Technical Memorandum

To: Veronica Sannes – Minnehaha Creek Watershed District
From: Michael McKinney, PE, Bryan Pitterle, PE and Sarah Stratton, CFM – Barr Engineering Co.
Subject: York Pond: Hydraulic and Hydrologic Design Review, Version 1
Date: December 3, 2025; Updated April 10, 2026
Project: 23272052.00
c: Ross Bintner – City of Edina

The City of Edina (City) intends to complete a lift station replacement, sediment management, and flood mitigation project at York Avenue Pond (York Pond), located east of the intersection of York Ave S and W 64th Street (Figure 1). York Pond is a known flooding area and has been previously studied (STS-406 Improvement Project, Barr, 2014; York Avenue Pond Improvement Study and Design, Barr, 2025). The primary outlets for the pond are two lift stations, one discharges to Xerxes Avenue and one discharges to Barrie Road. Flood impacts to a nearby apartment complex and parking lots have been documented, and modeling shows that there are potential flood impacts to two adjacent apartment complexes and four residences during the 1%-annual-chance (100-year) Atlas 14 design storm event. The major objectives of this pond improvement project are to:

1. Improve public safety by reducing flood risk to adjacent habitable structures and roadways.
2. Replace aging lift station and associated infrastructure.
3. Increase the pond capacity through sediment removal.
4. Implement adaptive level control systems (ALCS) (via lift station controls) to maximize flood protection benefit within the York Pond drainage area while also mitigating potential downstream impacts to waterbodies in Minnehaha Creek and Nine Mile Creek watersheds.
5. Improve water quality through removal of accumulated sediment and through extended residence time created using the ALCS.

In response to the initial permitting application organized by Barr Engineering Co. (Barr) and the City, Minnehaha Creek Watershed District (MCWD) provided a memorandum summarizing general comments and requests for additional information and analysis to satisfy permit application requirements (MCWD, Re: MCWD Permit Application #25-582: York Ave Pond Flood Storage Project; December 26, 2025). The following technical memorandum provides a summary of hydrologic and hydraulic analysis informing the design of York Pond improvements updated to directly address all comments provided in the December 26, 2025 incomplete permit application memorandum

1 Alternatives Analysis and Design Reference

The design is informed by previous studies and alternatives analyses (STS-406 Improvement Project, Barr, 2014; York Avenue Pond Improvement Study and Design, Barr, 2025). The York Pond Improvement and Design Study, completed February 25, 2025, explored over 15 design alternatives incorporating design elements such as pumping alternatives, pond expansion, volume reduction through street re-grading, sediment management, ALCS, and combination alternatives (see Table 1).

Table 1 York Pond alternatives evaluated in previous York Pond Improvement Study (Barr, 2025).

Strategy ID	Strategy Description
Strategy: Pumping Alternatives	
P01	SLS-5 restored (2x 500 GPM)
P02	SLS-5 restored, double pump rate (2x 1,000 GPM)
P03	SLS-11 max pump rate supported by gravity Sewer (2x 2,289 GPM)
P04	SLS-5 max pump rate supported by gravity Sewer (2x 2,737 GPM)
P05	SLS-11 and SLS-5 max pump rate (P03 + P04)
Strategy: ALCS and Sediment Management Alternatives	
A01	ALCS: 2-feet of pre-event drawdown
A02	ALCS & Sediment Management: 4-feet of pre-event drawdown
Strategy: Pond Expansion and ALCS	
E01	Pond expansion (Figure F)
E02	Pond expansion & ALCS: 2-feet pre-event drawdown
E03	Pond expansion & ALCS: 4-feet pre-event drawdown
Strategy: Volume Reduction Alternatives	
V01	Road raise at Xerxes and W 64th St: 0.25-feet
V02	Road raise at Xerxes and W 64th St: 0.5-feet
V03	Road raise at Xerxes and W 64th St: 1-feet
V04	Road raise at Xerxes and W 64th St: 2-feet
Strategy: Combination Alternatives	
C01	Sediment Management & ALCS: 4-feet drawdown & SLS-5: restored
C02	Sediment Management & ALCS: 4-feet drawdown & SLS-5: double pump rate
C03	Pond expansion & ALCS: 4-feet drawdown & SLS-5: double pump rate

The design reference was finalized following completion of the York Pond Improvement and Design Study (Barr, 2025) and is most similar to the "C01" strategy summarized in Table 1. Key elements of the final design summarized in this technical memorandum include:

- Sediment management to remove accumulated sediment and restore the historic wetland's permanent pool volume (Section 3).
- Replacement of the existing lift stations serving York Pond. Lift stations SLS-5 and SLS-11 discharge west to Barrie Road and east to Xerxes Avenue, respectively, as shown in Figure 1. The existing two lift stations will be replaced by a combined lift station capable of pumping in both directions. The combined outflow rate will match the combined existing capacity from SLS-5 and SLS-11 (Section 6).
- Replacement (in-kind) of the gravity intakes into the renovated SLS-5 and SLS.

- Implementation of an ALCS to control pumping from York Pond before and during rainfall events. ALCS will be operated to predictively drawdown York Pond ahead of large rainfall events and modify York Pond pumping during large rainfall events to mitigate potential downstream impacts (Section 6).

2 Existing Conditions: Study Area Summary

York Pond is a known flooding area and has been previously studied (STS-406 Improvement Project, Barr, 2014; York Avenue Pond Improvement Study and Design, Barr, 2025). The primary outlets for the pond are two lift stations, SLS-5 and SLS-11, which pump to gravity storm sewers located on Barrie Road and Xerxes Avenue, respectively. The gravity main from Xerxes drains south and west to Point of France Pond, which drains to Swim Pool Pond. The gravity main from Barrie Road drains west along the HW-62 corridor before discharging to Swim Pool Pond. Flow from Swim Pool Pond discharges to Lake Cornelia, and ultimately to Nine Mile Creek (Figure 1). Note that while York Pond is in the hydrologic boundary of Nine Mile Creek Watershed District, it is within the legal boundary of Minnehaha Creek Watershed District.

The following list provides additional key background information and hydrologic and hydraulic considerations which were considered during alternatives analysis and design of York Pond improvements:

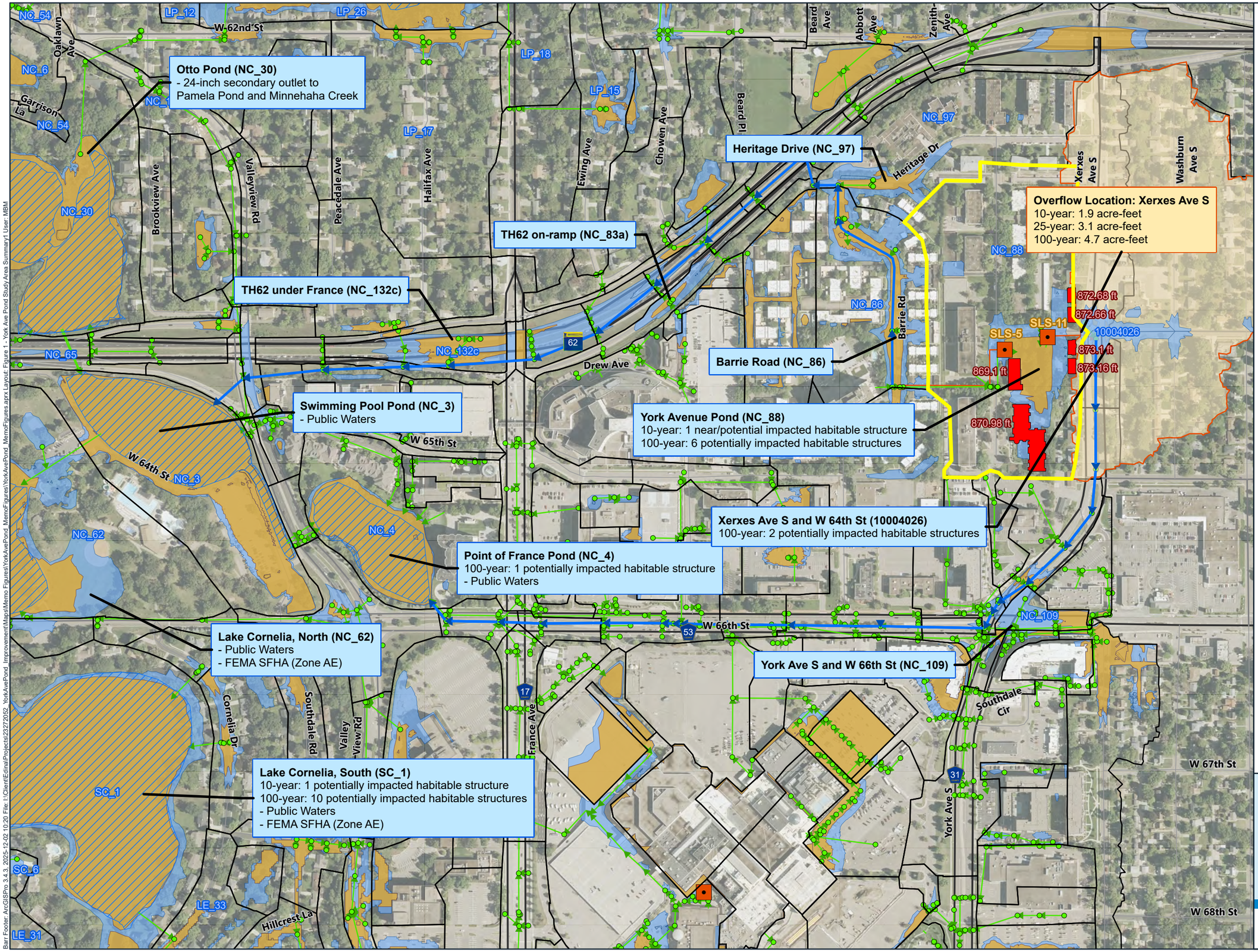
- **Inflow sources**: the primary inflow sources to York Pond are the 20.7-acre direct drainage area (NC_88) and overflow from Xerxes Ave S. An approximately 27-acre portion of the City of Richfield overflows to Xerxes Ave S, contributing to the extent and frequency of flooding at York Pond.

- **Historic wetland**: based on review of historic imagery, York Pond is a historic wetland. Due to classification as a wetland, planned sediment management is designed to comply with Wetland Conservation and Watershed District rules and regulations (Section 3).

- **Groundwater**: a Nine Mile Creek groundwater study (Barr, 2019) and existing York Pond lift station Supervisory Control and Data Acquisition (SCADA) data indicate York Pond is a perched waterbody and is losing to groundwater (Section 5).

- **Downstream waterbodies**: Stormwater pumped from York Pond discharges to Point of France Pond (NC_4), Swim Pool Pond (NC_3), and Lake Cornelia (NC_62 and SC_1) as shown on Figure 1. All three waterbodies are Public Waters, and Lake Cornelia is a FEMA-mapped Special Flood Hazard Area (SFHA, Zone AE). Accordingly, the potential impacts on downstream waterbodies were a primary consideration in the alternatives analysis that guided the design of the York Pond improvements.

- **Minnehaha Creek**: as shown on Figure 1, there is a small (24-inch) secondary outfall from Otto Pond that discharges north to Pamela Pond and ultimately to Minnehaha Creek. Discharge from York Pond and the planned design have minimal impact on the secondary outlet from Otto Pond to Minnehaha Creek as discussed in Section 8.



York Avenue Pond: Study Area Summary
York Avenue Pond Design
City of Edina

FIGURE 1

BARR

3 Existing Conditions: Hydrologic, Hydraulic, and Water Quality Modeling Summary

The City of Edina's Valley View 1D/2D XPSWMM model (v2023.1) was used to develop the existing condition model of the York Pond study area and was modified during design and evaluation of all proposed alternatives discussed in Section 1. During the Southdale B Neighborhood Roadway Reconstruction Engineering Study (Edina, 2023) and York Avenue Pond Improvement Study (Barr, 2025), best-available topographic and site survey data was reviewed and used to create an updated version of the existing condition model for the study area. Table 2 summarizes how reviewed data was incorporated into the updated existing condition model.

Table 2 Data acquisition and existing condition model update summary

Data Provided by the City / Collected by Barr	Description of Review and Model Updates
Topographic survey along Southdale B corridor (Barr, 2023) [1]	• Used to review/confirm road surface and key overflow elevations. • Confirmed no overflow from Barrie Rd (NC_86) and Heritage Dr (NC_97) east to York Ave S (NC_88). • Corrected overflow elevations from Barrie Rd (NC_86) to Heritage Dr (NC_97) and from Heritage Dr (NC_97) west to HW62 (NC_134).
Survey of low entry elevations (provided November 15, 2023) [1]	• Used to evaluate structure impacts, where available. Also utilized survey obtained during the STS-406 study (Barr, 2014).
Sanitary sewer data [1]	• Used to evaluate potential alignment conflicts and depth of cover conflicts associated with flood mitigation alternatives.
STS-406 Improvement Project (Barr, 2014)	• Reviewed to evaluate improvements for York Pond (NC_88) initially developed for the STS-406 study (Barr, 2014)
Southdale B Neighborhood Roadway Reconstruction Engineering Study (Edina, 2023)	• Referenced to incorporate the Southdale B Neighborhood project into the existing conditions model, including modifications to receiving storm sewer along Barrie Road.
Record drawings provided by the City (lift stations and gravity sewer)	• Barr incorporated all provided record drawings provided by the City. • Barr updated lift station operation in the model (e.g., on/off elevations and pump rate) based on provided data.
York Avenue Pond survey completed by Barr (May, 2024)	• Barr incorporated pond bathymetric survey data and sediment core data collected for this project into modeling and cost-estimating assumptions. • The pond survey conducted by Barr is discussed further in Section 4.
Richfield PCSWMM Model (provided by the City of Richfield)	• Barr updated modeling of the Edina-Richfield border by incorporating best-available existing condition PCSWMM modeling provided by the City of Richfield (Barr, 2019; Figure 1) • An approximately 27-acre portion of the City of Richfield model was incorporated into existing condition modeling for this project. Although there are no direct storm sewer connections from Richfield to Edina in this area, the 27-acre portion of Richfield drains towards the W 64th Street and Xerxes Ave S intersection, where flow in excess of existing storm sewer capacity overflows to York Pond.

1 Data originally provided during Southdale B: 2024 Road Reconstruction Improvements and Stormwater Management (Barr, 2023).

Based on review of best-available data (Barr, 2025; Table 2), it was determined that (a) no hydrologic modeling updates were required for the direct drainage area to York Pond (NC_88) and (b) no updates

were required for the 27-acre incorporated directly from the City of Richfield PCSWMM model (Barr, 2019; Figure 1). Complete documentation summarizing hydrologic and hydraulic modeling assumptions for both the City of Edina's Valley View 1D/2D XPSWMM model (v2023.1) and City of Richfield existing condition PCSWMM model can be found in the following reports:

- City of Edina Water Resources Management Plan (December 2022 Amendment); Appendix A. Water Resources | Edina, MN
- Barr Engineering Co. (Barr). 2019. Richfield Hydrologic and Hydraulic Modeling Report. Prepared for the City of Richfield. June 2019.

Table 3 provides a summary of the hydrologic inputs for the direct drainage area to York Pond (NC_88). In addition to XPSWMM modeling, Barr also conducted water quality modeling to evaluate the water quality benefit of pond sediment management as discussed in Section 8. The same reference land use and soils data summarized in the City of Edina Water Resources Management Plan were utilized to generate inputs for the water quality P8 model.

Table 3 Summary of key hydrologic parameters for the existing and proposed condition XPSWMM and water quality P8 models.

Subwatershed Parameter	XPSWMM Input	P8 Input
Subwatershed ID	NC_88	NC_88
Area (acres)	20.278	20.278
Total Imp. (%) [1]	--	53%
Directly Connected Impervious (%) [2]	47%	47%
Pervious Curve Number [3]	--	39
Width (ft)	717.9	--
Slope (ft/ft)	0.06	--
Horton: max infiltration rate (in/hr)	5	--
Horton: min infiltration rate (in/hr)	0.38	--
Horton: infiltration decay rate (1/sec)	0.00115	--

1 A value of "--" indicates the parameter is not utilized within the model.
2 Directly connected impervious area modeled as "not swept" within the P8 model.
3 Pervious curve for hydrologic soil group A, open space, good condition (grass cover > 75%) as outlined in Technical Release 55 Urban Hydrology for Small Watersheds. Note: soils within the NC_88 watershed are entirely HSG A per methodology outlined in the City of Edina Water Resources Management Plan.

Table 4 and Table 5 provides a summary of rainfall event modeling inputs for both the study area XPSWMM model and water quality P8 model, respectively. Hourly rain gauge data from the nearby Minneapolis-Saint Paul International Airport was used to generate hourly precipitation and temperature data for the water quality P8 model. To evaluate conditions over a broad range of annual hydrologic conditions, the P8 model was run for a 30-year time period (1993 through 2023).

Table 4 Summary of rainfall event modeling: XPSWMM

Atlas 14 Design Rainfall Event	Annual Chance of Exceedance (ACE), %	24-Hour Rainfall Depth (in)
2-year	50%	2.9
10-year	10%	4.3
100-year	1%	7.5

Table 5 Summary of key rainfall and job control parameters: P8

P8 Rainfall / Job Control Parameter	P8 Input
Model Start Date	1/1/1993
Model End Date	12/31/2023
Number of Rainfall Events, Total (#)	2,237
Avg. Annual Precipitation (in / yr)	31
Passes Thru Storm File (#)	15
Time Steps Per Hour (#)	20
P8 Particle File	NURP50

4 Sediment Management

The York Pond improvement design (Section 1) incorporates sediment management to remove accumulated sediment within the pond. Sediment management was incorporated into the design to (a) restore the historic wetland, (b) improve water quality through extended residence time, and (c) to provide flood mitigation benefit through ALCS pre-event drawdown (Section 6). On May 10, 2024, Barr staff completed bathymetric and soft sediment surveys of York Pond, as described below:

- **Bathymetric survey**: Barr staff collected 85 survey points to characterize the bathymetry of York Pond.
- **Soft sediment survey**: Barr staff collected an additional 67 survey points, pushing through accumulated soft sediment to reach compacted soils characterizing the natural bottom of the pond. Barr utilizes this survey method (survey rod transition method) to develop an estimate of the accumulated soft sediment volume within the pond.

Barr compared the pond bottom survey to the soft sediment survey to calculate the accumulated soft sediment volume in the pond. The York Pond design (Section 1) incorporates removal of accumulated, soft sediment which is typically considered a Wetland Conservation Act (WCA) “no-loss” activity. The calculated bathymetric volume and soft sediment volume is summarized in Table 6. Figure 2 shows the bathymetric survey point depths collected during the survey conducted on May 10, 2024.

Table 6 Bathymetric survey volume summary

Survey Parameter	Survey Method [1]	
	Bathymetric Survey	Soft Sediment Survey
Maximum pond depth (ft)	4.8	7.5
Bathymetric volume to NWL (acre-feet) [2]	1.0	1.7
Est. of Accumulated Sediment Volume (acre-feet)	--	0.7

1 Bathymetric survey refers to the survey of the existing pond bottom. Soft sediment survey pushes through accumulated, soft sediment and is used to estimate the volume of accumulated sediment within a basin.
2 The normal water level (NWL) of York Pond, as controlled by the SLS-11 lift station, is 863.0-feet NGVD29.

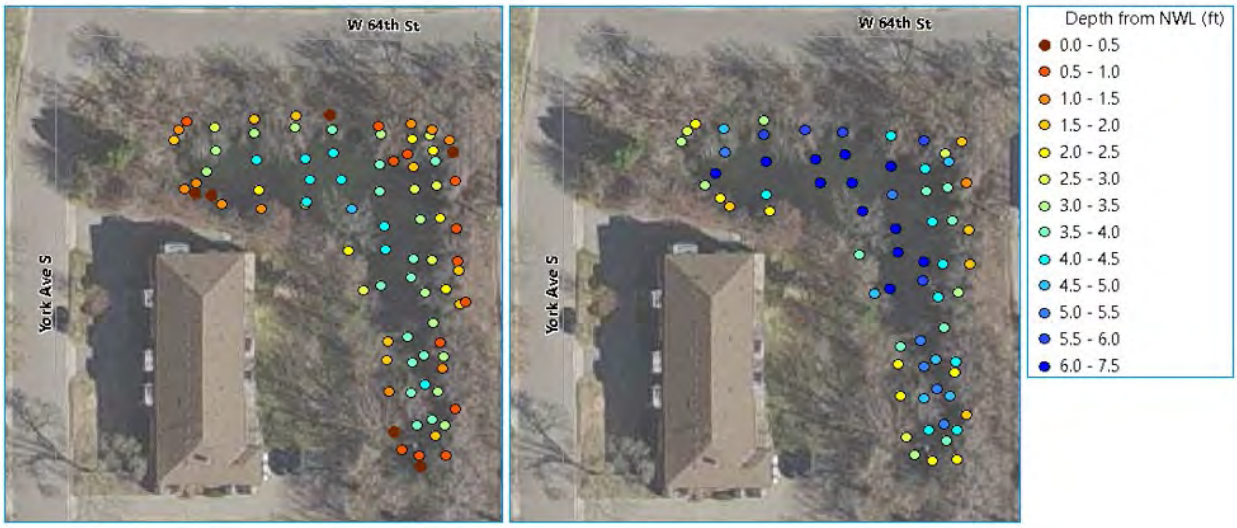


Figure 2 Bathymetric survey (left) and soft sediment survey (right) point depths

5 Groundwater Evaluation Summary

Due to being a pumped system, expansion of pond bathymetric volume and alternatives to existing pumping operations have the potential to impact the interaction between groundwater and surface water, particularly for “gaining” systems (i.e., waterbodies which receive net inflow from groundwater).

A NMCWD comprehensive study of groundwater and surface water interaction (Barr, 2019) indicated that York Pond is a “perched” surface water system that loses water to the unsaturated zone. This finding is corroborated by Barr’s review of York Pond’s existing lift station SCADA data. SCADA data indicates that from 2022 through 2024, the lift station pumps ran a total of 72 unique days. Based on comparison to MSP airport rainfall gauge data, Barr determined that pumping occurred on days where rainfall occurred (i.e., rainfall was detected at the MSP airport gauge on 76% of days where pumps operated) and often for a few days following rainfall. If York were gaining groundwater, we would expect to the see the pumps running more frequently than during rainfall events.

Because (a) evidence suggests York Pond is not a gaining system and (b) there is no change to the pond areal footprint, the proposed design (Section 1) is anticipated to have minimal impact on surface water and / or groundwater and surface water interaction.

6 York Pond Lift Station Operation Plan

As noted in Section 1, the York Pond project will replace the two existing lift stations (SLS-5 and SLS-11, see Figure 1) with a single lift station capable of pumping to Xerxes Aveune and Barrie Road. The existing lift stations have a combined outflow capacity of 2,000 gallons per minute (GPM) (i.e., SLS-5 and SLS-11 each have a pumping capacity of 1,000 GPM). To mitigate potential downstream impacts while maximizing flood protection benefit within the York Pond drainage area, the proposed design includes a pump operation plan for "normal" conditions and a separate plan for wet weather conditions which includes predictive pre-event drawdown. Specifically, the following outlines the pump operation plan for normal day-to-day operations, and a separate plan which will guide operation ahead of and during large rainfall events to maximize flood risk reduction benefit while mitigating potential downstream impacts:

- **Normal Condition Operation Plan:** under normal, day-to-day operation conditions (i.e., any condition where the ALCS operation plan is not initiated), the combined lift station will be operated as outlined below. Pump set point elevations were selected to match existing operations as closely as possible (i.e., pond pump on elevation remains unchanged from existing conditions, total outflow capacity does not exceed 2,000 GPM). All elevations are presented in the NGVD29 vertical datum.
    - **Lead Pump**: 1,000 GPM capacity discharging to Xerxes Avenue:
        - Pump on: 863.0 feet (matching existing conditions)
        - Pump off: 861.3 feet (matching existing conditions)
    - **Lag pump:** 2,000 GPM capacity discharging to Barrie Road:
        - Pump on: 863.5 feet (informed by the existing lag pumps from the SLS-5 and SLS-11 lift stations)
        - Pump off: 862.0 feet (matching existing conditions).
    - **Special Programmable Logic Controller (PLC) Notes**:
        - When the lag pump (Barrie Road pump) is activated, the lead pump (Xerxes Avenue pump) will be deactivated. This operation ensures that total capacity from York Pond never exceeds the existing maximum pump rate of 2,000 GPM.
- **ALCS Operation Plan:** the combined lift station will incorporate an ALCS to allow for (a) predictive pumping prior to large rainfall events and (b) altered pump operation during rainfall events. Development of the ALCS operation strategy outlined below was determined through iterative modeling using the City's hybrid 1D/2D XPSWMM model to maximize flood risks reduction benefit within the York Pond flood impact area while mitigating potential downstream impacts in terms of both rate control and flood impact. **Section 6.1** through **Section 6.3** provide additional analysis summarizing how frequently the ALCS operation plan is anticipated to be initiated by projected rainfall, how long pre-event drawdown will take, and how much rainfall is required to recover the pre-event drawdown (i.e., return York Pond to normal operational levels).
    - **Predictive pumping:** the ALCS will begin predictively pumping York Pond down to a maximum drawdown elevation of 858.5 feet (i.e., up to 4.5 feet below the existing pump on elevation of 863.0 feet) up to 24 hours ahead of a large, forecasted rainfall event. Pre-

event drawdown will utilize the 1,000 GPM Xerxes Avenue pump, this will require **between 4.4 and 8.0 hours**, depending on the current stage of York Pond (described in more detail in Section 5.3).

- **Wet Weather Mode:** when rainfall begins, the PLC will initiate wet weather model pumping controls, as outlined below:
  - The 1,000 GPM Xerxes Avenue pump will be disengaged during wet weather model after an initial drawdown. Operation of the 2,000 GPM Barrie Road pump will be altered as follows:
    - Pump on: 863.0 feet (matching existing conditions)
    - Normal Pump off: 862.0 feet, unless overwritten by the special ALCS pump off condition, below.
    - ALCS Pump on / off (hold period): at the point the ALCS no longer predicts potential for flood impact (see Section 6.1) the PLC will turn off all pumping once York Pond reaches 866.1 feet (i.e., 2 feet of freeboard to the low structure impact elevation) or at the current pond elevation, if lower than 866.1 feet. The ALCS will attempt to hold the pump off elevation for a period of 48-hours, unless forecasted rainfall re-initiates the wet weather mode condition. Holding the water level for 48-hours is done both (a) to improve water quality performance following a large rainfall event because it allows for settling, and (b) to achieve downstream flood protection goals (Section 9). During the 48-hour hold period, the PLC will update the pump on elevation to 866.1 feet and pump off elevation to 865.6 feet (0.5 feet lower). If at any point during the hold period York Pond reaches 866.7 feet (1.5 feet of freeboard to the low structure impact elevation), the PLC will revert to the normal condition operation plan or to wet weather mode, if triggered.

6.1 Response to MCWD Permitting Review Design Questions

MCWD performed initial review of permitting deliverables and provided the City of Edina review comments in a memorandum dated December 26, 2025. In addition to permitting comments pertaining to applicability of watershed district rules, MCWD provided general comments and questions regarding specific elements of the proposed York Pond lift station operation plan. The following summarizes design-related questions and provides answers to each.

Comment: In the existing conditions XPSWMM Model, the pump to Barrie Rd (SLS-5) is modeled as two pumps, each with 1.1 CFS (~500 GPM), for a total capacity of 2.2 CFS (~1,000 GPM). The first pump starts at 863 ft, which is consistent with the H&H Analysis Memo. However, the second pump starts at 864 ft, bringing the pump system to full capacity of 2.2 CFS (~1,000 GPM). Please provide clarification as to why the “ramp up” period is included in the existing conditions but not the proposed conditions.

Response: In existing conditions, there is a lead and a lag pump in each of the two lift stations (SLS-5 and SLS-11), resulting in a total of four (4) pumps. To reduce operational complexity of the system, the City desired to replace the existing two lift stations with one lift station, capable of

pumping in both directions (i.e., capable of pumping to both Xerxes Avenue and Barrie Road). The consolidation of the two lift stations results in the function of four total pumps being replaced by the function of two total pumps. Pump rates and on/off elevations selected were designed to mimic existing conditions to the maximum extent practicable during the "Normal Condition Operational Plan". Table 7 provides a summary of cumulative pump rate at key operational elevations for both existing and proposed conditions. Table 7 shows that there are elevations for which the existing condition has higher cumulative flow rate and elevations for which the proposed condition has higher cumulative flow rate. Operational on/off elevations minimize downstream impacts as discussed further in Section 8.

Comment: In the existing conditions XPSWMM Model, the pump to Xerxes Ave (SLS-11) is modeled as two pumps, each with 1.1 CFS (~500 GPM), for a total capacity of 2.2 CFS (~1,000 GPM). The first pump starts at 863 ft, which is consistent with the H&H Analysis Memo. However, the second pump starts at 863.3 ft, bringing the pump system to full capacity of 2.2 CFS (~1,000 GPM). Provide clarification as to why the "ramp up" period is included in the existing conditions but not the proposed conditions.

Response: See response to the above comment and the summary include in Table 7.

Comment: Please include justification of the increase in pump capacity from 1,000 GPM to 2,000 GPM into the Barrie Road storm sewer.

Response: increasing the total pump rate to Barrie Road from 1,000 GPM to 2,000 GPM was incorporated into proposed York Pond lift station operation plan for the following two reasons:

1) As noted in Section 2 and Figure 1, flood volume along the low area located at W 64th Street and Xerxes Avenue overflows into York Pond. For this reason, when pumping to this location during large events, a portion of the pumped volume overflows (i.e., recirculates) back into York Pond, reducing the efficiency of pumping to this location.
2) Although the current operation plan ensures that cumulative outflow capacity from York Pond never exceeds the existing maximum outflow rate of 2,000 GPM, the design allows for flexibility to modify operation in the future in response to changing downstream conditions (i.e., downstream flood mitigation projects that may allow for additional outflow rate from York Pond). The current design would support a maximum outflow rate of up to 3,000 GPM in the future. Evaluation of modification of the York Pond lift station operational plan to increase total outflow capacity would be done in conjunction with, or following, implementation of downstream flood mitigation projects.

Comment: During the 48-hour hold period after a wet weather mode is triggered and the pump off elevation is reached, if a smaller storm event occurs during the 48-hour period and causes the water level to rise to an elevation >866.1 ft but does not re-trigger wet weather mode, will the pump turn on again to drain the pond back down to 866.1 ft or will it continue to hold the pump off and let the water level rise to an elevation <869.1 ft?

Response: "predictive pumping", as described in the ALCS Operation Plan always takes precedence over all other potential operational conditions described in Section 6. As described further in Section 6.2, predictive pumping is engaged anytime the ALCS system predicts that runoff volume from rainfall over the next 24-hour period will result in flood impact, even if this occurs during the 48-hour hold period following wet weather mode.

Table 7 Cumulative pump rate summary for existing conditions and the proposed Normal Condition Operation Plan

Key York Pond Elevations	Cumulative Pump Rate (GPM) [1]	
	Existing Conditions	Proposed Normal Condition Operation Plan
863	1,000	1,000
863.3	1,500	1,000
863.5	1,500	2,000
864	2,000	2,000

1 Cumulative pump rate from York Pond to receiving storm sewer along Xerxes Avenue and Barrie Road.

6.2 Estimation of ALCS Operational Frequency

Opti is the likely ALCS supplier for continuous monitoring and adaptive control (CMAC) for York Pond. The City and Barr recently implemented an Opti CMAC system to control predictive pumping and wet weather pumping conditions for the *Morningside Flood Risk Reduction Infrastructure Design project* (Barr, 2022), meaning that the City and Barr have recent and ongoing experience with these technologies and this specific supplier. Table 7 provides a summary of total storage volume within York Pond and key operational elevations.

Table 8 York Pond volume summary at key elevations

Key York Pond Elevation	Elevation (NGVD29, ft)	Cumulative Volume (acre-feet)
4.5 foot drawdown	858.5	0.2
Pump OFF	861.3	1.0
Pump ON	863.0	1.7
Low structure	869.1	4.0

Opti utilizes user-based flood protection goals and a simplistic runoff estimation model to determine (a) if predictive pumping should occur and (b) how much volume needs to be pumped to achieve flood protection goals. Specifically, OptiCMAC follows the strategy below, referencing 15-minute rainfall predictions from the National Oceanic and Atmospheric Administration (NOAA):

- OptiCMAC determines the forecasted rainfall volume for the next 24 hour period
- Utilizing a simplistic runoff volume prediction volume, OptiCMAC calculates the runoff volume associated with the forecasted rainfall
- Referencing the total stored volume currently in the pond, OptiCMAC determines if the predicted runoff volume will cause an exceedance of the flood protection goal elevation.

- If an exceedance of the flood protection goal is predicted, OptiCMAC instructs the lift station to begin to predictively pump down the pond based on the predicted exceedance volume.

- Pumping continues until (a) OptiCMAC predicts that the flood protection goal elevation will not be exceeded or (b) the maximum drawdown elevation, set by the user, is reached.

As noted in Table 7, the York Pond ALCS design utilizes 869.1 feet NGVD29 as the predictive pumping protection goal, which is the the lowest surveyed low entry impact elevation . Referencing results from the City's hybrid 1D/2D XPSWMM model, Barr predicts that it will require a 24-hour forecasted rainfall depth of 2.9- to 3.4-inches to trigger pre-event drawdown. Specifically:

- If York Pond is at the pump on elevation (863.0 feet), it would require 2.4 acre-feet of runoff volume to trigger pre-event drawdown, which corresponds to **2.9 inches of rainfall**.

- If York Pond is at the pump off elevation (861.3 feet), it would require 3.0 acre-feet of runoff volume to trigger pre-event drawdown, which corresponds to **3.4 inches of rainfall**.

Referencing NOAA Atlas 14 precipitation-frequency data for the study area, a 24-hour rainfall depth of 2.9 inches corresponds to greater than a 2-year recurrence interval, and 3.4 inches corresponds to between a 2- and 5-year recurrence interval. Based on these projections, **it is anticipated that predictive pumping would be initiated on average once every other year or less.**

6.3 Estimation of Rainfall Required to Reestablish Normal Water Levels

Table 7 shows that the difference in storage volume between the York Pond pump off elevation (861.3 feet) and the **maximum** drawdown elevation (858.5 feet) is 0.8 acre-feet. Utilizing the same methodology referenced in Section 6.2, Barr predicts that it will require 1.7 inches of rainfall to fill York Pond back up to its normal operational volume. Specifically:

- If York Pond is at the maximum drawdown elevation (858.5 feet), it would require 0.8 acre-feet of runoff volume, which corresponds to **1.7 inches of rainfall**.

Assessing the possibility that (a) maximum predictive drawdown will occur and then (b) insufficient rainfall will occur to fill York Pond back up to operational elevations is difficult for the following reasons:

- OptiCMAC continually evaluates the drawdown determination. E.g.., if drawdown begins, but the forecast changes and OptiCMAC no longer predicts exceedance of the flood prediction goal, predictive pumping may stop.

- It is difficult to assess the accuracy of NOAA rainfall prediction on the scale of the York Pond watershed (i.e., 20.7 acres).

For these reasons, the system will be tracked and **adaptively managed** over the first years of operation to ensure project goals related to flood risk reduction and wetland protection are met. Based on experience coordinating with the ALCS supplier (Opti), it is possible to adjust the runoff prediction model to increase or reduce the frequency with which predictive pumping will be initiated. This will be adjusted as needed based on experience gained through operating the system predictively in response to rainfall forecasts.

6.4 Estimation of Time to Achieve Drawdown

As outlined in Section 6, pre-event drawdown will be performed by the 1,000 GPM Xerxes Avenue pump. The Xerxes Avenue pump was selected for pre-event drawdown, rather than the 2,000 GPM Barrie Road pump (a) based on results of the downstream impact analysis and (b) to allow for a longer window of drawdown time. As outlined in Section 6.1, OptiCMAC continually evaluates the pre-event drawdown determination in response to 15-minute NOAA rainfall predictions. For this reason, the longer the drawdown time, the more time OptiCMAC has to adjust and potentially alter the drawdown volume in response to changing rainfall forecasts.

As summarized in Table 7, achieving the maximum drawdown elevation (858.5 feet) will require pumping between 0.8 and 1.5 acre-feet of volume from York Pond. Utilizing the 1,000 GPM Xerxes Avenue pump, this will require **between 4.4 and 8.0 hours**, depending on the current stage of York Pond.

7 Rate Control Evaluation

The York Pond Lift Station Operation Plan (Section 6) provides a summary of pumping rates for “normal” day-to-day conditions as well as for ALCS operational conditions. As outlined in Section 6, cumulative pumping rate will never exceed 2,000 GPM, which is the maximum pumping rate of the existing lift stations serving York Pond. I.e., the proposed operation plan will not increase flow rate from York Pond to downstream waterbodies.

8 Downstream Impact Evaluation

The City’s hybrid 1D/2D XPSWMM model was used to evaluate the potential impact of York Pond improvements on downstream waterbodies. Specifically, Barr incorporated the “Normal Condition Operation Plan” and the “ALCS Operation Plan” described in Section 6 to evaluate the impacts within (a) the York Pond flood impact area and (b) all key flood impact areas downstream of York Pond shown in Figure 1. As outlined in Section 6.1, the 2-year Atlas 14 event is not anticipated to trigger the ALCS Operation Plan. For this reason, the following modeling conditions were assumed for the 2-, 10-, and 100-year Atlas 14 design events:

- 2-year Atlas 14 design event: Normal Condition Operation Plan (Section 6)
- 10- and 100-year Atlas 14 design events: ALCS Operation Plan (Section 6).

Table 8 provides a summary of the impact of the York Pond improvement project within the York Pond flood area and at key downstream flood areas. As shown, for a majority of combination of events and result summary locations, the proposed condition results in either a benefit or no change at key downstream result summary locations (e.g., Lake Cornelia, Point of France Pond, etc.). Notable exceptions include the following:

- Barrie Road (MC_86): the proposed condition results in a maximum flood depth increase of 0.09-, 0.03-, and 0.02-feet for the 2-, 10-, and 100-year events, respectively.
- Highway 62 near the France Avenue crossing (NC_83a): the proposed condition results in a maximum flood depth increase of 0.02 feet for the 2-year event.
- Lake Nancy (NC_2): the proposed condition results in a maximum flood depth increase of 0.01 feet for the 10-year event.

The proposed York Pond lift station operation plan reflects the alternative that (a) maximizes benefits to York Pond, (b) minimizes downstream impacts, and (c) preserves flexibility to modify and further mitigate flooding within the York Pond study area in response to implementation of future, downstream flood mitigation projects (e.g., ALCS implementation at Lake Cornelia). The following summary provides additional context for each of the downstream flood impacts listed above.

- Barrie Road (MC_86): although there are no habitable structures impacted along Barrie Road, there are potential impacts to garage structures during the 100-year Atlas 14 design event. During the STS-406 Improvement Project (Barr, 2014), survey elevations of low garage floor elevations were collected at potentially flood impacted garages along Barrie Road. Based on survey elevations collected, there are no garage impacts during the 2- and 10-year design events, but there are 10 potentially impacted garages during the 100-year event for both the existing condition and proposed condition (i.e., no change in number of potential garage impacts from the existing to the proposed condition). The increase in 100-year flood elevation (+0.02 feet) is attributed to the increased total pump rate to Barrie Road (i.e., pump rate to Barrie Road increases from 1,000- to 2,000-GPM from the existing to the proposed condition). Because the increase in pump rate is required to preserve flexibility of the York Pond pump system to increase pump rate and flood benefit in response to future, downstream flood mitigation projects, it was determined that the 100-year impact could not be further mitigated or eliminated without altering the design to provide less flexibility for future system improvements.
- Highway 62 near the France Avenue crossing (NC_83a): the proposed condition results in a flood depth increase of +0.02 feet during the 2-year event. During the 2-year event, flooding at this low area near the France crossing is minimal in extent (i.e., limited to the curb with limited spread). Additionally, the total duration of surface flooding is less than the save step duration of the model (30-seconds). For these reasons, the +0.02 foot flood depth increase for the 2-year event was deemed a negligible flood impact.
- Lake Nancy (NC_2): the proposed condition results in a flood depth increase of +0.01 foot during the 10-year event. Barr completed review of stage and flow timing from Lake Nancy and North Cornelia to confirm this result. During the 10-year event, outflow from Lake Nancy is restricted (i.e., tailwater impacted) by North Cornelia. During the rising limb of the Lake Nancy stage hydrograph, North Cornelia is slightly higher (e.g., 0.005 to 0.01 ft higher) for the proposed condition than in the existing condition. This is caused by the impact of the pre-event drawdown volume from York Pond, which is still moving through North Cornelia at the time when Lake Nancy is reaching its maximum water surface elevations during the 10-year event. Mitigating this impact would require reducing the pre-event drawdown volume from York Pond and / or alternating the pumping plan from York Pond. Because (a) the impact is small in magnitude (+0.01 ft impact), (b) is limited to the 10-year design event, and (c) altering design to address this impact could reduce flood mitigation benefit for other design events, therefore the City and Barr would to discuss with MCWD.

In addition to review of potential habitable and non-habitable structure flood impacts, Barr also evaluated the impact of the York Pond improvement project on flow splitting between the Minnehaha Creek and Nine Mile Creek Watersheds. As noted in Section 2 and Figure 1, Otto Pond contains a small (24-inch) secondary outfall to Lake Pamela and Minnehaha Creek. Table 9 summarizes the impact of the York Pond improvement project on volume splitting between the two major watersheds over the 4-day model duration. As summarized, the project has minimal impact on volume splitting between the watersheds, but overall, results in slightly less flow being routed to Minnehaha Creek over the 4-day modeling period.

Table 9 York Pond improvement project: impact of maximum water surface elevation.

Node ID	Description	Atlas 14, 24-Hour Event Results: Max Flood Elevation (NGVD29, feet) [1]						Difference: [B] - [A]		
		A: Existing Conditions			B: Proposed York Pond design					
		2-year	10-year	100-year	2-year	10-year	100-year	2-year	10-year	100-year
NC_88	York Pond	864.97	868.09	872.97	865.00	866.86	872.80	+0.03	-1.23	-0.18
NC_86	Barrie Road	878.84	879.75	880.73	878.93	879.78	880.75	+0.09	+0.03	+0.02
NC_97	Heritage Dr	878.90	879.38	880.37	878.90	879.38	880.37	0.00	0.00	+0.00
NC_83a	HW62 on-ramp (DS of OF)	872.19	874.76	876.30	872.18	874.76	876.31	-0.01	0.00	0.00
NC_132c	HW62 under France	870.30	871.47	874.23	870.32	871.47	874.21	+0.02	0.00	-0.02
NC_3	Swimming pool pond	865.29	865.86	866.16	865.29	865.86	866.16	0.00	0.00	0.00
10004026.0	Xerxes Ave S & W 64th St	876.46	877.09	877.54	876.46	877.09	877.53	0.00	0.00	-0.01
NC_109	York Ave S & W 66th St	872.33	875.23	876.99	871.81	875.22	876.99	-0.52	-0.01	0.00
NC_4	Point of France Pond	865.48	866.52	867.52	865.47	866.51	867.51	-0.01	-0.01	0.00
NC_30	Otto Pond	865.28	865.67	866.24	865.28	865.67	866.24	0.00	0.00	0.00
NC_2	Lake Nancy	863.99	865.18	866.24	863.99	865.20	866.24	0.00	+0.01	0.00
NC_40	West 64th Street Flood Area	867.07	867.97	869.15	867.07	867.97	869.15	0.00	0.00	0.00
NC_62	Cornelia (North)	861.19	863.04	864.74	861.19	863.03	864.74	0.00	-0.01	0.00
SC_1	Cornelia (South)	859.64	860.42	864.41	859.64	860.42	864.41	0.00	0.00	0.00

Table 10 York Pond improvement project: impact of flow volume split between the Minnehaha Creek and Nine Mile Creek watersheds.

Link ID	Description	Atlas 14, 24-Hour Event Results: Total Volume over 4-day model period (acre-feet) [1]						Difference: [B] - [A]		
		A: Existing Conditions			B: York Pond design					
		2-year	10-year	100-year	2-year	10-year	100-year	2-year	10-year	100-year
1587_p	24-inch secondary outflow from Otto Pond (to Minnehaha Creek)	39.7	48.2	61.6	39.2	46.9	60.3	-0.4	-1.2	-1.3
W_SC1	Weir outfall from South Cornelia (to Nine Mile Creek)	42.4	41.9	42.4	42.4	42.0	42.4	0.0	0.1	0.1

9 Water Quality Evaluation

Sediment management incorporated into the design (i.e., removal of approximately 0.7 acre-feet of accumulated sediment, Table 6) will increase the water quality performance of York Pond by increasing the residence time of sediment and associated pollutants within the pond. Additionally, removal of accumulated sediment increases the lifespan of the pond (i.e., the Minnesota Stormwater Manual recommends sediment management be conducted before 50-percent of the permanent pool volume has been lost).

Table 10 summarizes the water quality impact of sediment management as predicted using the water quality modeling program P8. As shown in the table, the additional bathymetric storage provided by removing accumulated sediment from the basin reduces total suspended sediment (TSS) r and total phosphorus loads by 2%. Note: the extended residence time provided following an event triggering ALCS operation (see Section 6) will increase pollutant settling and water quality performance following large rainfall events. However, due to the infrequency with which the ALCS operation plan will be implemented (e.g., on average, once every other year or less), ALCS operation will not have a significant impact on average annual water quality performance of York Pond, and therefore was not incorporated into the summary provided in Table 10.

Table 11 Pollutant reduction summary: impact of removal of accumulated sediment at York Pond

York Pond Summary	Pollutant Loading (lbs/yr)		Pollutant Recovery (lbs/yr)		Pollutant Recovery (%)	
	TSS	TP	TSS	TP	TSS	TP
Existing Conditions	13,732	42.9	10,975	21.3	80%	50%
York Pond Design			11,230	22.3	82%	52%
Increase in Pollutant Removal:			**255**	**1.0**	**2%**	**2%**

References

Barr Engineering Co. (Barr). 2014. STS-406 Improvement Project. Prepared for the City of Edina.

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