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Water Resource Inventory Area 9 Stormwater Retrofit Project: Estimating cost-effective stormwater infrastructure solutions to meet flow and water quality targets

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WRIA 9 Stormwater Retrofit Project:
Modeling cost-effective solutions to meet flow and water quality targets

Olivia Wright
Salish Sea Ecosystem Conference
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Objective

Estimate planning-level stormwater facility needs and costs for future development in the WRIA 9 study area.

1. Model cost-effective combinations of BMPs using the EPA SUSTAIN model.

2. Extrapolate model results to future (2040) land use of the study area.
WRIA 9 Study Area
Project Need

Development is projected to increase from 65% to 77%

2007 Satellite-derived Existing Land Use (UW 2007)

Simulated 2040 Future Land Use (Alberti 2009)
**SUSTAIN**: System for Urban Stormwater Treatment and Analysis INtegration

**Model Inputs:**
- BMP Design and Cost Assumptions
- Flow or water quality goals
- Decision variables

Source: EPA
Modeling Approach

- Model 135 hypothetical 100-acre catchments representing combinations of:
  - 5 generic land uses
  - 3 soil types
  - 2 slopes
  - 3 precipitation zones
  - 2 land costs
BMP Treatment Train
BMP Unit Design and Cost Assumptions

- Develop conceptual BMP unit designs
- 30-year life cycle costs assuming 5% real discount rate:
  - Capital
  - Operation and Maintenance (O&M)
  - Inspection and enforcement (I&E)
  - Land acquisition cost
- Assume construction of modeled BMP units are distributed over the 30-year period.
SUSTAIN Optimization Target: Reduce Stream Flashiness

High Pulse Count (HPC): Number of times mean daily flows ≥ high-flow threshold set at 2 X long-term mean daily flow rate
SUSTAIN Output

Effectiveness (% Reduction)

Cost ($ Millions)
Scale to Future Land Use

SUSTAIN Modeled Hypothetical Catchments

- Commercial/Industrial
- Agricultural/Grasslands
- High Density Residential
- Low Density Residential
- Forest

Simulated 2040 Future Land Use (Alberti 2009)
# Results: BMP Units and Storage

<table>
<thead>
<tr>
<th>BMP Unit</th>
<th>#Units</th>
<th>Volume (acre-ft)</th>
<th>Storage (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisterns</td>
<td>24,000</td>
<td>200</td>
<td>0.02</td>
</tr>
<tr>
<td>Rain Gardens</td>
<td>2,600,000</td>
<td>9,600</td>
<td>0.90</td>
</tr>
<tr>
<td>Roadside Bioretention</td>
<td>190,000</td>
<td>700</td>
<td>0.07</td>
</tr>
<tr>
<td>Detention Ponds</td>
<td>75,000</td>
<td>19,000</td>
<td>1.80</td>
</tr>
</tbody>
</table>

\[
\text{storage} = \frac{\text{volume of facilities}}{\text{developed area}}
\]

\(~2.7\text{ inches}\) of flow control needed for future development
BMP Effectiveness: Improvement in Biological Health

• King County data set from 16 flow and B-IBI stream stations (*DeGasperi et al. 2009*)

• Logarithmic-linear regression equation and confidence limits estimate improvement in B-IBI scores based on improvement in HPC (*Horner 2013*)
Potential Improvement in Hydrologic Indicators and B-IBI Scores

*Results for 446 catchments of study area
Potential B-IBI Improvement

2040 Land Use
No Stormwater Management

2040 Land Use
Full Stormwater Management

Source: http://pugetsoundstreambenthos.org/
Next step: Estimating Costs

• How will BMPs be implemented across the study area?

• Evaluate implementation strategies:
  ▫ Mitigation required with new and redevelopment
  ▫ Potential public stormwater program

• Identify existing facilities in study area
Questions?

For more details: King County’s WRIA 9 Retrofit Project SUSTAIN Modeling Report

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