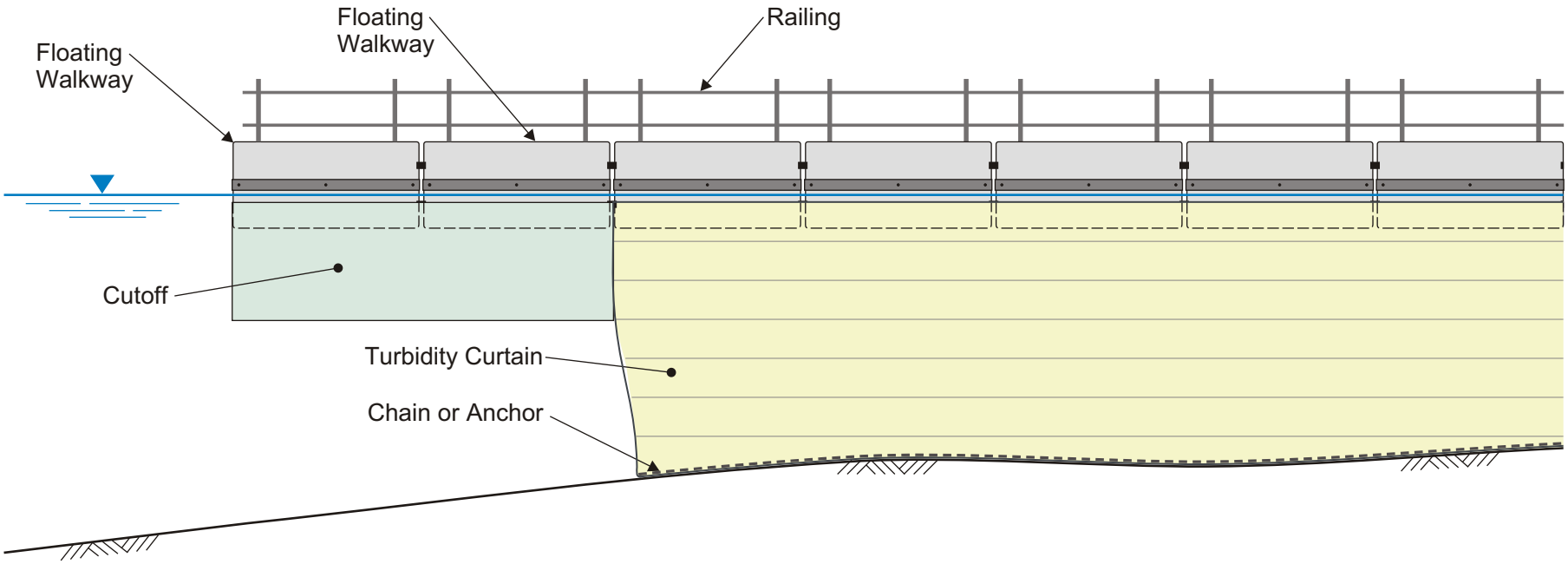


Figure 8

DIVERSION AND WALKWAY ALTERNATIVE
Schaper Pond
Basset Creek Watershed Management Commision
Hennepin County, Minnesota

Imagery Source: Aerials Express, 2009

Barr Footer: ArcGIS 10.0, 2011-11-14 18:01 File: i:\Client\BassettCreek\Work Orders\BassettCreekFeasibilityStudy 2011\Maps\Reports\Schaper PondFig08 Diversion and Walkway Alternative.mxd User: mbs2



PROPOSED DIVERSION AND WALKWAY
Schaper Pond
Bassett Creek Watershed
Management Commission
Golden Valley, Minnesota

Wetland Functional Assessment Summary

Wetland Name	Hydrogeomorphology	Maintenance of Hydrologic Regime	Flood/ Stormwater/ Attenuation	Downstream Water Quality	Maintenance of Wetland Water Quality	Shoreline Protection
Schaper Pond (Current)	Depressional/Flow-through (apparent inlet and outlet), Depressional/Flow-through (apparent inlet and outlet), Floodplain (outside waterbody banks)	0.30	0.56	0.49	0.33	0.00
		Low	Moderate	Moderate	Moderate	Not Applicable

							Additional Information		
Wetland Name	Maintenance of Characteristic Wildlife Habitat Structure	Maintenance of Characteristic Fish Habitat	Maintenance of Characteristic Amphibian Habitat	Aesthetics/ Recreation/ Education/ Cultural	Commercial Uses	Ground-Water Interaction	Wetland Restoration Potential	Wetland Sensitivity to Stormwater and Urban Development	Additional Stormwater Treatment Needs
Schaper Pond (Current)	0.45	0.50	0.22	0.70	0.00	Discharge	0.00	0.50	0.33
	Moderate	Moderate	Low	High	Not Applicable		Not Applicable	Moderate	Moderate

Wetland Community Summary

		Vegetative Diversity/Integrity							
		Community							
Wetland Name	Location	Cowardin Classification	Circular 39	Plant Community	Wetland Proportion	Individual Community Rating	Highest Wetland Rating	Average Wetland Rating	Weighted Average Wetland Rating
Schaper Pond (Current)	27-029-24--001	PUBH	Type 5	Shallow, Open Water Communities	70	0.1	0.50	0.23	0.14
							Moderate	Low	Low
		PEMF	Type 4	Deep Marsh	20	0.1	0.50	0.23	0.14
							Moderate	Low	Low
		PFO1A	Type 1	Floodplain Forest	10	0.5	0.50	0.23	0.14
							Moderate	Low	Low
					100		0.50	0.23	0.14

☑ *Denotes incomplete calculation data.*

Wetland Functional Assessment Summary

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