Canada's Climate Change Adaptation Platform Webinar Series Presents:

Advancing Adaptation in Practice: Innovative Solutions for Stormwater Management in a Changing Climate

March 24, 2022

Webinar Presenters

Ben Longstaff
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Re-imagining How Stormwater is Managed:
Applying a systems-based approach to maximize infrastructure performance at significantly lower cost

NRCan – Climate Change webinar

March 24, 2022

Ben Longstaff, LSRCA

Tracy Patterson, Freeman Associates

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FREEMAN Associates

Sustainable Technologies EVALUATION PROGRAM

The State of Stormwater Management (SWM) in Canada

- Municipalities trying to catch up with historical legacy of limited stormwater planning.
- Aging grey infrastructure in need of upgrades or replacement.
- Limited budgets and emphasis.
- Increasing liability and insurance costs
- Rapid urbanization + climate change = more frequent and severe storms that overburden existing infrastructure.

Adapting to climate change

- Economically sustainable
- Mitigate infrastructure risk
- Resilient stormwater system (quality and quantity)
- Whole system resilience (Social, economic, environment)

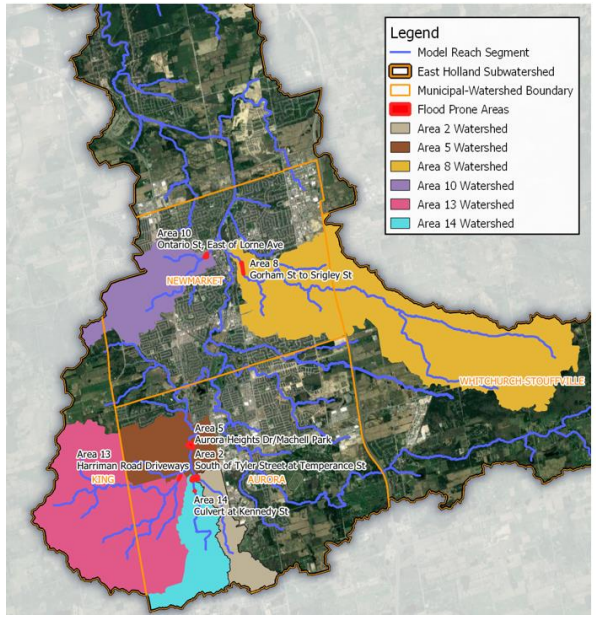
A re-tooling of SWM planning is needed:

SWM plans that build toward holistic, systemic planning that mimics pre-development, watershed-scale hydrology

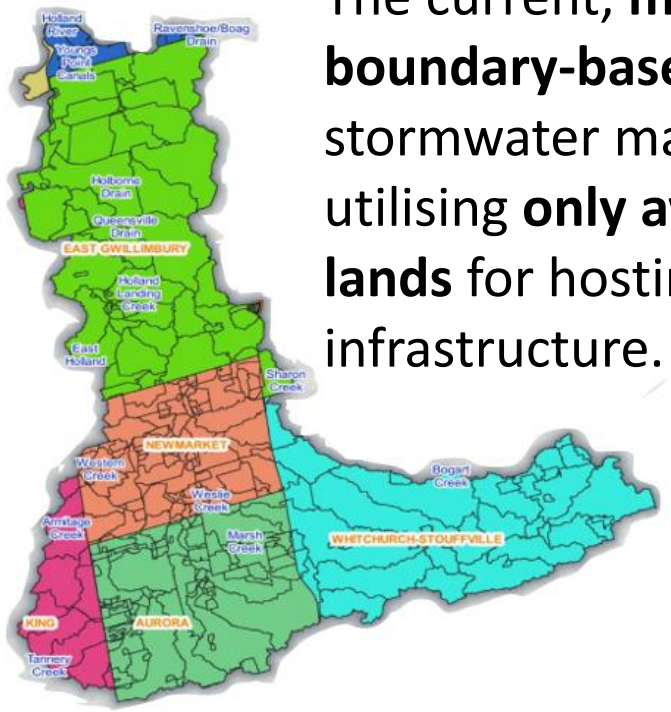
Planning and design driven by optimal performance at greatest level of cost-efficiency.

The Study Area

- East Holland River watershed
  - Rapid growth, peri-urban with significant water quality management challenges
  - Increased frequency of intense storms projected
  - Localized flooding
  - 40% P reduction target

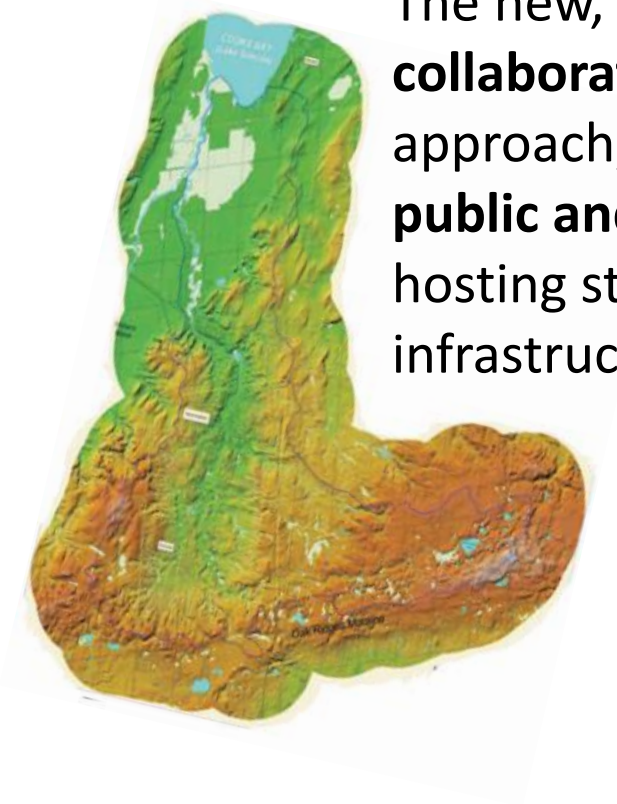


Optimization analysis was used to compare



The current, **municipal boundary-based** approach to stormwater management utilising **only available public lands** for hosting stormwater infrastructure.

VS



The new, **watershed-wide, collaborative, intermunicipal** approach, utilising both **public and private lands** for hosting stormwater infrastructure.

Study methodology

Simulate current conditions:

- Phosphorus
- Stream flow

Build future state model:

→Select stormwater control measures

- Decentralized (LID) & Centralized (e.g. hybrid ponds)

→ Performance of selected stormwater controls (e.g. P removal)

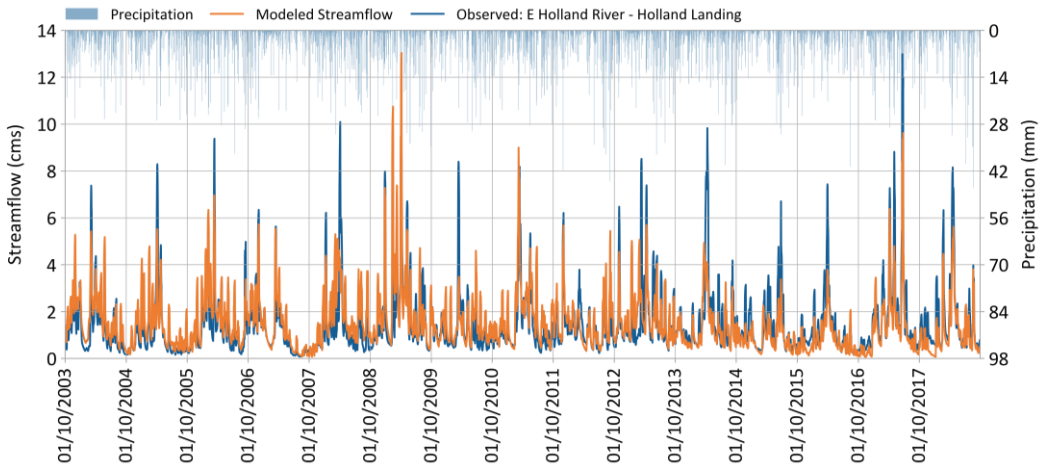
→ Cost of selected Stormwater control (capital, O&M)

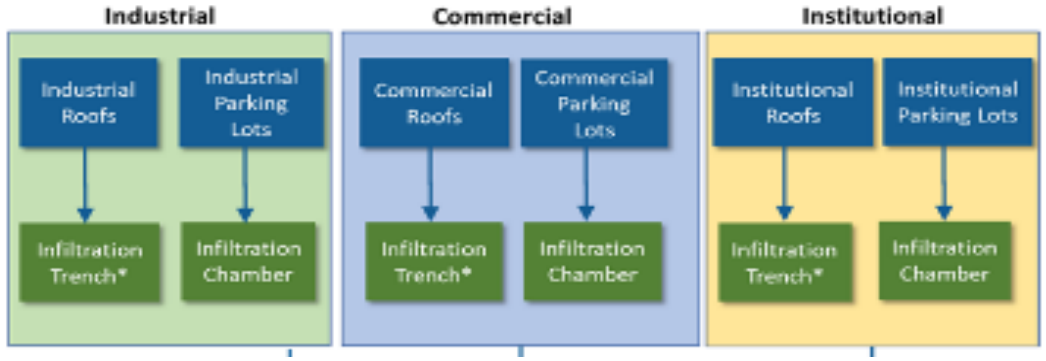
Optimization simulations:

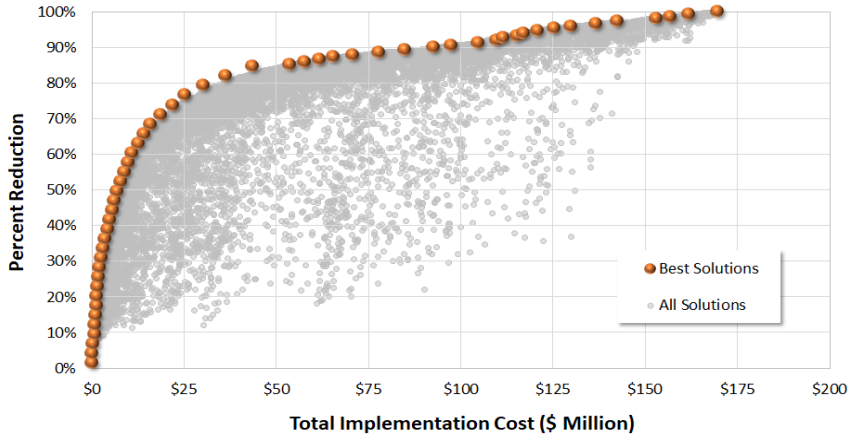
→ Watershed scale

→ Public vs public and private lands

→ Watershed vs Jurisdictional

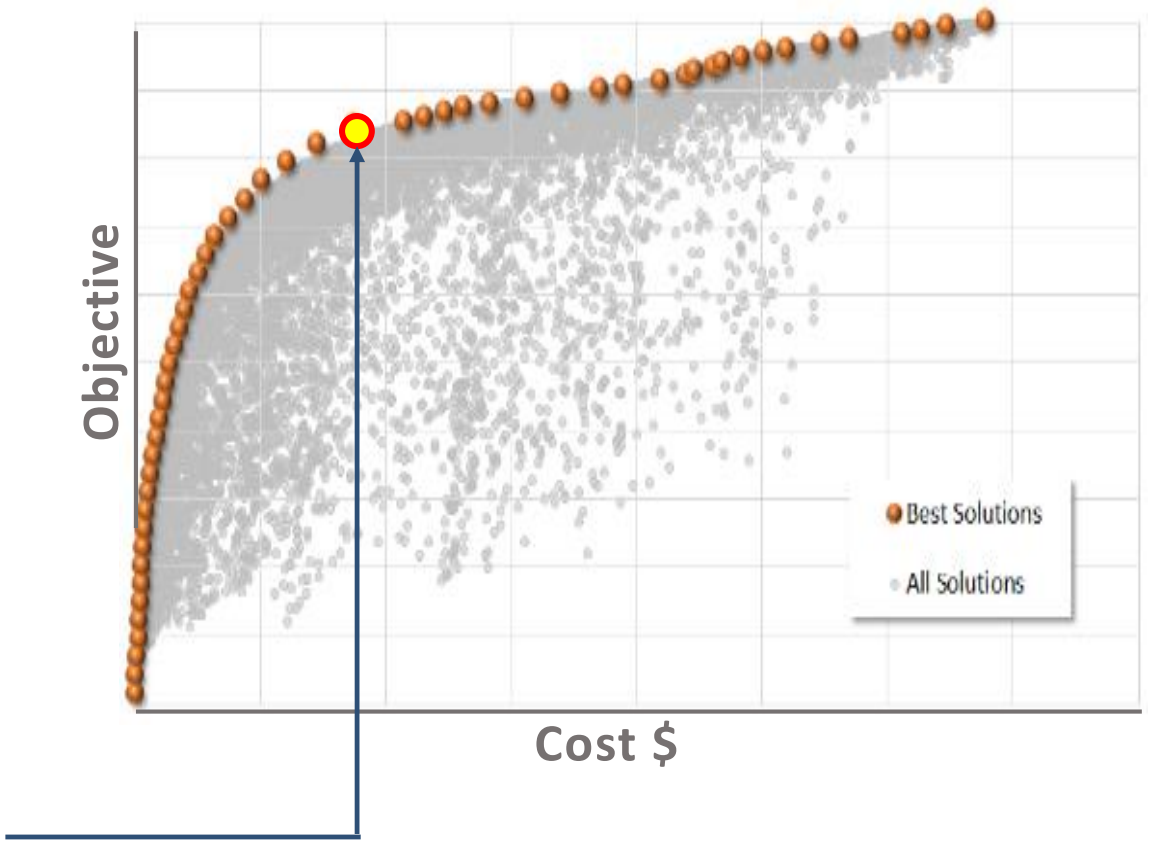




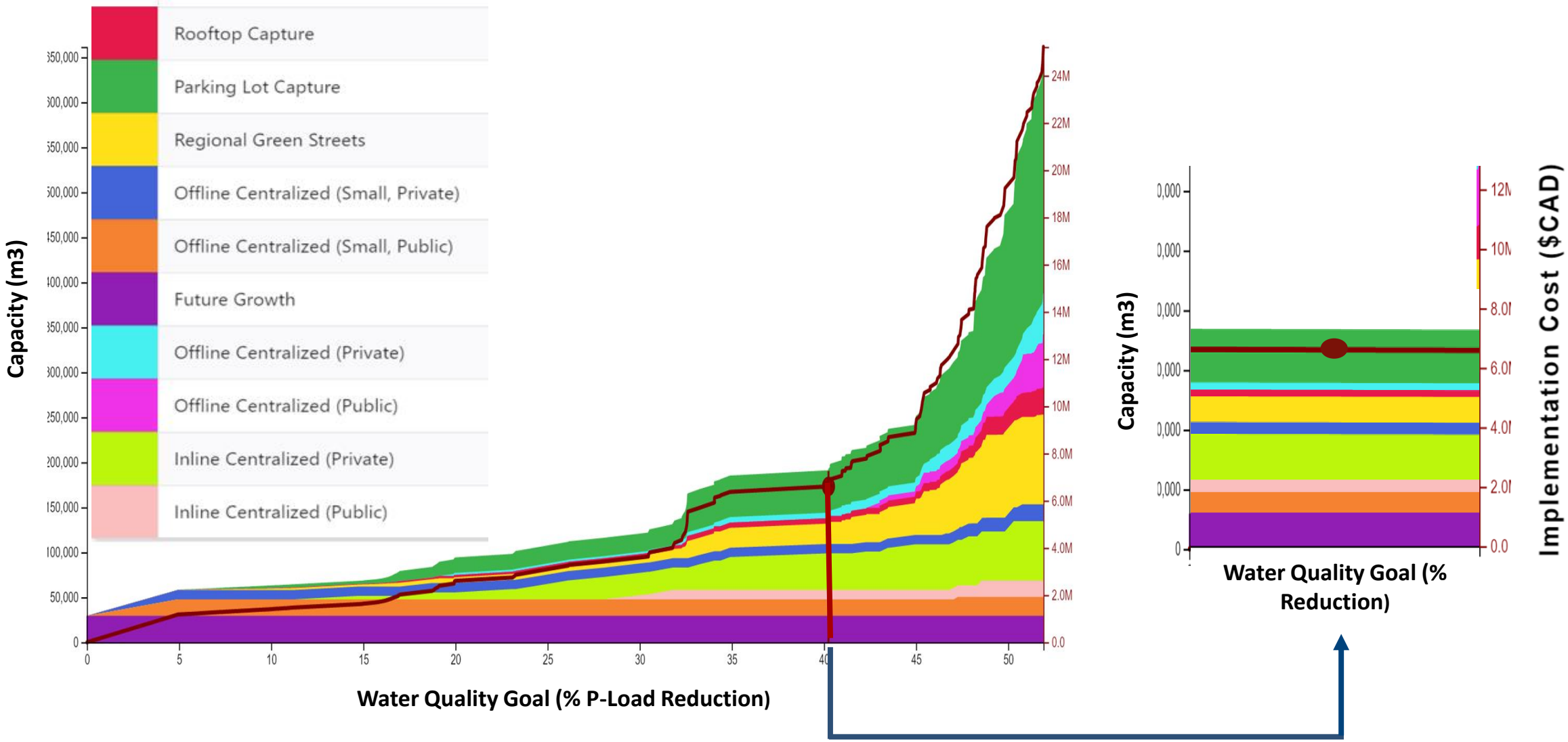


Optimization analysis

- Optimization modelling processes millions of options to pinpoint the most cost-effective strategy.
- Each dot represents a complete strategy – a combination of grey and green SWM infrastructure – encompassing all 314 'jurisheds' throughout the watershed.
- Dots along the curve line provide the highest level of effectiveness for the cost.
- The point at which the curve flattens is the most cost-effective strategy.



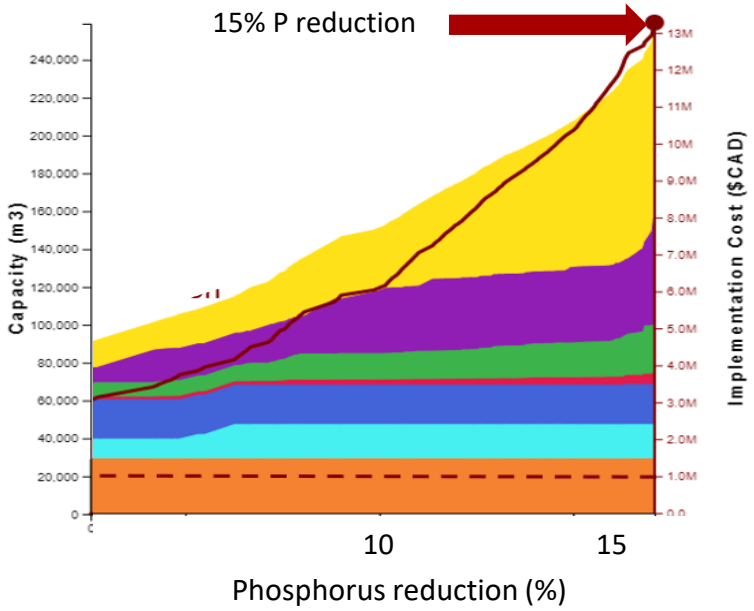
Cost Optimized Implementation Strategy



Key Study Findings

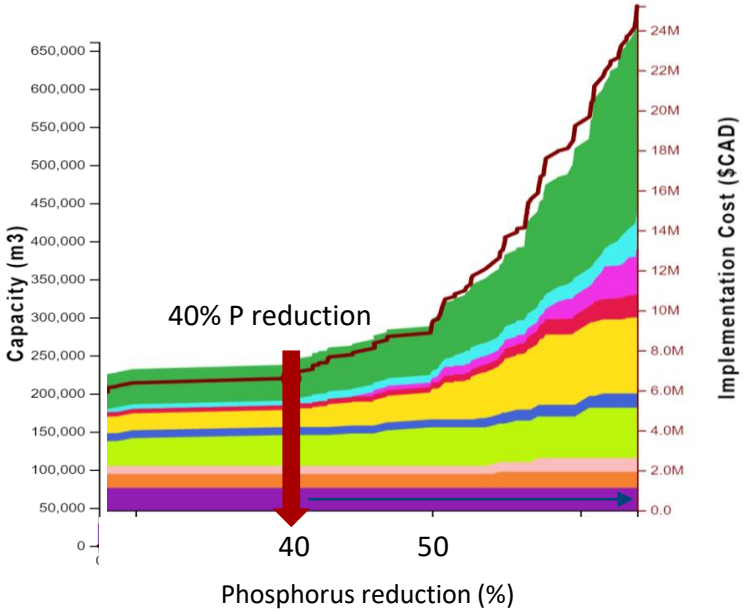
Current Approach – Public Lands Only:

- 15% maximum phosphorus reduction
- Costing $13 million per year*



New System-wide Approach – Both Private & Public Land:

- 40% phosphorus reduction
- To achieve the same 15% phosphorus reduction would cost only $2.6 million per year*
- Reduced risk of flooding and associated costs.
- Increased resilience to climate change and development.



**Costs are annualized over 30-years*

Key Study Findings

Assuming both public and private lands:

Individual Municipal Approach:

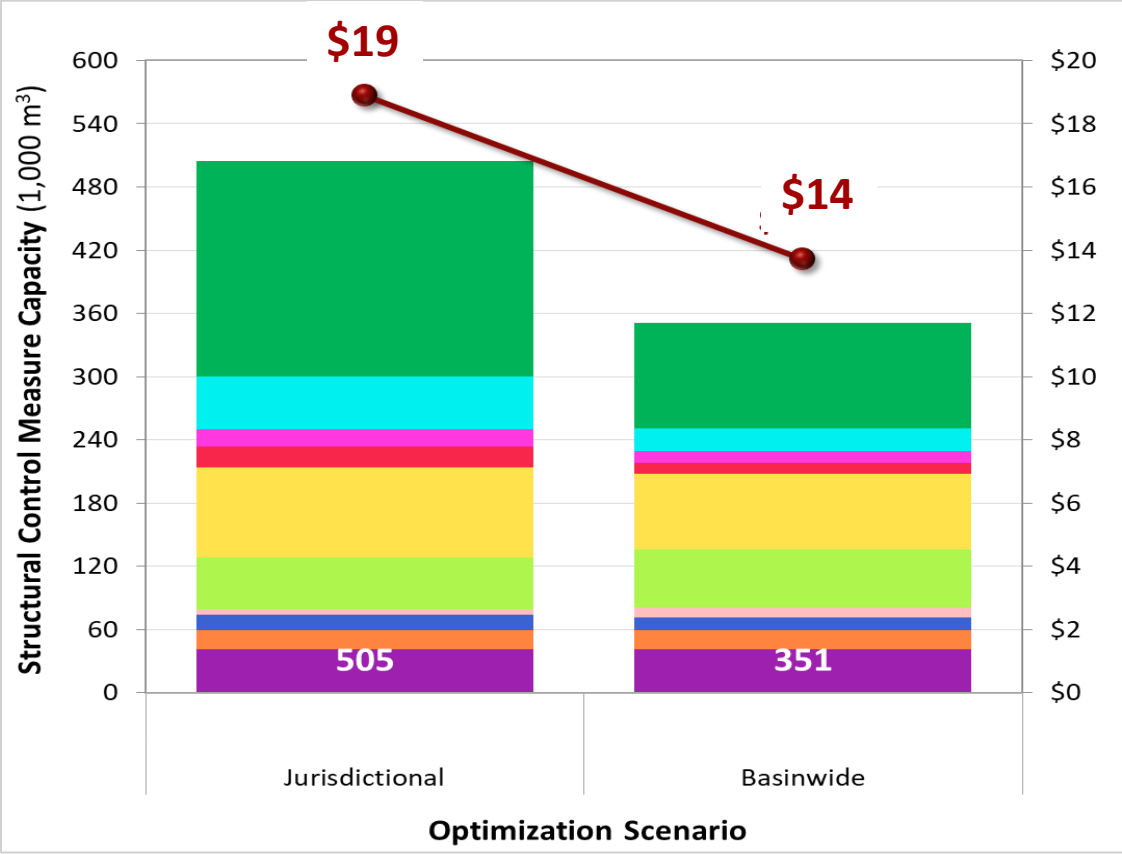
- 40% P reduction achieved for $19 Million.

Intermunicipal Collaboration:

- 40% P reduction achieved for $14 Million.

Collaboration:

- 28% Cost Savings.
- 30% Reduced capacity for SWM Infrastructure.



Potential Flood Reduction Benefits by Phosphorus SCMs

- ‘Water quality’ SCM can substantially reduce peak *flow rates*
- However, peak *water levels*, according to HEC-RAS, are not always sensitive to peak flow reductions.

Waterbody	Flood-prone Area ID	Description	Peak Flow				Elevation			
			10 yr	25 yr	50 yr	100 yr	10 yr	25 yr	50 yr	100 yr
Tannery Creek	Area 2	South of Tyler Street at Temperance St	17.21%	16.55%	14.65%	10.12%	7.83%	4.23%	3.14%	0.54%
Tannery Creek	Area 5	Aurora Heights Dr/Machell Park	20.06%	19.04%	16.62%	11.45%	1.93%	2.67%	7.79%	2.72%
Bogart Creek	Area 8	Gorham St to Srigley St	26.12%	24.44%	21.59%	15.68%	2.35%	2.99%	3.51%	3.41%
Western Creek	Area 10	Ontario St, East of Lorne Ave	16.74%	13.95%	13.85%	11.49%	6.84%	2.71%	1.50%	2.50%
Tannery Creek	Area 13	Harriman Driveways	23.79%	21.43%	18.41%	12.56%	8.46%	5.92%	3.73%	3.34%
Tannery Creek	Area 14	Kennedy St West Culert	17.78%	17.62%	15.78%	10.99%	10.65%	9.70%	10.43%	14.46%

Water level reductions much less than peak flow reductions due to constrictions in network

Simulating Benefit of SCM under Future Climate based on Flood Design Storms

- Future rainfall IDF curves under climate change extracted:
  - RCP 8.5: worst case
  - RCP 4.5: carbon emissions curbed
- The future storms were analyzed to forecast how much 'resiliency' the 40% TP reduction BMPs will build into the stormwater system

2021-2050									
Site	RCP 4.5								
	10 yr			25 yr			100 yr		
	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated
Area 2	+12.0%	-5.2%	100.0%	+46.9%	+30.4%	35.2%	+44.3%	+34.2%	22.8
Area 5	+20.4%	0.3%	98.5%	+33.3%	+14.2%	57.3%	+109.2%	+97.3%	10.9
Area 8	+11.4%	-11.4%	100.0%	+38.6%	+15.8%	59.2%	+90.7%	+75.8%	16.4
Area 10	+10.3%	-6.5%	100.0%	+31.5%	+15.3%	51.5%	+63.6%	+53.6%	15.8
Area 13	+11.4%	-11.7%	100.0%	+52.3%	+31.9%	39.1%	+55.5%	+44.5%	19.8
Area 14	+10.7%	-7.1%	100.0%	+32.0%	+14.3%	55.2%	+84.6%	+73.6%	13.0
Site	RCP 8.5								
	10 yr			25 yr			100 yr		
	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated	Non-Mitigated % Peak Flow Change	Mitigated % Peak Flow Change	Percent of Climate Change Mitgated
Area 2	+18.0%	+0.8%	95.8%	+52.8%	+36.3%	31.3%	+33.2%	+23.0%	30.5
Area 5	+26.5%	+6.5%	75.7%	+38.1%	+19.1%	50.0%	+67.8%	+55.9%	17.6
Area 8	+15.9%	-7.0%	100.0%	+44.1%	+21.2%	51.8%	+58.5%	+43.7%	25.4
Area 10	+14.3%	-2.4%	100.0%	+35.7%	+19.5%	45.5%	+42.3%	+32.2%	23.8
Area 13	+17.5%	-5.6%	100.0%	+59.1%	+38.6%	34.6%	+40.0%	+28.1%	29.7
Area 14	+14.5%	-3.2%	100.0%	+36.5%	+18.8%	48.3%	+54.2%	+43.3%	20.3

Climate Change Mitigation by SCMs (2021-2050)

A Compelling Case

INFRASTRUCTURE OPTIMIZATION
Cost savings and improved performance

MULTIPLE *T.B.L* BENEFITS
Reduced risk & liability
Greener, healthier communities.

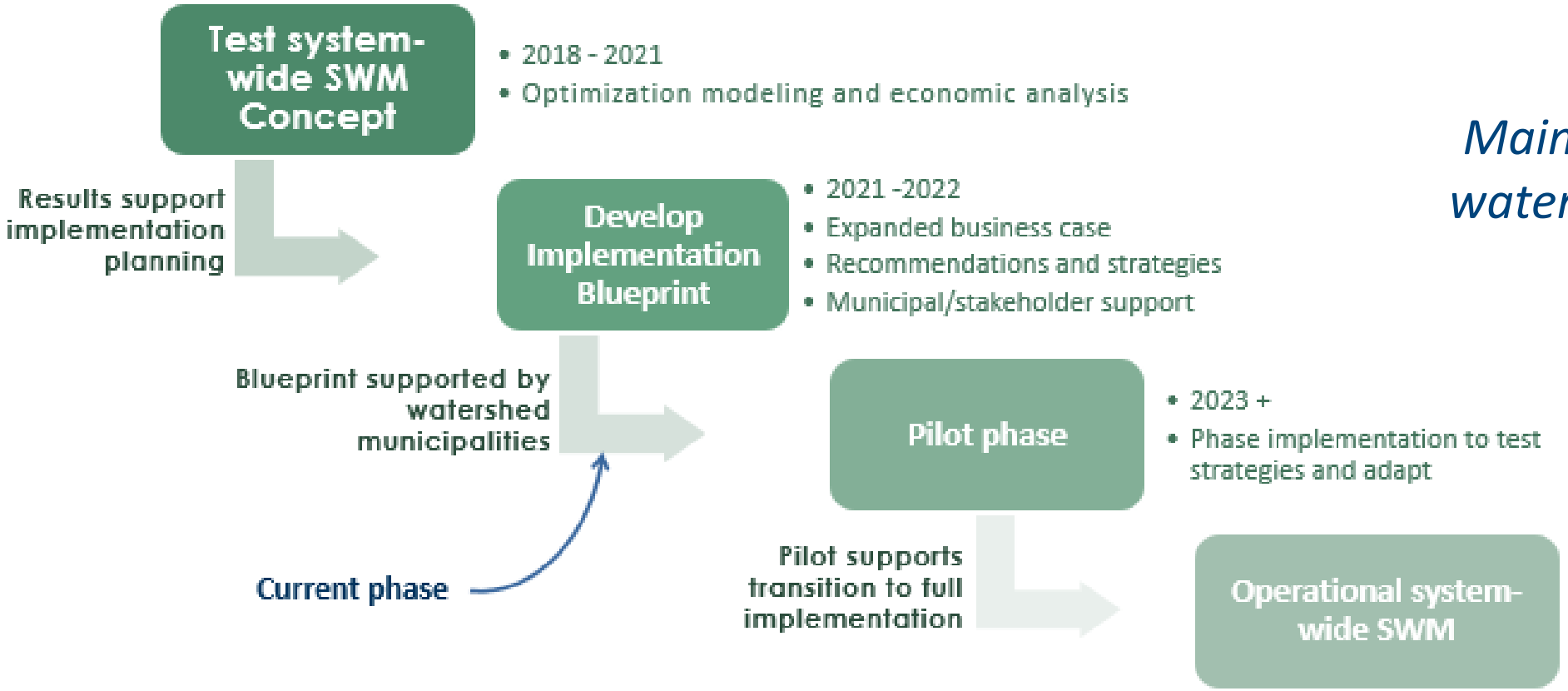
IMPROVED ENVIRONMENTAL OUTCOMES
Water quality and reduced flood risk.

ECONOMIC DEVELOPMENT OPPORTUNITY
A path to economic growth in burgeoning Green Infrastructure sector.

PROGRAMMING & RESOURCE OPTIMIZATION
Additional savings through collaboration and sharing of resources.

Next steps

- Complete the implementation blueprint
- Transition to pilot implementation, leading to full implementation

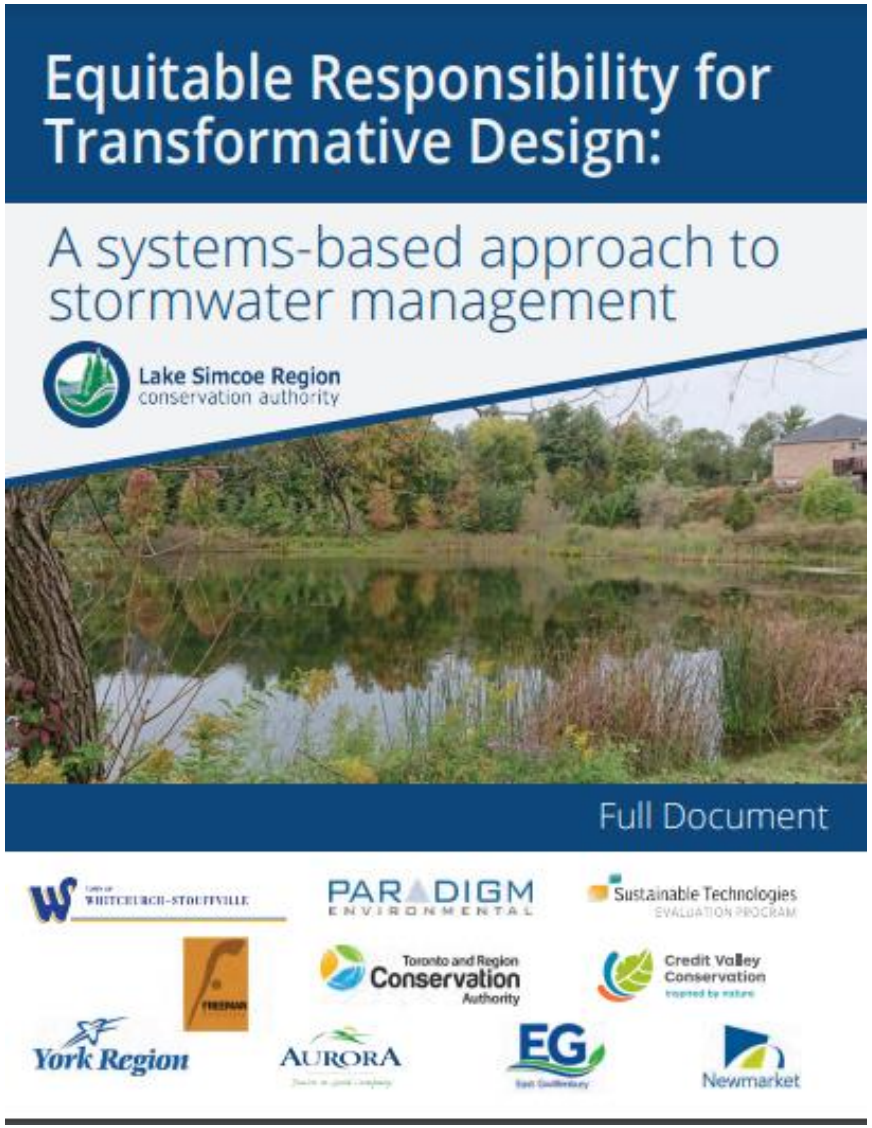


Maintain full support of watershed municipalities throughout

Transferability…

- Optimization methodology highly transferable to other municipalities and watershed management agencies
- A framework for intermunicipal stormwater collaboration and cost-sharing for watershed
- Market-based approaches (i.e. alternative and sustainable financing options) to incentivise private property participation

Study report



https://sustainabletechnologies.ca/app/uploads/2021/03/ERFTD_Final-Technical-Report.pdf
https://www.lsrca.on.ca/Shared%20Documents/reports/Stormwater-Management-Summary.pdf

Acknowledgements

TECHNICAL ADVISORY COMMITTEE MEMBERS

Municipalities

- York Region
- Town of Newmarket
- Town of Aurora
- Town of East Gwillimbury
- Town of Whitchurch-Stouffville

Conservation Authorities

- Toronto Region
- Credit Valley
- Lake Simcoe

Provincial Government

- Ministry of Environment, Conservation & Parks

Consultants

- Freeman Associates Ltd.
- Paradigm Environmental
- Fortin Economics
- Barry Hassler

Funding Partners

- Natural Resources Canada (NRCAN)
- Federation of Canadian Municipalities (FCM)
- National Disaster Mitigation Program (NDMP)
- York Region
- Lake Simcoe Conservation Foundation
- Toronto Region Conservation Authority (TRCA)
- Credit Valley Conservation (CVC)
- Town of Newmarket

Thank you

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Bridging the Gap: How public and private property owners can work together to improve stormwater management

Presented by: Phil James and Kyle Vander Linden

Date: March 24, 2022

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The water component of STEP is a collaborative of:

Lake Simcoe Region conservation authority

Credit Valley Conservation inspired by nature

Toronto and Region Conservation Authority

Overview

STEP is a multi-agency initiative developed to support broader implementation of sustainable technologies and practices within a Canadian context.

The water component of STEP is a conservation authority collaborative. Current partners are:

Lake Simcoe Region conservation authority

Credit Valley Conservation inspired by nature

Toronto and Region Conservation Authority

Our key areas of focus are:

- Low Impact Development
- Erosion and Sediment Control
- Road Salt Management
- Natural Features Restoration

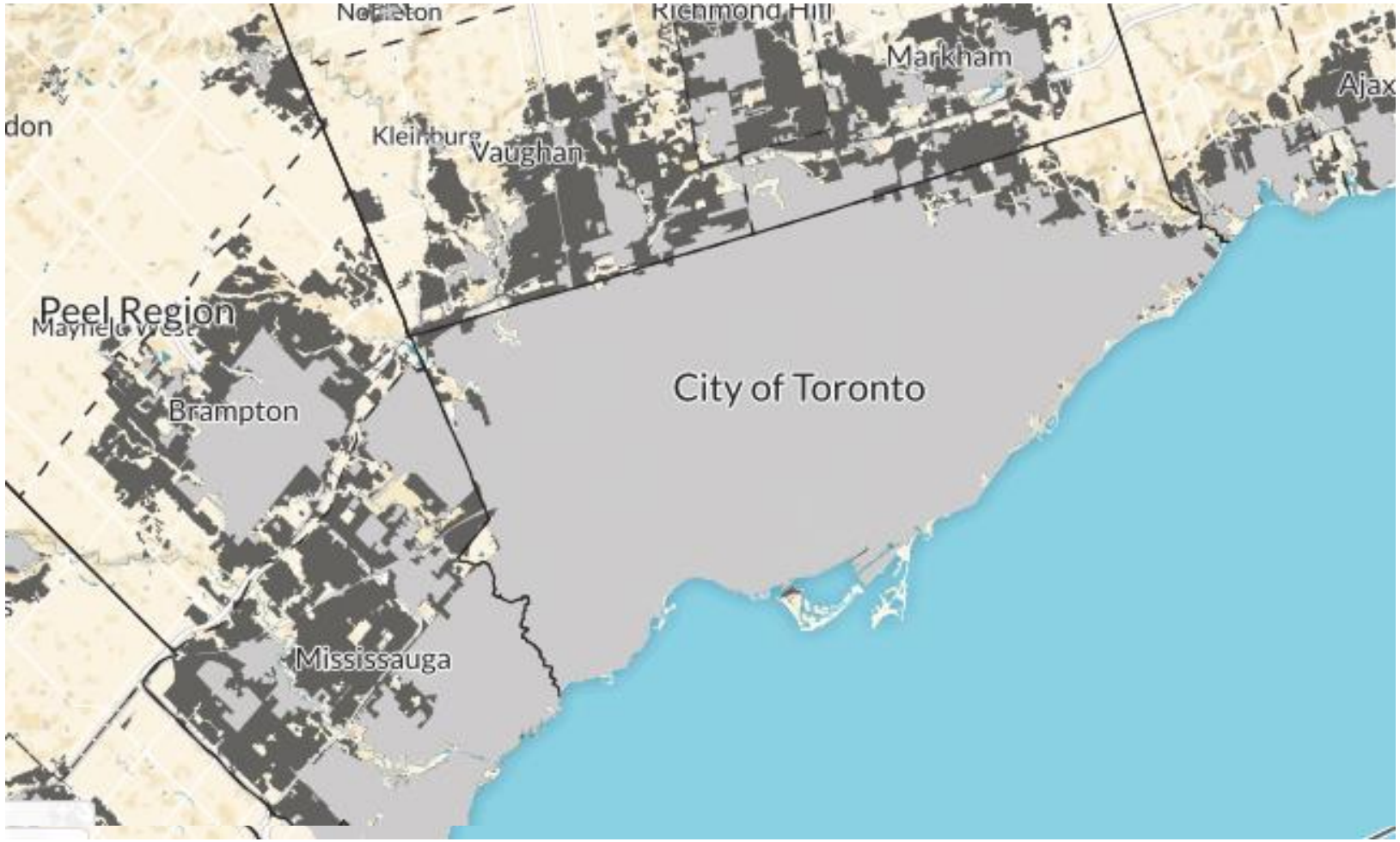
Agenda

1. *Current Challenges with Urban Stormwater Management*
2. *A 'Made in Ontario' Innovative Solution to Stormwater Management*
3. *Outcomes of the Guidance Document*
4. *Professional Capacity Building*

The problem: legacy stormwater infrastructure

Development prior to 1981

Development between 1981 and 2011



Source: Neptis Geoweb (2020)

Urban Stormwater Challenges

Credit: www.teenaintoronto.com

Solution to Urban Stormwater Challenges: Low Impact Development

Source: USEPA

Source: ADS

Barriers to Low Impact Development Uptake

Private Property Owner Barriers

- Despite stormwater credit programs there is low uptake
- Pay back period for SWM retrofits is poor
- Lack of defined process to solve drainage problems

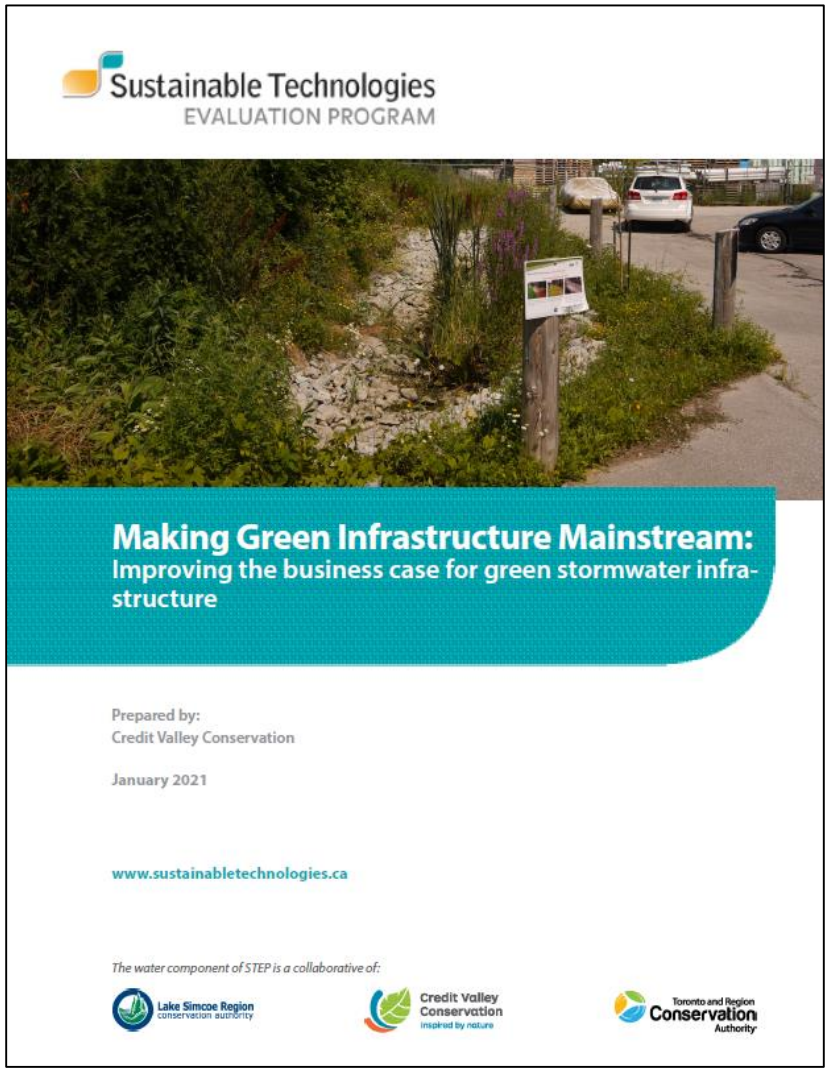
Municipal Barriers

- Cost of retrofitting public lands and lack of space
- How to ensure features on private property are maintained

Making Green Infrastructure Mainstream

Features four case studies:

- City of Kitchener
- City of Vancouver
- City of Edmonton
- Southdown, Mississauga



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Making Green Infrastructure Mainstream:
Improving the business case for green stormwater infrastructure

Prepared by:
Credit Valley Conservation

January 2021

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The water component of STEP is a collaborative of:

Lake Simcoe Region conservation authority
Credit Valley Conservation inspired by nature
Toronto and Region Conservation Authority

Common Themes: Key Findings Overview

Systematic Approaches

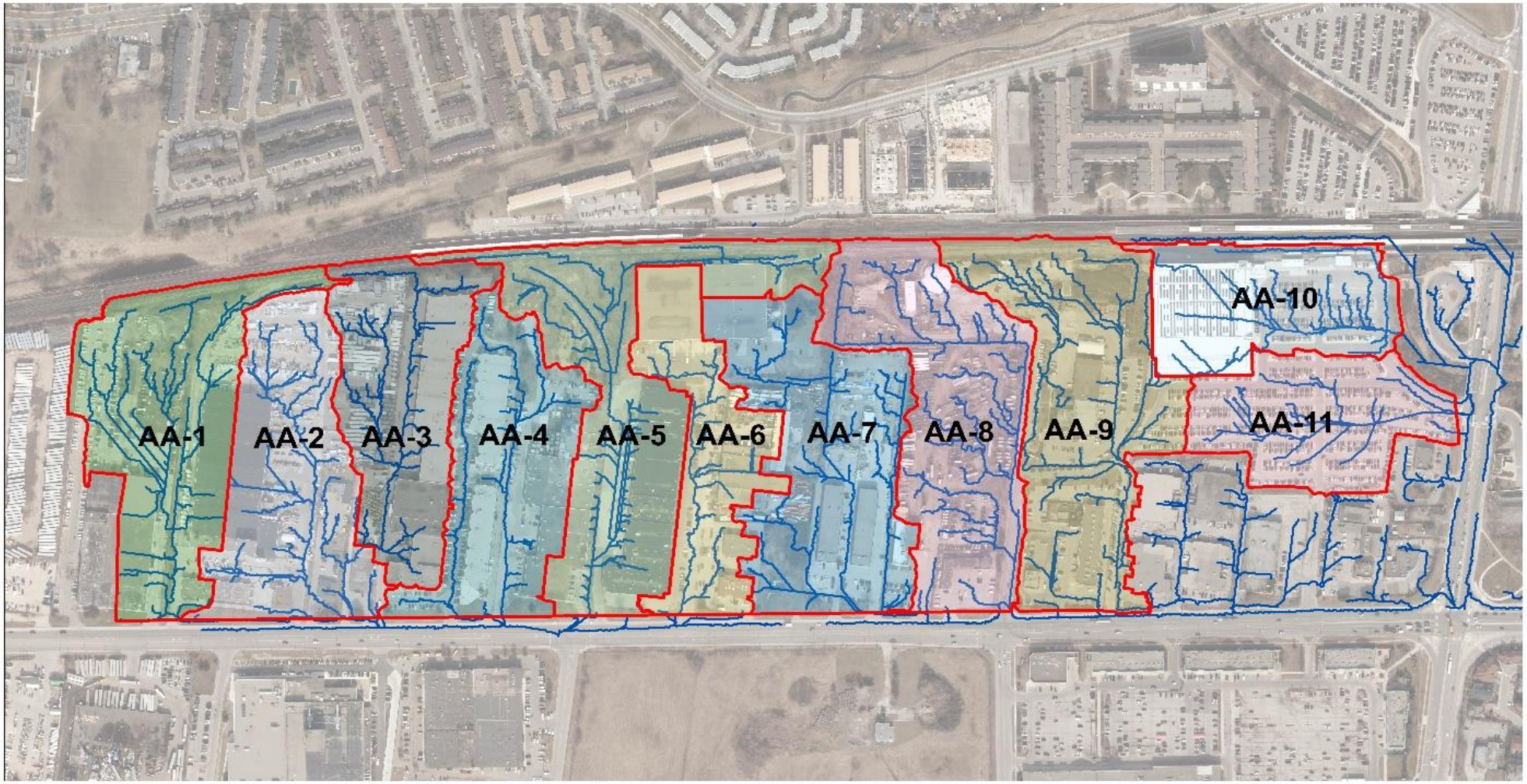
Flexibility and multi-functional infrastructure

Building Economies of Scale

Bridging Public-Private Divide

Co-benefits and shared objectives

Study Area

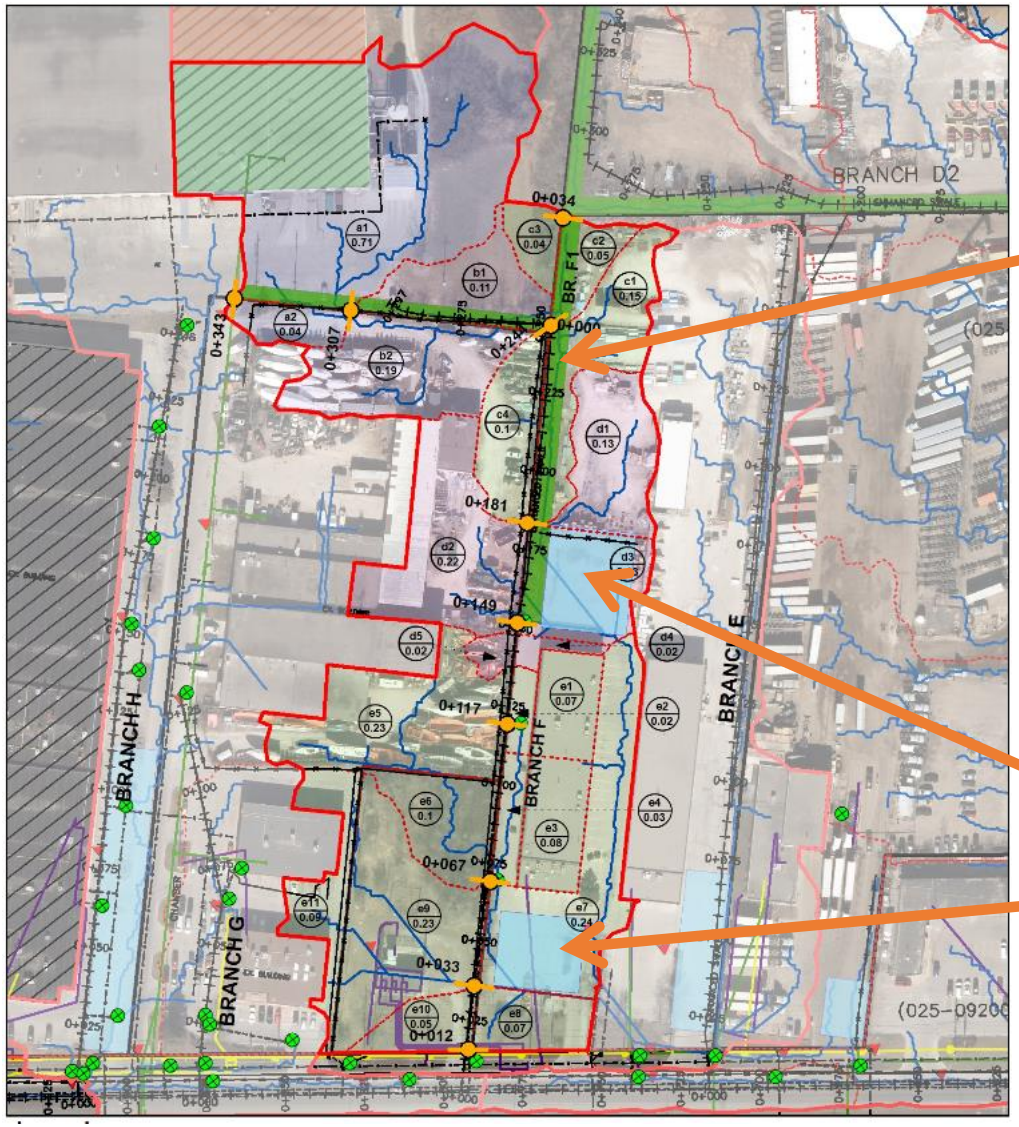


Legend

- Major Subcatchment
- Overland flow routes

0 50 100 200 Meters

Why is Cooperation Advantageous?



Meet minimum requirements to achieves 50% credit

Enhanced Grass Swale + OGS

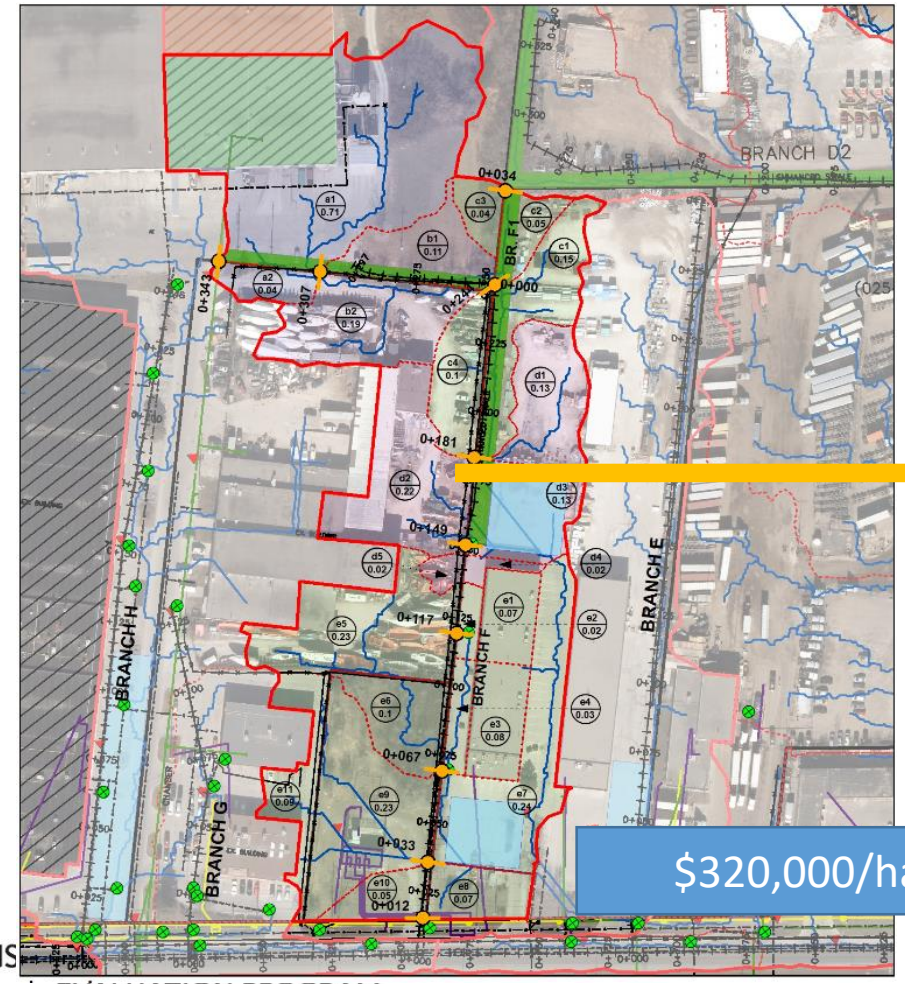
Underground Storage

Bottom Line: Its 20 % Cheaper to Build Communal LID on Private Property than Pond on Public Property

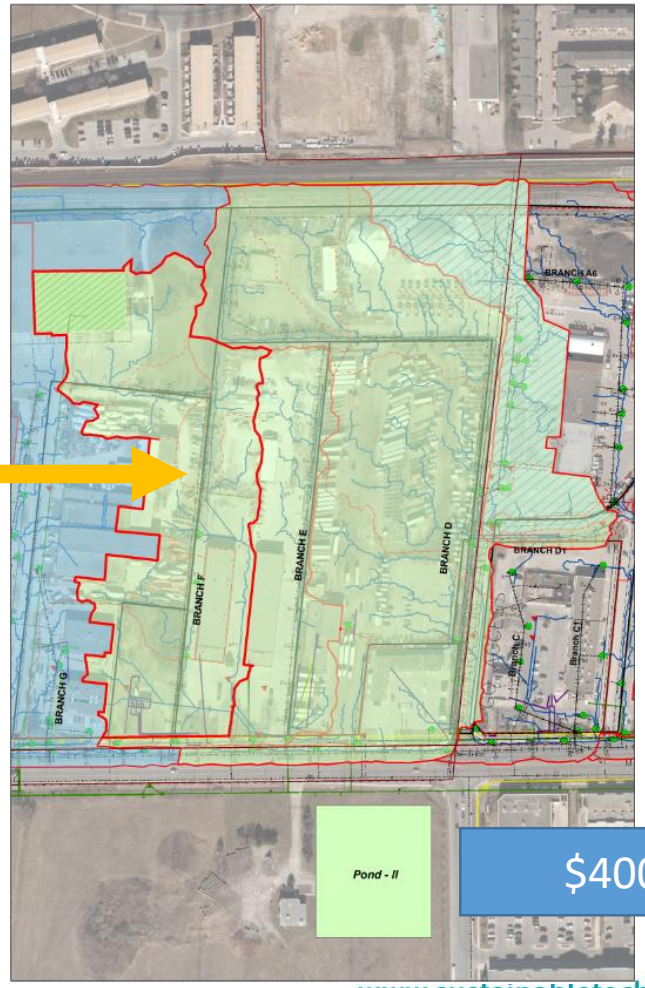
Communal LID on 4 Private Properties

VS

End of Pipe on Public Property



Apples to Apples Comparison

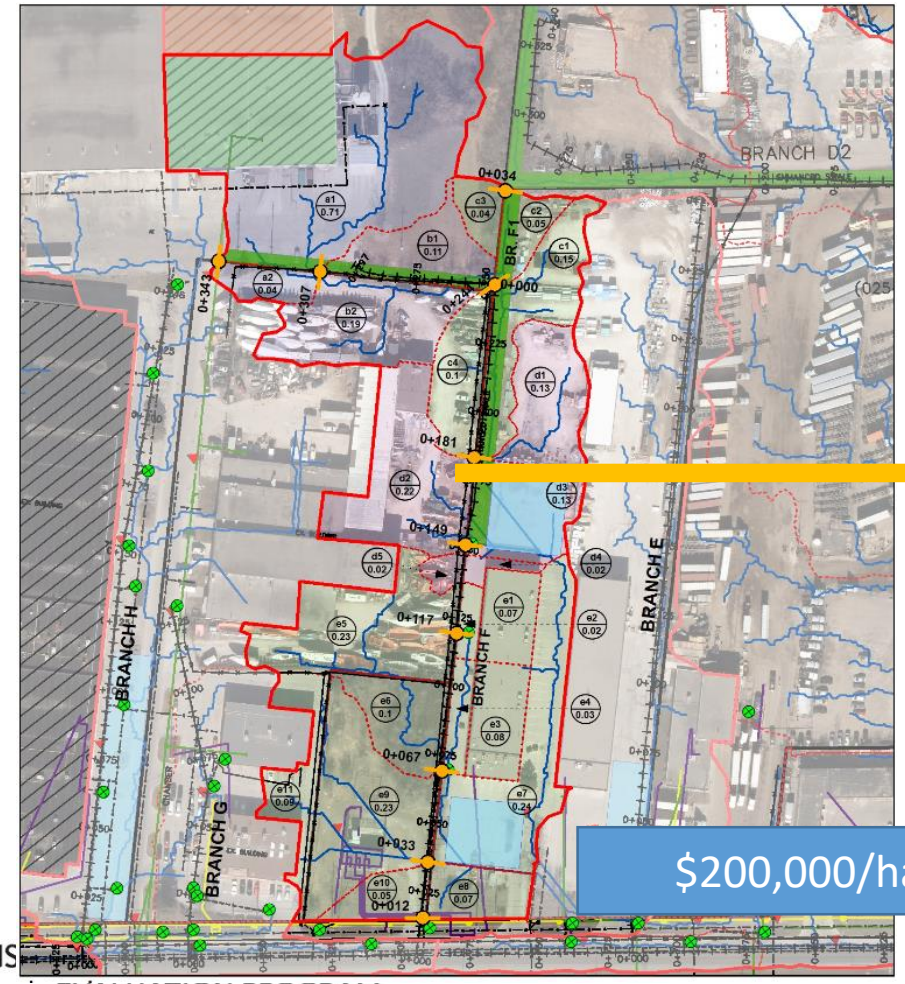


$320,000/ha

$400,000/ha

Bottom Line: Cost Savings Increase to 50 % when Cost Sharing is Employed

Communal LID on 4 Private Properties VS **End of Pipe on Public Property**



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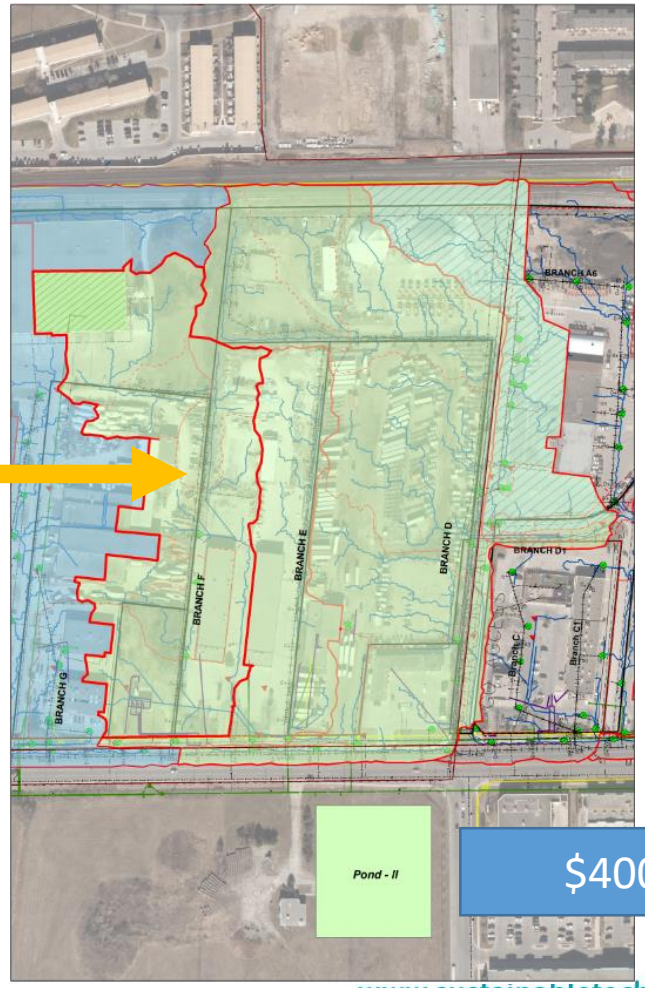
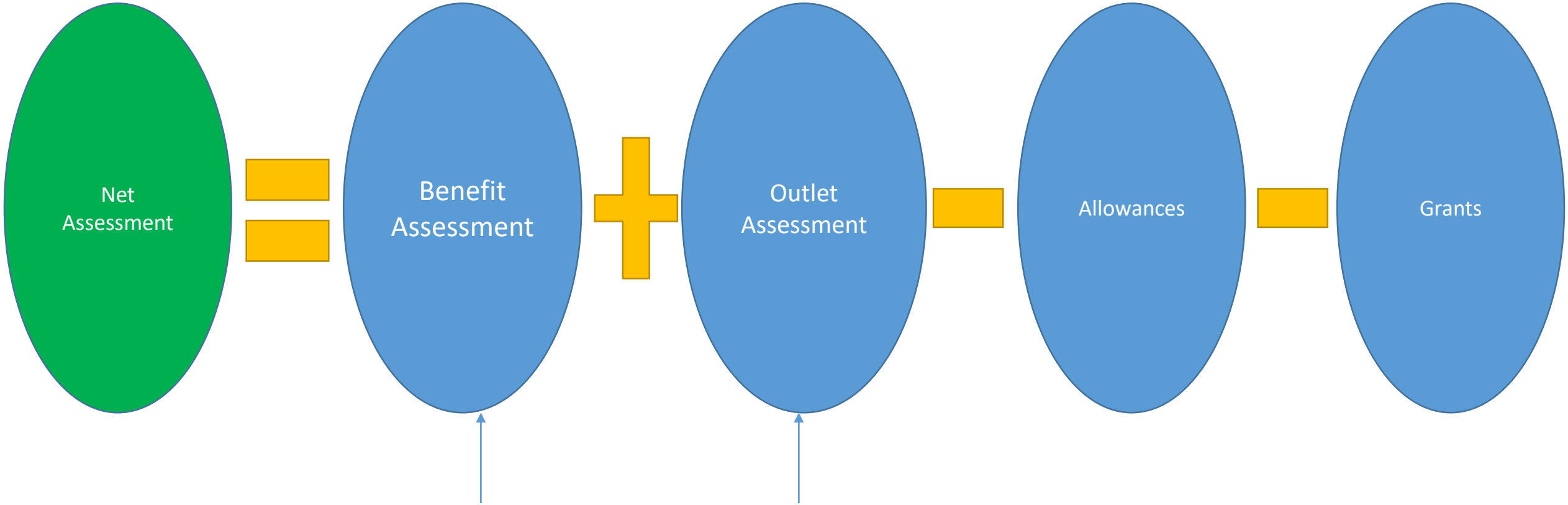


$200,000/ha

$400,000/ha

Cost Sharing



Based on how much each property benefits from the system

Based on how much water each property outlets to the system

Net Assessment Schedules

Schedule A - Total Net Assessment

Con	Lot	Roll No.	Owner	Total Ha Affected	Benefit ($)	Outlet ($)	Total ($)	General Grants ($)	Allow-ances ($)	NET ASSESS. ($)	Cost to Manage Br F using End of Pipe Controls [2, 3]	Savings to Municipality [4] ($)
		21-05-020-221	Landowner 1	0.86	3,568	62,445	66,013		40,981	25,032		
		21-05-020-222	Landowner 2	0.89	7,582	49,012	56,593		0	56,593		
		21-05-020-223	Landowner 3	0.38	36,245	7,245	43,490		0	43,490		
		21-05-020-224	Landowner 4	1.00	143,376	35,975	179,351		155,136	24,215		
		Road Allowance	Municipality		456,912		456,912			456,912	1,257,443.27	800,531.03
Total Assessments for Branch F				3.13	647,683	154,677	802,360	0	196,117	606,243		

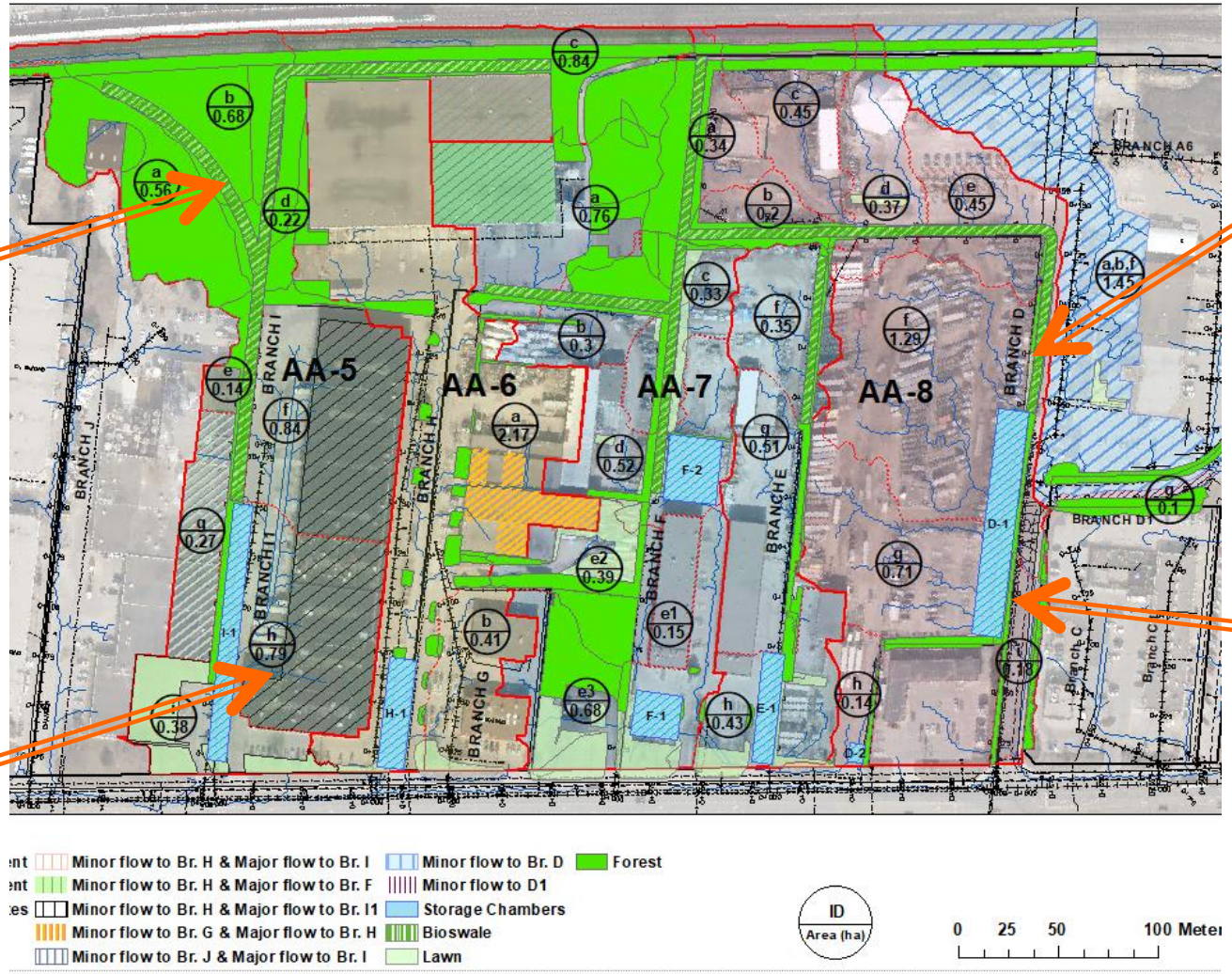
Note: This example is to help illustrate how the process works and the process of arriving at the net assessment.

It is the engineer's responsibility to fairly assess benefits and the landowners have the ability to appeal their assessment if they don't agree.

Building Climate Resilience in a Collaborative Cost-Effective Manner

Natural Assets - Forest

Communal Rainwater Harvesting



Bioswale

Underground Storage with infiltration trench

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How the study supports our municipal and provincial partners

Ministry of the Environment Conservation and Park's (MECP) System Wide Linear ECA

Drainage Study – Communal Retrofit Opportunities

Mississauga Stormwater Charge Multi-Property Credit

Assessment of Legal Mechanisms to Ensure Linear ECA Compliance

OMAFRA's 1) Engineers Guide to Working Under the Drainage Act and 2) Drainage Superintendent's Guide

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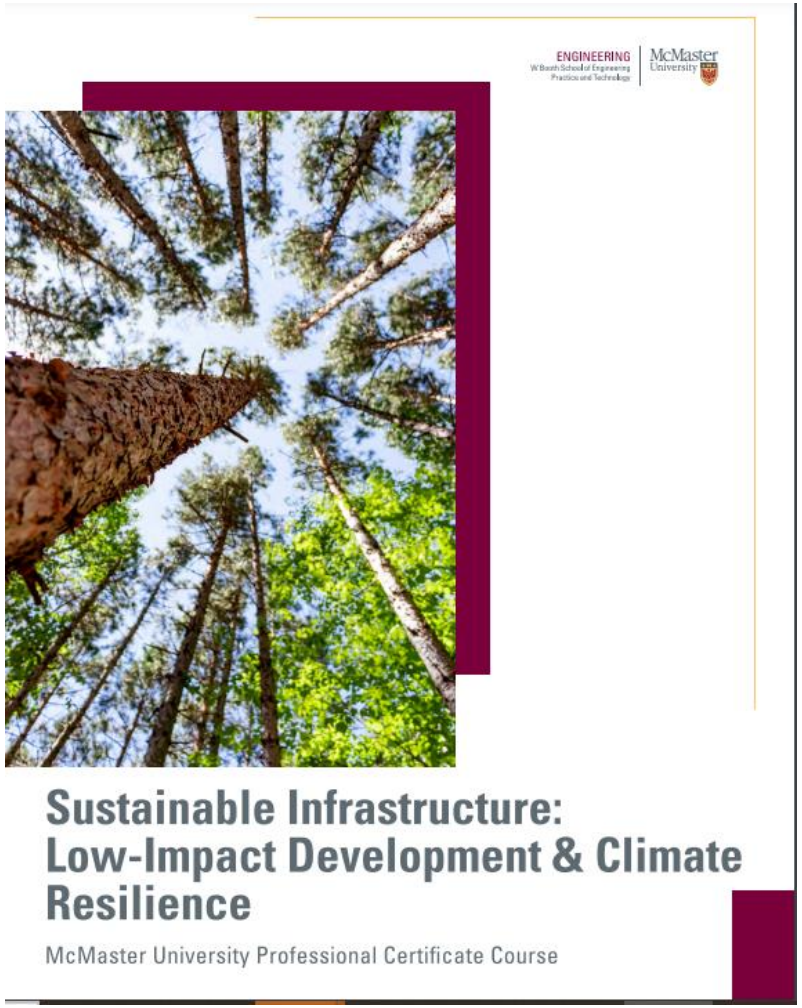
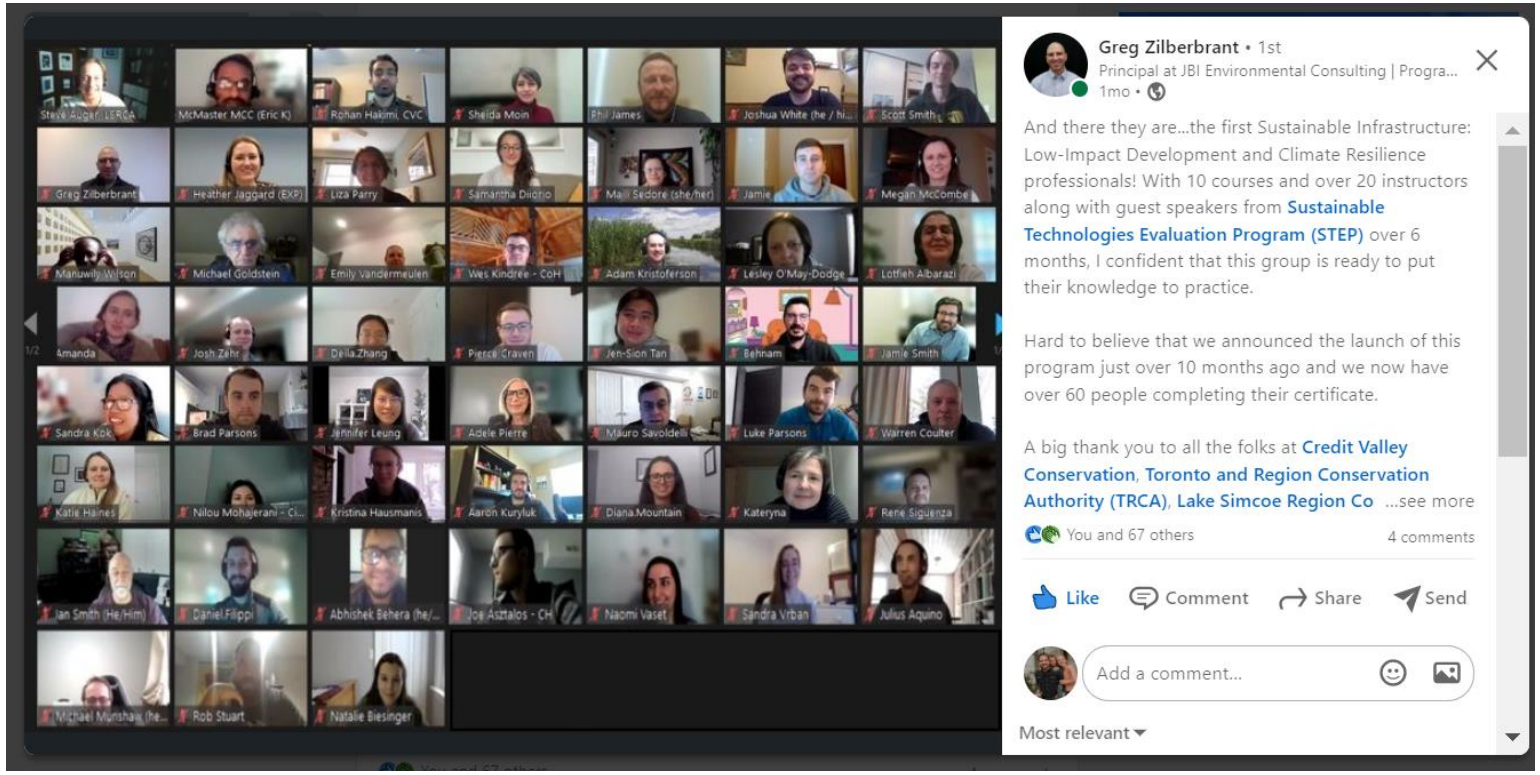
Click here for a message from CISEC Inc. regarding membership payment changes. Members of IECA, Landscape Ontario, and AORS are eligible for discounts on some courses.

Upcoming Training | Pre-recorded Webinars | E-Learning | TRIECA 2020 Webinars

Filling an Industry Gap: STEP and McMaster University Training Collaboration and Certificate in LID and Climate Resilience





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Next Steps

- Engineer’s Report
- Aggregation Methodology
- Further scenario analysis

Thank You

For more information:

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Questions?

Thank you!

Learn more about the Adaptation Platform Webinar Series:
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Upcoming webinar…

Health of Canadians in a Changing Climate: Advancing Our Knowledge for Action

March 29, 2022 from 1-2pm EST

For more information and to register:

https://climateriskinstitute.ca/2022/03/21/webinar-health-of-canadians-in-a-changing-climate-advancing-our-knowledge-for-action/

Access the report at ChangingClimate.ca