Video: http://www.peelregion.ca/climate-energy/

Region of Peel
working with you

Toronto and Region Conservation Authority

Assessing Green Infrastructure Opportunities to Increase Climate Change Resiliency in Region of Peel

Grey to Green Conference
April 4, 2019

Mark Pajot	Yuestas David
Advisor, Office of Climate Change & Energy Management (OCCEM)	Project Manager, Research and Knowledge Management
Region of Peel	Toronto and Region Conservation Authority

GREY TO GREEN
Toronto | April 4 & 5, 2019

Outline

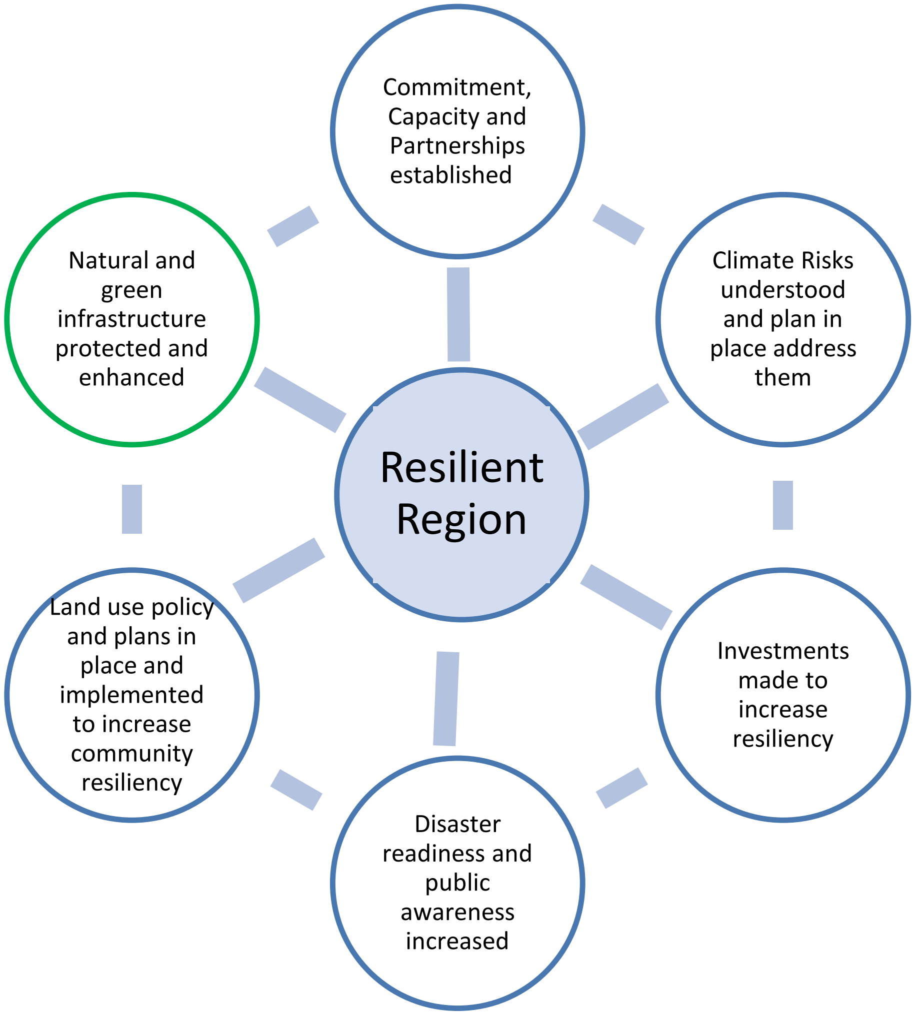
- Urgent Action Needed
- Climate Change Drivers, Risks and Impacts
- Towards Climate Resilient Cities and Regions
- The case for green infrastructure as key climate resilient feature
- Community partnership plans and maps
- Supportive policy, plans, and standards
- Case Studies
- Discussion

Urgent Action Needed on Climate Change

A little warming will lead to a lot of problems

- 2°C will be far worse than 1.5°C
- Hundred millions of more people exposed to water stress, food scarcity and climate related poverty
- More extreme heat causing forest fires and mortality in the vulnerable
- Sixth extinction underway

Towards Climate Resilient Cities and Regions



Sources:

1. UN ISDR Sendai Framework for Disaster Risk Reduction (2015) https://www.unisdr.org/we/coordinate/sendai-framework
2. Climate Change Adaptation Indicators Framework for the City of Boston (2015)
3. Municipalities and Climate Change: A Framework for Analyzing Local Adaptation Policy. (2014) Paper prepared for the Annual Meeting of the Canadian Political Science Association Session E1 – Beyond Borders: Local Climate Change Policy and Inter-Local Cooperation Brock University, St. Catharines, Ontario.

Commitment, Capacity and Partnerships established

Commitment and Capacity Established

Previous decade counted

Leadership stepped up to the challenge

2017: Council's Statement of Commitment Endorsed

- Outlined principles and desired outcomes to ensure concrete action is taken
- Acknowledged GHG Emissions Reduction Targets
- Provided direction for Climate Change Master Plan

Commitment, Capacity and Partnerships established

Community Climate Change Partnership Supported

Mandate

Working together to adapt to and mitigate the effects of climate change as we transition to low carbon and resilient communities within Peel Region

	1) Low Carbon Community	2) Flood Resiliency	3) Green Natural Infrastructure	4) Public Education
Strategies	Develop and implement actions that result in reducing community greenhouse gas (GHG) emissions in priority areas	Strengthen the integrated approach to water management for collective action in reducing flood risk in priority areas	Increase the number of healthy trees in priority areas to reduce public health risk and enhance social and environmental outcomes	Deepen knowledge and understanding of climate change corporately and in the community, contributing to long-term behaviour changes that build resilient regional communities and neighbourhoods
Outcomes	Net reduction in community GHG emissions	Reduce flood risk by increasing flood resiliency in priority areas	Increase canopy cover in priority areas to provide multiple co-benefits	Increase knowledge and awareness of climate change that results in behaviour change to build resilient communities in support of the Peel Climate Change Partnership Plan
Success Metric	Number and use of electric vehicle charging stations across the Region	Reduced flood risk as a result of utilized adaptation measures and priority planning; i.e. SNAP, Modelling Tools	Number of healthy trees on public land in priority areas	Increase the number of coordinated activities with partners
	Reduction in energy use in priority areas	Number of inter-agency policies, plans, programs and projects that integrate flood resiliency into practice	Surface temperature in priority areas	Number of people reached with climate change messaging from the Community Climate Change Plan

Integrated Approach

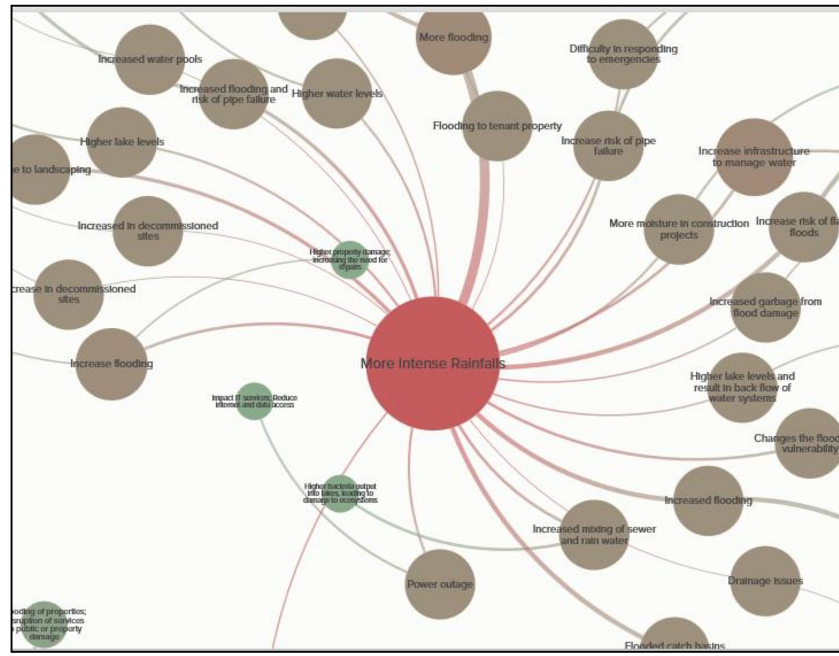
Map to identify priority areas | Benchmark and Report | Coordinate funding | Innovate

Climate Risks understood and plan in place address them

Vulnerabilities and Risks Assessed

Climate Trends and Vulnerability Assessments (2014-2016)

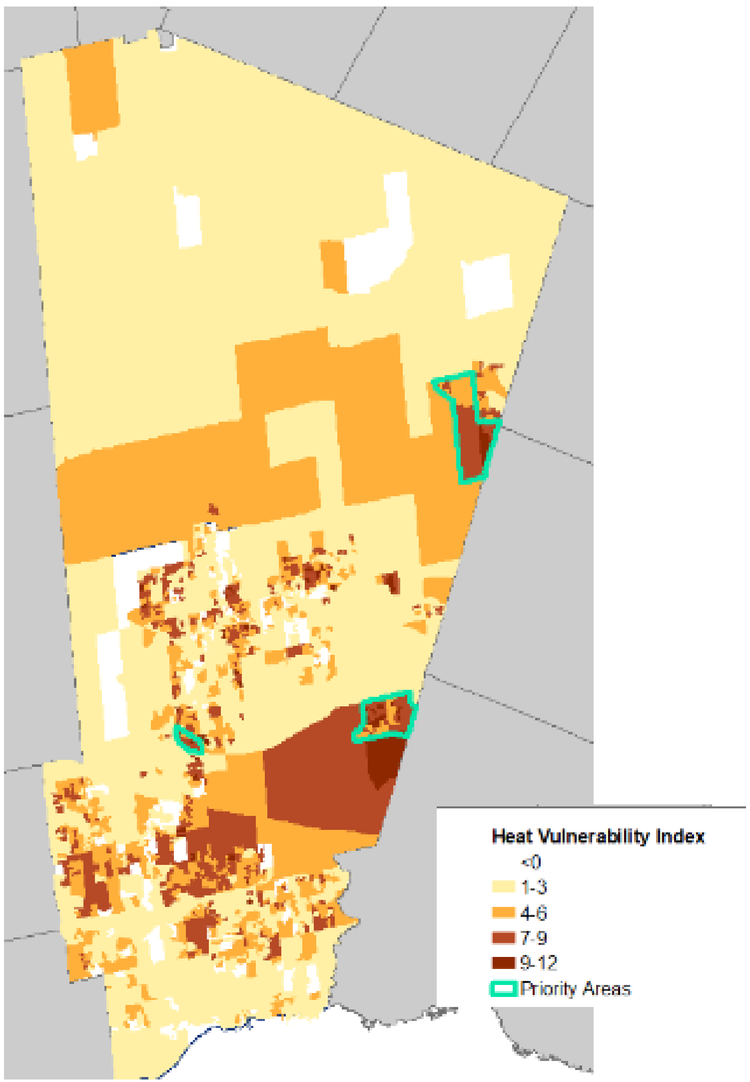
Corporate Risks (2017)



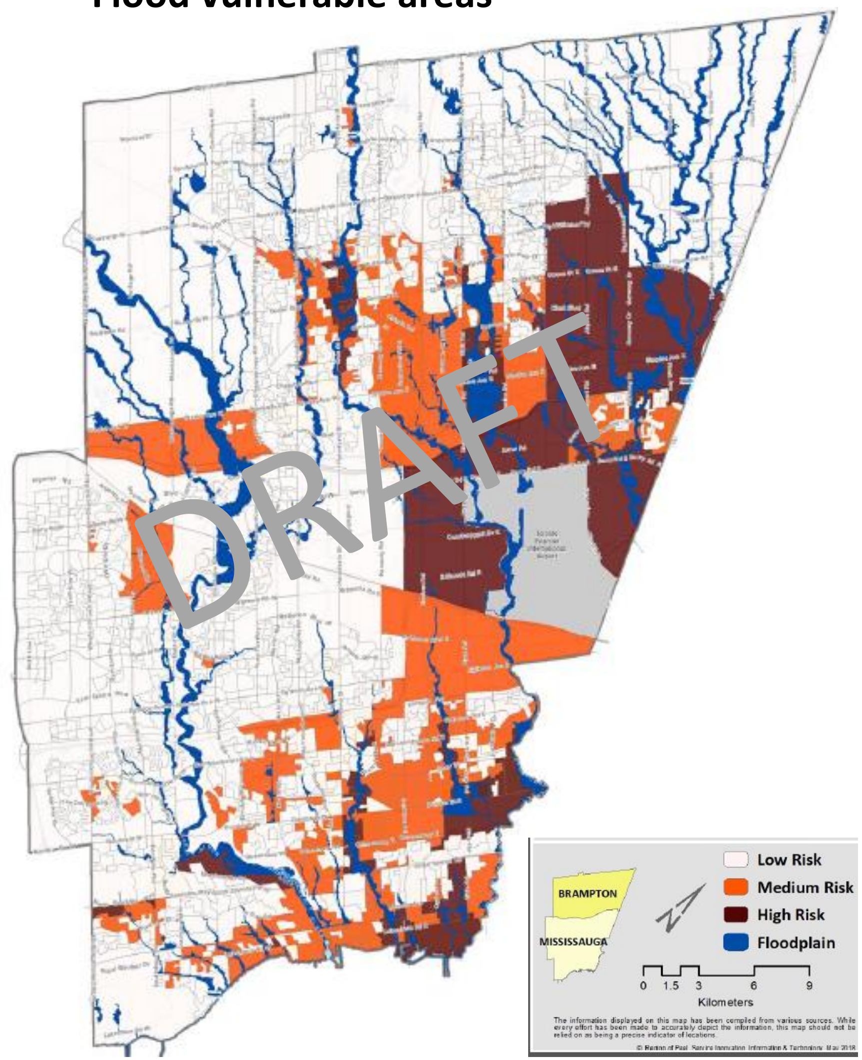
Climate Risks understood and plan in place address them

Heat and Flood and Vulnerable Areas Identified

Heat vulnerable areas



Flood vulnerable areas



Investments made to increase resiliency

Investments Increasing

2019

Enterprise Programs and Services

Climate change mitigation and energy management – 2.2 million

Water and Wastewater

Reduce incidents of sewer back-ups during severe weather events caused by surcharge of the sanitary system.

Roads and Transportation

Adapting to and to mitigating the effects of climate change by implementing low-impact development measures into our road designs so more water can be absorbed during severe weather events

2019-2028

2019-2028 Capital Plan Forecast

Government is future-oriented and accountable: $39 million for climate change studies and investments as well as technology initiatives to provide modern service to citizens

Disaster readiness and public awareness increased

Preparing for greater weather related emergencies

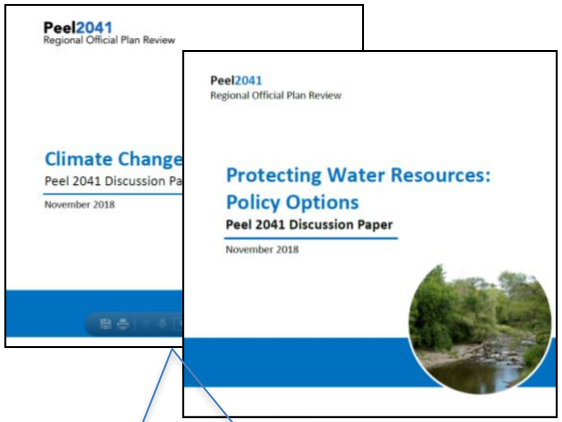
https://vimeo.com/324691127

Climate Risks understood and plan in place address them

Land use policy and plans implemented to increase community

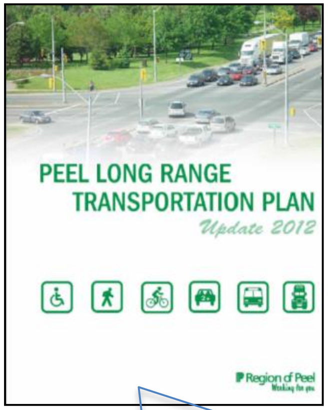
Supportive Policies, Plans and Standards in Development

Official Plan Policy (2041)



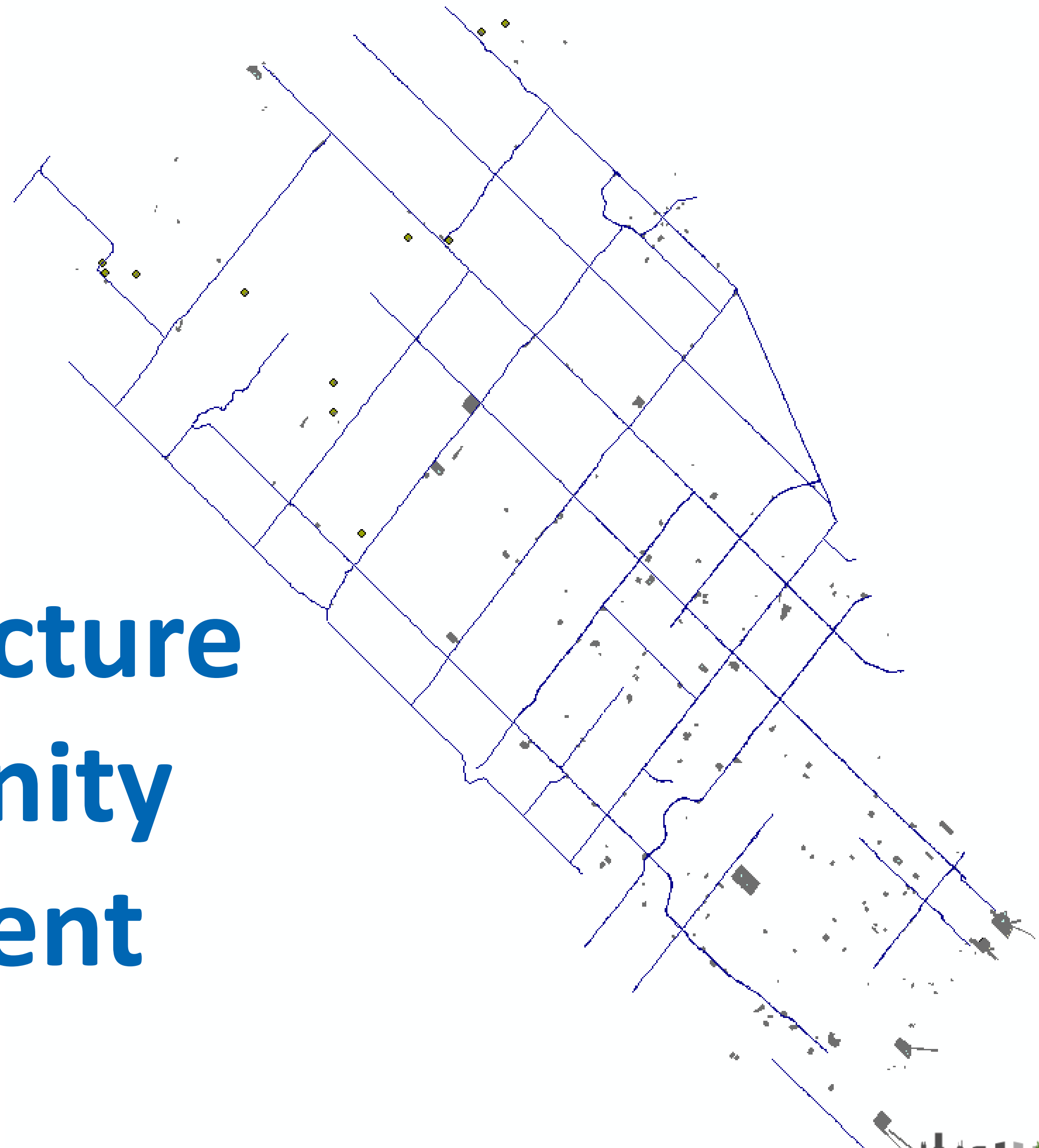
"Support comprehensive stormwater management planning, including low impact development and green infrastructure."

Transportation Planning and Storm water management



- Condition assessment
- Hydraulic modelling
- Storm Servicing Master Plan
- Storm water Criteria and Procedural Manual
- Tree planting standards

Green Infrastructure Opportunity Assessment



Objectives and Deliverables

Objectives

Design and size Green Infrastructure for sites to meet a selected **SWM criteria**, calculate the **cost of implementation**, and test the **performance** of the site design for future **climate change** scenario.

Key Deliverables

1. Inventory land assets
2. Model Base/GI stormwater management + Current/Future climate
3. Estimate cost

Inventory of RoP's Land Assets

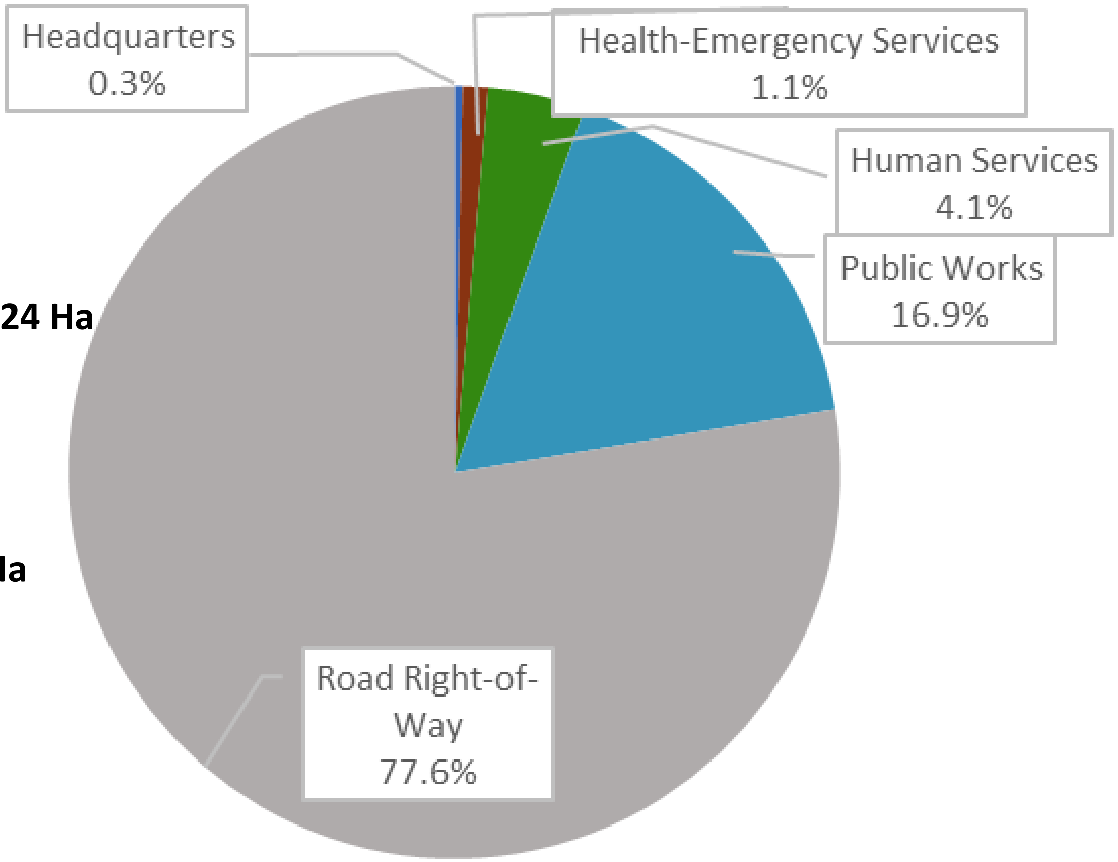
Human Services - 92 Ha
- Child Care
- Social Housing
- Shelters

Headquarters – 7.5 Ha
- Administration Offices

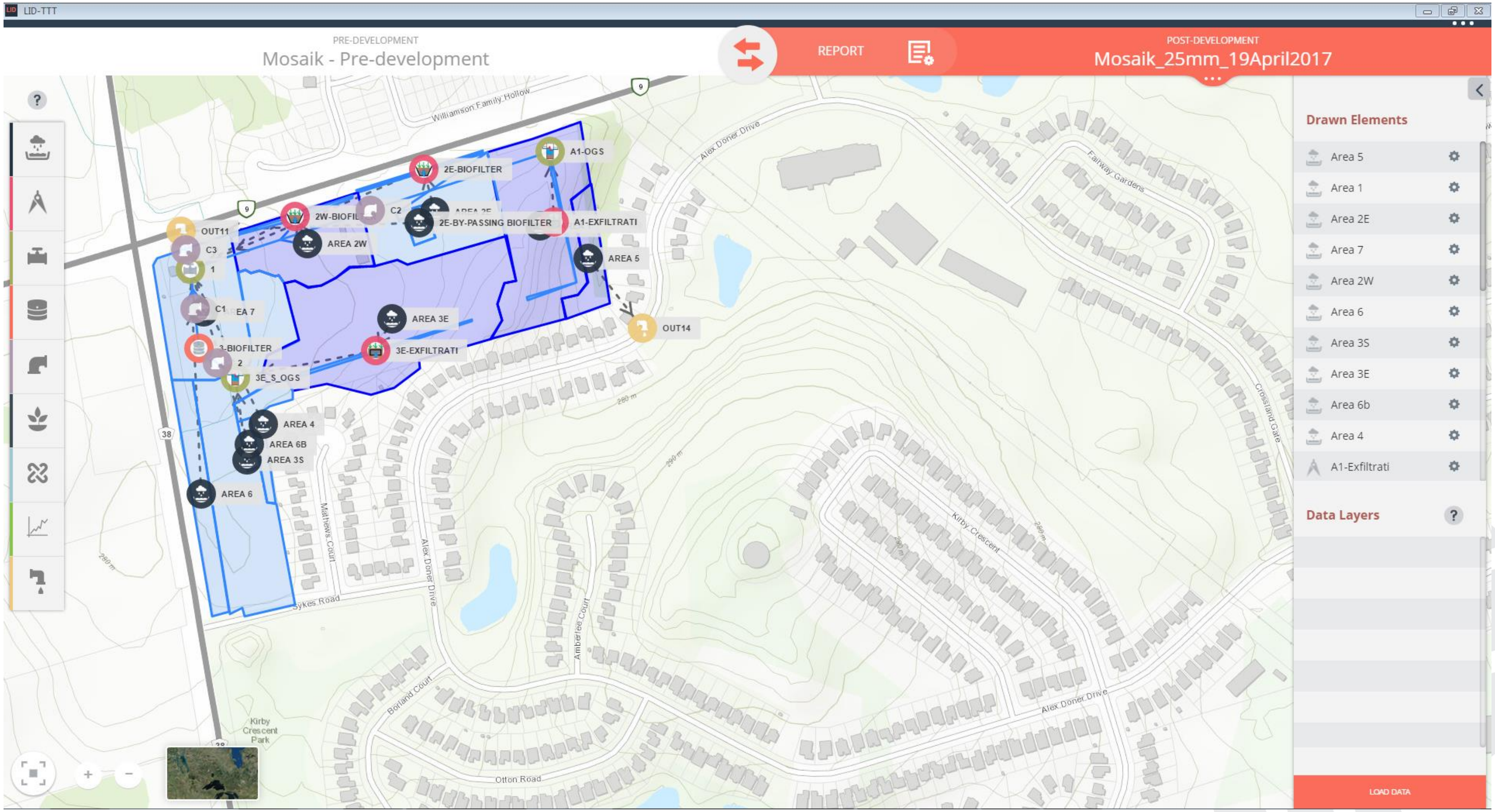
Health/Emergency Services – 24 Ha
- Paramedics
- Long Term Care
- Police

Public Works Facilities – 382 Ha
- Public Works Facility
- Water Storage Buildings
- Water Treatment Plants
- Sewage Treatment Plants

Road Right of Way – 1752 Ha
- Regional Roads
- Regional Road Sidewalks & Medians



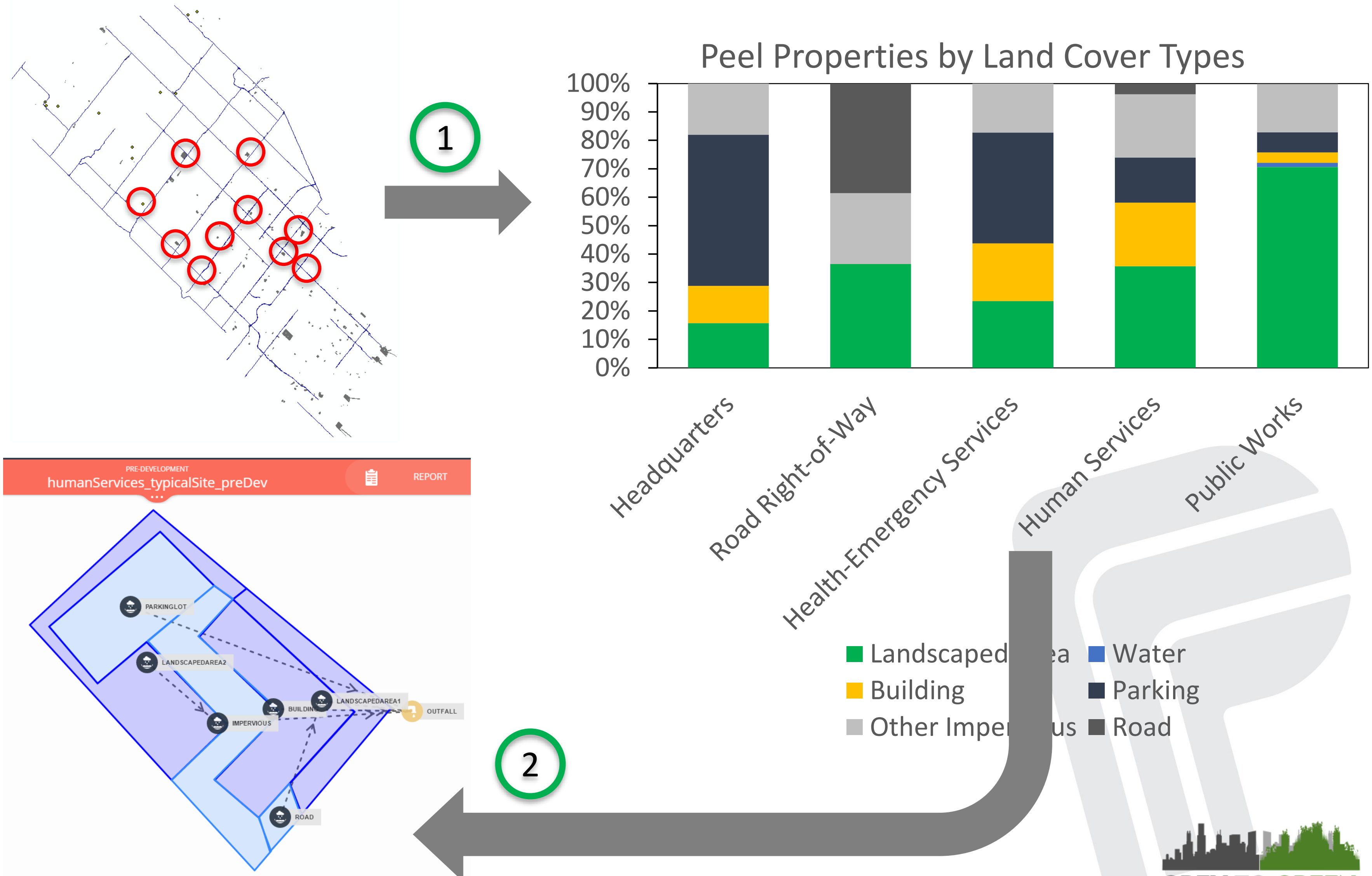
LID Treatment Train Tool (Free)



lidttt.sustainabletechnologies.ca

GREY TO GREEN
Toronto | April 4 & 5, 2019

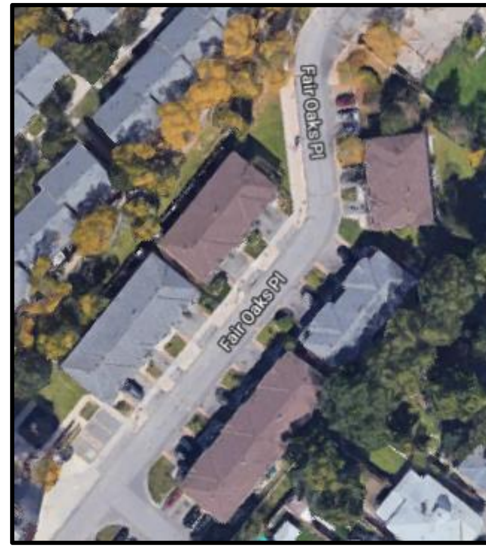
Typical Site Summaries

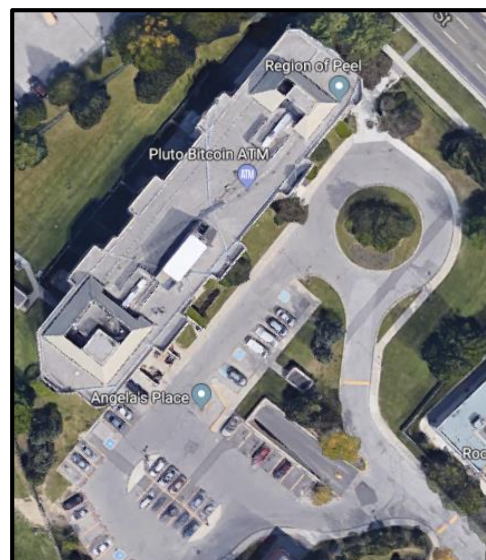


Typical Site Summary – Human Services

Site Characteristics	
Median site size	0.88 hectares
Soil type	Clay loam
Type of use	Medium-high density housing, shelters, and child care

Land cover type breakdown	
Building	22%
Parking Lot	16%
Roads	4%
Other Impervious	22%
Pervious	36%



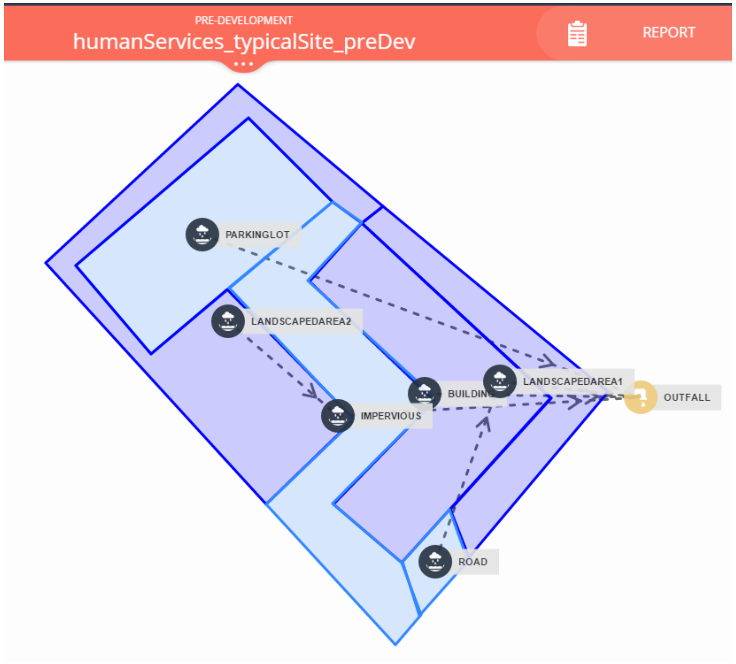


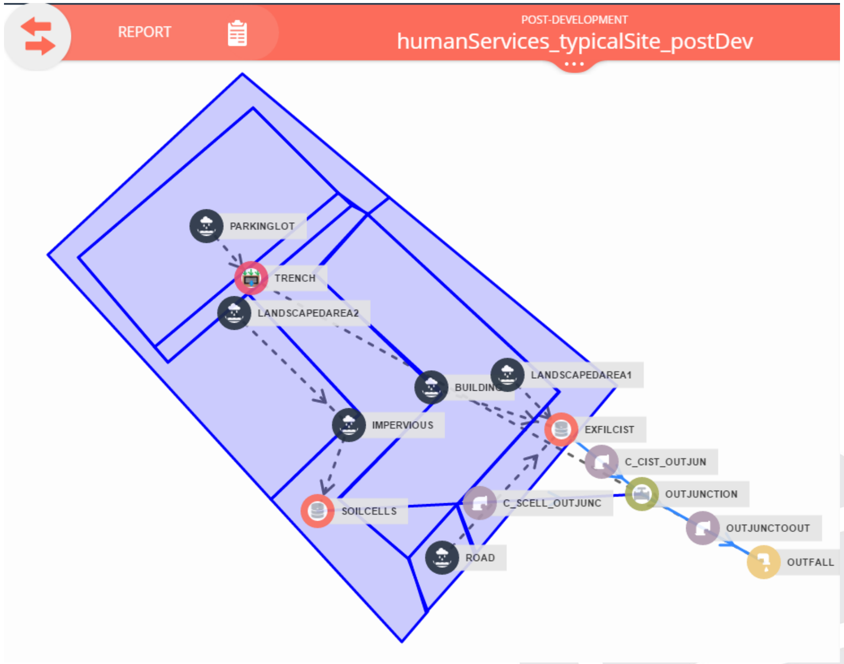
GI/ Site Design Considerations

- Maintain current functionalities of the site
- Site should mimic natural hydrologic processes
- Satisfy SWM criteria: retain 90th percentile storm (27 mm); approx. 34 mm in 2040 – 2050
- Cost conscious but explore various GIs

GREY TO GREEN
Toronto | April 4 & 5, 2019

Pre – to Post – Green Infrastructure





Human Services – SWM Results

Opportunities Assessed

Infiltration trenches

Tree planting with soil cells

Downspout disconnect to perforated cistern

Results

Stormwater Outcomes	27mm - Baseline	27mm-GI	CC (34mm)+ Baseline	CC (34mm) + GI
Water Quantity				
Rainfall Volume (m^3)	238		298	
Rainfall Reduction (%)	31%	100%	27%	94%
Water Quality – Load Reduction (%)				
Total Suspended Solids	15%	100%	16.9%	90-95%
Total Phosphorus	15%	100%	17%	90-95%

STEP's LID Life Cycle Costing Tool

Sustainable Technologies EVALUATION PROGRAM

Fostering Sustainability Through Innovation

Join our eNewsletter (Privacy Policy):

Subscribe

ABOUT US | PROJECTS | LIVING LABS | EVENTS & TRAINING | NEWS | RESOURCE LIBRARY | CONTACT US

Low Impact Development Life Cycle Costs

There is increasing interest in the use of Low Impact Development practices to manage urban runoff. However, those considering implementing the practices continue to wonder how their use will affect the bottom line. In this project the capital and life cycle costs of seven Low Impact Development (LID) practices and seventeen design scenarios were evaluated based on a detailed assessment of input costs, maintenance requirements, rehabilitation costs and practice designs relevant to Canadian climates.

The LID practices evaluated include bioretention cells, permeable pavement, infiltration trenches and chambers, enhanced swales, rainwater harvesting and green roofs. Dry swales and perforated pipe systems were considered to be similar to bioretention and infiltration trenches, respectively, and therefore were not evaluated as separate practices. The savings from LID approaches associated with improved aesthetics, air quality, community livability and other public benefits were not assessed, as these savings are best evaluated in relation to specific case study examples.

A spreadsheet decision support tool based on the cost calculations gathered during this study was developed to assist industry professionals estimate the capital and life cycle costs of site specific LID practice designs. The tool provides users with a more comprehensive understanding of all relevant costs, facilitates cost comparisons, and allows users to optimize proposed designs based on both performance and cost.

Downloads

Assessment of Life Cycle Costs for Low Impact Development Practices
Executive summary | Full report

LID Practices Costing Tool
5.6 MB

LID Practices Costing Tool (no macros)
5.5 MB

Having trouble with the tool? Click here

Please send any comments or feedback on the tool to STEP@trca.on.ca

Partners

» Toronto and Region Conservation Authority (TRCA)

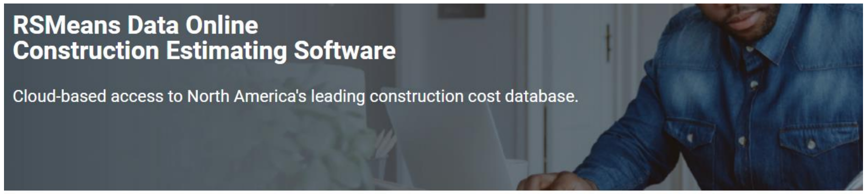
» University of Toronto

» Government of Canada's Great Lakes Sustainability Fund

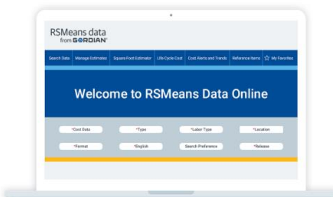
» City of Toronto

sustainabletechnologies.ca

RSMeans –> LID Life Cycle Costing Tool



Developed With Robust Tools and Features



INFILTRATION TRENCH

USERS: Please enter information into "User Inputs" section, DO NOT LEAVE BLANK

* Purple coloured cells are model defaults and can be changed by the user.

Site and Design Information

USER INPUTS		
Roof drainage area	0	m2
Road drainage area	1630	m2
Total drainage area (DA)	1630	m2
Drainage type	Road Only	Unitless
Drainage period	48	hours
Inlet locations (manholes)	1	Unitless
Infiltration rate of the subgrade	10	mm/hr
Safety factor	2.5	Unitless
Void ratio	40	%
TOOL RESULTS		
Depth of trench 1	0.80	m
Width of trench	5.00	m
Length of trench	43.9	m
Surface area of trench	220	m2
Rainfall captured	27	mm
Total drainage area to surface area ratio (DA:S	7.42:1	m2:m2
Water storage volume	44.0	m3

Notes:

[1] If the rainfall capture is adjusted from the default, the depth will not decrease below the depth required for the infiltration rate of the subgrade

[2] The ratio of impervious drainage area to footprint surface area of the practice should be no greater than 20:1 to limit the accumulation of fine sediments and thereby prevent clogging

[3] Includes compaction tests, 1 Proctor test, and 4 Nuclear Density tests

[4] Project Acceptance inspections include the following options: Option #1: Natural event testing: Includes 2 months of water level monitoring, materials and staff; Option #2: Simulated event testing: Includes water truck, materials and staff, plus 2 weeks of water level monitoring; Option #3: Continuous water level monitoring: 6 months of water level monitoring, materials and staff.

User Notes:

Capital Costs Information

Costs are 2010 data, apply inflation rate (%)	13.696

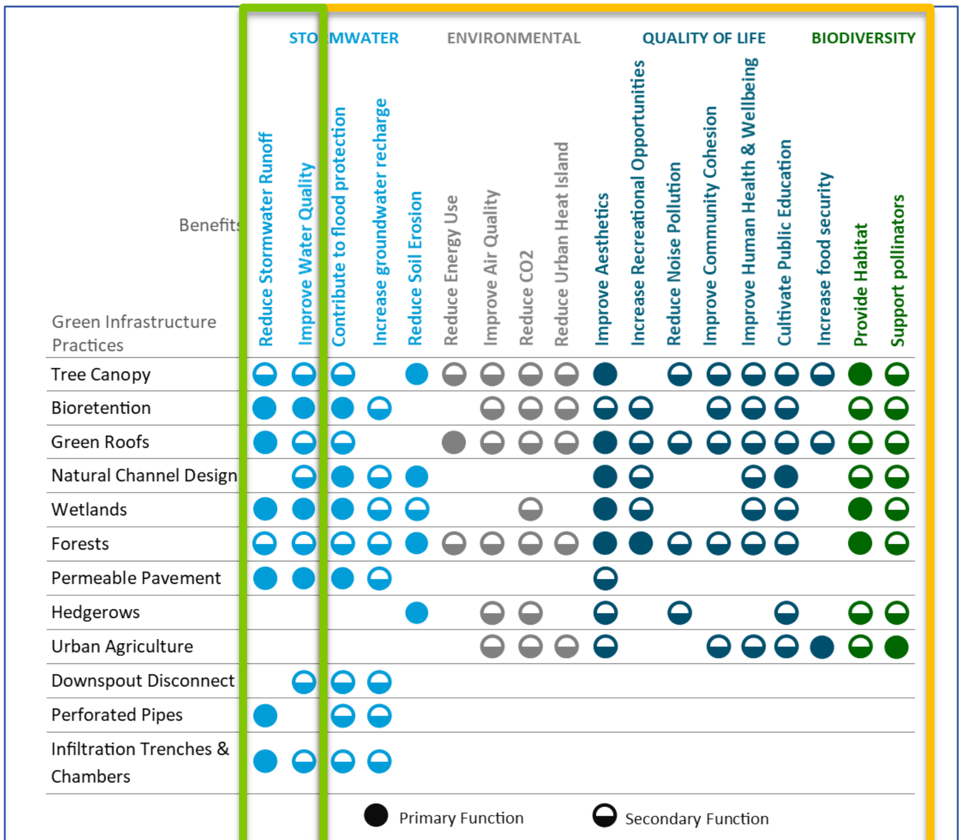
PRE-CONSTRUCTION		Unit	Cost	emove Cost
Test pits (2)	3.8	m^3	$322.61	No
Infiltration tests (2 per test pit)	4	tests/pit	$335.40	No
Stakeout of utilities	1	visit	$568.48	No
Erosion and sediment controls	43.9	m	$198.75	No
Add additional costs if necessary			$0.00	
EXCAVATION				
Topsoil salvage, haul to stockpile	33.4	m^3	$121.83	No
Excavate trench with trench box	314	m^3	$1,568.84	No
Loading	15	% of excavation	$253.60	No
Hauling	5.6	hours	$1,102.94	No
Safety Fencing	14	m (1 week rental)	$268.53	No
Add additional costs if necessary			$0.00	
MATERIALS & INSTALLATION				
Manhole (4' dia.) & inlet attachment	1	each	$9,358.26	No
Geotextile (Polypropylene filtration fabric)	486	m^2	$1,934.71	No
Roof to system attachment	0	each	$0.00	No
Hydrodynamic Separator	1	each	$17,249.05	No
Overflow attachment	1	each	$279.69	No
Perforated Pipe (300 mm)	43.3	m	$1,856.38	No
Line pipe with expandable rings	41	m^2	$341.99	No
Monitoring wells (150 mm)	3	each	$690.24	No
Place and compact stone (50 mm clear)	102.3	Bm^3 & Cm^3	$4,681.98	No
Place and compact fill [3]	164.7	Bm^3 & Cm^3	$1,527.54	No
Add additional costs if necessary			$0.00	
INSPECTIONS				
Construction Inspections	5	visit	1,200.44	No
Project Acceptance Inspections[4]	1.5	visit	480.15	No
Option #2: Natural event testing	1	tests	2,273.92	No
Option #3: Simulated event testing	1	tests	2,540.44	No
Option #4: 6 months water level monitoring	1	tests	6,821.76	No
Add additional costs if necessary			0.00	
TOTALS				
Sub-total			$55,977.54	
Overhead	10	%	$5,597.75	
Other	0	%	$0.00	
GRAND TOTAL			**$61,575.29**	

Human Services – GI Costs

Green Infrastructure	Capital Construction Cost ($)	Average Annual Maintenance Cost ($)
Infiltration Trench	$61,575	$2,525
Cistern	$88,239	$3,051
Soil Cells	$210,000	$1,265
Trees	$12,000	$2,400
Total	$370,814	$9,241

1. $ Total /ha of Typical Site = $/ha/Category
2. $/ha/Category * ha of Category Region Wide = $/Category
3. Sum $/Category = Total Region Cost

Next Steps



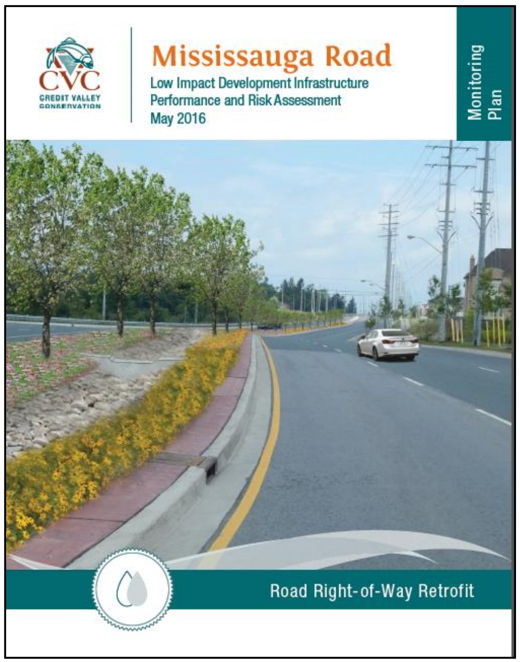
Green Infrastructure Practices / Benefits	STORMWATER					ENVIRONMENTAL				QUALITY OF LIFE							BIODIVERSITY	
	Reduce Stormwater Runoff	Improve Water Quality	Contribute to flood protection	Increase groundwater recharge	Reduce Soil Erosion	Reduce Energy Use	Improve Air Quality	Reduce CO2	Reduce Urban Heat Island	Improve Aesthetics	Increase Recreational Opportunities	Reduce Noise Pollution	Improve Community Cohesion	Improve Human Health & Wellbeing	Cultivate Public Education	Increase food security	Provide Habitat	Support pollinators
Tree Canopy	◒	◒	◒		●	◒	◒	◒	◒	●		◒	◒	◒	◒	◒	●	◒
Bioretention	●	●	●	◒			◒	◒	◒	◒	◒		◒	◒	◒		◒	◒
Green Roofs	●	◒	◒			●	◒	◒	◒	●	◒	◒	◒	◒	◒	◒	◒	◒
Natural Channel Design		◒	●	◒	●					●	◒			◒	●		◒	◒
Wetlands	●	●	●	◒	◒			◒		●	◒			◒	◒		●	◒
Forests	◒	◒	◒	◒	●	◒	◒	◒	◒	●	●	◒	◒	◒	◒		●	◒
Permeable Pavement	●	●	●	◒						◒								
Hedgerows					●		◒	◒		◒		◒			◒		◒	◒
Urban Agriculture							◒	◒	◒	◒			◒	◒	◒	●	◒	●
Downspout Disconnect		◒	◒	◒														
Perforated Pipes	●		◒	◒														
Infiltration Trenches & Chambers	●	◒	◒	◒														

● Primary Function ◒ Secondary Function

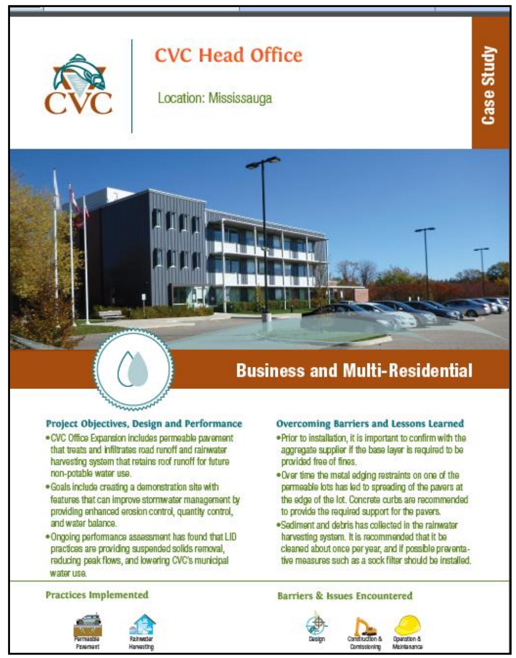
- Integrate the costing tool into the LID TTT
- Evaluate the other benefits of GI
- Combine into a decision support tool for GI implementation
- Site level case studies for ROP

Green Infrastructure Projects in the Ground

Regional Road Right of Way

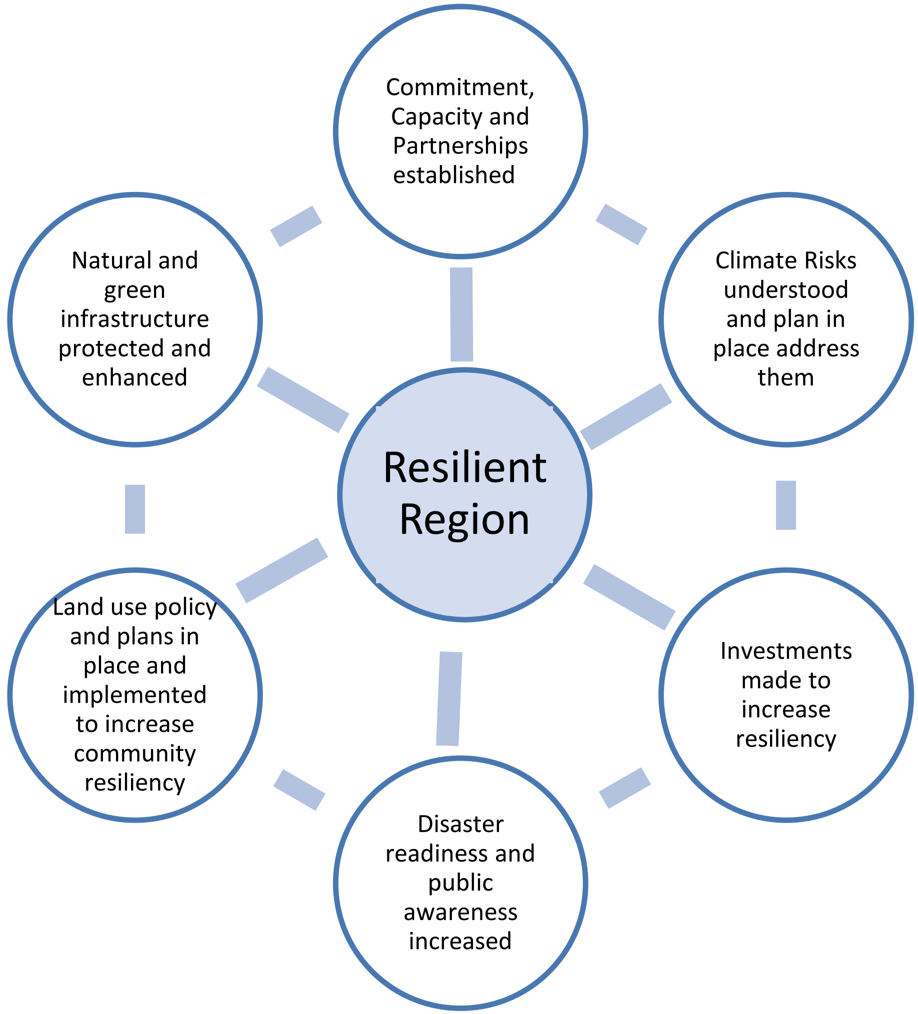


Administrative Buildings



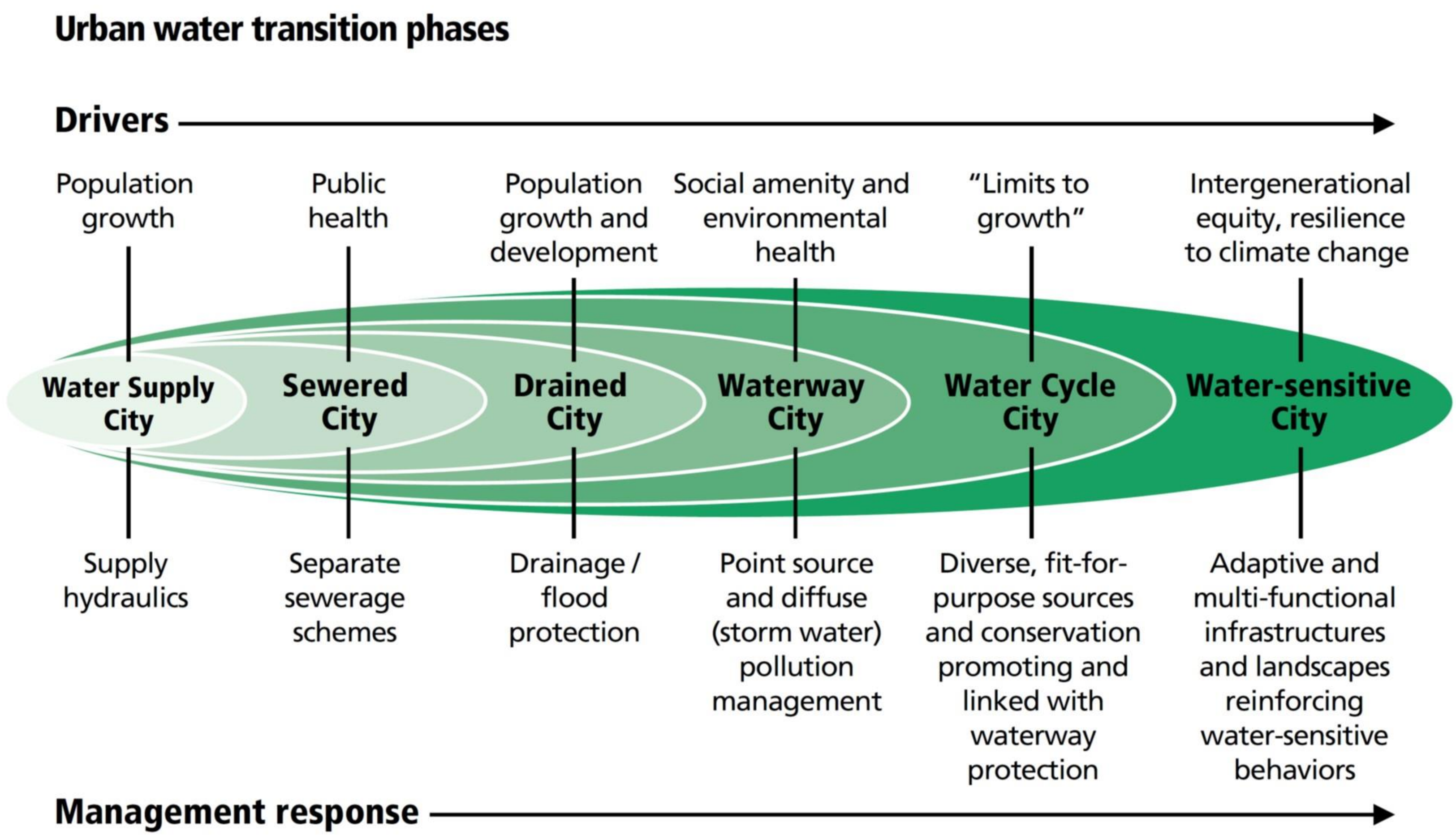
Neighborhood Retrofit

How is your municipality planning to increase its resiliency to climate change?

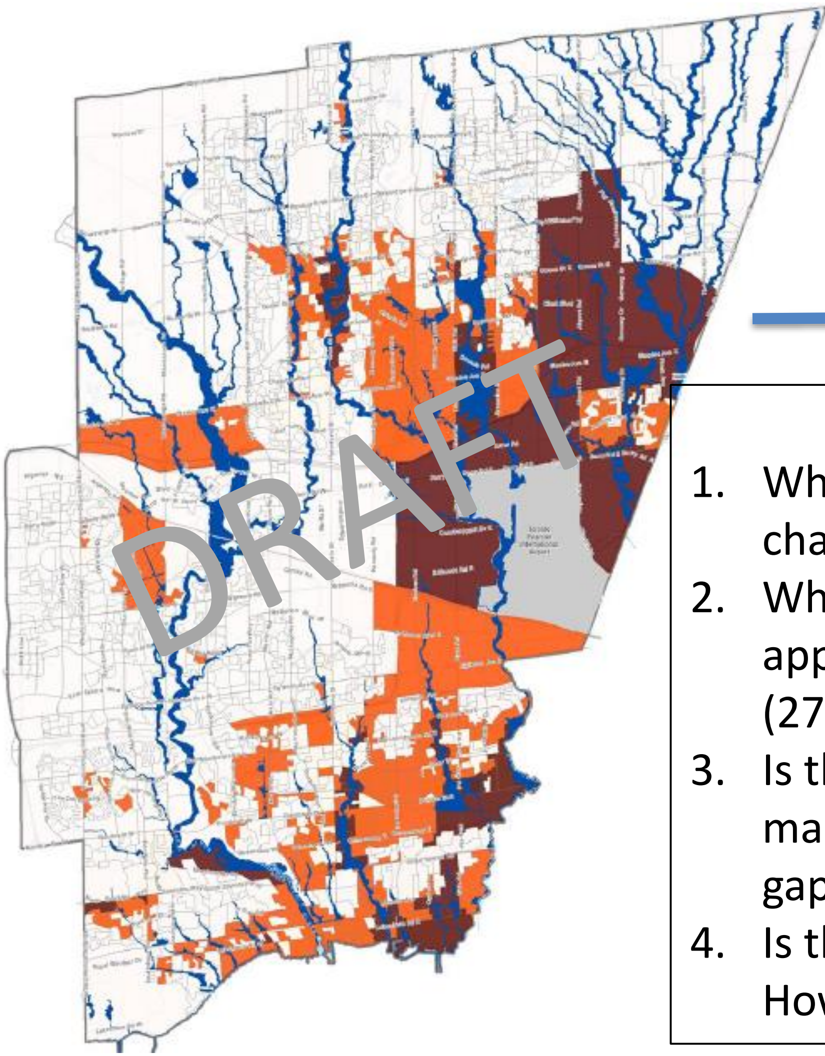


What approaches or frameworks do you reference to advance more integrated planning?

Example: Water Sensitive Cities



2019



2050

?

DISCUSSION QUESTIONS

1. What tools are being used to integrate climate change into planning?
2. What water retention targets / criteria may be appropriate in flood vulnerable areas (given CC)? (27mm)?
3. Is there adequate funding, resources and capacity to manage risks? If not, how are you addressing the gap?
4. Is there governance or regulatory barriers /issues? How are you overcoming these?

Continue the Conversation

Mark Pajot	Yuestas David
Advisor, Office of Climate Change & Energy Management (OCCEM) Region of Peel	Project Manager, Research and Knowledge Management Toronto and Region Conservation Authority
mark.pajot@peelregion.ca 437-998-3094	yuestas.david@trca.on.ca 416-661-6600 ext. 5742