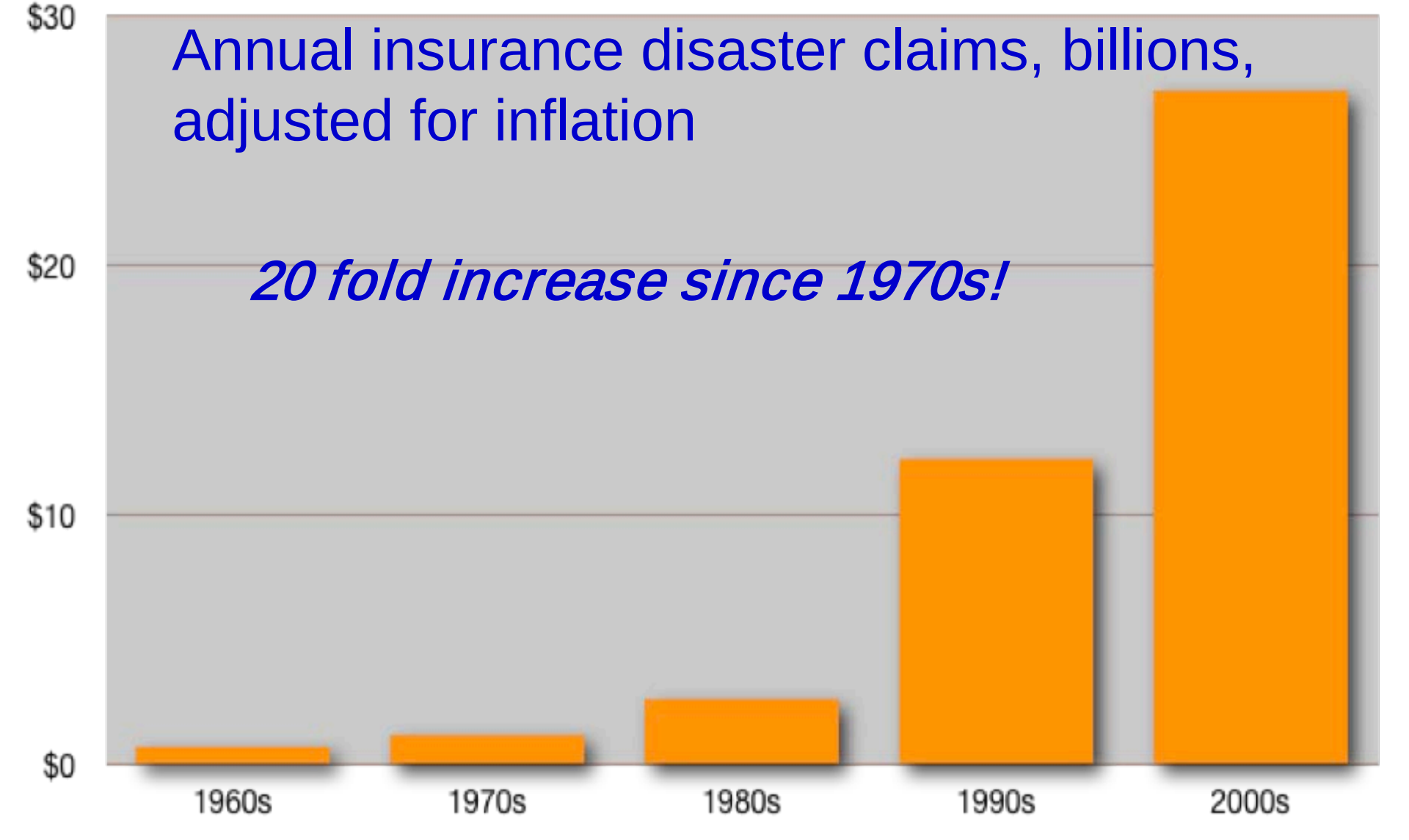

OUR WORLD IS CHANGING

Health Impact of Extreme Events

- The stress faced by pregnant women during the 1998 Quebec ice storm = children at a greater risk to develop asthma, diabetes or obesity, similar results from Calgary flood

…… If this strange and severe weather was once hard to imagine, it's now hard to ignore…..Maclean's Magazine



58% of Canadians think municipalities are upgrading systems to handle excess storm water

REALITY: 60-75% of GTA was built prior to flood control


22 8:53 AM

Developing Areas

Despite meeting current MOE requirements with the use of ponds:

- Increasing trends in wet weather stream-flow- 90 times pre-development
- Increasing pollutant loading, temp and erosion, flood risks downstream
- Reduced dry weather streamflows impacting wastewater dilution, water takings from streams, fisheries

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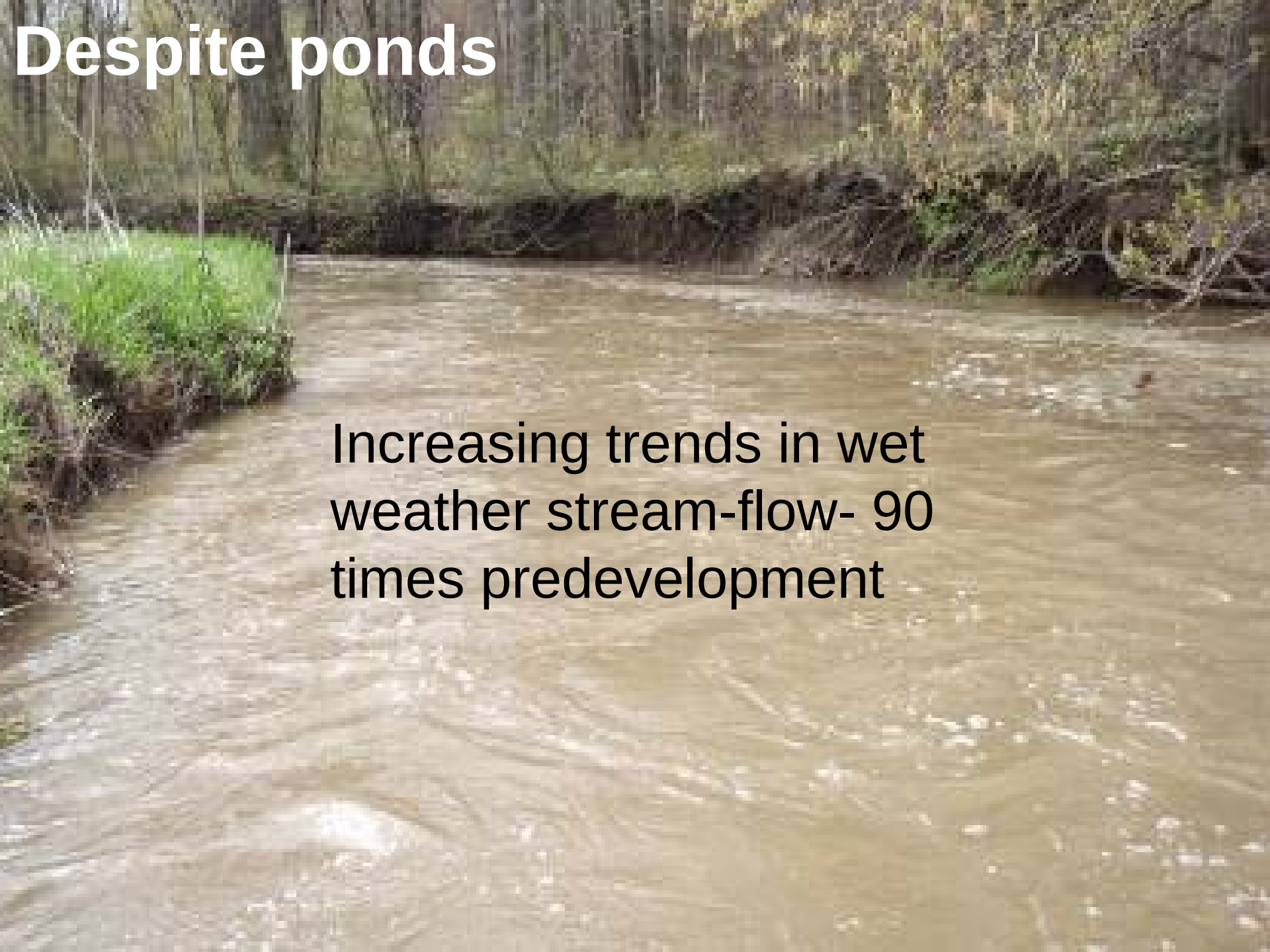
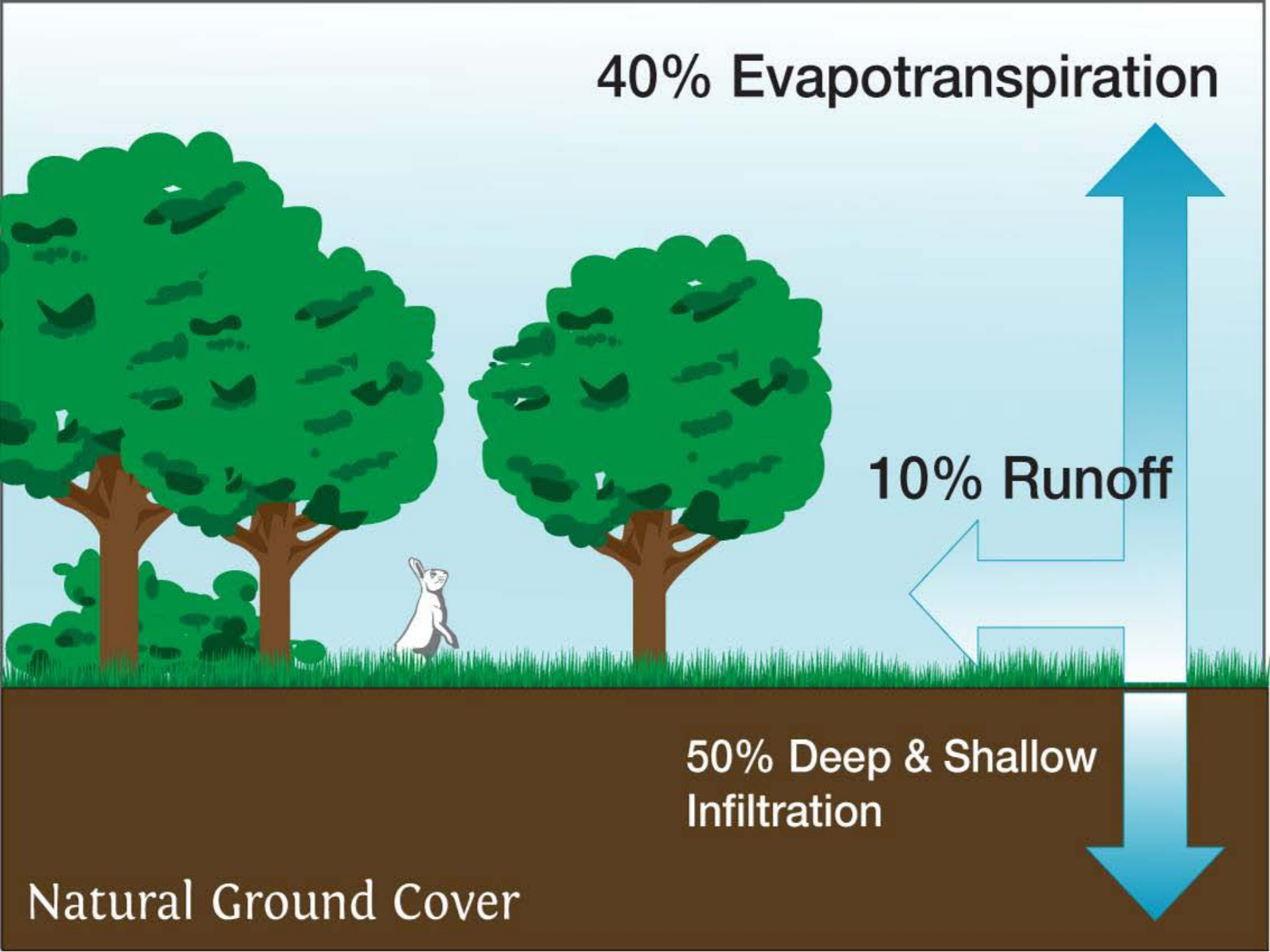
Despite ponds



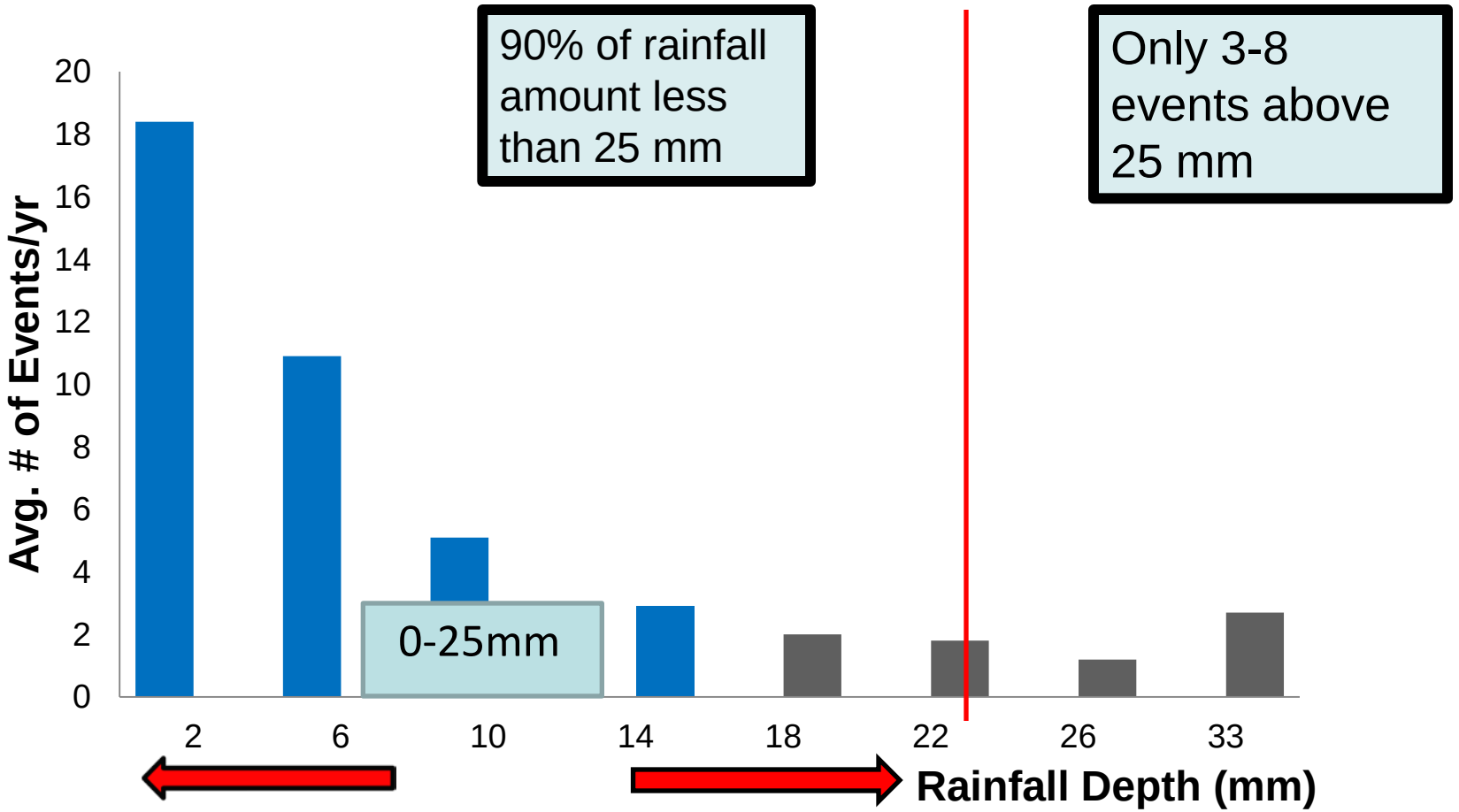
Increasing trends in wet weather stream-flow- 90 times predevelopment

Despite ponds

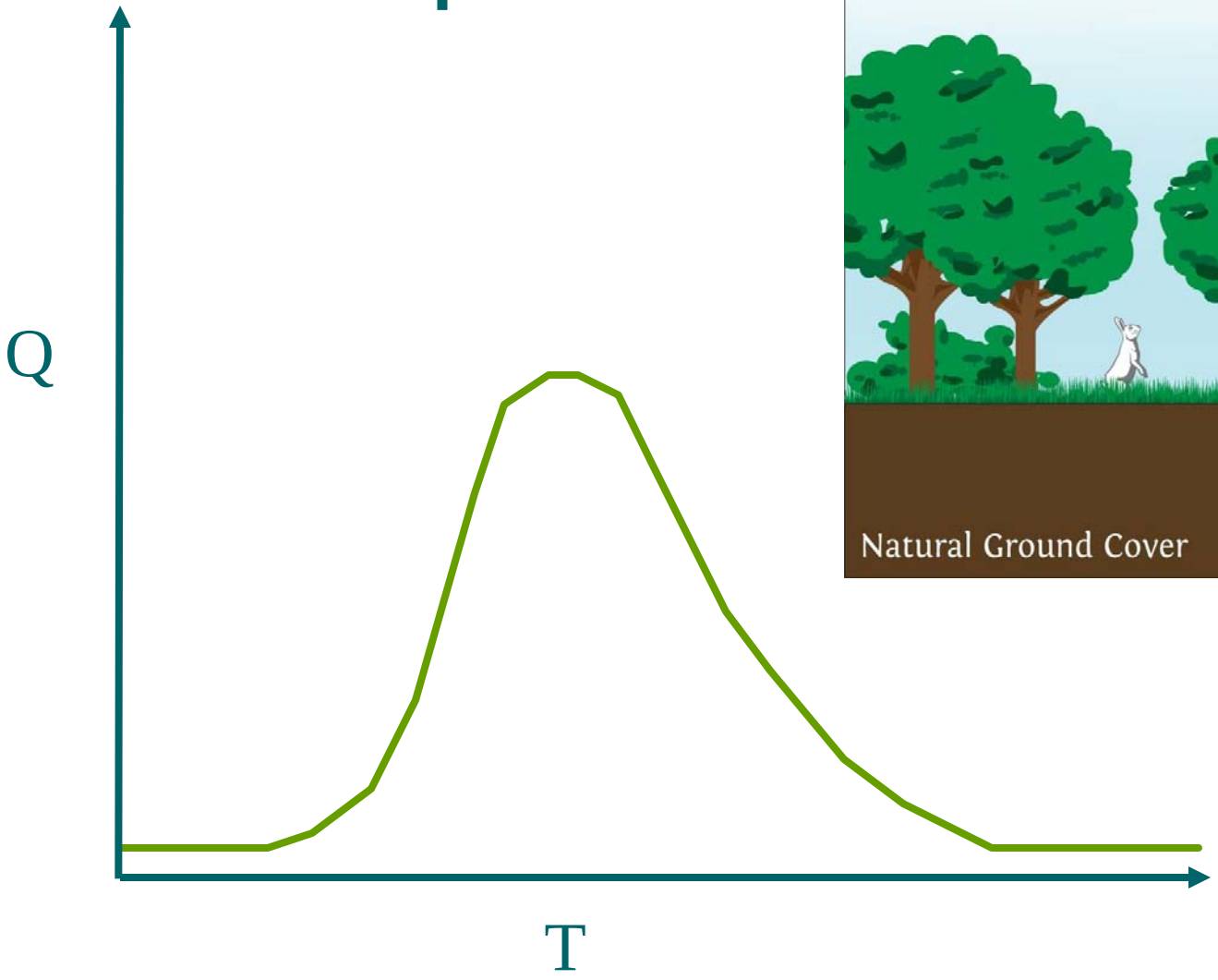
Reduced dry weather streamflows

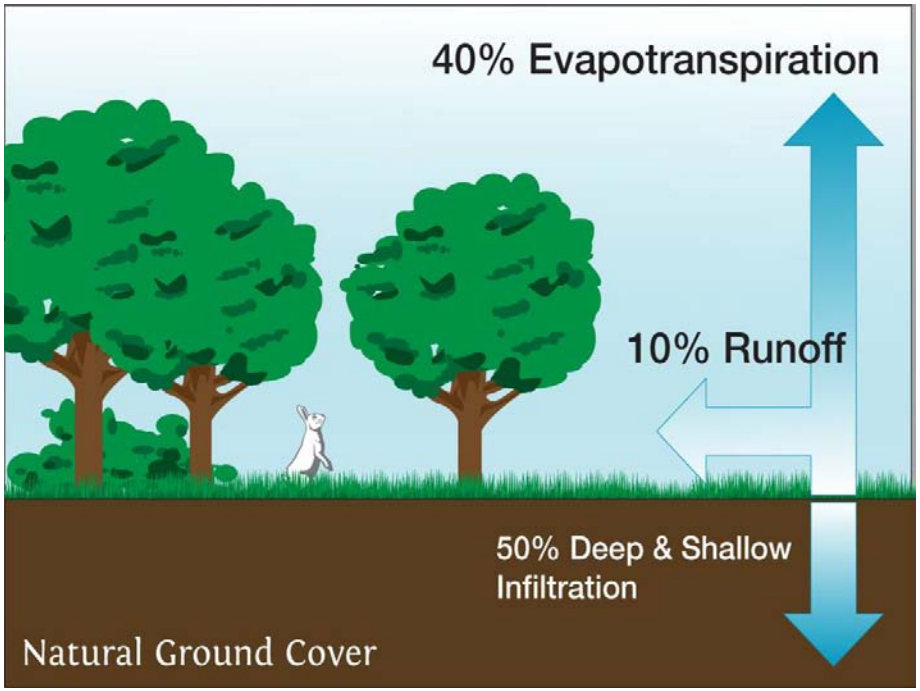

40% Evapotranspiration
10% Runoff
50% Deep & Shallow Infiltration
Natural Ground Cover

Typical Annual Rainfall Frequency Distribution For Toronto, Ontario



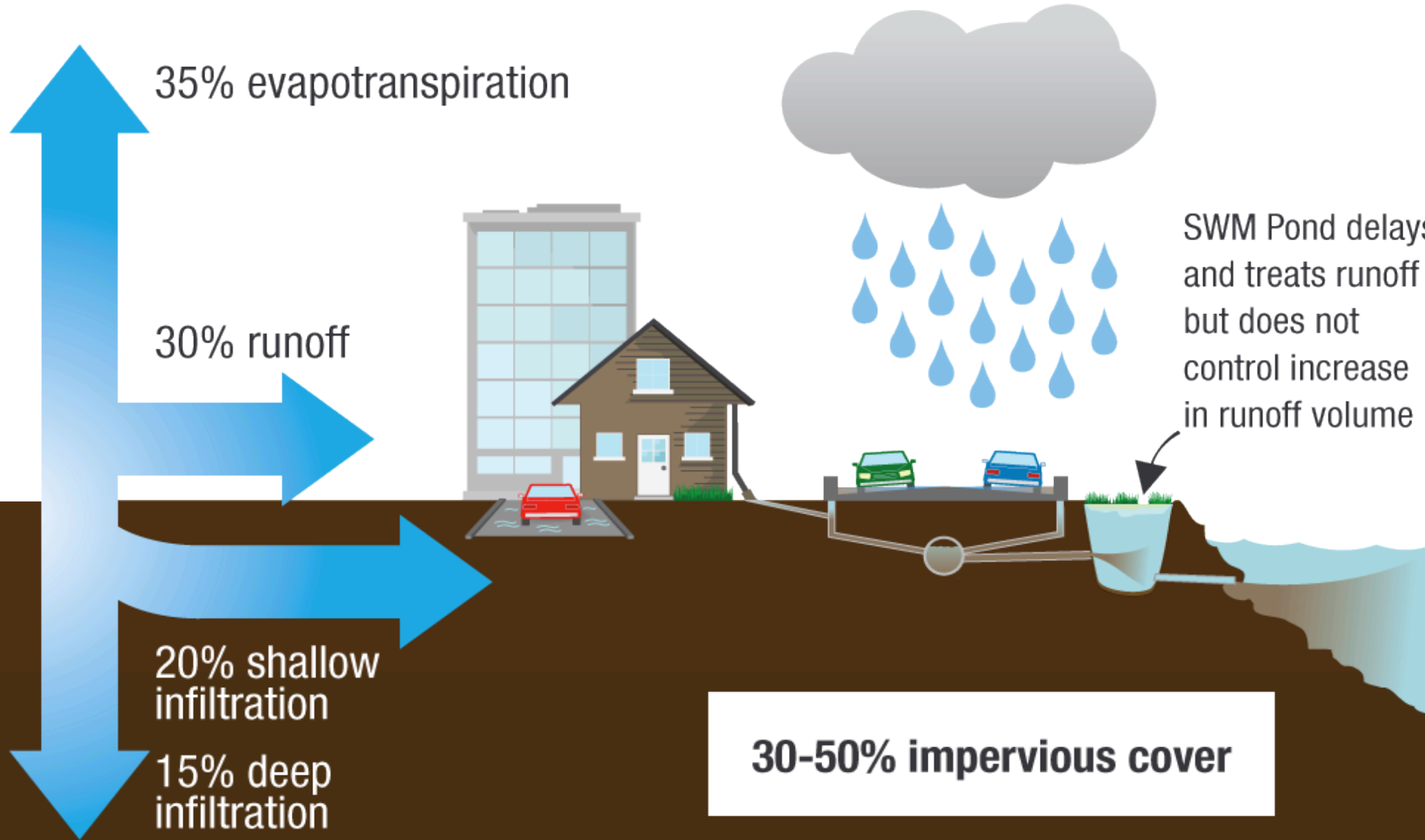
Pre-Development

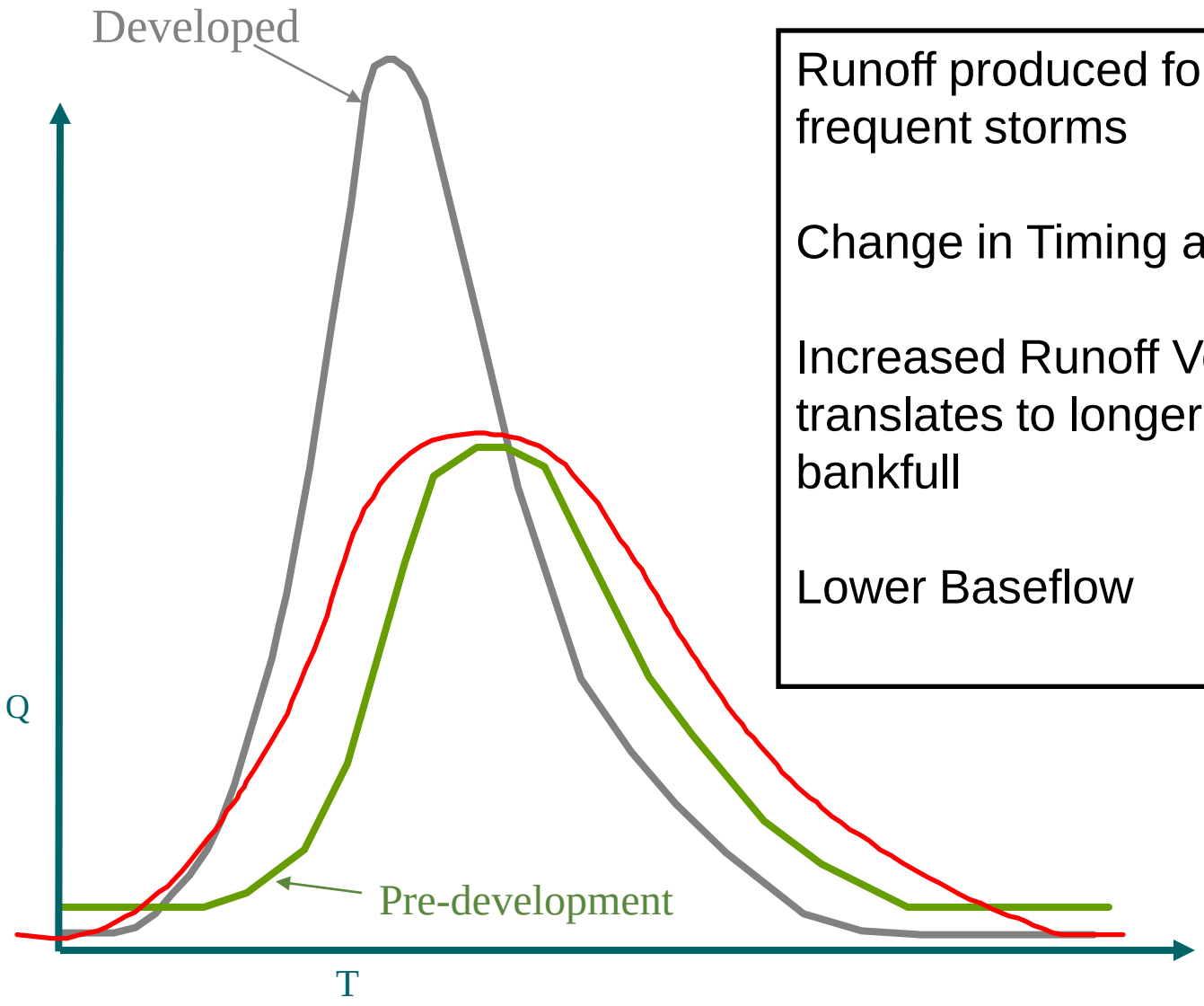




Urban Hydrology

Typical development: Stormwater management using End of Pipe SWM Pond





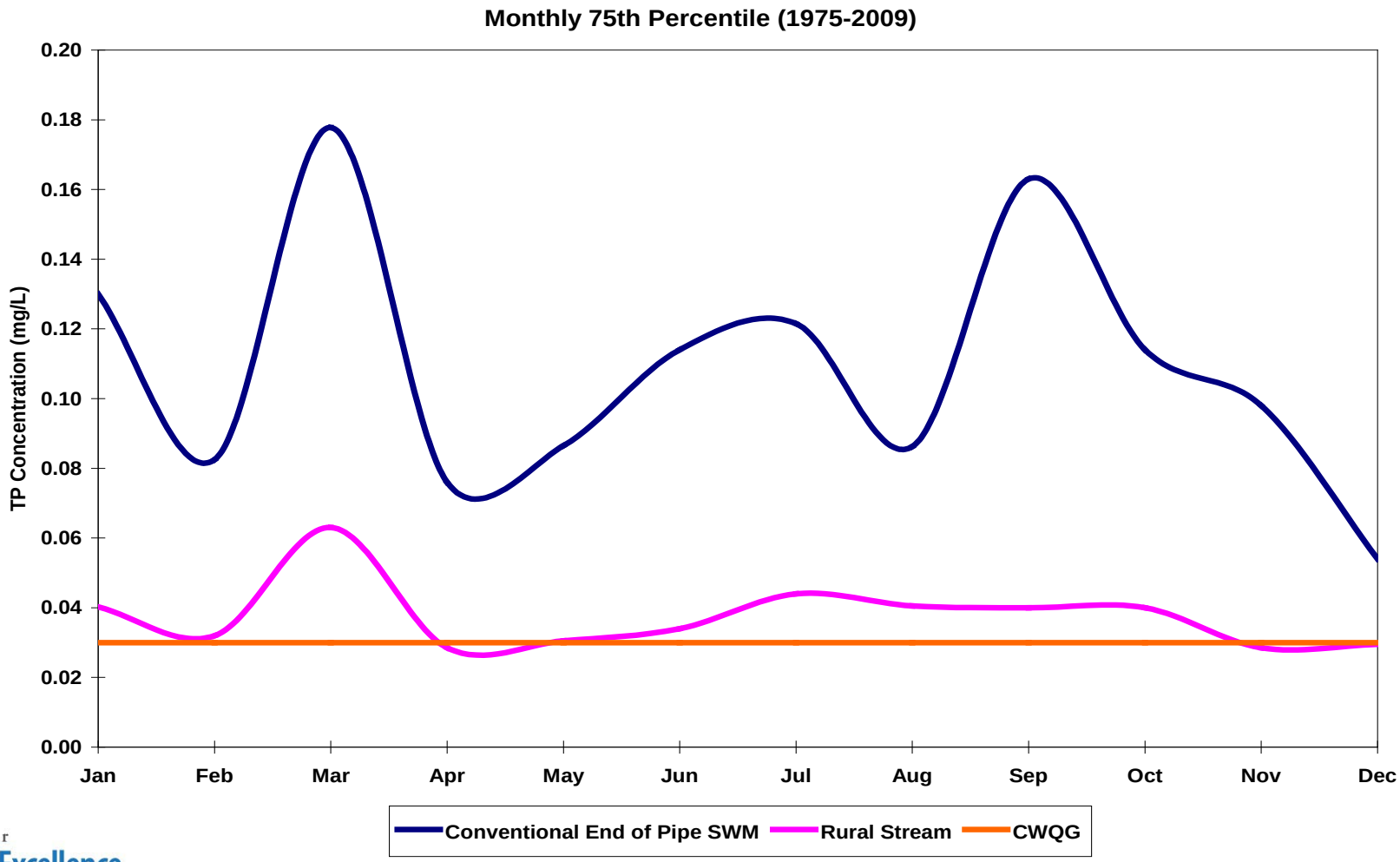
Runoff produced for more frequent storms

Change in Timing and Peak

Increased Runoff Volume- translates to longer periods of bankfull

Lower Baseflow

Total Phosphorus



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SWM Pond Performance

- More events produce runoff= pollutant loading more often
- Literature finds end-of-pipe facilities less effective than LID in removing finer particles

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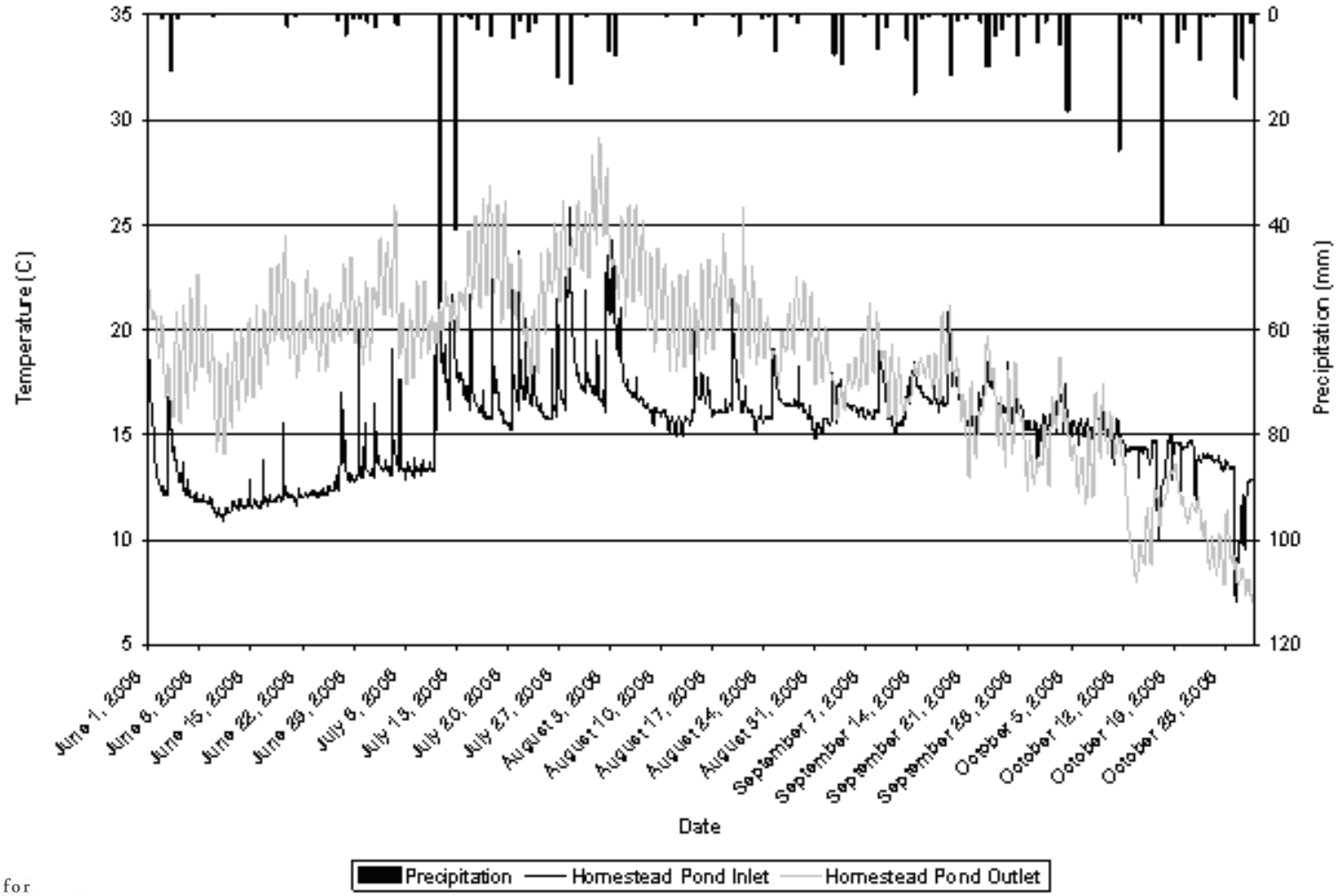
Water Temperature



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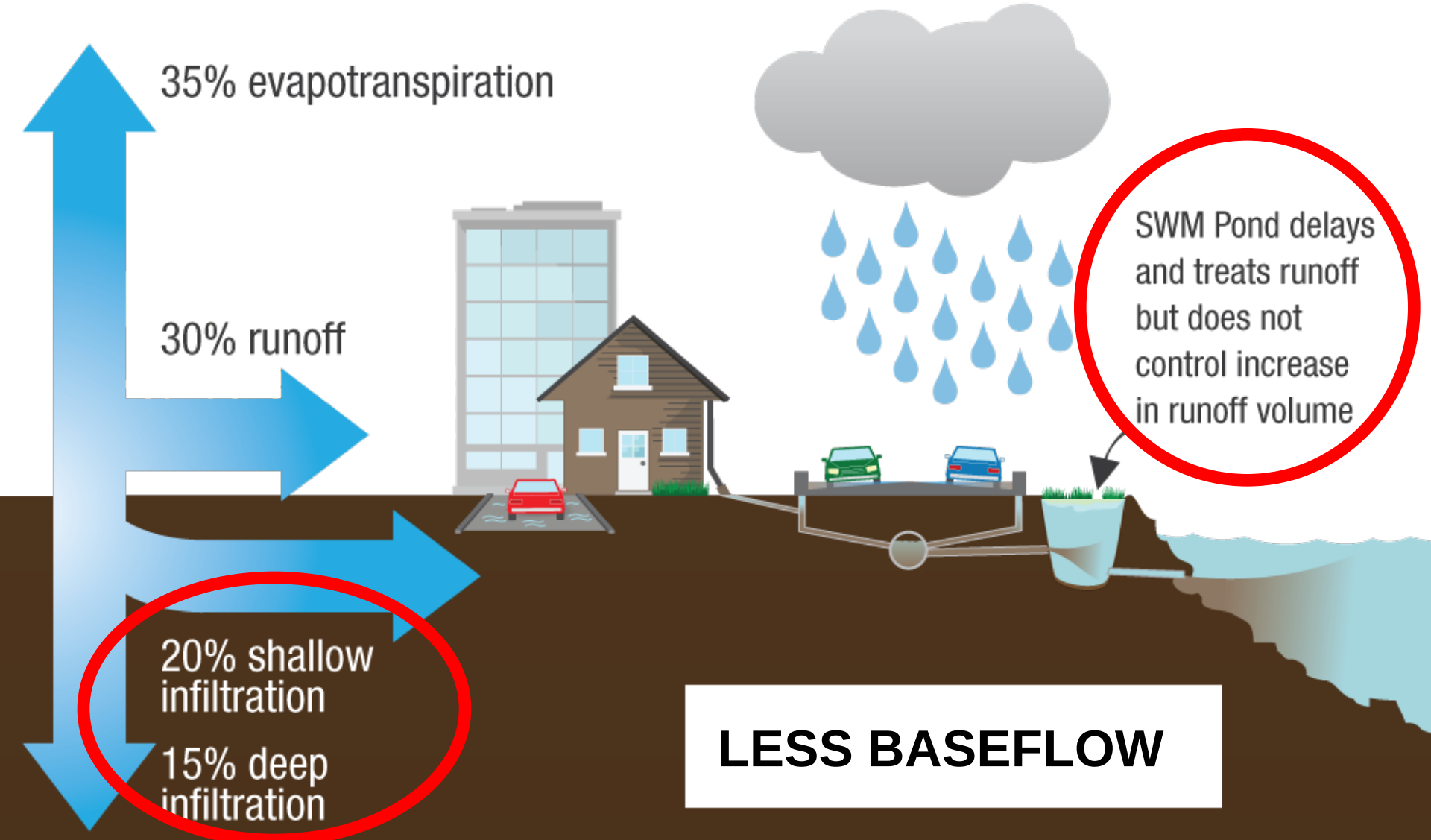
Elevated nutrients impact Water Treatment Plant operations $$$, beach closures, and local business revenues

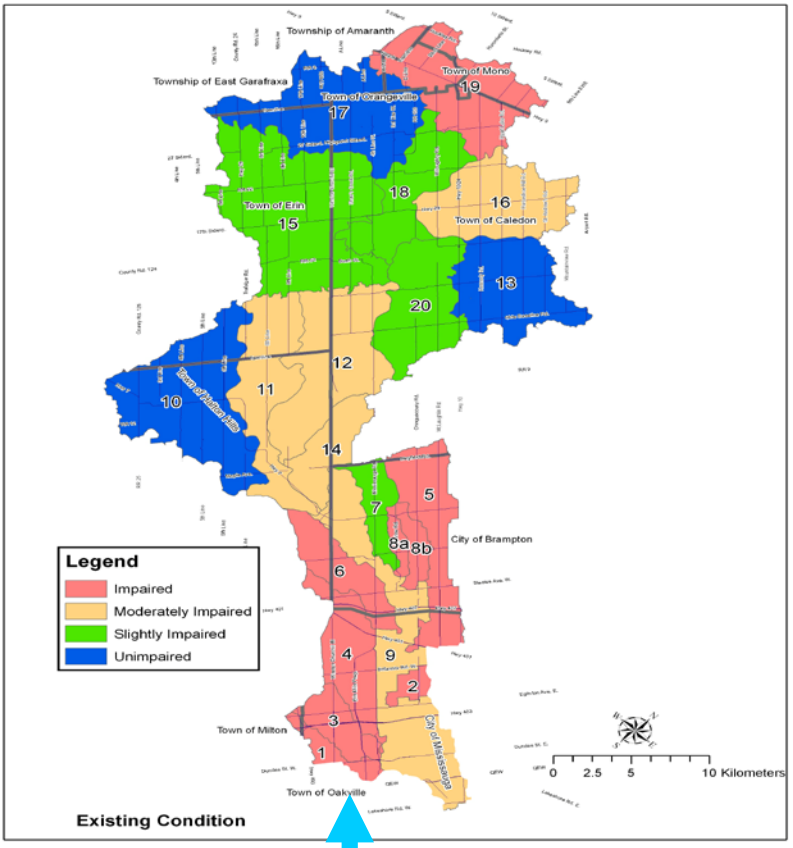
Increases in Cl impacts plume from Credit River, elevated nutrients at water in-take pipe- increasing WTP $$$

In-stream monitoring shows increasing temp and nutrient trends due to increased urbanization, climate change exacerbates

Urban Hydrology

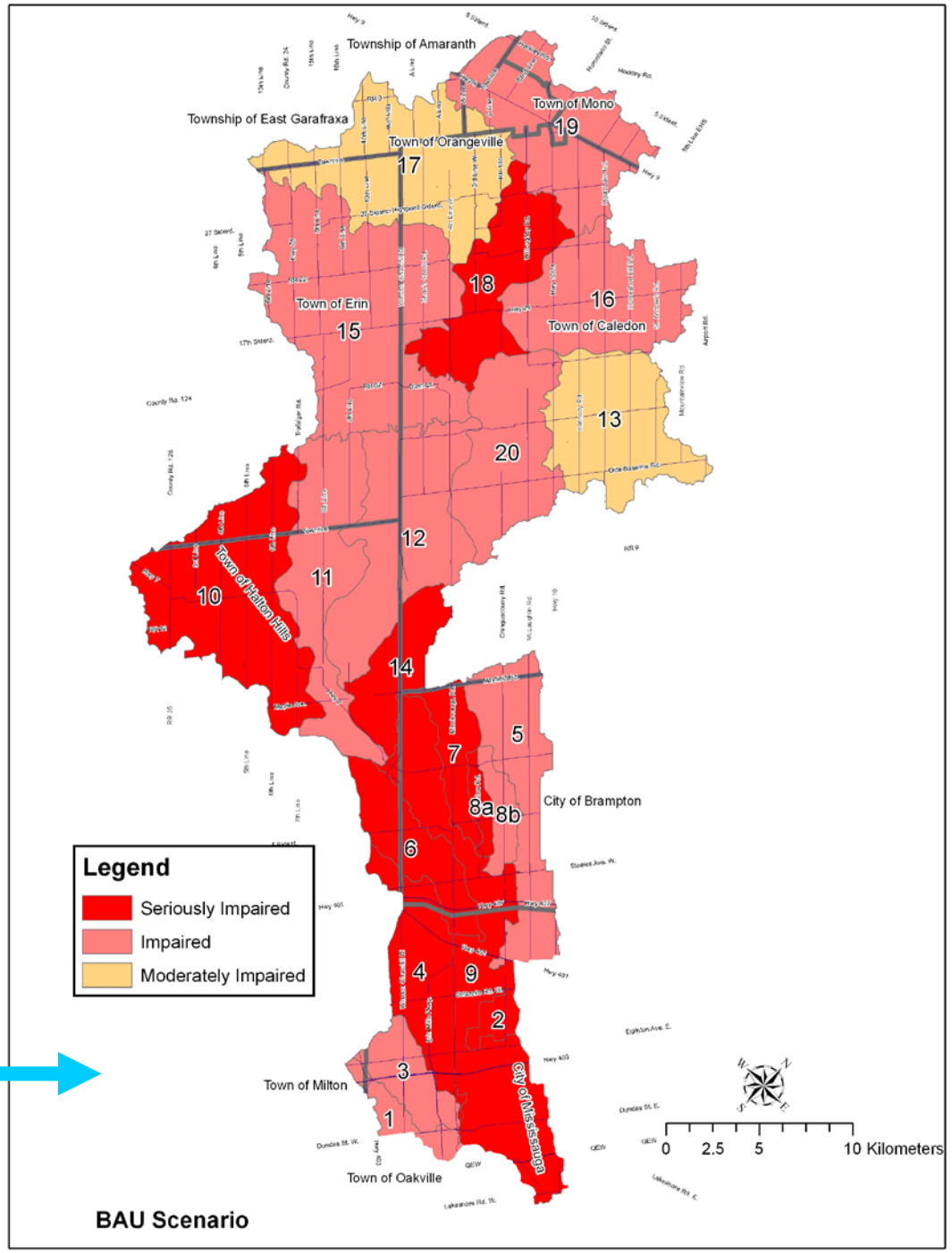
Typical development: Stormwater management using End of Pipe SWM Pond

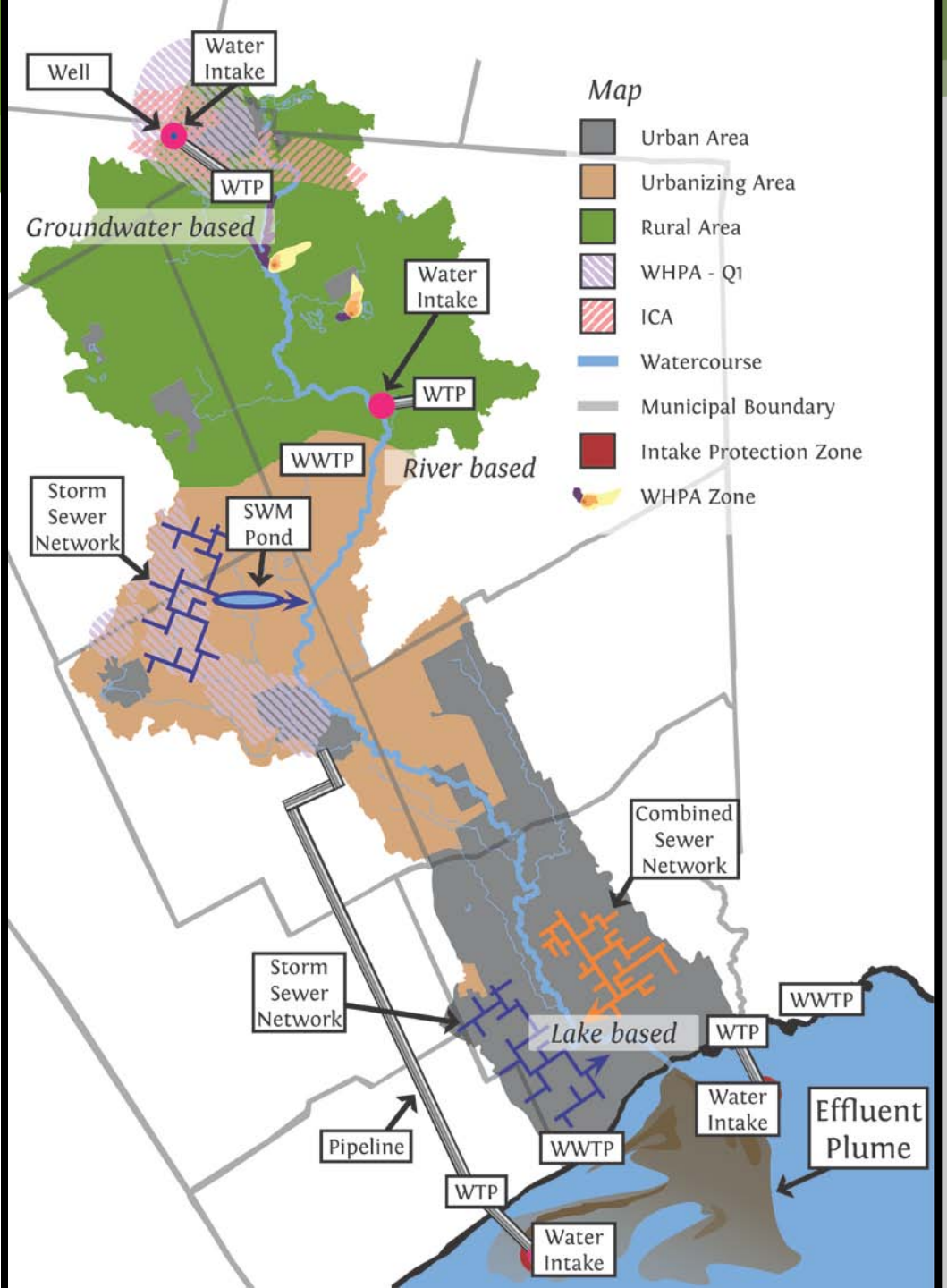




EXISTING CONDITIONS
(15% URBANIZATION)

BUSINESS AS USUAL
MANAGEMENT ALTERNATIVE
(25% URBANIZATION)





Credit Valley Conservation

- Watershed Perspective
- Infrastructure Types - W, WW, SW
- Governance/Policy/Legislation
- Upstream actions - downstream impacts
- Challenging!

Integrated Water Resources Management: The Emperor's New Clothes or Indispensable Process?

"IWRM is easy to talk about but hard to implement." – a practitioner

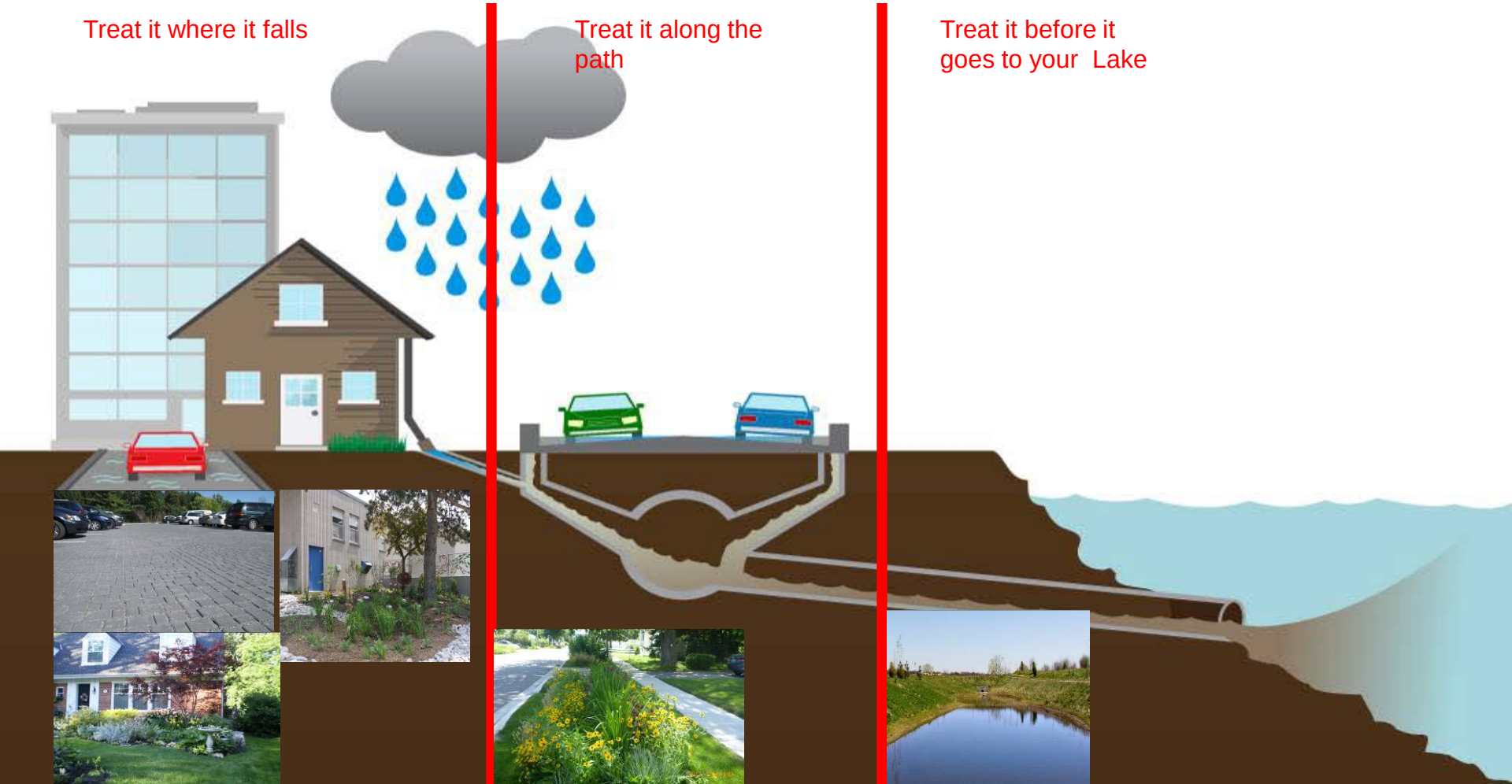
Integrated Stormwater Management

(called LID- or Low Impact Development)

Treat it where it falls

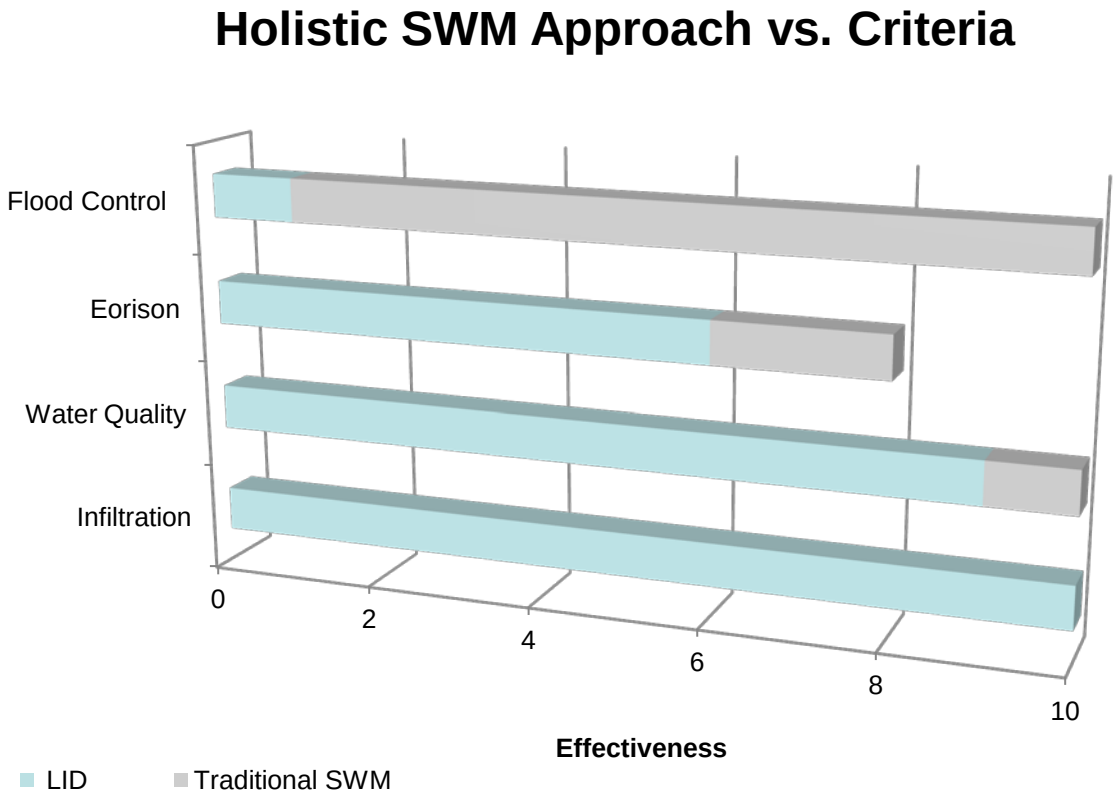
Treat it along the path

Treat it before it goes to your Lake



Holistic Approach & Criteria

- When used together



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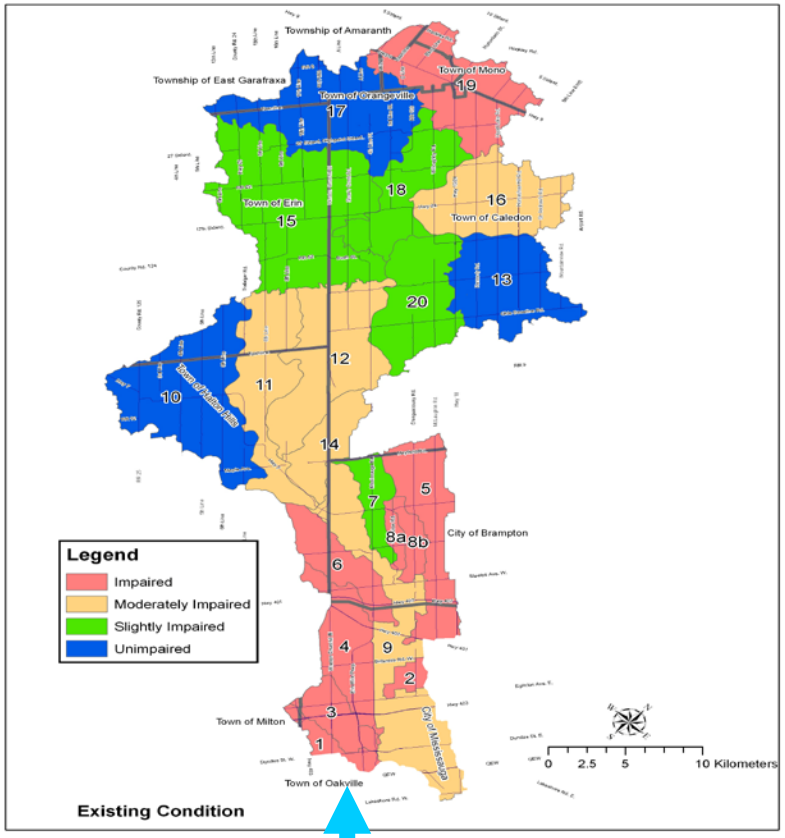
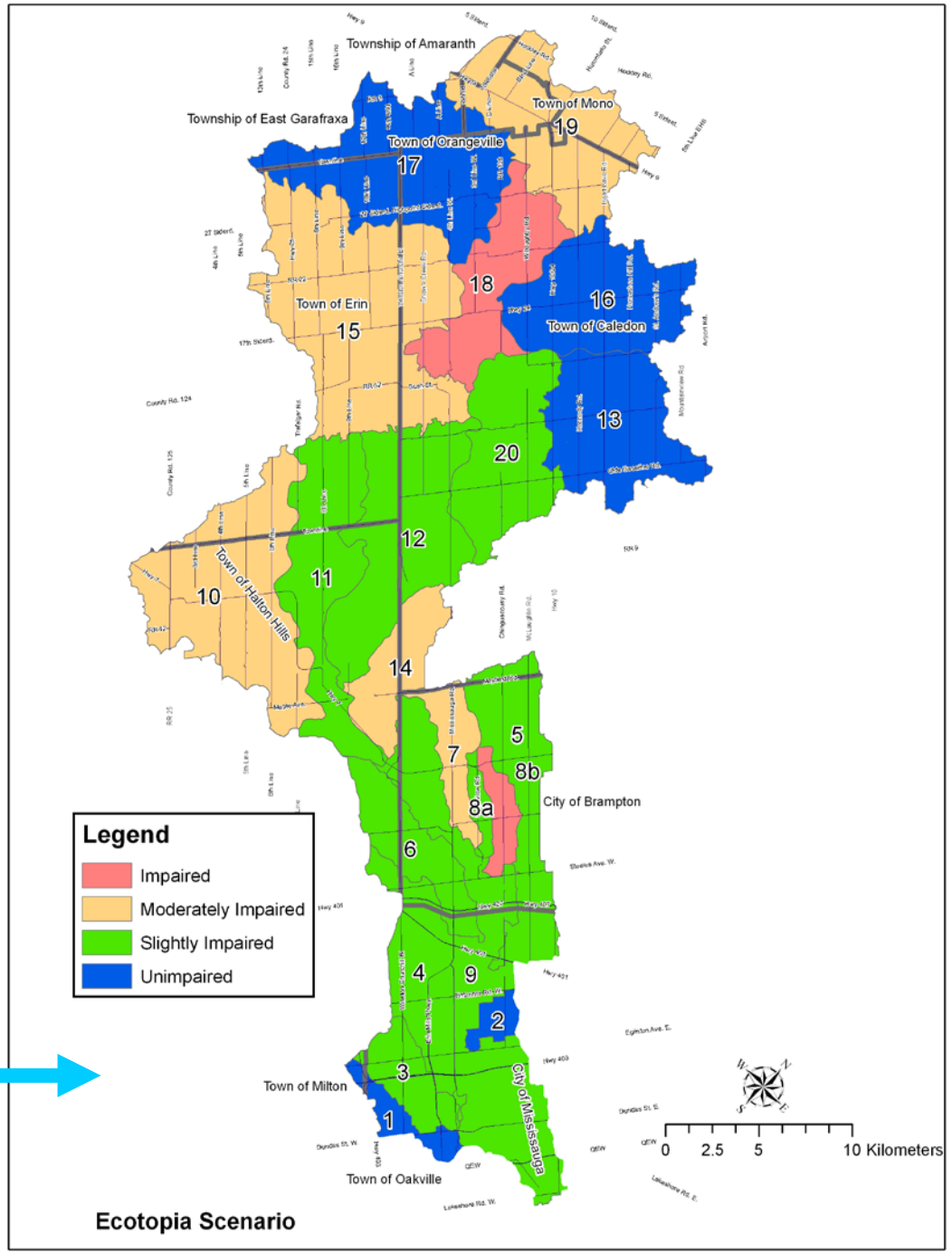


EXISTING CONDITIONS (15% URBANIZATION)

PREFERRED MANAGEMENT ALTERNATIVE (25%

URBANIZATION)



Provincial Support for Treatment Train Approach

- PPS 2014
- Water Opportunities Act, Sustainabilty Planning
- Great Lakes Protection Strategy
- Lake Simcoe Protection Act
- MOE: SWM Policy Review In-light of Climate Change and MOE 2003 SWM Guidelines
- MOI: Building Together

Change is Risky?

"*Playing it safe is the riskiest choice we can ever make*."

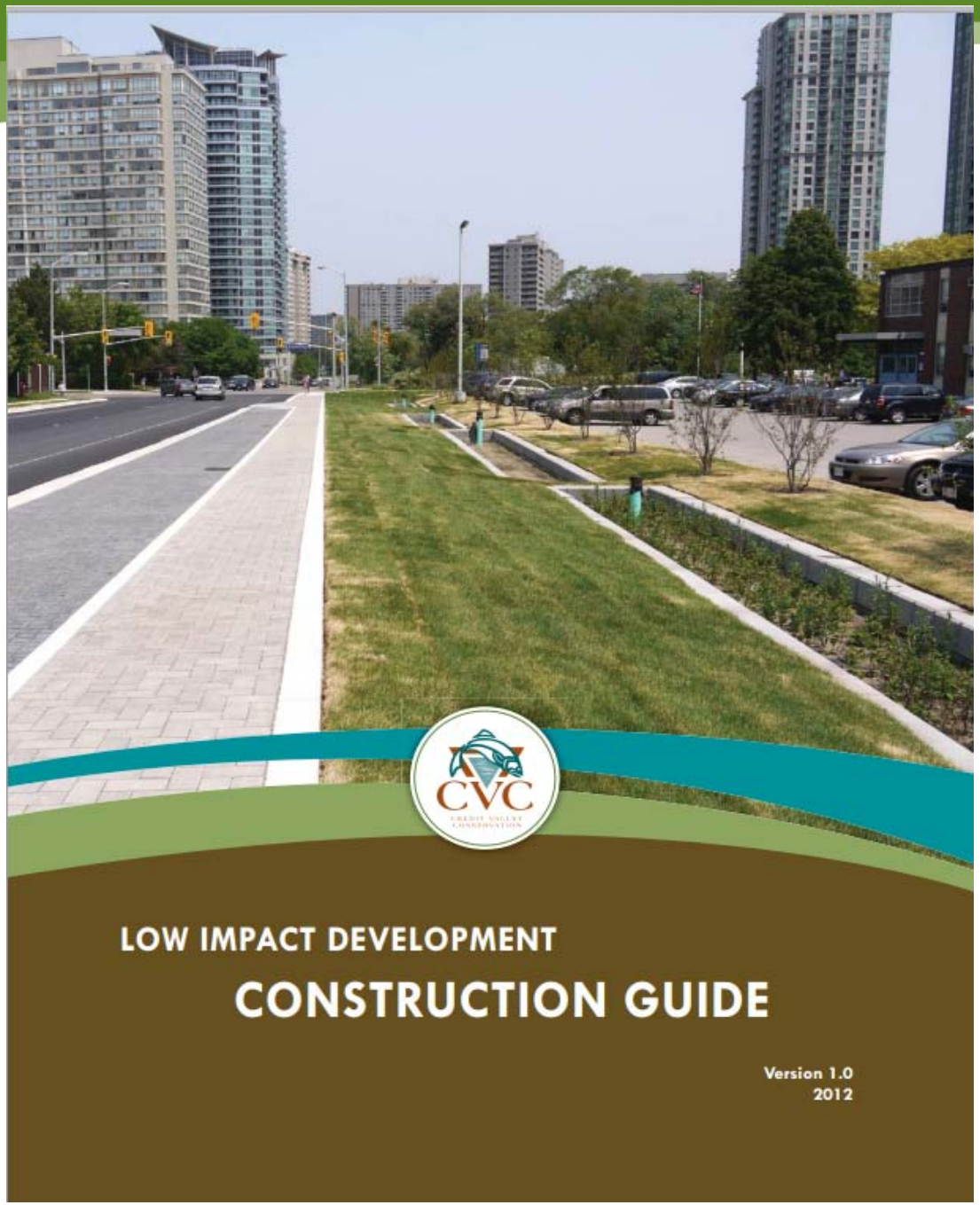
Sarah Ban Breathnach

Definition of Insanity: doing the same thing over and over again and expecting different results. Albert Einstein

“Sometimes when you innovate, you make mistakes. It is best to admit them quickly, and get on with improving.”

Steve Jobs


Failures can
lead to our
greatest
success and
opportunities



LOW IMPACT DEVELOPMENT
CONSTRUCTION GUIDE

Version 1.0
2012

Top Stakeholder Priorities

1. **Water quality and quantity performance of LID design in low infiltration soils**
2. **How multiple LID treats and manage stormwater**
3. **Performance of flood control, erosion control, water quality and natural heritage protection**
4. Long term maintenance
5. Lifecycle costs

Credit Valley Conservation

Road Right of Way – Performance Monitoring

- 90% of all rainfall events are absorbed by LID
- Only 3-12 rainfall events each year produce runoff
- For those 3-12 events, LID removed up to 99% of Total Suspended Solids and 84% Total Phosphorus
- Works during winter thaws

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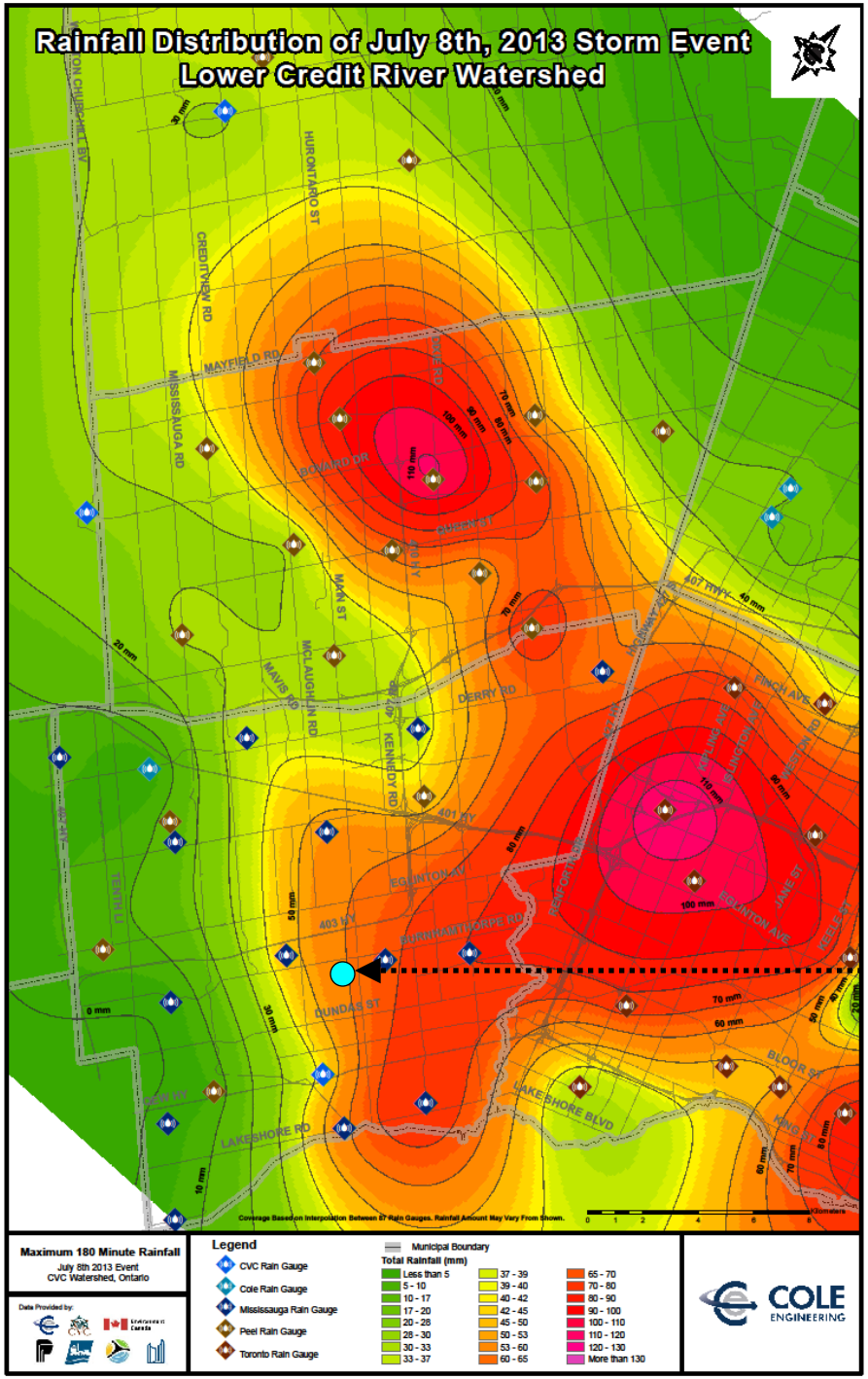

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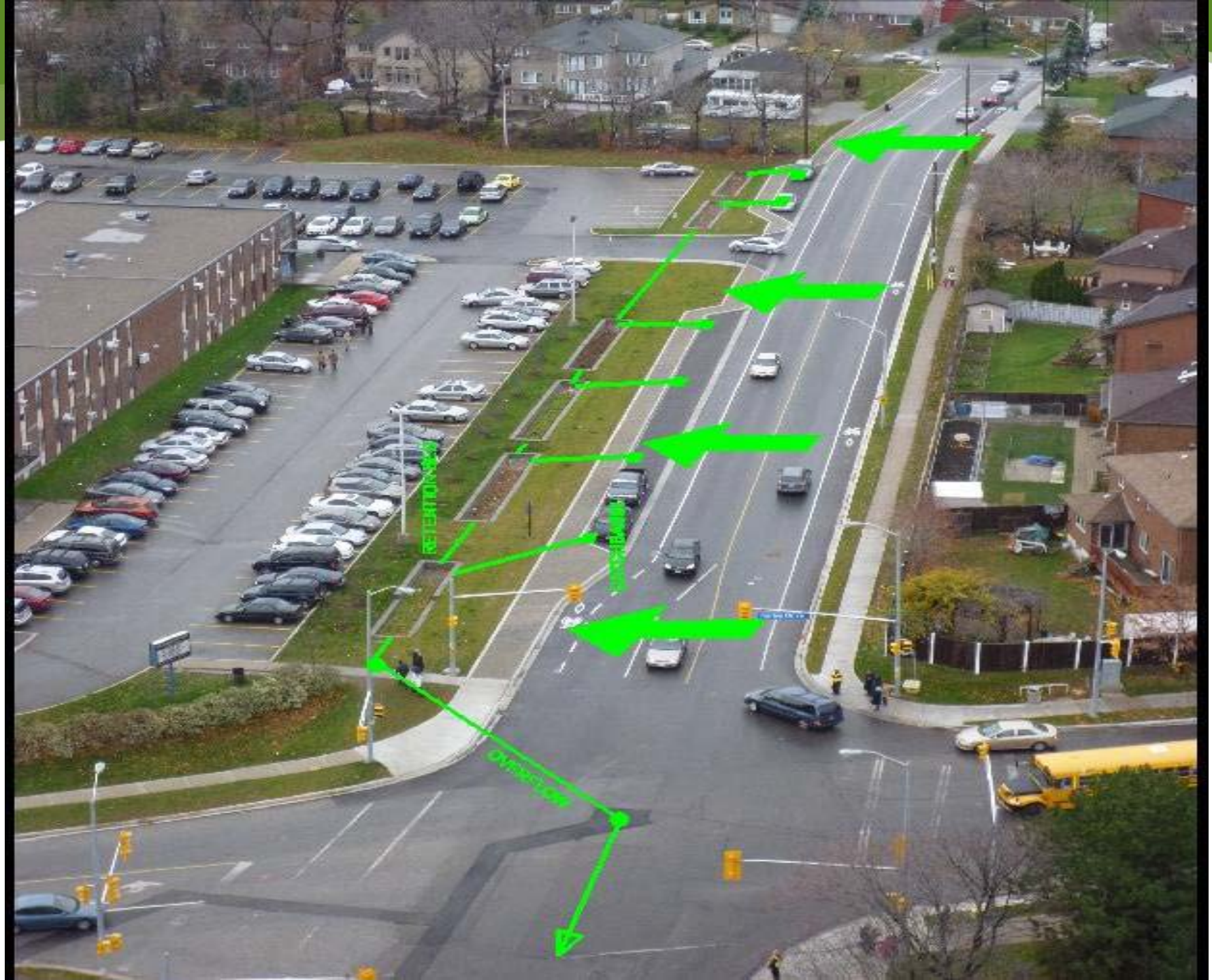
July 8th 2013 Thunder Storm

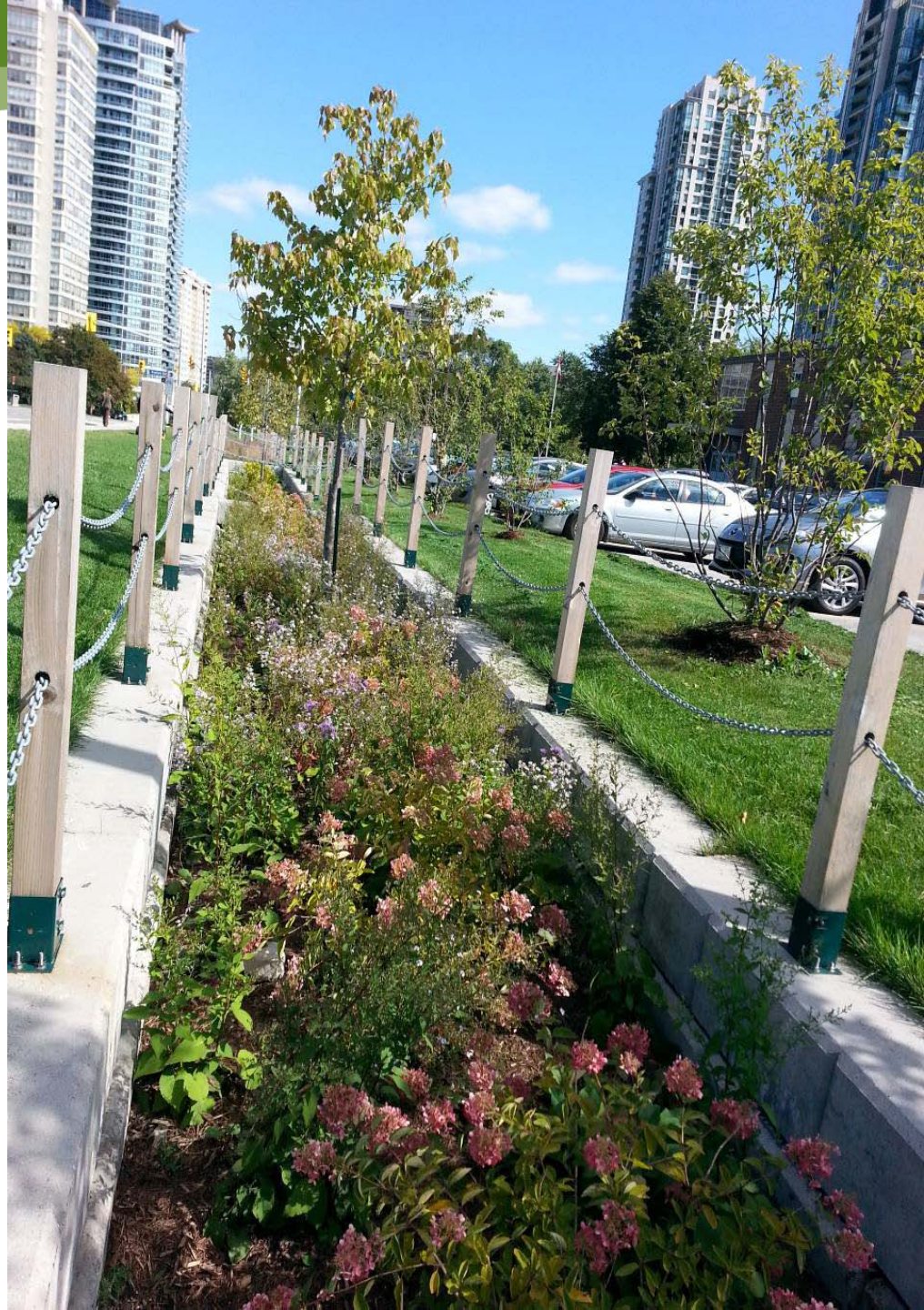
Greater than 100 Year Event

Elm Drive LID Site


RETENTION
DIVERSION

LID Performance

- LID reduced up to 60% of the peak runoff;
- LID reduced volume by 30% (30 mm)
- Delayed the timing of the peak by 20 minutes



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Erosion Control

Design Goal for Elm	To the extent possible
CVC Stormwater Management Criteria	As a minimum, on site detention of 5 mm. For sites w. a SWM Pond, detain the 25 mm event for 48 hrs
Observed Performance	Volume of the 25 mm event is absorbed reduced by 100% going well beyond criteria. **Performance exceeding all criteria**

Water Balance

Design Goal for Elm	None
CVC Stormwater Management Criteria	Minimum of 3 mm of groundwater recharge per event. (Low Volume Groundwater Recharge Area)
Observed Performance	All runoff is exfiltrated for events under 25 mm. Up to 13 mm is recharged for events of this size. For larger events where discharge was observed: 11-16 mm of recharge provided **Performance exceeding all criteria**

Monitoring Suggests

- LID offers “quick-win” opportunities in flood prone areas while larger scale SWM measures are being designed, constructed
- Data supports International BMP database (BMPDB) and National Stormwater Quality Database (NSQD), and STEP;
- City of Mississauga passes Resolution to look at all capital roads projects for LID feasibility

CVC's Infrastructure Performance & Risk Assessment Program

Top Stakeholder Priorities

1. Water quality and quantity performance of LID design in low infiltration soils

2. How multiple LID treats and manage stormwater

3. Performance of flood control, erosion control, water quality and natural heritage protection

4. **Long term maintenance**

5. **Lifecycle costs**

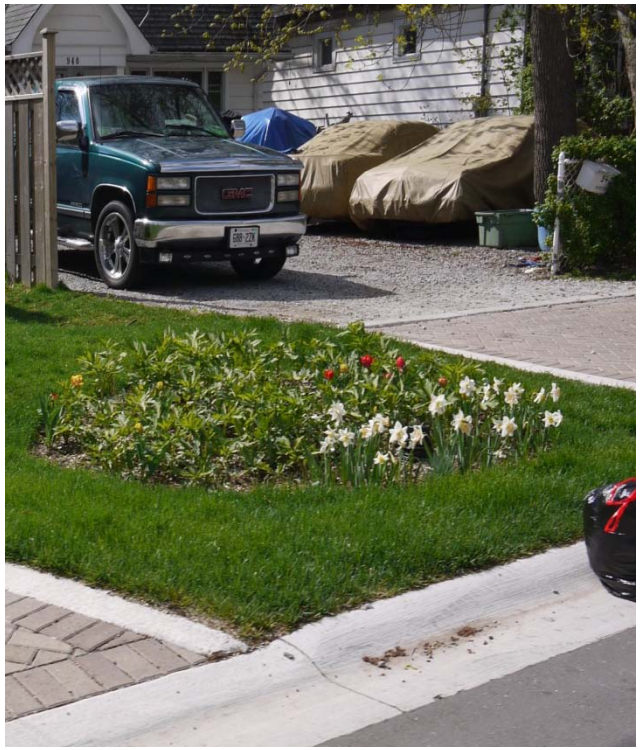
“Your most unhappy customers are the greatest source of learning.”

Bill Gates

LID Options - Right Design for the Right Location

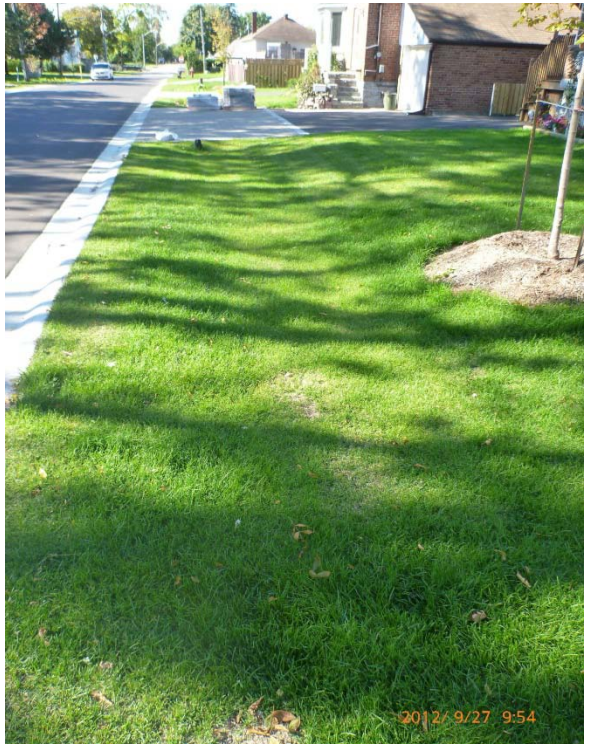
City Centre Showcase Area

Well maintained by city as with other landscaping beds in showcase areas



Neighbourhood with high ownership rate

– will be adopted by owners and maintained



High rental rate / ongoing maintenance concerns

– low maintenance grass option preferred

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KNOW YOUR AUDIENCE

“Everything is either an opportunity to grow or an obstacle to keep you from growing. You get to choose.”
Wayne Dyer

No additional maintenance is required at parks with LID.

- Tad Makula and Rich Hurren, City of Mississauga

PERCEPTION:
Can’t do LID because of road salt

County Court Road Retrofit – City of Brampton

- Impermeable liner will protect groundwater
- Monitor performance to support implementation in groundwater sensitive areas

Kitchener, Ontario

Shut-off grates installed at inlets during winter months to prevent salt contamination

PERCEPTION:
Doing something for the environment comes at a cost

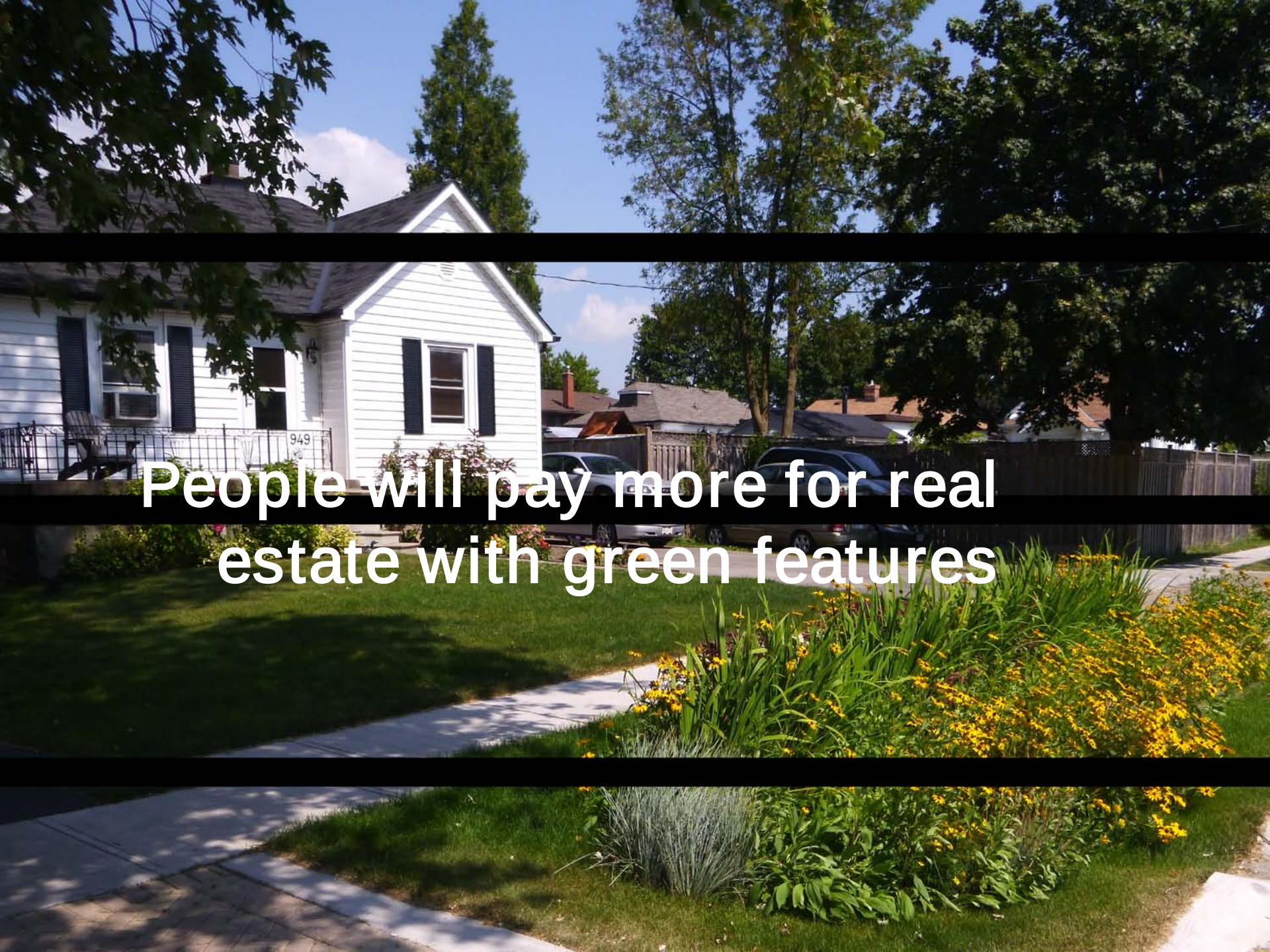

Savings of
25%
compared to
conventional
practices

The Economic Side of LID: Local Green Jobs

LID projects built through CVC's Showcasing Water Innovation grant help to raise the profile of LID. Local business are seeing an increase in their services related to LID. One local business reported that 40% of new work has been driven by LID and that net revenue is expected to grow by $900,000 over the next five years.[xxii] With stronger profitability, companies are also able to train and hire more employees.

This project will remedy a number of challenging maintenance issues and reduce our operating costs over the long term

- Nancy Cole, IMAX


People will pay more for real estate with green features

Cost Benefit Comparison for Retrofit Scenarios

Direct Benefit Rating: ● High ◎ Moderate ○ Low ⊘ None

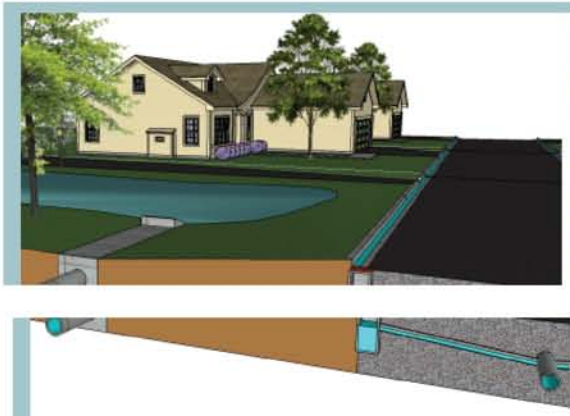
Boulevard bioretention units and permeable paver driveway:

Direct benefits:
- ● Volume reduction
- ● Erosion control
- ● Water quality
- ○ Flood control

Indirect benefits:
- ✔ Climate change mitigation & adaptation
- ✔ Groundwater recharge
- ✔ Improve baseflow
- ✔ Protect Great Lakes
- ✔ Increase amenity value
- ✔ Street greening
- ✔ Helps to meet or exceed environmental strategic plan objectives

Risks and liabilities:
- ✕ Impaired function from owner encroachment or lack of maintenance

Best value $895,000



Curb-and-gutter with stormwater management pond:

Direct benefits:
- ○ Volume reduction
- ◎ Erosion control
- ◎ Water quality
- ● Flood control

Indirect benefits:
- ✔ Maintains traditional road aesthetic
- ✔ Protect Great Lakes
- ✔ Help meet environmental strategic plan objectives
- ✔ Open space amenity

Risks and liabilities:
- ✕ Long-term maintenance liability
- ✕ Increased erosion control costs
- ✕ Harm to fisheries
- ✕ No groundwater recharge
- ✕ Pond sediment clean out

High cost, moderate benefits $1,090,000

Conventional road reconstruction (curb-and-gutter) with no SWM:

Direct benefits:
- ⊘ Volume reduction
- ⊘ Erosion control

Indirect benefits:
- ✔ Maintains traditional road aesthetic

Risks and liabilities:
- ✕ Downstream flood risk
- ✕ Increased erosion control costs
- ✕ Harm to fisheries
- ✕ No groundwater recharge

Funding Opportunities for LID

- MOI Building Together
  - MOE Water Sustainability Plans – require integration of Water, Wastewater and Stormwater
  - Gas Tax – up to 30% of projects can be SWM
- SWM Fees (Halton Hills, Mississauga)
- Insurance rebates for home/business??
- Roofing contractor rebates

Credit Valley Conservation

Grey to Green Guides and Case Studies