Swan Lake

Annual Meeting with Markham Subcommittee

Environmental Services

Authors: Robert Muir, Manager, Stormwater
Zahra Parhizgari, Environmental Engineer, Stormwater

June 18, 2025

Agenda

- Background
- Completed Work
- Lake Conditions
- Findings of Flow Diversion Study
- 2025 Plan and Recommendations
- Parks Operation Updates

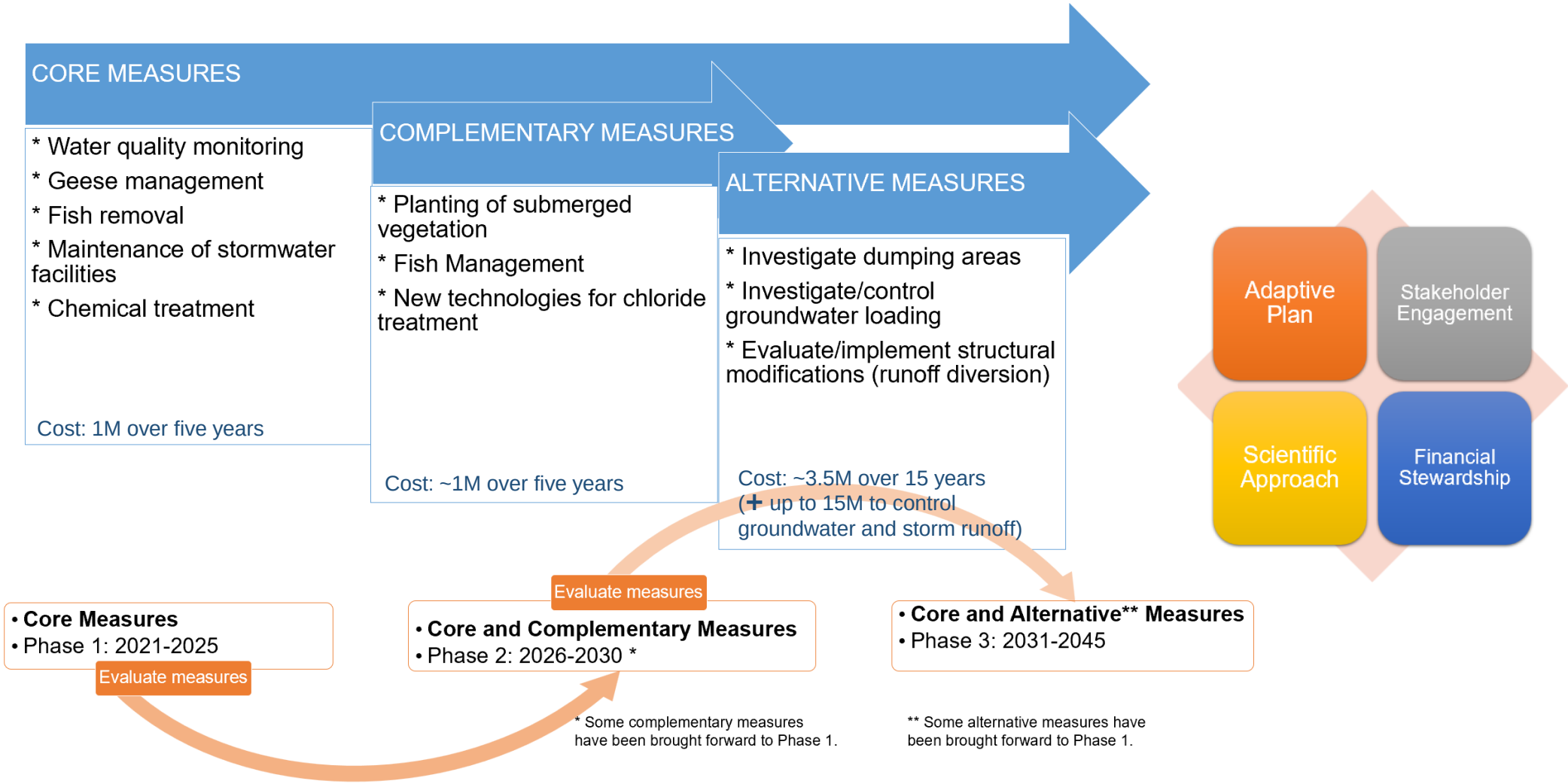
Background

Location and History

- Operated in the 1960s and 1970s as a gravel pit
- Construction waste dump in early 1980s
- Lake created when gravel pit operations stopped
- Drainage area is fully developed with stormwater ponds and oil/grit separators
- Closed system and prone to nutrient build-up and algae growth.
- Winter maintenance introduces chloride to the lake
- Water quality issues noticed since 2010 or earlier
- Active management since 2013, including Phoslock treatment, geese management, and monitoring

Swan Lake Location Map

Long Term Management Plan (2021)



2024 Council Resolutions

That the following motion passed at the July 29, 2024, Markham Sub-Committee meeting be received for information purposes:

1. That the minutes of the July 29, 2024 Markham Sub-Committee meeting be received for information purposes; and,

2. That the report entitled "Swan Lake- 2024 Water Quality Status and Updates" be received; and,

3. That the deputations from Fred Peters, Friends of Swan Lake Park, Ali Asgary and Satinder Brar, York University, Peter Miller, William Dewberry, and Pamela Nitert, Amica Swan Lake, made to the July 29, 2024 Markham Sub-Committee be received; and,

4. That the funding request by Friends of Swan Lake Park and the CIFAL proposal, as well as the request for shoreline viewing nodes be referred to Staff to report back in the future; and,

5. That Staff continue to implement the Long-term Management Plan for Swan Lake approved by Council in December 2021, including advancement of submerged aquatic vegetation, research into chloride treatment, and flow diversion evaluation (previously in Phases 2 and 3 of the Plan); and,

6. That Staff report back annually on water quality results and evaluation of adapted Core and Complementary measures for consideration in Phase 2 of the Plan through the Markham Sub-Committee with the participation of the Friends of Swan Lake Park; and,

7. That the next review of the Plan will be in 2025 (after the completion of Phase 1 and other measures as listed under item 2) with consideration for a workshop in 2026; and further,

8. That Staff be authorized and directed to do all things necessary to give effect to this resolution.

Completed Work

List of 2024 Activities

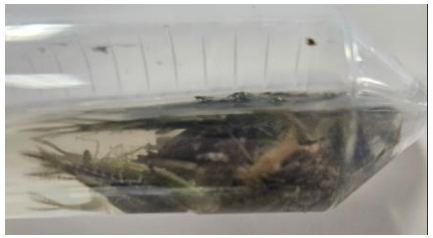
Activity	Phase 1 Core Measures (Years 1-5)
Water Quality Monitoring (and annual reporting to Subcommittee)	☑
Geese Management	☑
Chemical Treatment	☑
Fish Management (removal of benthic fish and fish stocking)	☑ (fish stocking in 2025)
Planting of Submerged Plants *	☑
Maintenance of stormwater management facilities	☑
Community Engagement	☑
Flow Diversion Feasibility Study **	☑ (completed recently)
New Technologies for Chloride Treatment *	☑ underway
Phase 1 Review	☑ underway

* Originally planned for Phase 2
** Originally planned for Phase 3

Water Quality Monitoring

Understanding Issues and Planning Solutions

- Chemistry and biology
- Water level
- City staff measurements and Trent University data
- Accredited labs analyze the samples
- Regular checks and observations at the site
- External Specialists review

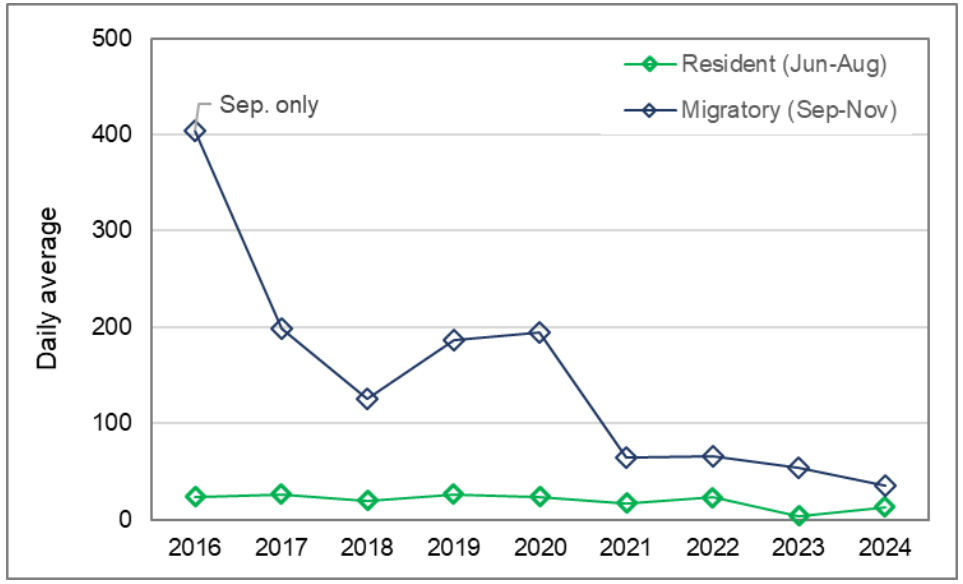


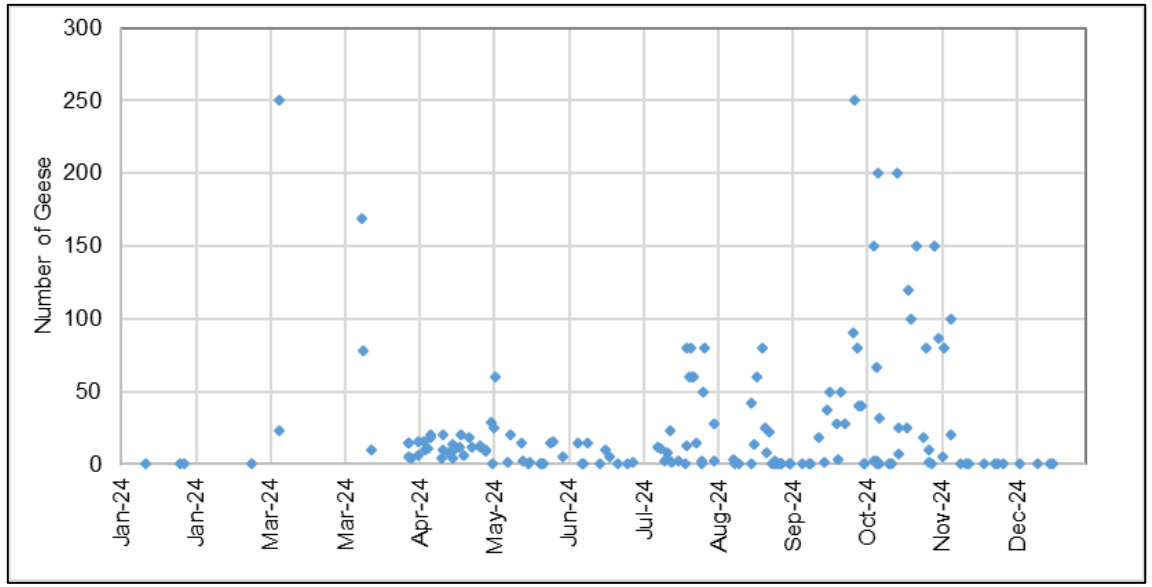


Geese Management

- Nest depredation, laser light, avian distress call and limited strategic zinc crackler pyro
- Geese relocation
- No evidence of strobe lights being effective

Swan Lake Geese Count Survey QR Code





* Some assumptions have been made in calculating the daily average for each year to fill in data gaps.

Chemical Treatment

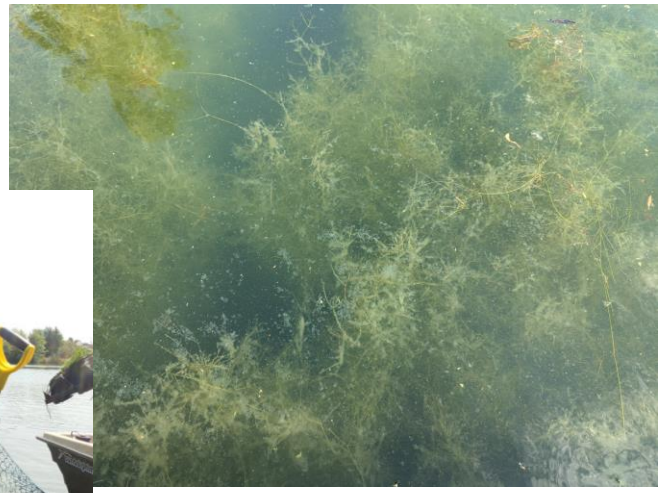
- Second treatment on June 17-25, 2024
- Nine tonnes of PAC (a substance that reduces phosphorus and algae) was added to the lake.
- Each treatment was followed by 1-2 days of rest for testing and floc formation.
- Water clarity improved to 1 meter and stayed above 0.5 meters until late November.

Fish Management

- Removing bottom-dwelling fish to prevent sediment disturbance.
- Fish in the Lake included Common Carp, Brown Bullhead, and Fathead Minnow.
- Fish stocking completed in May 2025 through consultation with TRCA, MNRF, and by a private contractor.
- 500 juvenile largemouth bass added to the lake.
- Bluegill may be added later, depending on availability at MNRF facility.

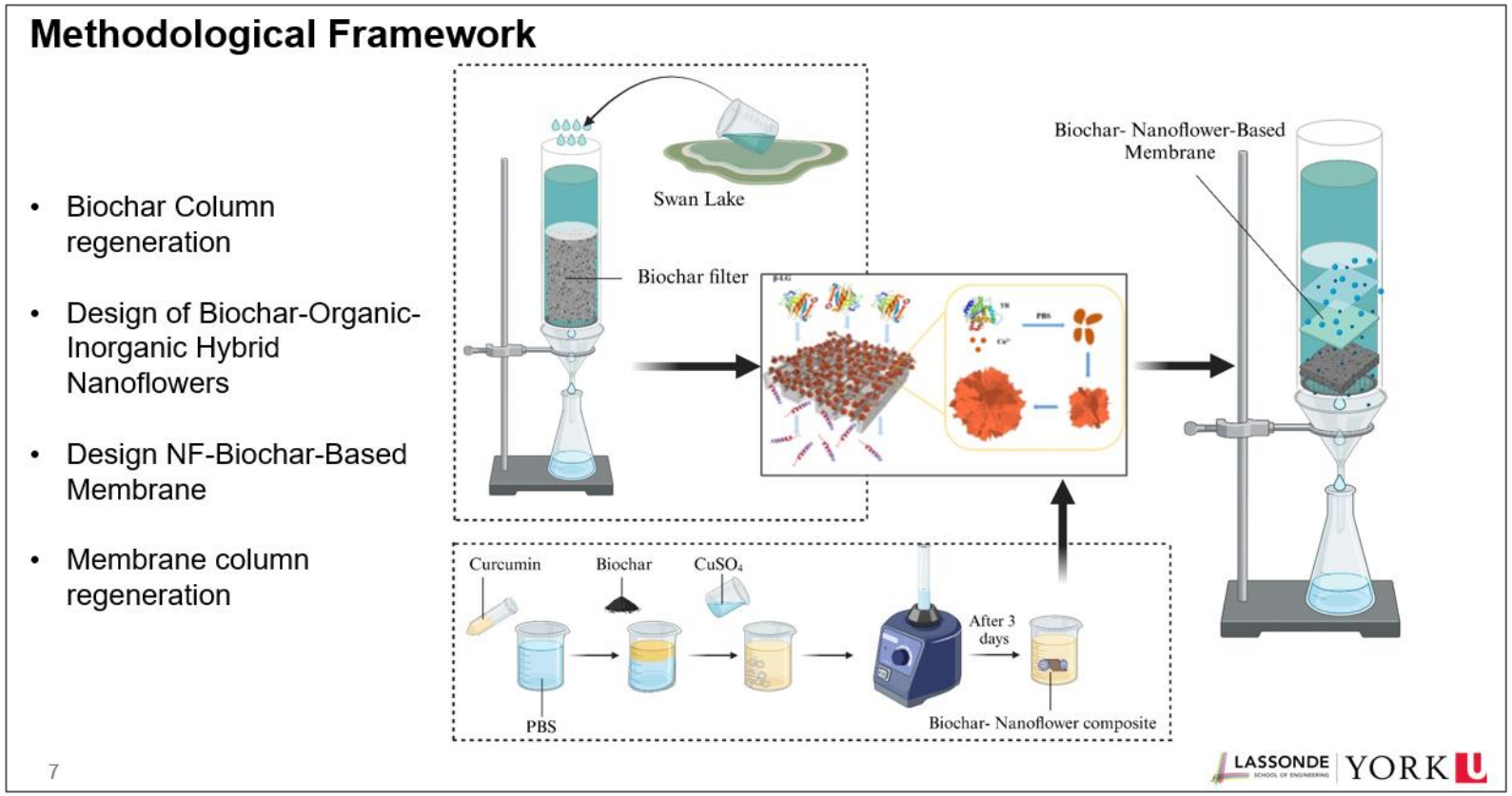
Planting of Submerged Aquatic Vegetation

- Submerged aquatic vegetation (macrophytes) can compete with and help mitigate algae (phytoplankton) growth
- Macrophytes will increase water clarity, which in turn, enhances their own growing conditions.
- TRCA planted 3000 stems of wild celery in fenced locations on the north site in 2023 and 2024
- Naturally growing aquatic plants were also abundant in 2024
- In 2025, existing plants will be monitored for survival and natural propagation
- Further SAV planting will be assessed through the five-year review process



Assessment of New Technologies for Chloride Treatment

- Initially planned for 2027; advanced to 2024 at the request of FOSLP
- Lab-scale testing of a 'Biochar-nanoflower-based Column Filtration System' for removing chloride from Lake water- proposed and implemented by York University
- Work underway, expected to be completed by end of 2025



Pahlavan et al 2023
https://www.sciencedirect.com/science/article/abs/pii/S0045653523004393?via%3Dihub

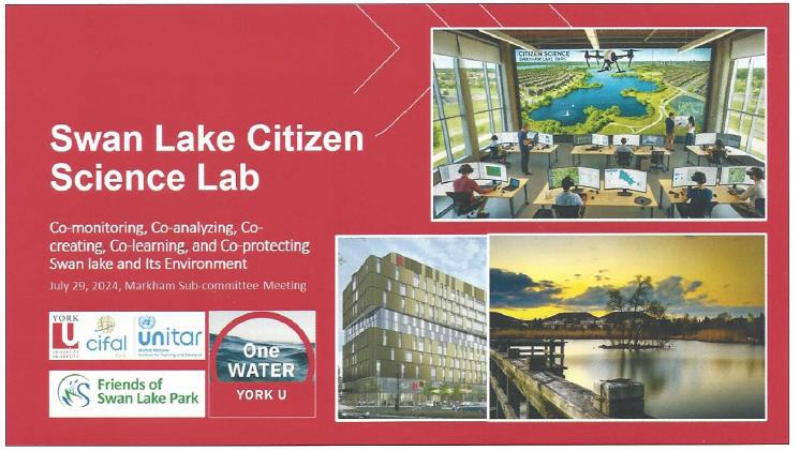
Maintenance of Stormwater Management Facilities

- Stormwater pond assumption process underway

Community Engagement – Water Quality Monitoring

Council directed staff to review CIFAL York proposal on Swan Lake Citizen Science Lab:

- Proposal reviewed by staff and Dr. Karst-Riddoch, Principal Aquatic Scientist at AECOM
- Drone image would only provide qualitative imagery, while City (and Trent University) collect quantitative measurements
- Swan Lake is small enough for visual monitoring; drones are more useful in large systems
- There is no need for 'co-monitoring' of water quality
- The City does not regulate drone use and image disclosure- York and FOSLP to follow applicable regulations and avoid disturbing park use by residents and wildlife
- *Other objectives of CIFAL proposal outside the scope of Environmental Services*



Community Engagement- Funding Request

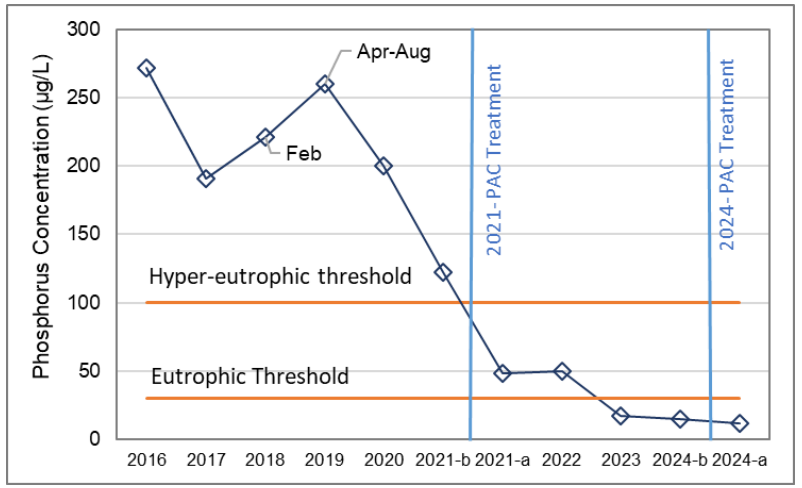
Council directed staff to review FOSLP's funding request:

- FOSLP requested funding support to hire environmental consultants to 'advise on the rehabilitation of both Swan Lake and Swan Lake Park'
- The City has allocated funding in 2025 for an external consultant to review the water quality program
- Additional fundraising is not needed to move the program review forward
- The City is investing significant funds, and adapting measures based on the approved plan
- Research and technical studies originally planned for later phases are already underway, as requested by FOSLP.

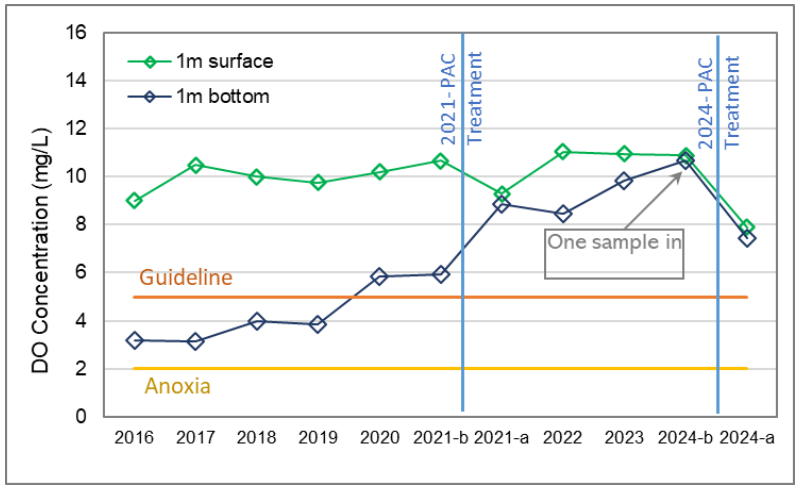
Lake Conditions

Water Quality- Nutrients and Oxygen

- Total Phosphorus:
  - Average under 30 µg/L during growing season (below the threshold for eutrophic condition)
  - Decreased significantly after each treatment
- Total Nitrogen:
  - Average below 0.65 mg/L during growing season (below the threshold for eutrophic condition)
  - Dominant forms not bioavailable
- Dissolved Oxygen:
  - Surface concentration > 6.4 mg/L all year
  - Bottom concentration showed a decline during dry months of August and September about 50% time
  - Data do not indicate anoxia-driven phosphorus enrichment



Phosphorus

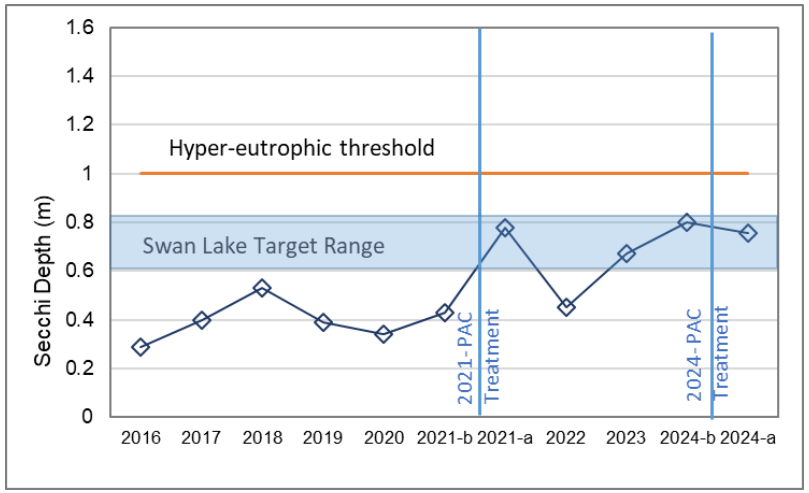


Dissolved Oxygen

Water Quality- Algae and Clarity

- Algal growth:
  - Surface bloom not occurring since treatment
  - 2024 Cyanobacteria cell numbers 40% lower than 2023
  - Chlorophyll-a within eutrophic state
- Clarity:
  - Above >0.6 m (target), except occasional decline to 0.5 m in fall
  - Growing-season average within target

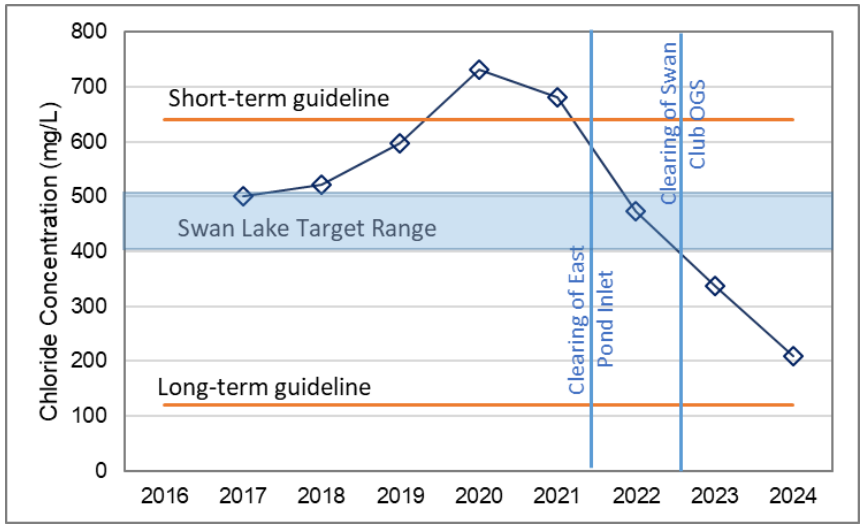
Algal bloom before treatment (photo from July 2020)



No surface bloom since treatment (photo from July 2024)

Water Quality- Chloride

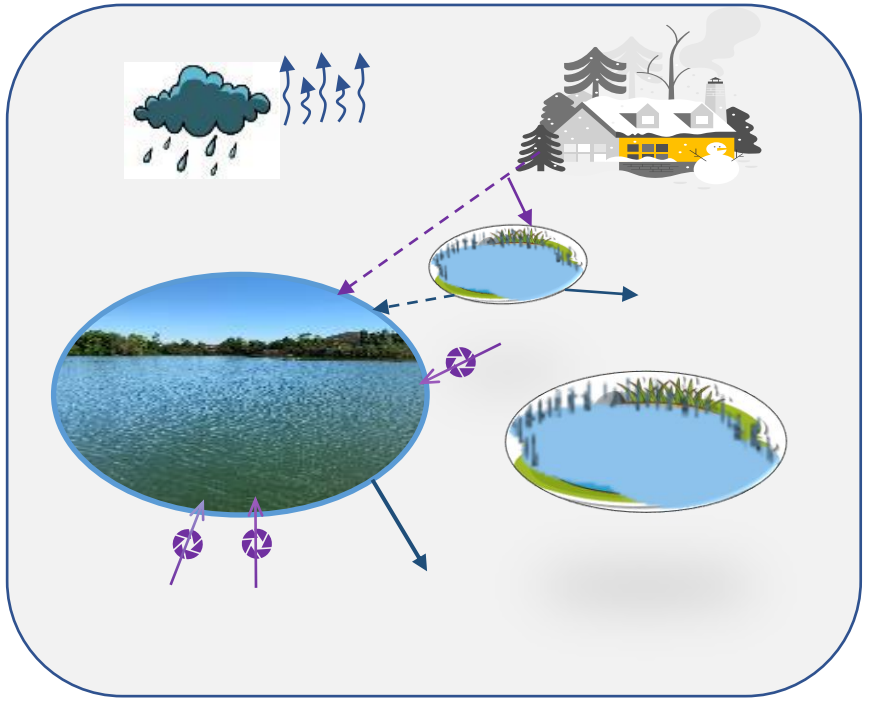
- Chloride enters the Lake through winter maintenance:
  - Swan Lake Village Corporation
  - City roads
  - Residents north of the Lake
  - AMICA Corporation to the south
- Previously on upward trend likely due to blockages, which resulted in untreated flows to the Lake
- Since 2021 decreased due to clearing the blockage at the East Pond inlet and Swan Club OGS
- The presence of minnows in large numbers indicate chloride concentrations are not negatively impacting aquatic life

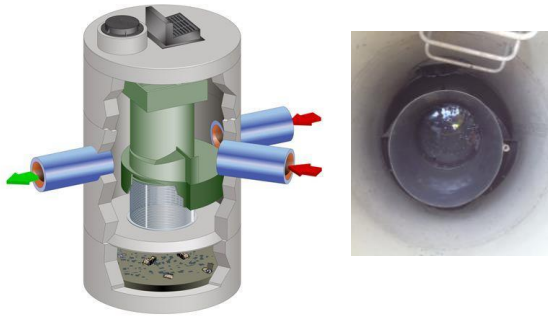


Findings of Flow Diversion Study

Flow Diversion Feasibility Study

- Alternative measure in Phase 3; brought forward at the request of FOSLP
- Stormwater runoff from the catchment area contains nutrients, metals, chloride and other constituents
- Stormwater management is accomplished using:
  - Ponds: store water and release gradually, treat water by sedimentation, infiltration, plant uptake (mostly solids- limited efficiency for chloride)
  - Oil and Grit Separators (OGS): no storage, treat water by sedimentation (lower efficiency than ponds; mostly solids-limited efficiency for chloride)
- Flow diversion involves redirecting all or part of runoff from the lake (after or before treatment in ponds and/or OGSs)

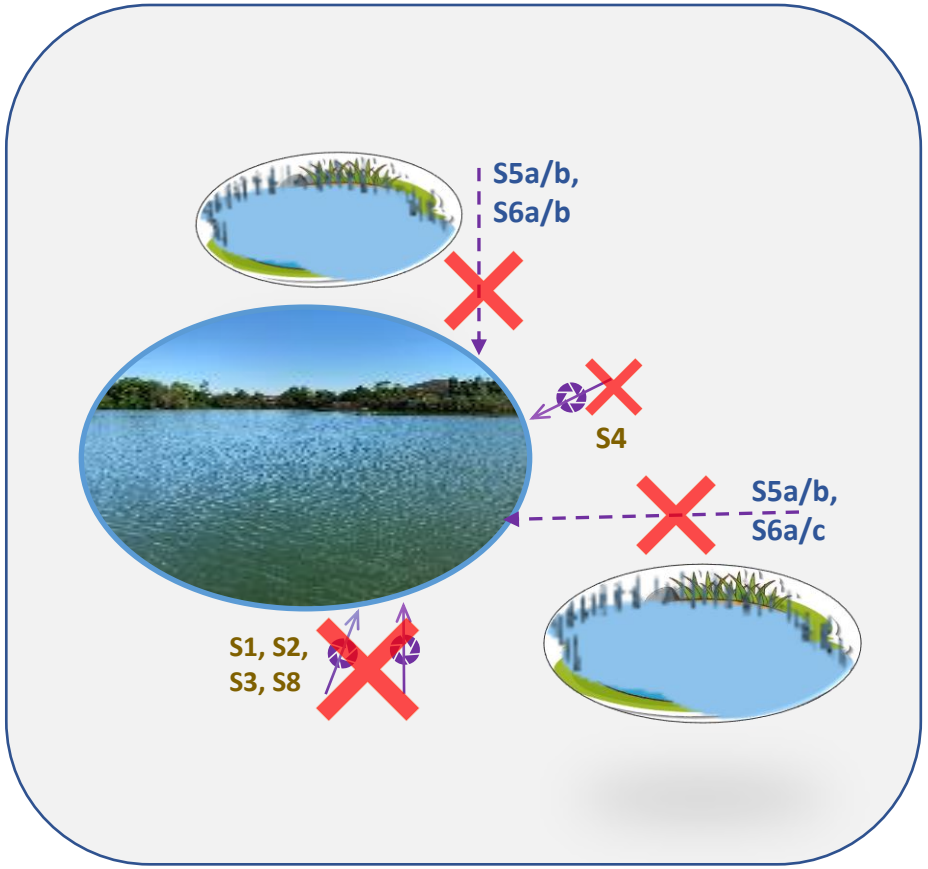




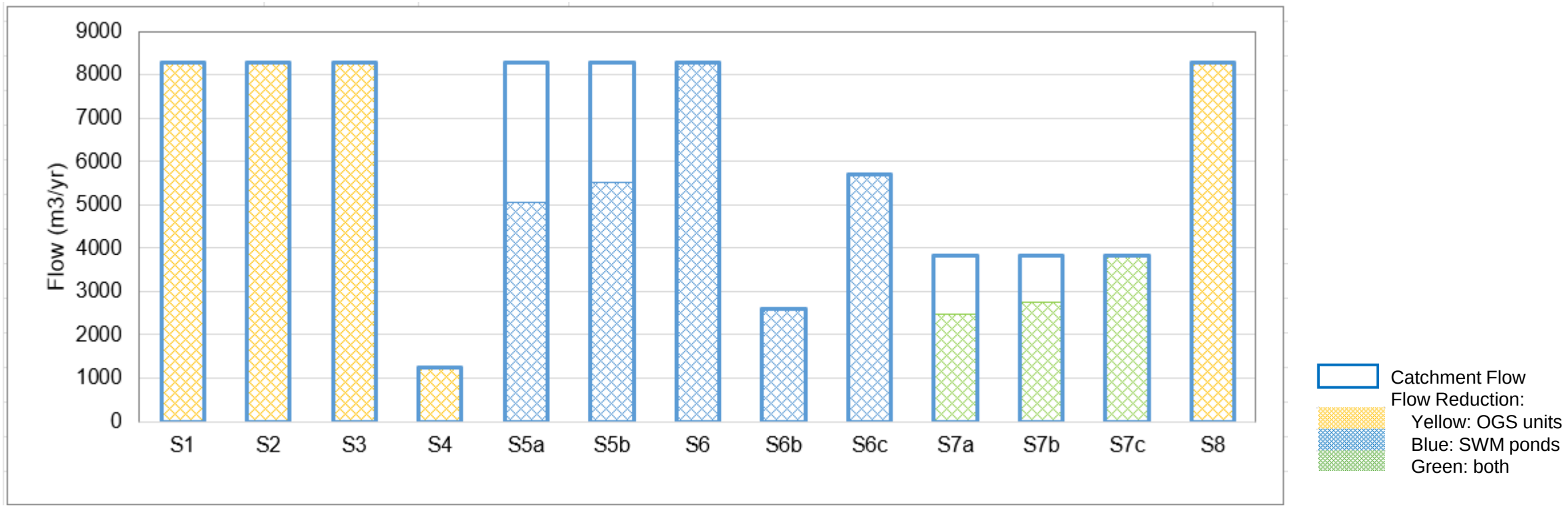
Flow Diversion Scenarios

S1	Divert minor system flow Amica and Swan Lake Blvd. OGSs to 16t Ave.
S2	Divert only "First Flush" from Amica and Swan Lake Blvd. OGSs to 16th Ave.
S3	Divert minor system flow Amica and Swan Lake Blvd. OGSs to Lake outlet
S4	Divert minor system flow from Swan Club OGS to the North Pond
S5a	Raise the flow split weir at the North and East Ponds
S5b	Raise the flow split weir at the North and East Ponds while upsizing the inflow pipes
S6a	Expand storage capacity in north and east pond
S6b	North pond portion of S6
S6c	East pond portion of S6
S7a	Combine S4 with raising north pond weir (5a)
S7b	Combine S4 with raising north pond weir and upsize pond (5b)
S7c	Combine S4 with S6b
S8	Divert minor system flow Amica and Swan Lake Blvd. OGSs to underground storage

Yellow: OGS units
Blue: SWM ponds
Green: both

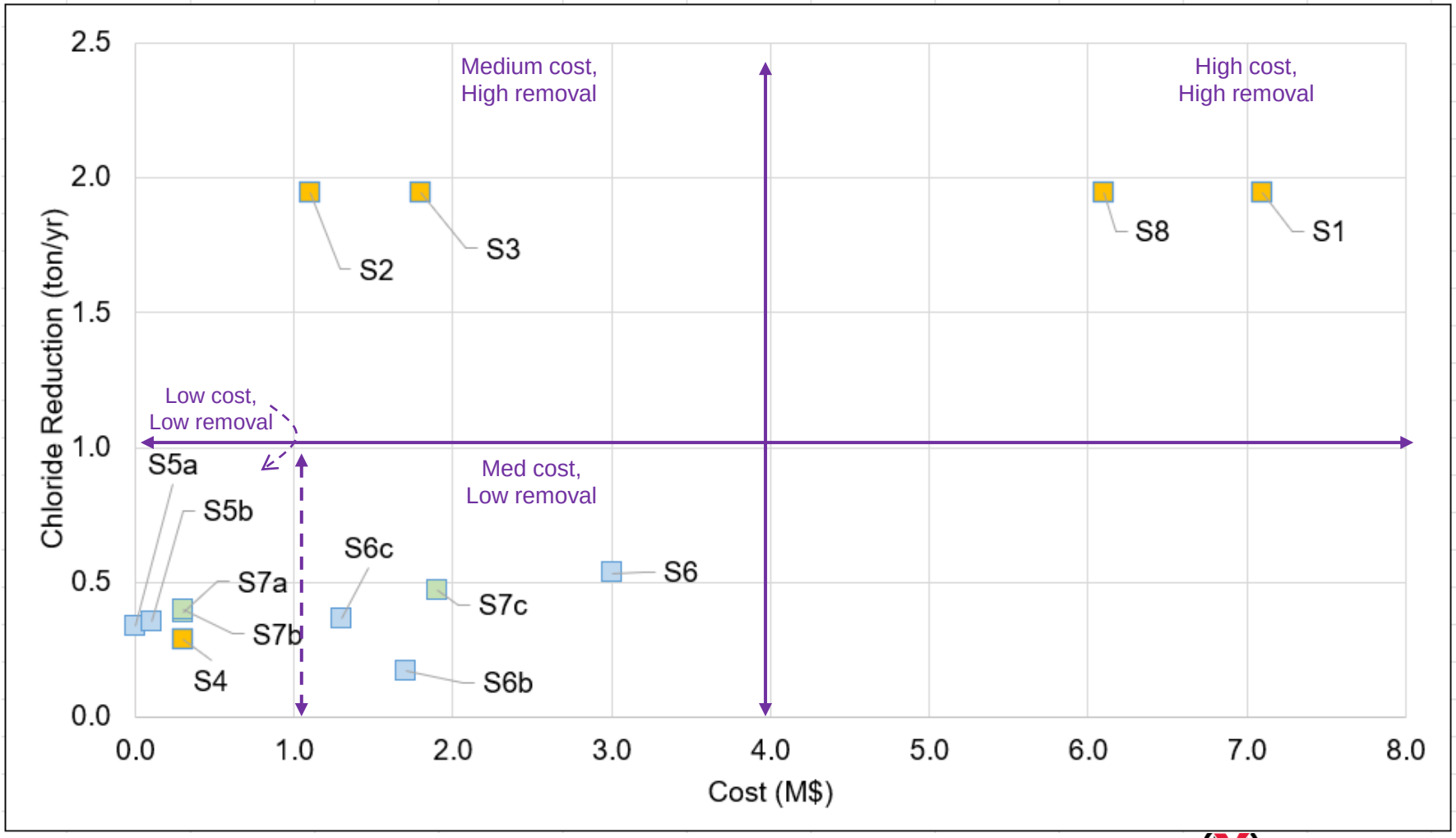


Flow Reduction Impact



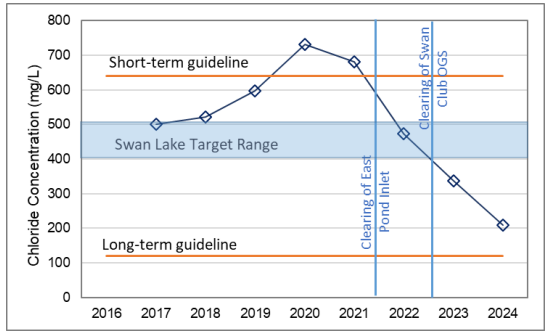
Chloride Reduction Impact and Costs

- Redirecting OGS flows achieves the highest chloride reduction at high cost
- Pond expansion is less costly but achieves lower chloride reduction and has negative impacts (see next slide)
- Low-cost scenarios with low chloride reduction outcome have negative impacts (see next slide)



Overall Evaluation

- Given that chloride concentration are favorable, even the highest-ranking scenario are not recommended at this point.
- Could be considered in Phase 3, if needed.



Scenario	Cost (M$)	Cl-Removal	Other Impacts	Overall Rank
S1	7.1	High	Requires downstream pipe upgrade	Low
S2	1.1	High	Risk of backflow	Medium
S3	1.8	High	-	High
S4	0.3	Low	Low effectiveness due to constraint at North Pond	Low
S5a	0	Low	Increases risk of basement flooding, potential for bypass, ownership	Low
S5b	0.1	Low	Increases flow bypass, ownership	Low
S6	3	Low	Disturbance and loss of park and maintenance area, ownership	Low
S6b	1.7	Low	Significant soil removal, disturbance and loss of park area, ownership	Low
S6c	1.3	Low	Constraint by roadway and trails, limited space for pond cleaning, ownership	Low
S7a	0.3	Low	Ownership	Low
S7b	0.3	Low	Ownership	Low
S7c	1.9	Low	Significant soil removal, disturbance and loss of park area	Low
S8	6.1	High	Requires underground storage construction	Low

2025 Plan and Recommendations

2025/2026 Planned Activities

CORE MEASURES:

- Water quality monitoring and annual reporting to Subcommittee
- Geese and fish management
- Community engagement
- Shoreline restoration (Operations)
- Continue pond assumption process
- 5-year review in 2025

COMPLEMENTARY AND ALTERNATIVE MEASURES:

- Monitoring of planted Submerged Aquatic Vegetation
- Continue the Chloride Treatment Pilot Study

NEW COMPLEMENTARY MEASURES:

- ❑ Ultrasound Pilot Study
- ❑ Research by Trent University on Rare Earth Elements

Ultrasound Pilot Project

- City implemented an ultrasound pilot project to control algal growth in a stormwater pond in 2023 with promising results
- A low-cost and durable measure used to control algae growth in drinking water reservoirs
- It induces vibration and ruptures gas vacuoles (i.e., which control algae buoyancy), sinking algae to lower light levels of the pond deactivating algae growth
- Device installed in May 2025

Before Ultrasonic Treatment – September 2018

After Ultrasonic Treatment – September 2023

Plan Review Process

Expert Consultation and Engagement

- Engage with deputants and technical stakeholders involved in the Markham Subcommittee process
- Participate in a workshop or other interactive consultation with external experts and agencies (e.g., TRCA, MNRF)
- Review of stakeholders' input

Study

- Update existing condition
- Review of management outcome
- Evaluate additional management measures
- Review and update goals, objectives and targets
- Update strategy and implementation plan

Plan Update

- Share draft report with stakeholders
- Receive feedback
- Present final report to Markham Subcommittee

Program Outcomes

- Significant improvements in water quality and habitat have been realized, including aquatic vegetation and fish community
- Water quality now consistently meets expectations for shallow urban water bodies
- Innovative technologies and academic research are actively being evaluated
- Structural modification for chloride reduction is not required at this stage
- Phase 1 of the Long-Term Management Plan has successfully met all established goals and targets.

Recommendations

1. THAT the report entitled "Swan Lake- 2024 Water Quality Status and Updates" be received;

2. AND THAT Staff continue to implement the Long-term Management Plan for Swan Lake approved by Council in December 2021, including advancements previously made from Phases 2 and 3 of the Plan;

3. AND THAT Staff report back annually on water quality results and evaluation of adapted Core and Complementary measures for consideration in Phase 2 of the Plan through the Markham Sub-Committee with the participation of the Friends of Swan Lake Park;

4. AND THAT Staff consider findings and evaluations of chloride diversion options in Phase 3 of the Plan if required given future chloride levels in the Lake;

5. AND THAT the Plan review be initiated in 2025 with consideration for a workshop to review external feedback;

6. AND THAT Staff be authorized and directed to do all things necessary to give effect to this resolution.

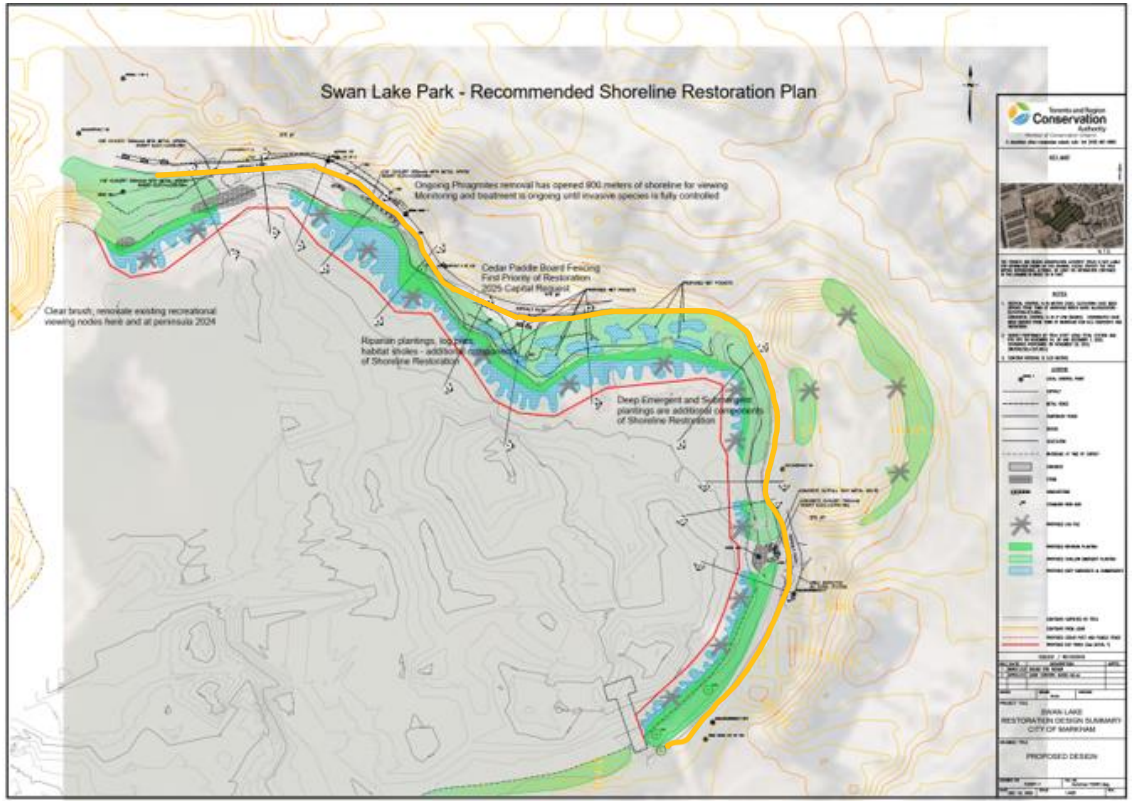
Parks Operations

Community Engagement – Parks

- Following review of design concepts, staff did not recommend adopting recreational viewing nodes due to cost and with consideration for City-wide equity
- As noted by Regional Councillor Ho at the 2024 annual meeting, funding is limited for this type of construction
- Staff presented the approved shoreline restoration plan at the 2024 Public Meeting which did not include recreational viewing nodes
- Staff spoke to the approved plan and outlined the proposed scope of work for 2025 and beyond.
- There has been no change in the conditions affecting the recommended shoreline plan.

Parks Operations Next Steps

- The City is advancing the approved shoreline restoration plan which includes permanent barrier fence for waterfowl in the area where Phragmites was removed as shown by the thick yellow line of the restoration plan and image of typical fencing which will be closer to the waters edge when constructed.



Questions?

Swan Lake

Annual Meeting with Markham Subcommittee

June 18, 2025