SOURCE TO STREAM 2024 Conference

Canada's Premier Stormwater and Erosion and Sediment Control Conference

Thank you to our sponsors!

EXECUTIVE SPONSORS

ADS – Our reason is water.

citygreen – Urban Landscape Solutions

CUPOLEX – Engineering Solutions Inc.

ENVIROPOD

Aquafor Beech Limited

Cleanflo – Water Technologies Inc

filtrexx – Canada – Sustainable Technologies – let nature do it.

imbrium

Matrix Solutions Inc. – A Montrose Environmental Company

Hydro International

NEXT STORM

OAKS – Landscape Products

Sustainable Technologies Evaluation Program

MEDIA SPONSOR

Environmental & Science Engineering Magazine

HOSTS

Presented by:

Toronto and Region Conservation Authority

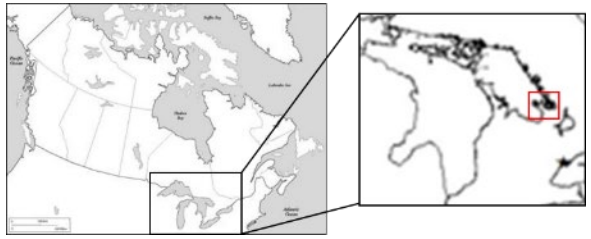
In association with:

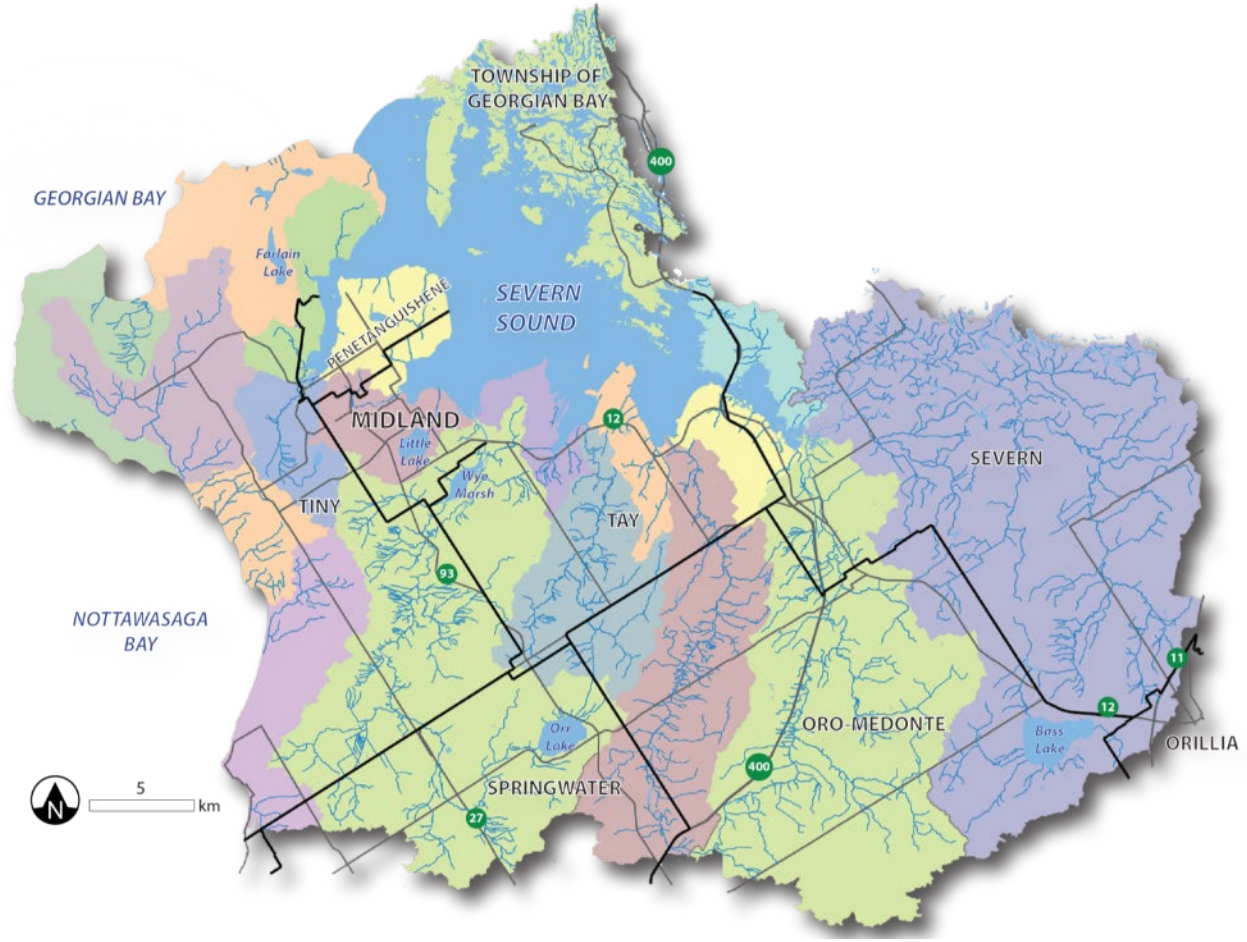
Lake Simcoe Region conservation authority

Credit Valley Conservation – inspired by nature

Stormwater Monitoring – Piloting the Inclusion of Effluent Monitoring into Existing Long-Term Watershed Monitoring Program

Severn Sound





SSEA Origin

1987

Severn Sound was designated 1 of 17 Canadian (5 are binational) Great Lakes Areas of Concern (AOCs)

- Each AOC developed a Remedial Action Plan (RAP) to improve degraded water & habitat quality

2003

Canada formally announced the removal of the Severn Sound from the list of AOCs

1997

Severn Sound Environmental Association Formed (SSEA - facilitate delisting)

2009

Municipal Leadership & obligation to maintain water quality improvements - SSEA Joint Municipal Service Board (Municipal Act) Agreement, continued protection & wise stewardship of the Severn Sound watershed

Environmental success of the RAP leads to municipal legacy commitment in the form of the SSEA & the JMSB

Background & Objectives

Project Background

- Stormwater (SW) and wastewater (WW) convey nutrients and harmful pollutants (e.g. salt, bacteria and other contaminants) to receiving waters
- First step in reducing pollutants is to collect baseline information and identify existing and potential issues

Study Objectives

- Pilot a targeted approach to monitoring wastewater and stormwater effluent impacts on receiving waters from a rural settlement (Elmvale)
- Demonstrate how SSEA can support municipal partners when upcoming monitoring requirements come into effect under new CLI ECAs (Consolidated Linear Infrastructure Environmental Compliance Approvals)
- Map SW/WW infrastructure across the Severn Sound watershed area in relation to existing SSEA monitoring sites to show benefit of a shared service model

Stormwater drainpipe located at site SWM04

Study Approach

- Where: 6 sites along the Wye River through Elmvale
- When: Spring & Winter snowmelt, dry and wet periods during Spring, Summer and Fall
- What: - water chemistry samples for lab analysis
  - field measurements of pH, conductivity, temperature, & turbidity
  - temperature loggers (30 min intervals)
  - baseflow measurements (dry periods only)

Curb drain (left) and end of pipe (right) showing sediment rich stormwater entering the Wye River during a rain event at site SWM04 (Heritage Park)

Number of Sampling Events per Season

	Spring	Summer	Fall	Winter
Snowmelt	1			1
Wet	1	2	2	
Dry	1	1	1	

Project Area

Legend

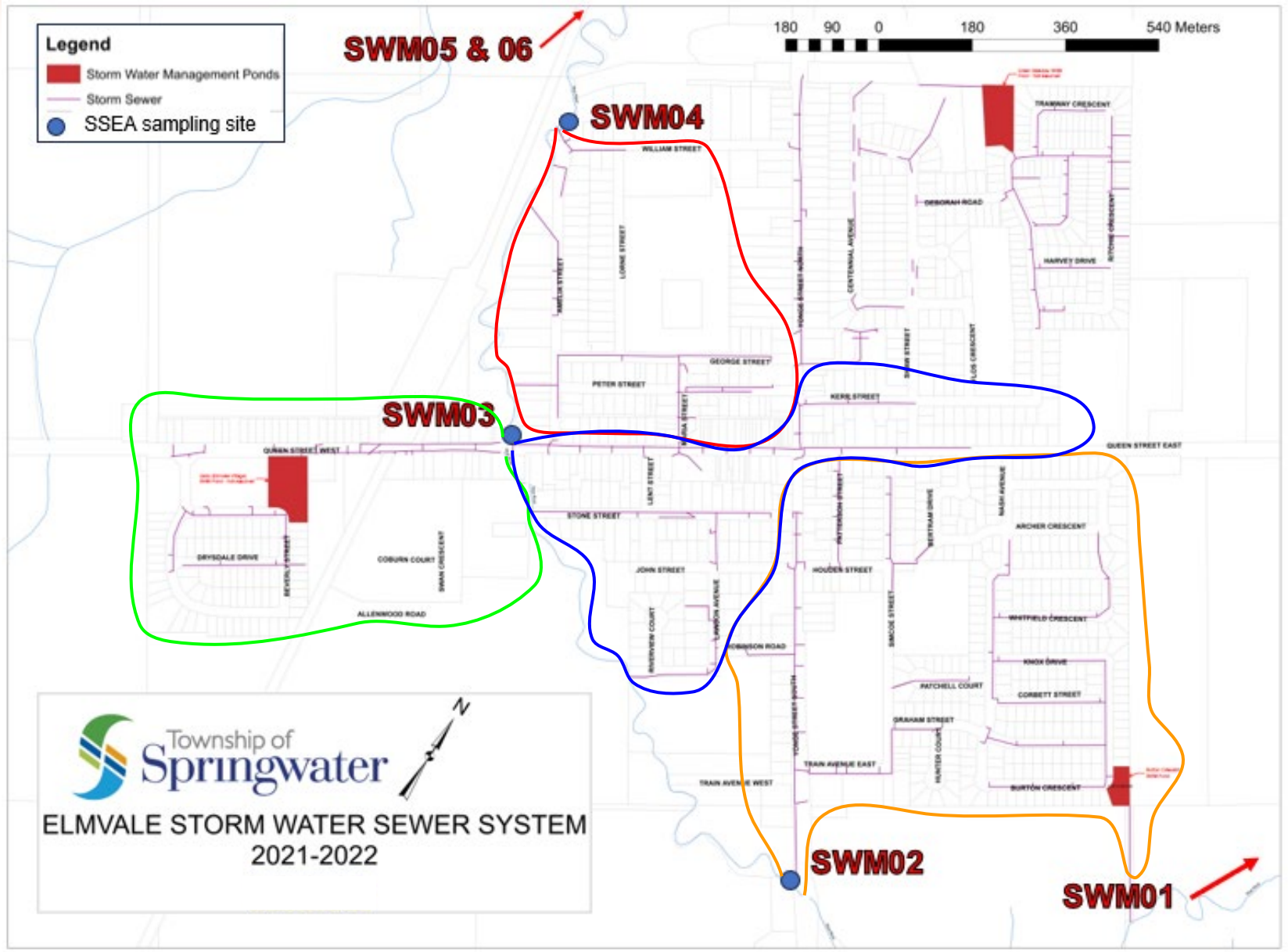
- Sampling Sites
- Inland Lakes
- Drainage (Surface)
- Road

N

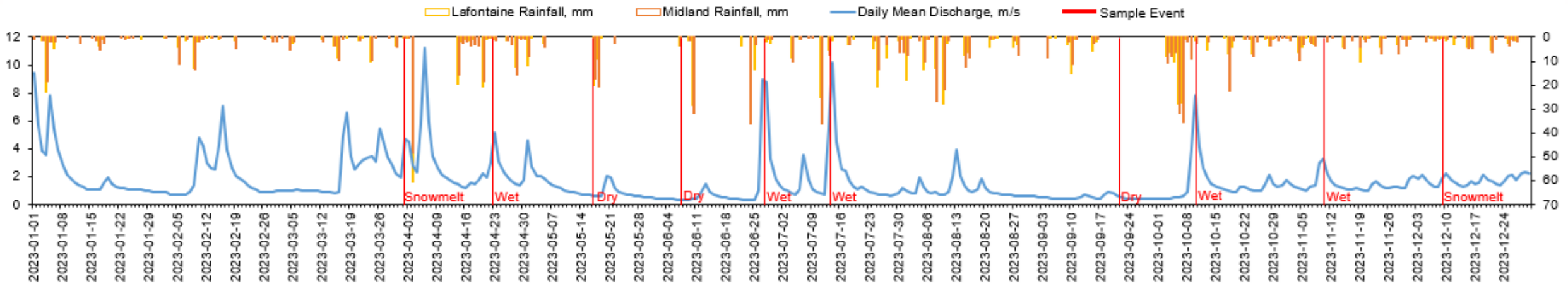
0 0.5 1 km

Stormwater/Wastewater Receiving Water Monitoring Pilot Project Area

Site Selection



Monitoring Plan Implementation – Flow & Weather Events



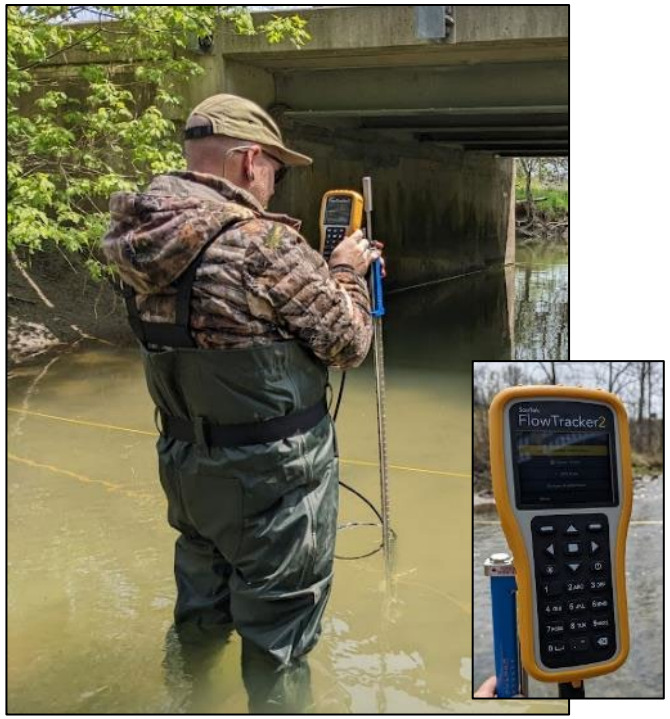
- Wye River average daily flow (blue) & total daily rainfall (orange/yellow)
- Red bars show timing of sampling events

Site SWM06 during spring (left) and summer (right) wet weather events

Flow data from Water Survey of Canada gauge (Dawson Sdrd at 4th Conc Rd E)

Monitoring Plan Implementation – Field Data Collection & Sampling

Measuring baseflow



Measuring field variables

Collecting water samples

Field data tables

Sample information								Field Data							
Sample Type	# of Samples Collected	Odour	Particulate Size	Colour Type	Colour	Clarity	Sheen	Time Measured	Meter	Temp	DO (%)	DO (mg/L)	Cond	pH	Turbidity (FNU
Grab	3	Sewage	Small	Colourless	None	Clear	No	16:03	YSI & Hanna	16	122.8	12.27	421	8.15	8.4
Grab	3	None	Small	Tint	Yellow	Cloudy	No	9:05	YSI & Hanna	14.3	87.5	8.98	413	7.84	9
Grab	3	None	Small	Colourless	None	Clear	No	10:24	YSI & Hanna	16.1	82.8	7.54	384	7.96	8.5
Grab	3	None	Large	Tint	Brown	Murky	No	10:19	YSI & Hanna	10.5	80.9	9.13	327	7.53	26
Grab	3	None	Small	Tint	Brown	Murky	No	10:56	YSI & Hanna	10.6	77.1	8.69	386	7.36	35.9
Grab	3	None	Small	Tint	mixed Y/B	Cloudy	No	11:18	YSI & Hanna	10.6	78	8.8	388	7.42	30

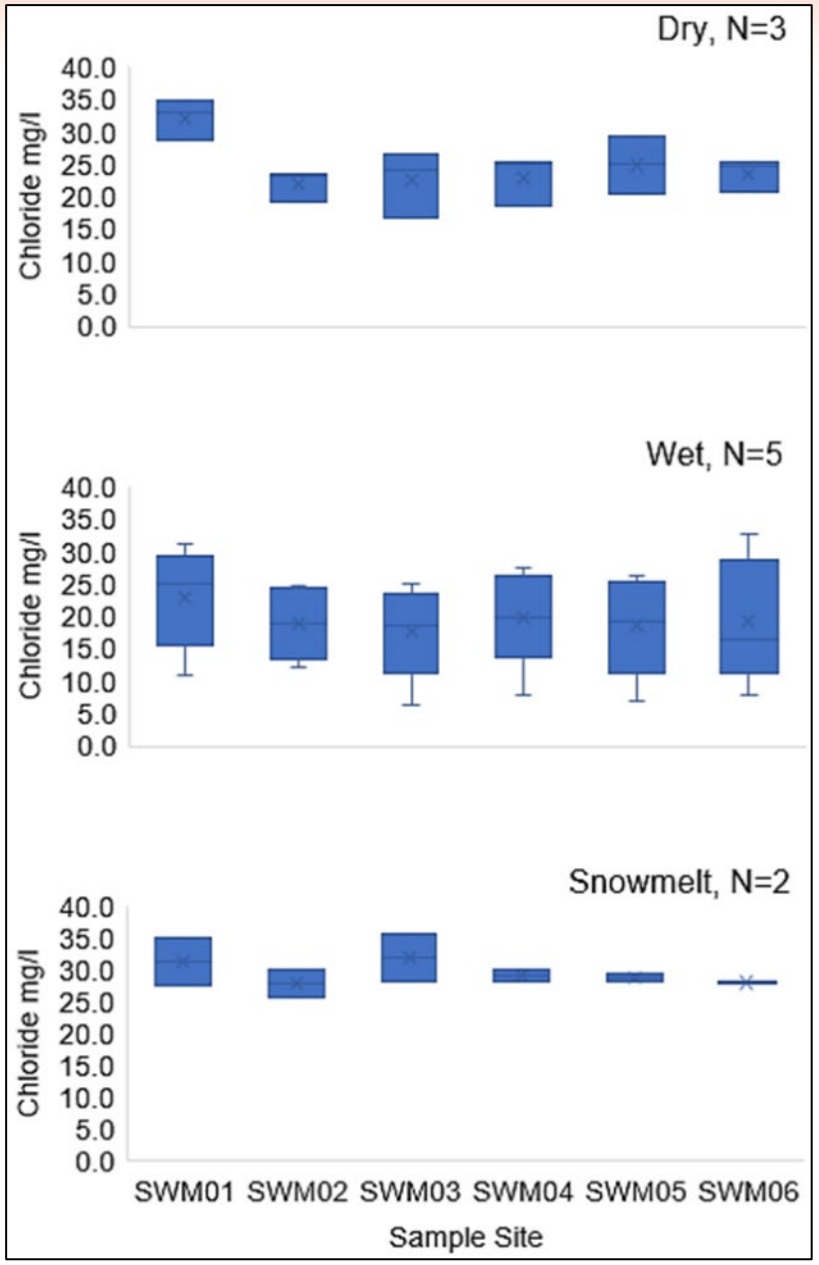
Results Overview

- Variables included **chemical** (Chloride, Nitrate, Ammonia, Total Phosphorus) and **physical** characteristics (Total Suspended Solids, temperature, flow)
    - all indicators of stormwater or wastewater effluent impacts on the stream, which can affect stream life
- Chart ranks chemistry variables from lowest (light blue) to highest (dark blue) concentration to illustrate differences between different weather events; where colours are the same, concentrations were not different

		Chloride (Cl)	Nitrate (NO_3)	Ammonia (NH_3)	Phosphorus (TP)	Suspended Solids (TSS)
Lowest	Dry					
	Wet					
Highest	Snowmelt					

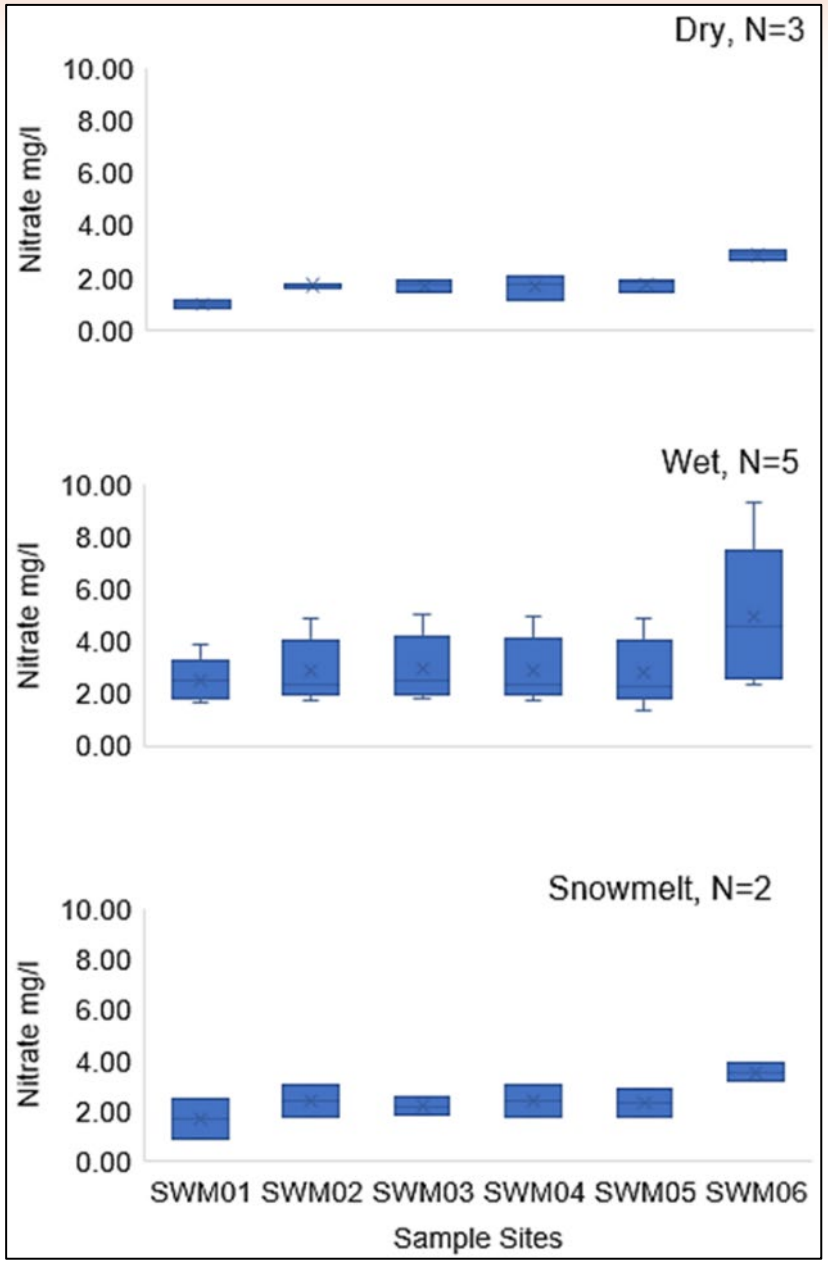
Site SWM05 during spring (left) and summer (right) wet weather events causing extreme flooding along banks

Chloride (Cl)



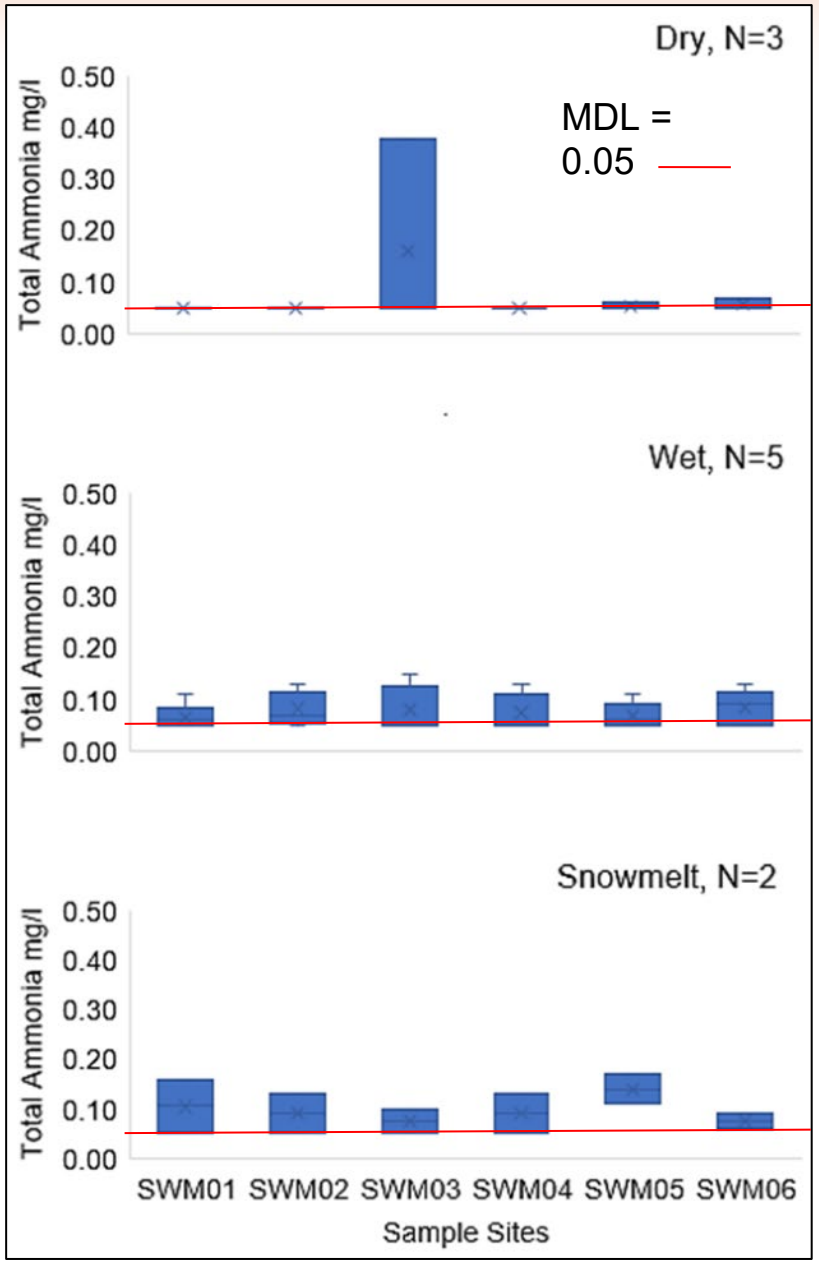
- *Why measure?* Toxic to invertebrates, which are the backbone of stream foodwebs
- Concentrations below Canadian Water Quality Guideline for chronic exposure of 120 mg/L
- Cl is higher at SWM01, upstream of Elmvale, during all weather events
  - high coming out of Orr Lake (avg 29 mg/L at outlet in 2021)
  - likely impacts of salting on Hwy 93 & septics
- Dilution likely leading to reduction of Cl at the sites downstream of SWM01
- During the snowmelt events, the highest concentrations are observed at urban site SWM03

Nitrate (NO_3)



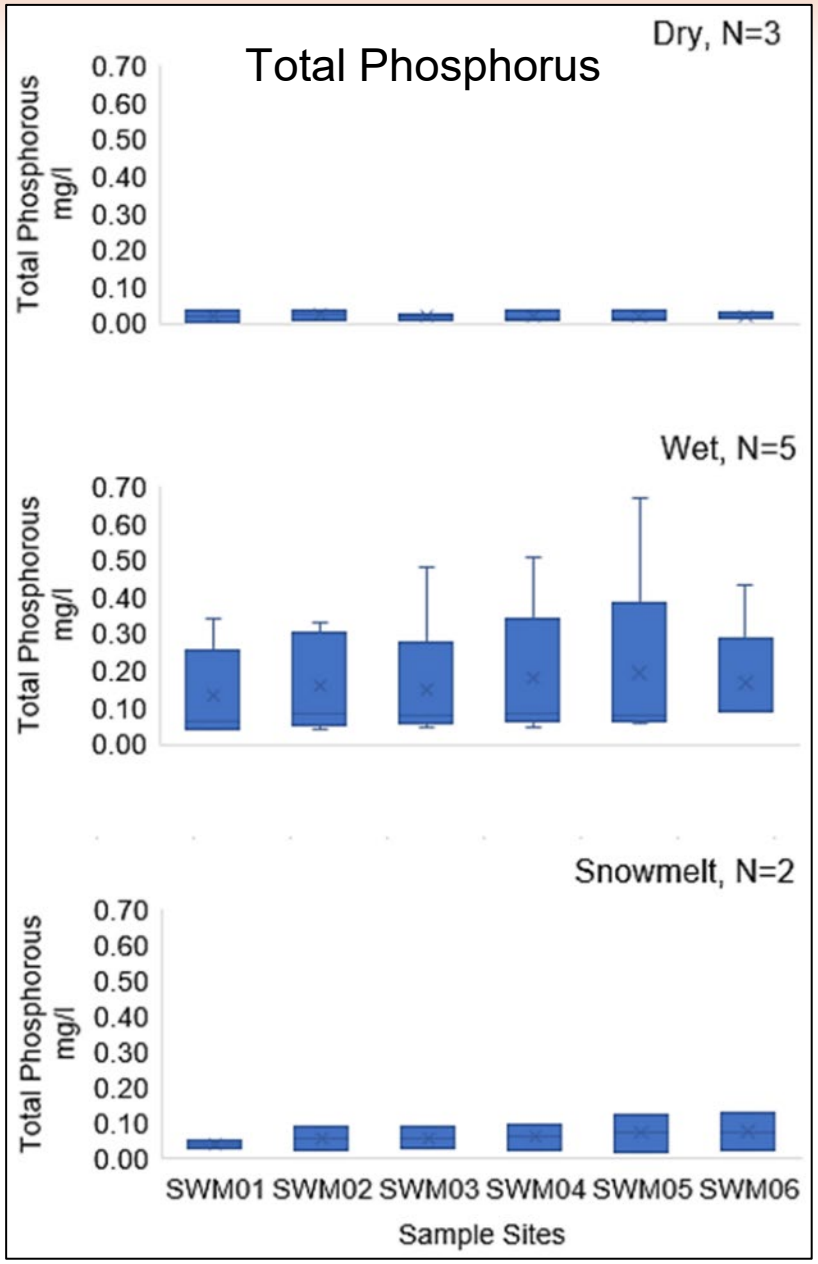
- *Why measure?* Fuels plant & algae growth
- Highest value (9.4 mg/L) approaching Canadian Water Quality Guideline for chronic exposure of 13 mg/L
- Gradual increases in NO_3 moving from upstream to downstream during every weather event
- Highest at the furthest downstream site SWM06, especially during wet weather events

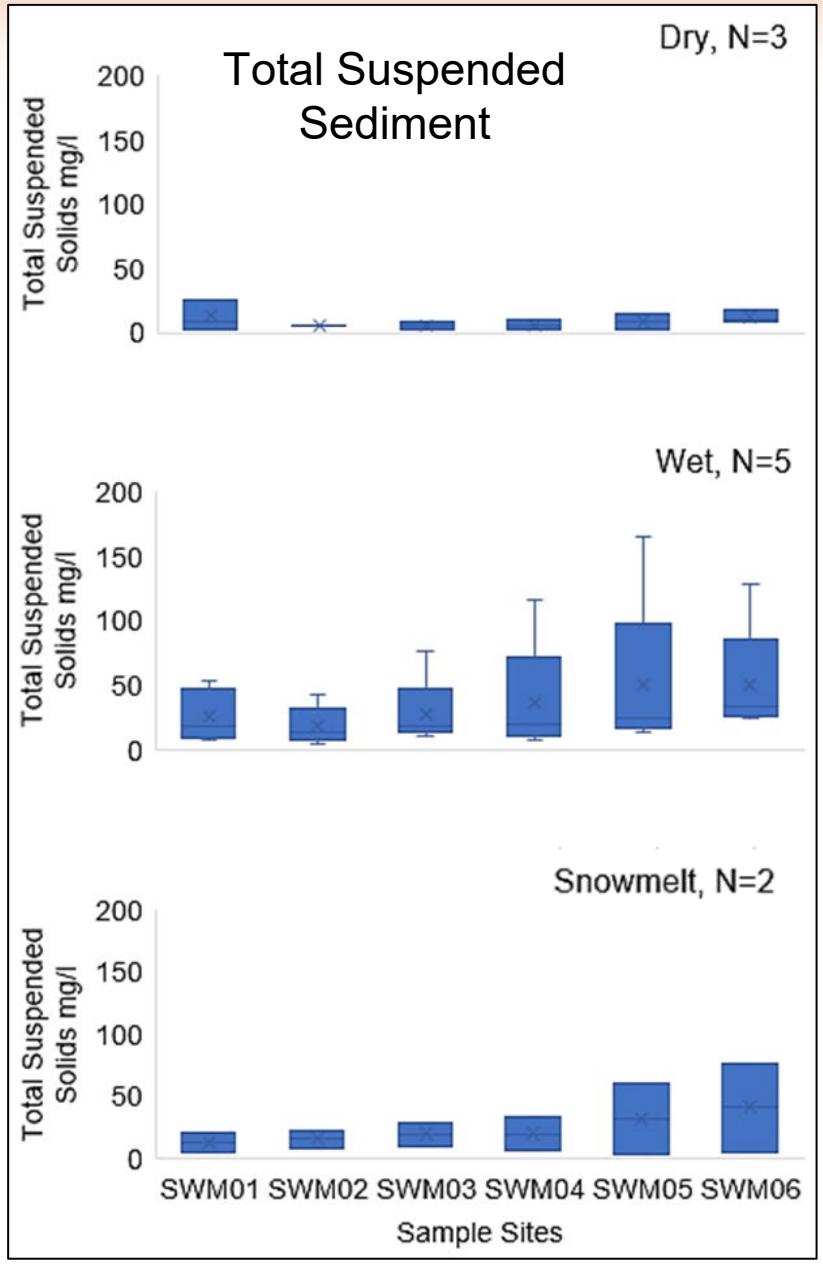
Total Ammonia (TNH_3)



- *Why measure?* Toxic to fish & invertebrates in high concentrations, transforms to nitrate (NO_3) which fuels plant & algae growth
- Ontario Water Quality Objective for un-ionized ammonia of 20 mg/L exceeded once (calculated value = 23 mg/L)
- TNH_3 mostly near or below detection limit during dry weather events
  - Unusual spike in TNH_3 during one dry event despite all other events & sites having low concentrations
- 65% of values above detection limit during wet and snowmelt events

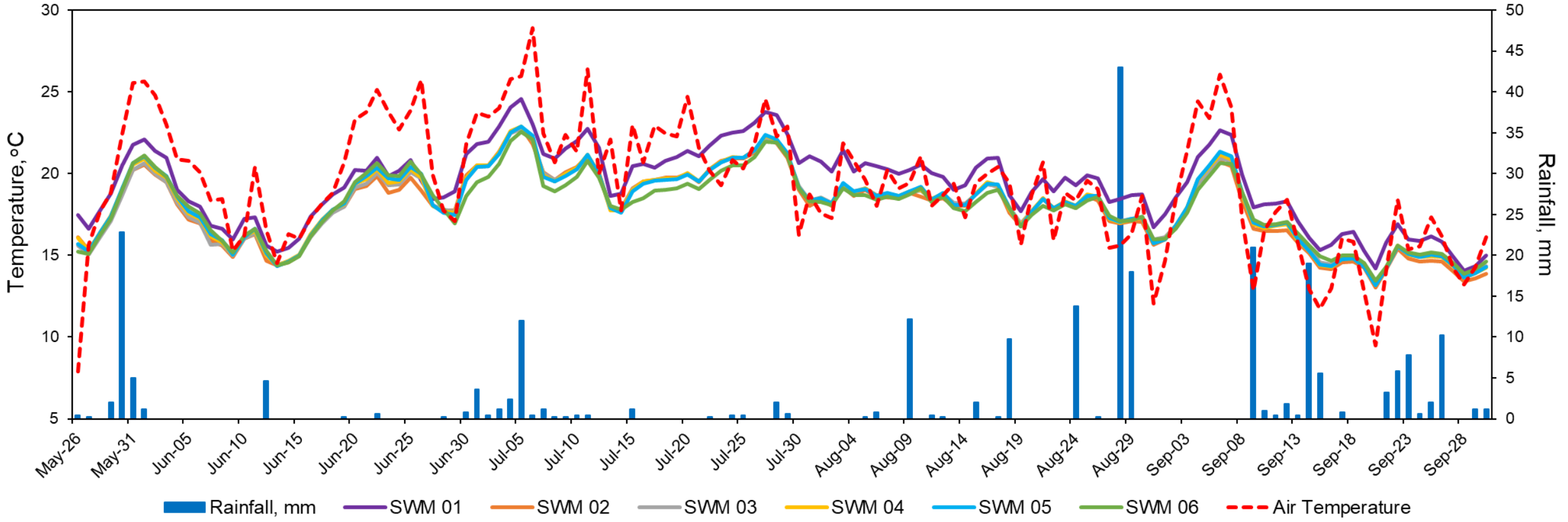
Total Phosphorus (TP) & Total Suspended Solids (TSS)





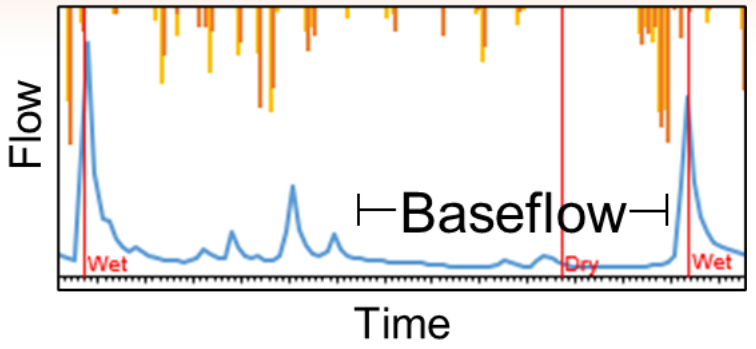
- *Why measure?* TP fuels plant & algae growth; TSS impacts fish & invertebrates
- Exceedances of Ontario TP guideline of 0.03 mg/L:
  - 22% - dry events
  - 100% - spring snowmelt & wet events
  - 0% - winter snowmelt
- TP & TSS increase from upstream to downstream sites during snowmelt & wet events
- Highest TP & TSS observed during wet events
- TP increases align with TSS - portion of TP is bound to sediment particles

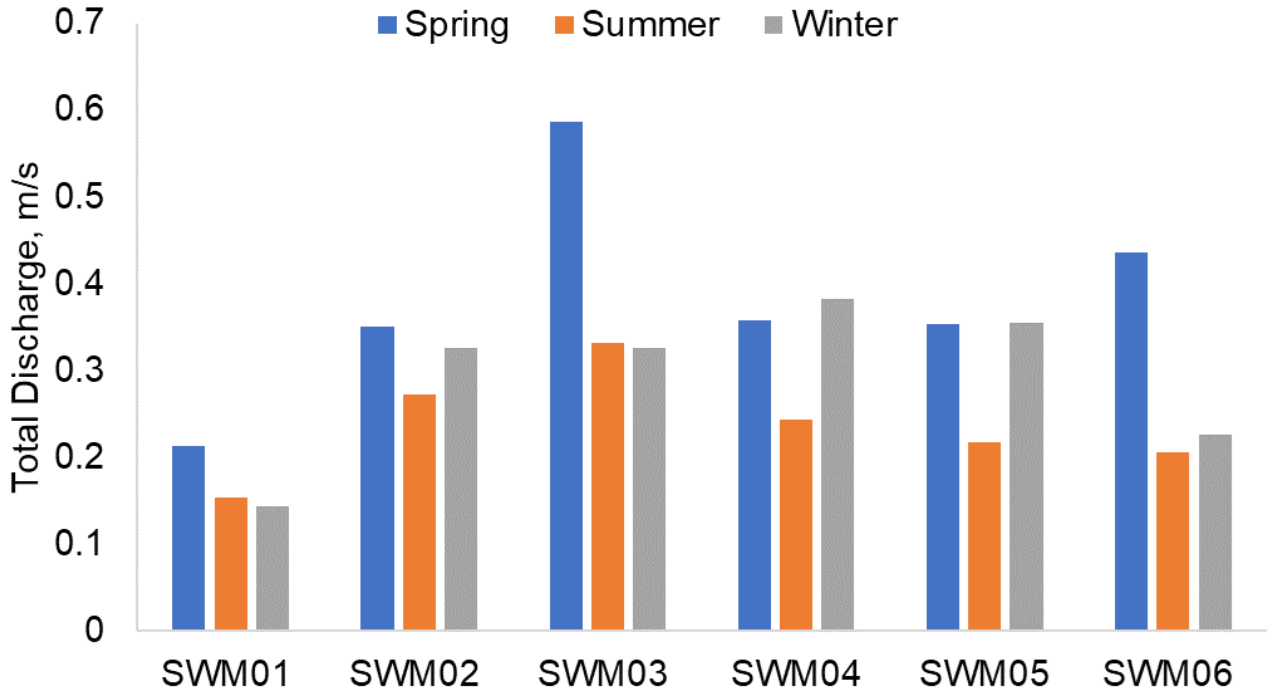
Stream Temperature



- *Why measure?* Warm water causes stress to fish, holds less oxygen, increases toxicity of things like ammonia
- Water temperature closely related to air temperature - urban runoff from rain events didn't have a noticeable impact
- Upstream site SWM01 was warmest, other sites were similar

Baseflow

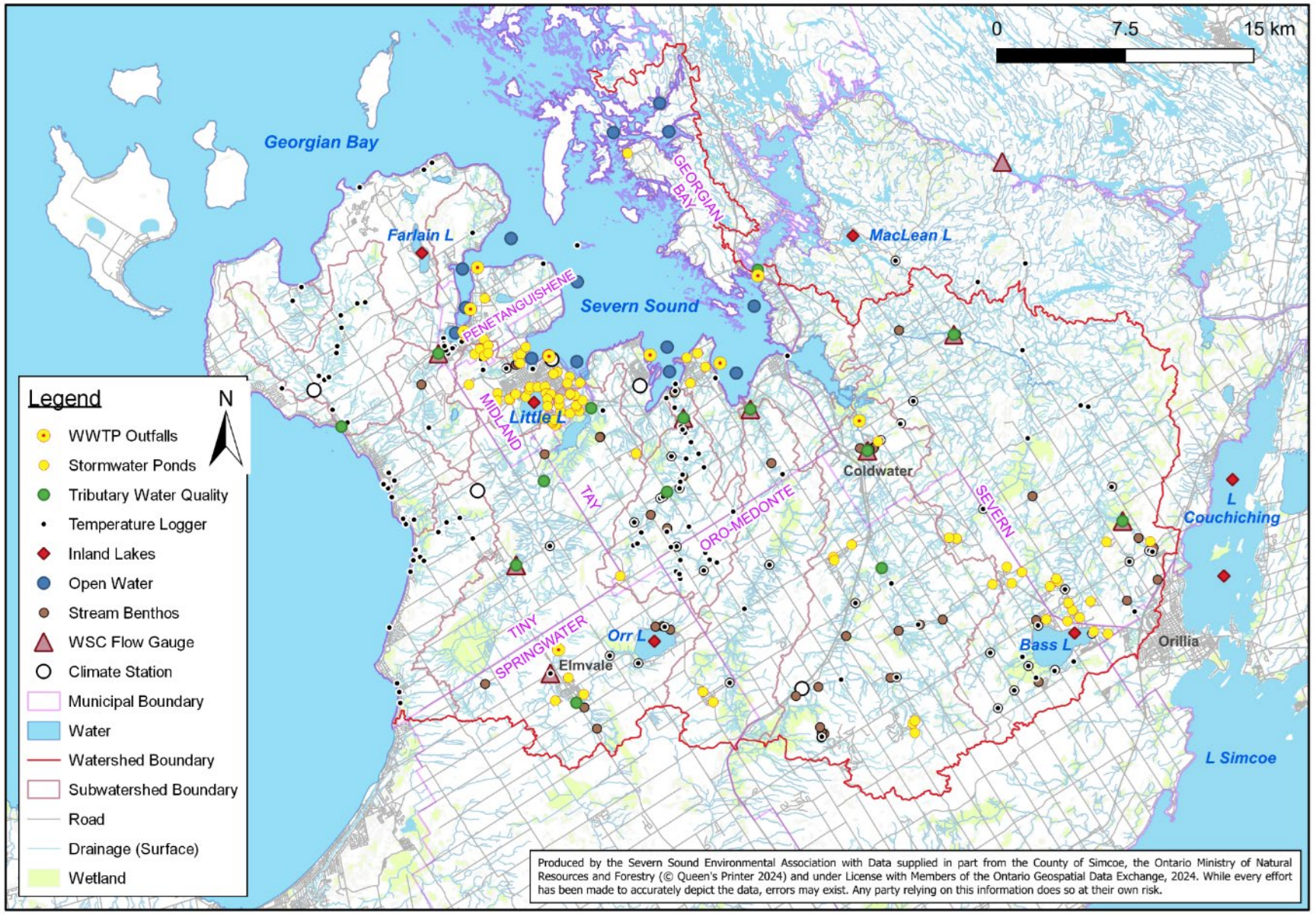




Baseflow measured using handheld flow meter at study sites during dry weather events.

- **Baseflow** - the amount of flow in a stream that is not runoff; it is maintained by groundwater inputs
- Measured using a handheld flow meter or permanent flow gauge
- *Why measure?* Paving over groundwater recharge areas can reduce baseflow - bad for all stream life
- Baseflow was highest in the spring and lowest during the summer event

Integrating SW/WW Monitoring into Long Term Programs



Cost Analysis

Project Expenditures	Cost
Staff time for sampling, logistics, data compilation, analysis, mapping, project oversight @ SSEA INTERNAL RATE	$45,740
Lab analysis (incl. bottles, coolers), 60 sets of samples @ $65/sample (phosphorus, chloride, suspended sediment, nitrate, ammonia)	$4,685
Sample shipping	$220
Vehicle rental & fuel for sampling activities ($150/day) for 13 days	$1,950
Laptop and software for Coordinator	$2,200
Flow meter	$22,215
Misc sampling gear (waders, GPS, camera, field tablet, sampling pole)	$1,060
Total Cost	$78,070

One-time costs

Recommendations

Springwater Township Specific

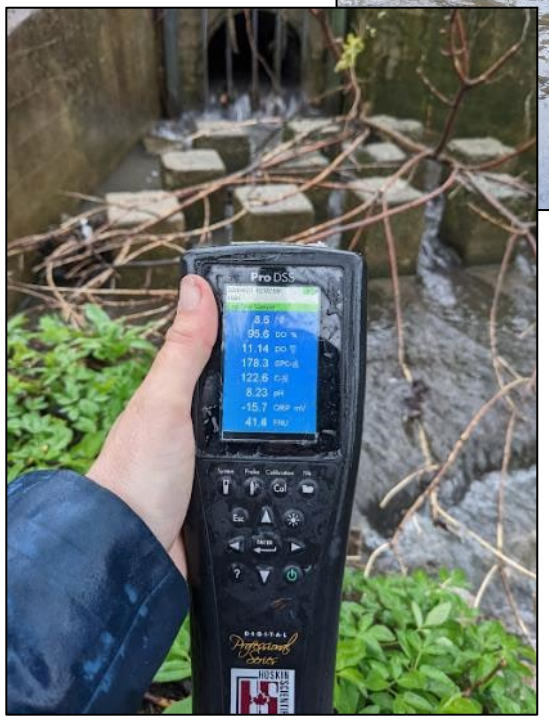
- Continue monitoring for multiple years at upstream and downstream locations (SWM01 and SWM06) to establish baseline water quality - review after 5 years to examine trends
- Optimize municipal operations based on findings (e.g. de-icing salt use, WWTP, inspect SW ponds for sediment accumulation)

Scaling Up - Monitoring Program Design Across Severn Sound Watershed

- Settlements across watershed have unique geographies in relation to water bodies receiving SW/WW effluent - use common monitoring framework with settlement-specific considerations (e.g. site locations, number of sites)
- Where SSEA monitoring sites exist, make use of available data and long-term monitoring programs (e.g. PWQMN, benthic macroinvertebrates, stream temperature)
- Design monitoring on a subwatershed basis, not just within municipal boundaries - effects are cumulative
- Consider incorporating benthic macroinvertebrate monitoring for more integrated look at water quality
- Make use of Water Survey of Canada (WSC) permanent flow gauges to inform sample timing, characterize flow patterns
- Permanent flow gauges or use of tow-across current profiler needed in areas without WSC gauge - permanent gauge allows for continuous monitoring, providing localized hydrology data that can better inform SW management planning

Summary

- Water quality in the Wye River through Elmvale was impacted by SW/WW effluent during rain and snowmelt events
  - higher Cl in response to de-icing salt use
  - higher NO_3 downstream of WWTP
  - higher TP/TSS in response to cumulative SW inputs
- Monitoring receiving water for stormwater impacts is critical for protecting water quality
- Using SSEA as shared service delivery partner is a cost-effective option for SW/WW receiving water monitoring



Acknowledgements

- Funding support from the Province of Ontario
- Support from Springwater staff
- SSEA municipal members
- SSEA staff

Thank-you!

www.severnsound.ca
sseainfo@severnsound.ca
705-534-7283

Nikki Priestman, Watershed Health Specialist
monitoring@severnsound.ca

Aisha Chiandet, Water Scientist/Limnologist
achiandet@severnsound.ca

SOURCE TO STREAM 2024 Conference

Canada's Premier Stormwater and Erosion and Sediment Control Conference

Thank you to our sponsors!

EXECUTIVE SPONSORS

ADS – Our reason is water.

citygreen – Urban Landscape Solutions

CUPOLEX – Engineering Solutions Inc.

ENVIROPOD

Aquafor Beech Limited

Cleanflo – Water Technologies Inc

filtrexx – Canada – Sustainable Technologies – let nature do it.

imbrium

Matrix Solutions Inc. – A Montrose Environmental Company

Hydro International

NEXT STORM

OAKS – Landscape Products

Sustainable Technologies Evaluation Program

MEDIA SPONSOR

Environmental & Science Engineering Magazine

HOSTS

Presented by:

Toronto and Region Conservation Authority

In association with:

Lake Simcoe Region conservation authority

Credit Valley Conservation – inspired by nature