Using Green Infrastructure to Meet Environmental Flow Needs

To Natural Channels Conference

September 27, 2016

Presentation done in partnership with Wolfgang Wolter
Outline

• Defining environmental flows
• History of environmental flow research in Ontario
• Urbanization, climate change, green infrastructure and environmental flows
• Case study example
Environmental Flows
The Definition

‘Environmental flows describe the quantity, timing and quality of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend upon these ecosystems.’

(Brisbane Declaration, 2007)

‘The scientific literature supports natural flow regimes as essential to sustaining the health of riverine ecosystems and the fisheries dependence on them. Riverine ecosystems and the fisheries they sustain are placed at increasing risk with increasing alteration of natural flow regimes.’

(Department of Fisheries and Ocean, 2013)
Clear relationship between dynamic flow regime and stream health
Clear relationship between dynamic flow regime and stream health

Source: Australian River Institute
It is now widely recognized that a “dynamic, variable water regime is required to maintain the native biodiversity and ecological processes characteristic of every river and wetland ecosystem.”

(Arthington et al. 2009)

Yet it remains a challenge to translate the “natural flow regime paradigm” into quantitative environmental flow specifications for individual river reaches and wetlands.
Environmental Flows in Ontario
Applies to woodlots, wetlands, and streams

Hydrograph showing daily groundwater levels from the 10 m piezometer at the case study wetland from August 15, 2011 to December 7, 2015. Daily precipitation amount is shown at the top of the hydrograph. Ground level is indicated by the dotted brown line.
Urbanization and climate change are changing flows
1. Urban Influences on the Water Cycle

![Diagram showing natural and urban water balances.](image-url)
Example - flows are increasing in our urban areas

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Population</td>
<td>4050</td>
<td>9,700</td>
</tr>
<tr>
<td>Urban</td>
<td>15%</td>
<td>22%</td>
</tr>
<tr>
<td>Rural</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>38%</td>
<td>21%</td>
</tr>
<tr>
<td>Pumping Rate (m³/day)</td>
<td>3,362</td>
<td>5328</td>
</tr>
<tr>
<td>WWTP discharge (m³/day)</td>
<td>4,545</td>
<td>7,000</td>
</tr>
</tbody>
</table>
Example - Flows are increasing in our urban areas
2. Influence of climate change on flows

- Climate model projections indicate that the frequency and magnitude of hydrological extremes will increase in a future climate\(^1\).

- Increase in precipitation depth will lead to high peak flows and will bring floods with higher inundation depths\(^1\).

- Winter temperatures, particularly daily minimum temperatures have risen, which is shifting snowfall to rainfall and increasing winter surface runoff and infiltration\(^2\).

Source:
\(^1\) Dwight Boyd (2011) Presentation on Climate Change A Flood Management Perspective
\(^2\) Dr. Trevor Dickinson and Dr. Ramesh Rudra (2014) Presentation on Climate Change & Development Have Changed our River Flows
Need to Go from Grey to Green

- Industrial & Commercial Lands
- Residential Lands
- Road Right of Ways
- Public Lands
Case Study
Kenollie P.S. Rain Garden
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Kenollie P.S. Rain Garden

Subsurface drainage
Kenollie P.S. Rain Garden
Kenollie P.S. Rain Garden

Vertical Underdrain
Kenollie P.S. Rain Garden
Kenollie P.S. Rain Garden
Kenollie P.S. Rain Garden

- Video of project
Key Messages

1. Improving or preserving stream health requires further consideration of the variable flow needs of a river.

2. Inclusion of green infrastructure within our existing urban areas improves management of streams flows where there currently lacks sufficient services.

3. We must begin adopting adaptable infrastructure to mitigate the impacts of climate change.

4. Flow-habitat-biota relationships remain uncertain. Use water balance hydrology as a surrogate for environmental flows remains a powerful tool.
Project Partners
Questions
Together, it’s our nature to conserve and our future to shape.