Connecting the Dots: Natural Channel Restoration and the Influence of Upland Communal Low Impact Stormwater Management

Natural Channels Conference
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STEP Water is a partnership between:

- Toronto and Region Conservation
- Credit Valley Conservation
- Lake Simcoe Region Conservation Authority
Clearview Creek

1. Preliminary Natural Channel Design
   – Restore concrete channel section

2. Upland Urban Hydromodification
   – Potential impact of upstream low impact stormwater controls
Clearview Creek

- Located on the Mississauga and Oakville border
- Drains into Lake Ontario
- 370 ha drainage area
- 3.2 km length
• Land use
  – Residential in upper section
  – Industrial/Commercial in mid section
  – Underdeveloped in lower section

• History channel realignment and hardening
A geomorphic assessment was completed.

Property access prevented the survey of the entire creek.

Reference reach was identified.
Reference Reach Conditions

- 8 cross-sections were surveyed including pebble counts
- The results from the surveys provided the information to create the design concepts
Channel Design Objectives for Restoration

• Eliminate concrete lining
• Remove barriers to fish passage
• Restore meander belt
• Create a more naturalized channel which more closely mimics predevelopment conditions
Design Options

Legend

- Reach Breaks
- Clearview Creek
- Not Assessed
- Corridor Buffer 50m Option A
- Corridor Buffer 50m Option B
- Corridor Buffer 50m Option C
- Subwatershed Boundary

0 40 80 160 Meters
Question: Should the design be based on current hydrologic conditions, ideal future state or some in between combination?
Part 2 – Upland Hydromodification with LID

- Preliminary modeling exercise see the effect of multiple low impact development uptake scenarios have on:
  - Peak flow of stormwater runoff
  - Baseflow
Preliminary Modeling

- Peak Flow of Stormwater Runoff – Visual OTTHYMO (VO3) modelling used to model pre and post development peak flows. Simulated peak flow of stormwater runoff for different LID uptake scenarios.

- Base Flow – Calculated infiltration volumes and effect on baseflow for different LID uptake scenarios.
Study Area for LID Retrofit Modeling
Study Area for LID Retrofit Modeling

- Current lack of stormwater management
- High levels of existing development and imperviousness
- Eligible to receive stormwater credits through City of Mississauga's stormwater credit program
Selecting Assumptions for LID Performance

Mississauga’s stormwater credit program

- Peak Flow (100 year post-to-pre): 40%
- Infiltration (15 mm): 15%
- Water Quality (80% removal of TSS): 10%
- Pollution Prevention: 5%

Capped at 50%
<table>
<thead>
<tr>
<th></th>
<th>2 Year</th>
<th>5 Year</th>
<th>10 Year</th>
<th>25 Year</th>
<th>50 Year</th>
<th>100 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-development</td>
<td>0.74</td>
<td>1.38</td>
<td>2.06</td>
<td>2.66</td>
<td>3.26</td>
<td>3.93</td>
</tr>
<tr>
<td>Post-development (existing conditions)</td>
<td>11.2</td>
<td>16.3</td>
<td>21.0</td>
<td>25.3</td>
<td>28.8</td>
<td>32.9</td>
</tr>
<tr>
<td>Post – development (100% uptake)</td>
<td>0.71</td>
<td>1.45</td>
<td>2.19</td>
<td>2.79</td>
<td>3.37</td>
<td>3.97</td>
</tr>
</tbody>
</table>

Post-retrofit peak flows are roughly equivalent to pre-development condition!
Peak Flows Under Retrofit Conditions

**Percentage of Peak Flow Removed by Different Levels of LID Structures**

- **X-axis:** Percentage Area of LID Structure Applied
- **Y-axis:** Removed Peak Flow (%)

Lines represent different return periods:
- 2 Year
- 5 Year
- 10 Year
- 25 Year
- 50 Year
- 100 Year
Baseflow – Infiltrated Runoff

• If 15 mm of each rainfall event was abstracted through infiltration
  – In 2014 733 mm of precipitation
    • 68 mm/y direct runoff, 665 mm/y infiltrated
  – Reduction in effective precipitation of 91%
What does this mean for base flow?

<table>
<thead>
<tr>
<th>Hydrologic Metric</th>
<th>25% Uptake</th>
<th>50% Uptake</th>
<th>75% Uptake</th>
<th>100% Uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Volume Infiltrated (m³)</td>
<td>139,000</td>
<td>219,000</td>
<td>418,000</td>
<td>558,000</td>
</tr>
<tr>
<td>Base Flow Increase (m³ s⁻¹)</td>
<td>0.004</td>
<td>0.009</td>
<td>0.013</td>
<td>0.018</td>
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<tr>
<td>Percentage Base Flow Increase (%)</td>
<td>9%</td>
<td>18%</td>
<td>26%</td>
<td>35%</td>
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</table>

Baseflow 2014 (Existing Conditions) = 0.05 m³ s⁻¹
How do we facilitate the implementation of low impact stormwater management at the communal scale?
A ‘Made in Ontario’ Solution:  
The Drainage Act as an Innovation Tool

• Unique to Ontario – Administered by OMAFRA
• Enabling legislation for people desiring drainage
• 180+ years of the Drainage Act
• Three key element of drainage systems
  1. Community Project
  2. Legal Existence
  3. Municipal Infrastructure
Facilitating Communal LID Implementation using the Drainage Act

- Allows trans property boundary movement of water
- Aggregation cost savings
- Additional cost savings (HST exempt)
- Maintenance ensured
Flagship Demonstration Site – Applying the Drainage Act Process in Mississauga

- 14 properties in southwest Mississauga
- 36 ha study area
- Annual stormwater utility fee of $120,000 for study area
Tying it Together and Next Steps

- Preliminary design options for creek restoration
- Preliminary insight on modifying upland hydrology
- Facilitating modifying upland hydrology

Next Steps

- Prepare detailed design for creek restoration
- Facilitate communal scale implementation of LID
  - Apply Drainage Act process in Mississauga
Funders

Government of Canada

Gouvernement du Canada

Canada

Ontario

RBC
Questions?