U.S. EPA NATIONAL STORMWATER CALCULATOR:
Low Impact Development Stormwater Control
Cost Estimation Module & Future Enhancements

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Presentation Outline

• Stormwater Calculator Background Information

• Potential Applications

• Cost Estimation Module

• Using the Calculator: Baltimore, MD (May 2017 Application)

• Development of Mobile Web Application

• Discussion & Questions
National Stormwater Calculator

EPA’s National Stormwater Calculator (SWC) is a desktop application that estimates the annual amount of rainwater and frequency of runoff from a specific site anywhere in the United States (including Puerto Rico). Estimates are based on local soil conditions, land cover, and historic rainfall records.

http://www2.epa.gov/water-research/national-stormwater-calculator
National Stormwater Calculator User’s Guide

The National Stormwater Calculator shows users how land use decisions and green infrastructure practices affect the amount of stormwater runoff produced. Green infrastructure, such as the street planter and porous paving shown above (Image 1), can help prevent pollution and overflows by absorbing water and allowing it to wash into streets and down storm drains, as it does with traditional grey infrastructure shown above (Image 2). These practices allow the stormwater to be used as a resource rather than a waste product. Having less water runoff into storm drains and outfalls can help prevent contamination of waterways, infrastructure degradation, flooding, and overtaxing of treatment plants.

National Stormwater Calculator (SWC)

Tool that helps users control runoff to promote the natural movement of water.

Stormwater discharges continue to cause impairment of our Nation’s waterbodies. In order to reduce impairment, EPA has developed the National Stormwater Calculator (SWC) to help support local, state, and national stormwater management objectives and regulatory efforts to reduce runoff through infiltration and retention using green infrastructure practices as low impact development (LID) controls. The primary focus of the SWC is to inform site developers on how well they can meet a desired stormwater retention target with and without the use of green infrastructure. It can also be used by local officials and homeowners.

Platform: The SWC is a Windows-based desktop program that requires an internet connection. A mobile web application version that will be compatible with all operating systems is currently being developed.

Cost Module: An LID cost estimation module within the application allows planners and managers to evaluate LID controls based on comparison of regional and national project planning level cost estimates (capital and annual maintenance) and predicted LID control performance. Cost estimation is accomplished based on user-identified site configuration of the LID control infrastructure and other key project and site-specific variables. This includes whether the project is being applied as part of new development or redevelopment and if there are existing site constraints.

Climate Sensitivity: The SWC allows users to consider how runoff may vary based on historical weather and potential future climate conditions. To better inform decisions, it is recommended that the user develop a range of SWC results with various assumptions about model inputs such as percent of impervious surface, soil type, sizing of green infrastructure, as well as historical weather and future climate scenarios.

Please check with local authorities about whether and how use of these tools may support local stormwater management goals.

The SWC is comprised of ten tabbed pages:

1. Location: This step has an address lookup feature that allows the user to easily navigate to a site selected anywhere within the United States.
2. Soil Type: In this step, soil type is identified and is used to infer infiltration properties. It can be selected based on local knowledge or from the online database.
3. Soil Drainage: This step identifies how quickly water drains into the soil. Conductivity can be selected based on local knowledge or retrieved from the online database.
4. Topography: Here, the site’s surface topography is characterized, as measured by the surface slope. The user can rely on the slope data display as a guide or can use local knowledge to describe the site’s topography.
What Developed and Why?

• Stormwater Management (Green Infrastructure/Low Impact Development) Design and Planning Tool

  • Model post-construction urban stormwater runoff discharges

  • Allow for screening-level analysis of various green infrastructure practices, including planning level costs (green roofs, rain gardens, cisterns, etc.) throughout the U.S.

  • Allow non-technical professionals to conduct screening level stormwater runoff for small to medium sized (less than 1 - 12 acres) sites
Who We Created the Calculator for…

- Local planners
- Land developers
- Landscape architects
- Homeowners, etc.

…to assist meeting stormwater design and planning goals or requirements
Potential Applications

- State or MS4 (Municipal Separate Storm Sewer System) Post Construction Stormwater Design Standards
- Voluntary Stormwater Retrofits for private property owners
- Voluntary Programs: LEED (US Green Building Council)
- Climate Resiliency Planning: Rockefeller Foundation’s 100 Resilient Cities
- LID/Green Infrastructure Design Competitions: Campus EPA RainWorks Challenge
The calculator is based on SWMM: dynamic rainfall-runoff simulation model for long-term simulation of runoff quantity.

SWMM produces stormwater runoff estimates in the background of the Stormwater Calculator.
National Stormwater Calculator (SWC): Site Parameters and Embedded GIS Data-sets

- **Location**: Bing Maps
- **Soils**: NRCS SSURGO
- **Slope**: NRCS SSURGO
- **Hydraulic Conductivity**: NRCS SSURGO
- **Precipitation and Temperature**: National Climate Center (NCDC)-NOAA from EPA’s BASINS Model
- **Evaporation**: calculation based on meteorological data
- **Climate Change Future Scenarios**: precipitation & evaporation
- **Land-Cover/Use**: user provided
- **LID Practices (*new costing module available*)**: user provided
Welcome to the EPA National Stormwater Calculator

This calculator estimates the amount of stormwater runoff generated from a land parcel under different development and control scenarios over a long-term period of historical rainfall.

The analysis takes into account local soil conditions, topography, land cover and meteorology. Different types of low impact development (LID) practices can be employed to help capture and retain rainfall on-site. Localized climate change scenarios can also be analyzed.

Site information is provided to the calculator using the tabbed pages listed above. The Results page is where the site’s runoff is computed and displayed.

This program was produced by the U.S. Environmental Protection Agency and was subject to both internal and external technical review. Please check with local authorities about whether and how it can be used to support local stormwater management goals and requirements.

Select the Location tab to begin analyzing a new site.
SWC Cost Estimation Module *(Released Spring 2017)*

- **Intended Uses:**
  - Planning level cost estimates (magnitude of costs between planning scenarios)

- **Limitations:**
  - Not final construction/build costs
  - Not lifecycle costs (gives annual O & M costs, not replacement costs)
  - Regional costs not available for all areas of the US (many of the Western states)

- **Intended Audience**
  - Planners, landscape architects, homeowners, developers, students, etc.
## SWC Cost Estimation Module:
**Site Complexity Effects on Costs of Stormwater Projects**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Simple</th>
<th>Typical</th>
<th>Complex</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New vs. existing development</strong></td>
<td>New</td>
<td>Existing</td>
<td>Existing</td>
</tr>
<tr>
<td><em>(Pretreatment) Outflow and overflow discharge safety constraints</em></td>
<td>Safe &amp; unconstrained</td>
<td>Slightly constrained &amp; may require some grading or pipe infrastructure for safe discharge</td>
<td>Likely constrained &amp; may require significant grading or pipe infrastructure for safe discharge</td>
</tr>
<tr>
<td><strong>Equipment accessibility</strong></td>
<td>Easy access</td>
<td>Fairly easy</td>
<td>Difficult access</td>
</tr>
<tr>
<td><strong>Slope for LID control placement</strong></td>
<td>Flat to moderately flat (0 – 4%)</td>
<td>Moderately flat (4 – 7%)</td>
<td>Steeper slope (greater than 7%)</td>
</tr>
<tr>
<td><strong>Soil infiltration rate</strong></td>
<td>High infiltration (HSG: A)</td>
<td>Moderate infiltration (HSG: B)</td>
<td>Low infiltration (HSG: C and D)</td>
</tr>
</tbody>
</table>
Accounting for Uncertainty with Cost Estimates (Regression Cost Curves)
Development of Regionalized Low Impact Development/Green Infrastructure Costs

• Utilization of Bureau of Labor Statistics (BLS) Data for regional costs
  — National Producer Price Index: outputs of service, construction, utilities, and other goods producing entities
    • Examples include: concrete storm sewer pipe, construction sand and gravel, etc.
  — Consumer Price Index: regional/city data (23 major US cities)
    • Examples include: fuels and utilities, energy, and diesel fuel

• Data easily updated and maintained annually by EPA

• Development of regional costs comparable to Engineering News Record (ENR) and RS Means
Street planters as part of a complete street
SWC Case Study:
Green & Complete Streets Building Blocks Workshop (April, 2017): Pigtown Neighborhood - Baltimore, MD
Stormwater Management Statistics:

Total Treatment Per Rainfall Event: 1,810 cf
Total Impervious Removal: 2,125 sf (168 cf)
Annual Treatment: 68,418 cf or 512,000 gallons
Existing Planning Costs for Bio-retention at Scott Street (Pigtown Mainstreet consultant team, 2017)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QTY (H)</th>
<th>EXCA. QTY</th>
<th>UNITS</th>
<th>COST</th>
<th>TOTAL COST</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROBIORETENTION AREAS</td>
<td>582</td>
<td>291</td>
<td>1.1</td>
<td>640SF</td>
<td>$35</td>
<td>$22,407 includes plants</td>
</tr>
</tbody>
</table>

*Costs do not include annual maintenance and operations*
SWC Analysis: Scott Street

Project Location
SWC Analysis: Scott Street
Soil Runoff Potential
SWC Analysis: Scott Street

Soil Drainage
SWC Analysis: Scott Street

Topography

Map showing topography with options for different slope categories:
- Flat (0% Slope)
- Moderately Flat (5% Slope)
- Moderately Steep (10% Slope)
- Steep (above 15% Slope)

Additional information:
- View soil survey data
- Options for precipitation, evaporation, climate change, land cover, LID controls, results

Help text:
- Describe your site’s topography
- Select a slope category directly from the map.
SWC Analysis: Scott Street

Historical Precipitation

Select a rain gage location to use as a source of hourly rainfall data:

1. WFO-02-CR-BALTIMORE
   (1999-2000) 41.54""}

2. BALTIMORE WASH INTL AP
   (1970-2000) 41.96""}

3. CLARKSVILLE 2 NNE
   (1970-2000) 44.79""}

4. LAUREL 3 W
   (1970-2000) 46.70""}

5. ANNAPOLIS POLICE BRKS
   (1970-2000) 46.00""}

Select a source of long-term hourly rainfall data.
SWC Analysis: 
Climate Change Impacts for the Northeast

Heat waves, heavy downpours, and sea level rise pose growing challenges to many aspects of life in the Northeast. Infrastructure, agriculture, fisheries, and ecosystems will be increasingly compromised. Many states and cities are beginning to incorporate climate change into their planning.

Northeast

Explore how climate change is affecting the Northeast.

Sea Level is Rising

Figure 1b.1: Major local sea level trends in the northeast region. Plotted is the observed rate of change of the mean sea level (in feet/year) for the period 1993-2012. The observed trend shows an increase of 0.01 feet/year, which is consistent with the global sea level rise trend. (Source: NCEI)
SWC Analysis: Scott Street

Climate Change Scenarios

[Graph showing percentage change in monthly rainfall and annual max. day rainfall for near term projections.]
SWC Analysis: Scott Street

Existing Land Cover

~85% Impervious Surface
SWC Analysis: Scott Street
LID: Redevelopment Project

Re-Development
Re-Development is construction that is a change in existing development (land cover, land use, or similar development alteration) which requires new or alteration of existing stormwater management facilities.

Costs of removal, decommissioning, or alteration of existing structures or additional (new) infrastructure is typically required to connect existing structures and results in costs that are greater than what would be anticipated with a new development site.

Re-development and extensive retrofit costs are typically higher than new development costs because existing structures might have to be removed or new structures may be required but may not be located in a preferred location.

Selecting "Re-development" on the "LID Controls" tab of the National Stormwater Calculator influences the site complexity, and shifts the costs towards a higher complexity cost estimation.

Re-development combined with information on site suitability, topography, and soil drainage determines whether complex, typical, or simple cost curves apply. See User Guide for more information.
SWC Analysis: Scott Street  

LID: Site Suitability (Poor)
SWC Analysis: Scott Street

Runoff Reduction Results

Current Scenario
Annual Rainfall = 42.21 inches

Statistic | Current Scenario | Baseline Scenario
--- | --- | ---
Average Annual Rainfall (inches) | 42.21 | 46.00
Average Annual Runoff (inches) | 11.72 | 11.98
Days per Year With Runoff | 64.71 | 66.13
Days per Year with Runoff | 27.23 | 27.87
Percent of Wet Days Retained | 57.82 | 56.74
Smallest Rainfall w/o Runoff (inches) | 0.15 | 0.15
Largest Rainfall w/o Runoff (inches) | 0.53 | 0.53
Max. Rainfall Retained (inches) | 1.36 | 1.36
SWC Analysis: Scott Street
Capital Costs Summary (Poor Site Suitability)
SWC Analysis: Scott Street
Annual Maintenance Costs Summary (Poor Site Suitability)

### Estimate of Probable Maintenance Costs

<table>
<thead>
<tr>
<th>Cost By LID Control Type</th>
<th>Current Scenario (C)</th>
<th>Baseline Scenario (B)</th>
<th>Difference (C - B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Disconnections</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td>Rain Gardens</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td>Green Roofs</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td>Street Planters</td>
<td>$49</td>
<td>$1,169</td>
<td>-</td>
</tr>
<tr>
<td>Infiltration Basins</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td>Permeable Pavement</td>
<td>$0</td>
<td>$0</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$49</strong></td>
<td><strong>$1,169</strong></td>
<td>-</td>
</tr>
</tbody>
</table>

### Current Scenario

- Dew Type: Re-development
- Site Suitability: Poor
- Topography: Mod. Flat (3% Slope)
- Soil Type: C
- Cost Region: Washington (40 miles) 0.92

### Baseline Scenario

- -
- -
- -
- -
Interpreting the Results

- Informing next steps for finalizing costs of stormwater projects

- Comparing the relative magnitude of planning level costs (capital & operations/maintenance costs) for different stormwater management solutions.

- Comparisons may be made between national and regional cost estimates:
  - Using local knowledge in selection of regional BLS cost multipliers
    - Washington, DC, Philadelphia, PA, etc.
SWC Mobile Web App Development
Discussion and Questions
Thank You!

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National Stormwater Calculator Website:
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