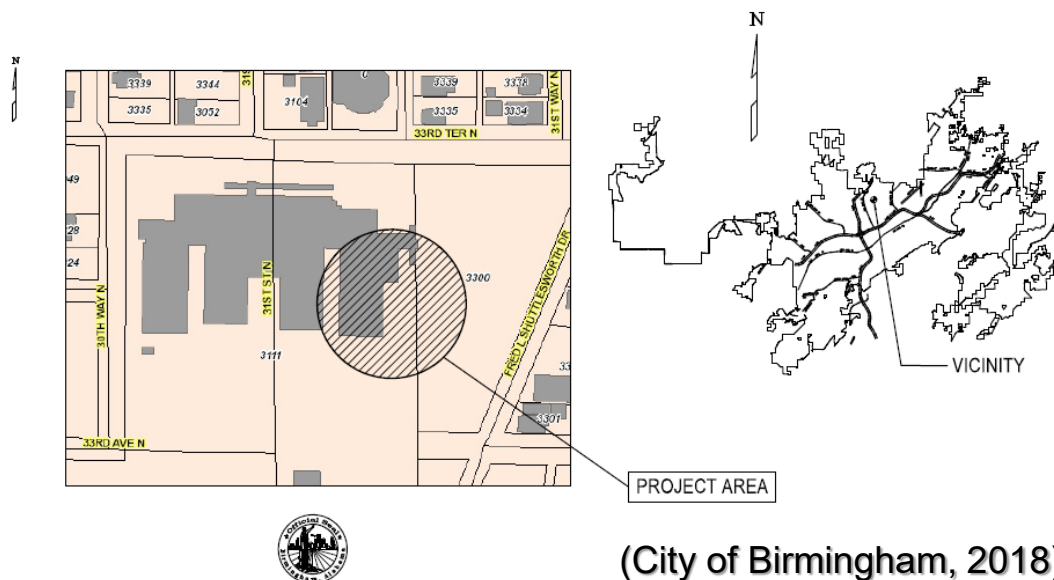


HUDSON K-8 SCHOOL BIO-RETENTION POND AND PERVIOUS PAVEMENT

(SE1/4 SEC, S 13-T 17S-R 3W)



U.S. EPA National Stormwater Calculator: City of Birmingham, AL. Demonstration



The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.

Outline

U.S. EPA National Stormwater Calculator

- Stormwater Calculator (SWC) Background Information
- Low Impact Development (LID) Cost Estimation Module
- SWC Web Application
- Example Application: Hudson K-8 School, Birmingham, AL.
- Interpreting Results
- Potential Next Steps
- Case Study with Actual Costs: Buckingham Elementary School, Dillwyn, VA
- Discussion & Questions

National Stormwater Calculator Website

EPA United States Environmental Protection Agency

Environmental Topics Laws & Regulations About EPA Search EPA.gov

Related Topics: [Water Research](#) CONTACT US SHARE

National Stormwater Calculator

Register now for a [free webinar](#) on January 31, 2018 that will provide a demonstration and introduce new features.

Tool to help control runoff and promote the natural movement of water

EPA's National Stormwater Calculator (SWC) is a software application that estimates the annual amount of rainwater and frequency of runoff from a specific site. Estimates are based on local soil conditions, land cover, and historic rainfall records. It is designed to be used by anyone interested in reducing runoff from a property, including site developers, landscape architects, urban planners, and homeowners.

The SWC accesses several national databases that provide soil, topography, rainfall, and evaporation information for a chosen site. The user supplies information about the site's land cover and selects low impact development (LID) controls they would like to use. The LID controls include seven green infrastructure practices.

[Access the Mobile Web App](#)

[Green Infrastructure as Low Impact Development Controls](#) +

[Capabilities](#) +

[Real-World Applications](#) +

[Software and Documentation](#) +

Additional Information

EPA's National Stormwater Calculator

<http://www2.epa.gov/water-research/national-stormwater-calculator>

What We Developed and Why?

A Stormwater Management (Green Infrastructure/LID) Design and Planning Tool

- To estimate post-construction urban stormwater runoff discharges
- Screening-level stormwater runoff reduction and cost analyses of various green infrastructure/LID practices, including:
 - 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

Potential Applications

- State or MS4 (Municipal Separate Storm Sewer System) Post Construction Stormwater Design Standards
- Voluntary Stormwater Retrofits for private property owners
- Climate Resiliency Planning: Rockefeller Foundation's 100 Resilient Cities (extreme storm events)
- Green Building Programs: LEED (U.S. Green Building Council) and Sustainable Sites Initiative stormwater credits

Communities using the SWC

- Northeastern Regional Ohio Sewer District (Cleveland, OH):

[Home](#) > [Stormwater](#) > [Green Infrastructure Grant Program](#)

Green Infrastructure Grant Program



<https://www.neorsd.org/stormwater-2/green-infrastructure-grant-program>

- EPA's Green & Complete Streets Building Blocks Program Recipients (2016- 2017):

- Manatee County, FL
- Baltimore, MD
- Central Falls, RI



<https://www.epa.gov/smartgrowth/building-blocks-sustainable-communities>

Storm Water Management Model (SWMM)

EPA United States Environmental Protection Agency

Environmental Topics Laws & Regulations About EPA Search EPA.gov

Related Topics: [Water Research](#) CONTACT US SHARE [f](#) [t](#) [p](#) [e](#)


Storm Water Management Model (SWMM)

Version 5.1.012 with Low Impact Development Controls

- [Description](#)
- [Capabilities](#)
- [Applications](#)
- [Add-in Tool](#)
- [Support](#)
- [Downloads](#)
- [Documentation](#)
- [Helpful Resources](#)
- [Contact](#)

- SWC 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 SWC

National Stormwater Calculator (SWC) Desktop Application

 National Stormwater Calculator

Overview | Location | Soil Type | Soil Drainage | Topography | Precipitation | Evaporation | Climate Change | Land Cover | LID Controls | Results

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.

Release 1.2.0.0

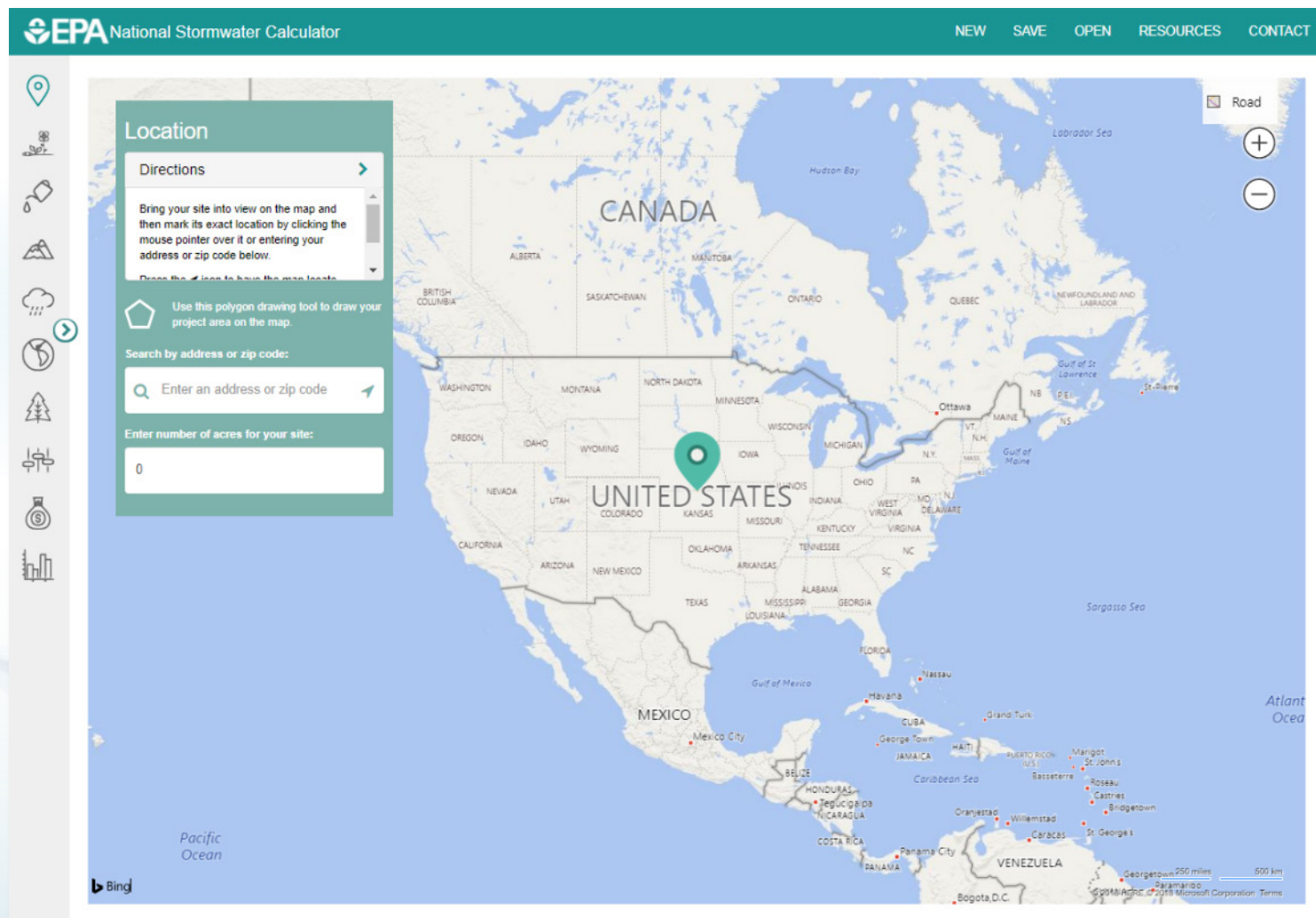


Map of North America showing the United States, Canada, and Mexico. The map includes labels for the Bering Sea, Gulf of Alaska, Hudson Bay, Labrador Sea, Sargasso Sea, Atlantic Ocean, Caribbean Sea, Gulf of Mexico, Pacific Ocean, and various countries like Canada, United States, Mexico, Venezuela, Colombia, and Ecuador. A red square marks a location in the United States. The map also shows a scale bar for 500 miles and 1000 km, and copyright information for 2017 Microsoft Corporation and 2017 HERE.

Select the Location tab to begin analyzing a new site.

[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

SWC Mobile Web App



LID Cost Estimation Module

(Released May 2017):

- **Intended Uses:**

- Planning level cost estimates (magnitude of costs between planning scenarios)

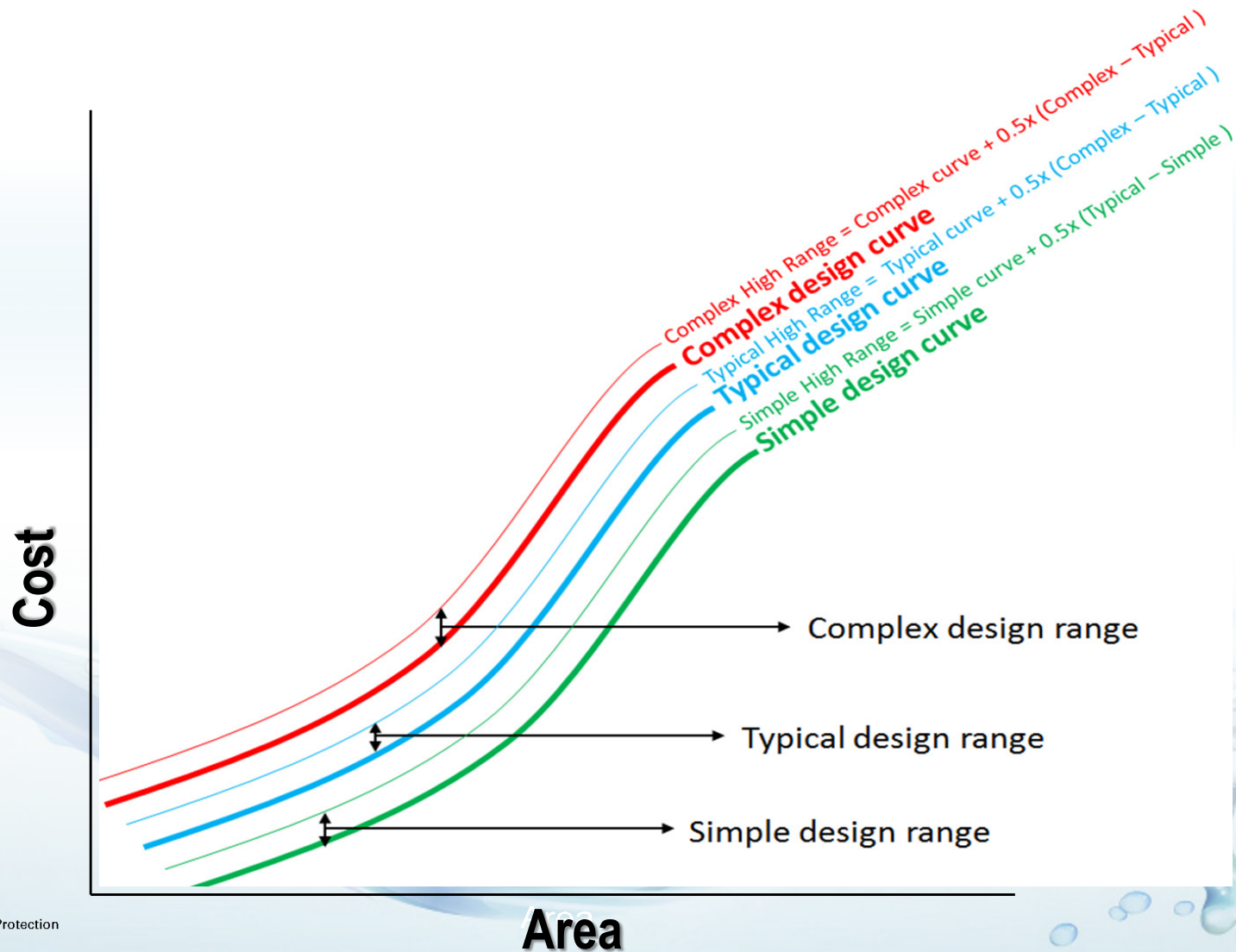
- **Limitations:**

- Doesn't provide final construction costs
- Doesn't provide lifecycle costs (gives annual operation and maintenance (O & M) costs, not replacement costs)
- Regional costs not available for all areas of the US (many of the Western states)



LID Cost Estimation Module:

Accounting for Uncertainty with Cost Estimates (Regression Cost Curves)



LID Cost Estimation Module:

Development of Regionalized LID/Green Infrastructure Costs

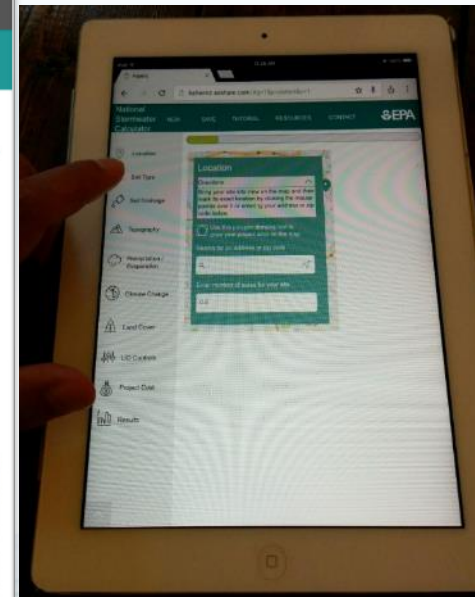
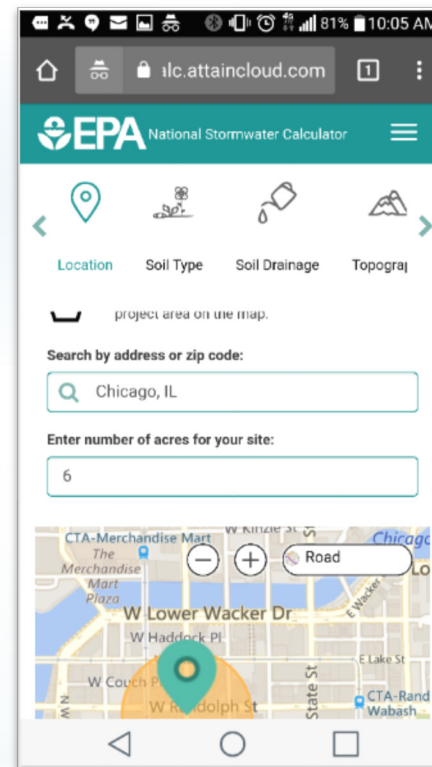
- **Utilization of Bureau of Labor Statistics (BLS) Data for regional costs**
 - National Producer Price Index: outputs of service, construction, utilities, and other goods producing entities
 - Examples include: concrete storm sewer pipe, construction sand and gravel, etc.
 - Consumer Price Index: regional/city data (17 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**

Release of SWC Web App

Sept. 2017

***Web app link: <https://swcweb.epa.gov/stormwatercalculator/>**

- Ability to function on any web browser
- Mobile friendly design (tablets and smartphones)
- Platform neutral: functions on Windows, Apple, and Linux computers
- Not found in an “app store” (Google Play or Apple Store)
 - Save it as a “favorite” website
- **Requires a live Internet connection**

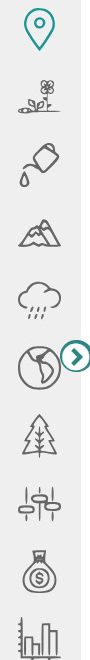


Example views from smartphone and tablet

SWC Mobile Web App Application

(Hudson K-8 School, Birmingham, AL)

Location:



Location

Directions

Bring your site into view on the map and then mark its exact location by clicking the mouse pointer over it or entering your address or zip code below.

Press the  icon to have the map locate:

Use this polygon drawing tool to draw your project area on the map.

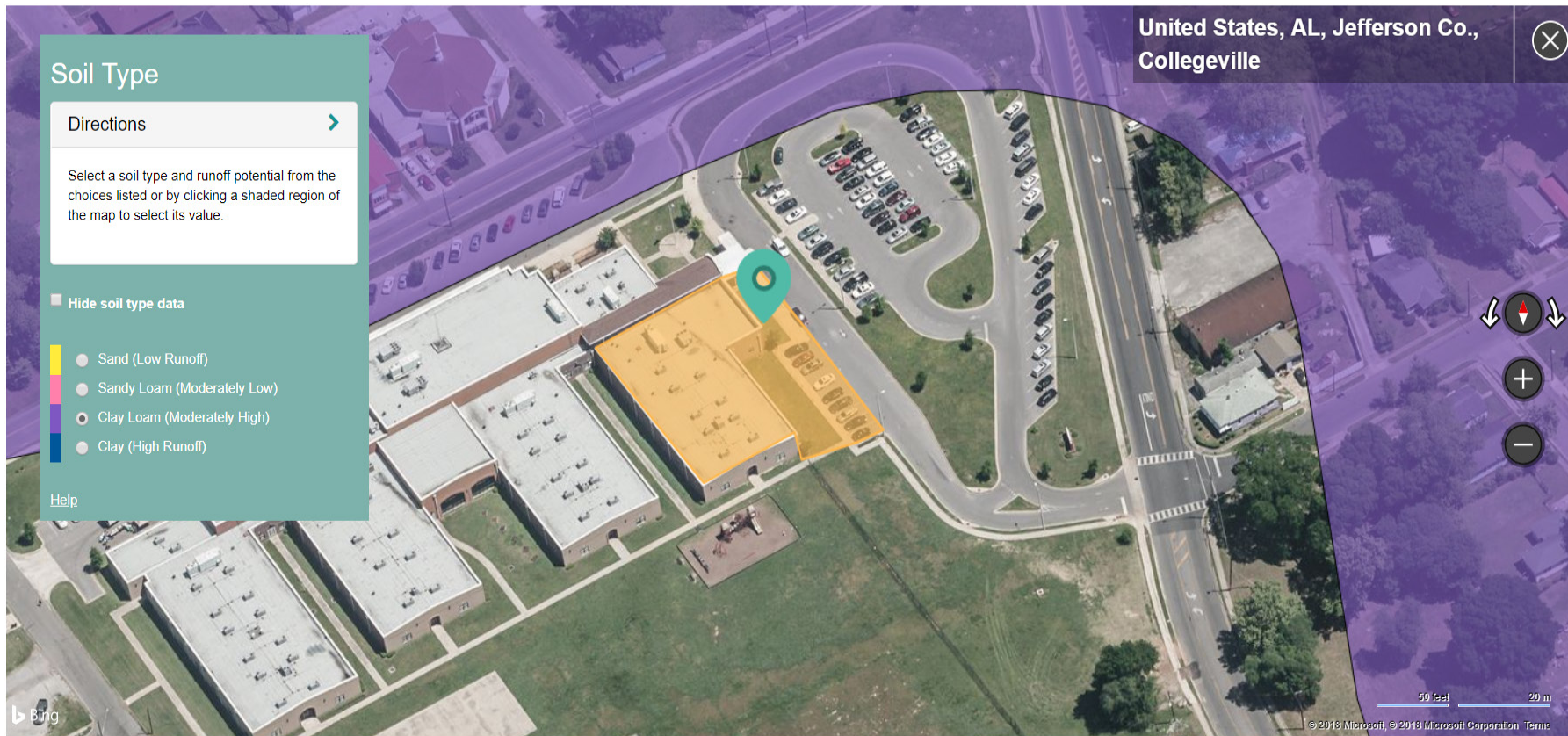
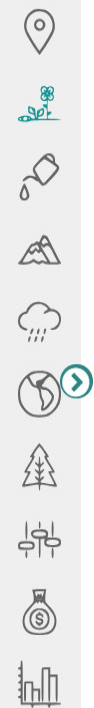
Search by address or zip code:

Enter number of acres for your site:

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Soil Runoff Potential:



Soil Infiltration Capacity:



United States, AL, Jefferson Co.,
Collegeville

Soil Drainage

Directions

Enter your own conductivity value directly into the input field below or click a shaded region on the map to select its conductivity value. If you leave the edit box blank, the default conductivity associated with the

☐ Hide soil type data

- ≤ 0.01 inches/hour
- > 0.01 to ≤ 0.1 inches/hour
- > 0.1 to ≤ 1.0 inches/hour
- > 1 inches/hour

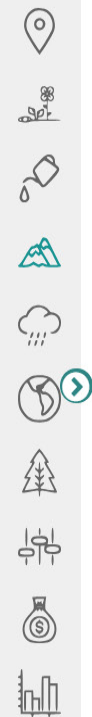
How fast does rainwater runoff from pervious areas of your site (inches/hour)?

[Help](#)

50 feet 20 m

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Topography/Slope:







Topography

Directions >

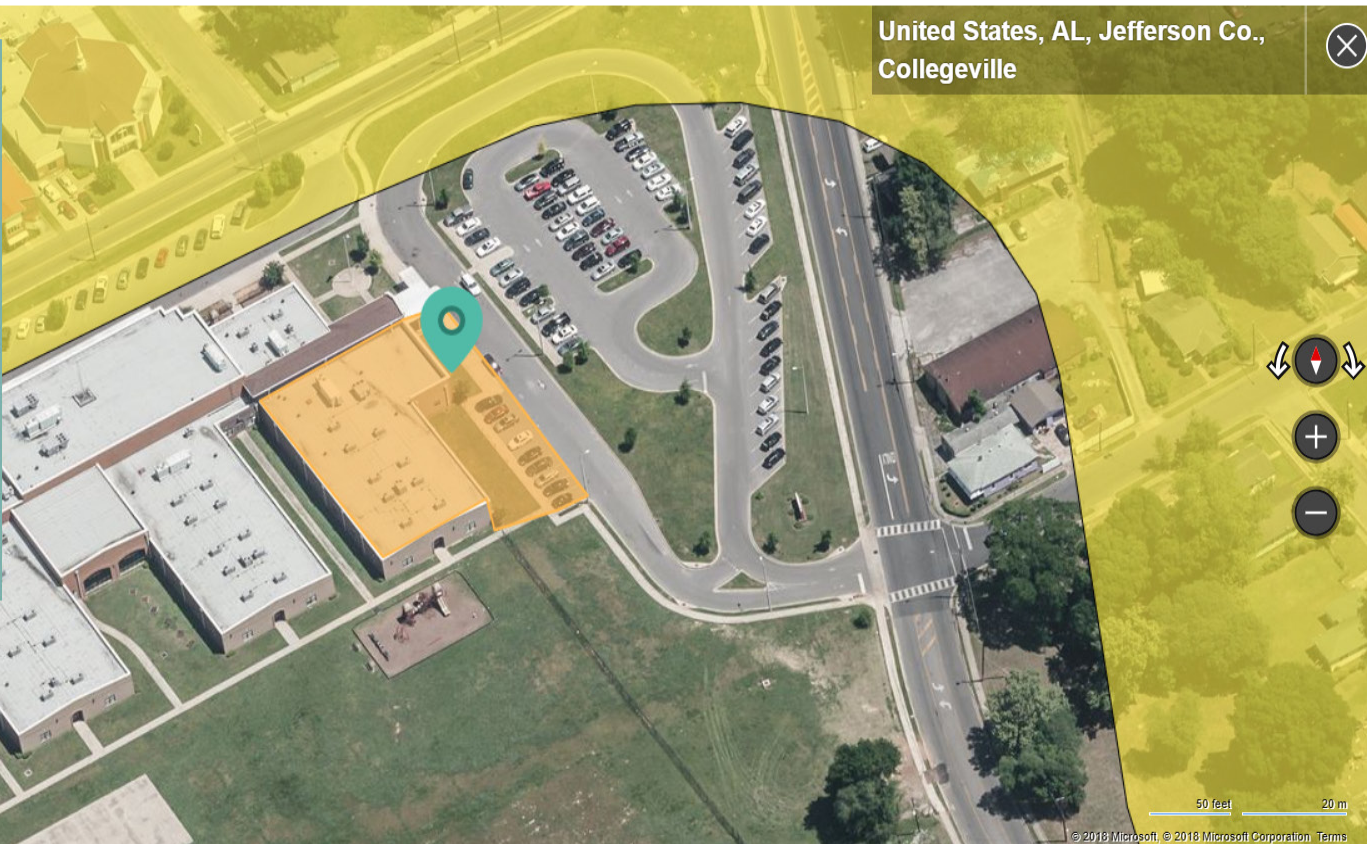
Select a slope from the choices listed below or click a shaded region on the map to select its value.

☐ Hide soil type data

-  Flat (2% Slope)
-  Moderately Flat (5% Slope)
-  Moderately Steep (10% Slope)
-  Steep (Above 15% Slope)

[Help](#)

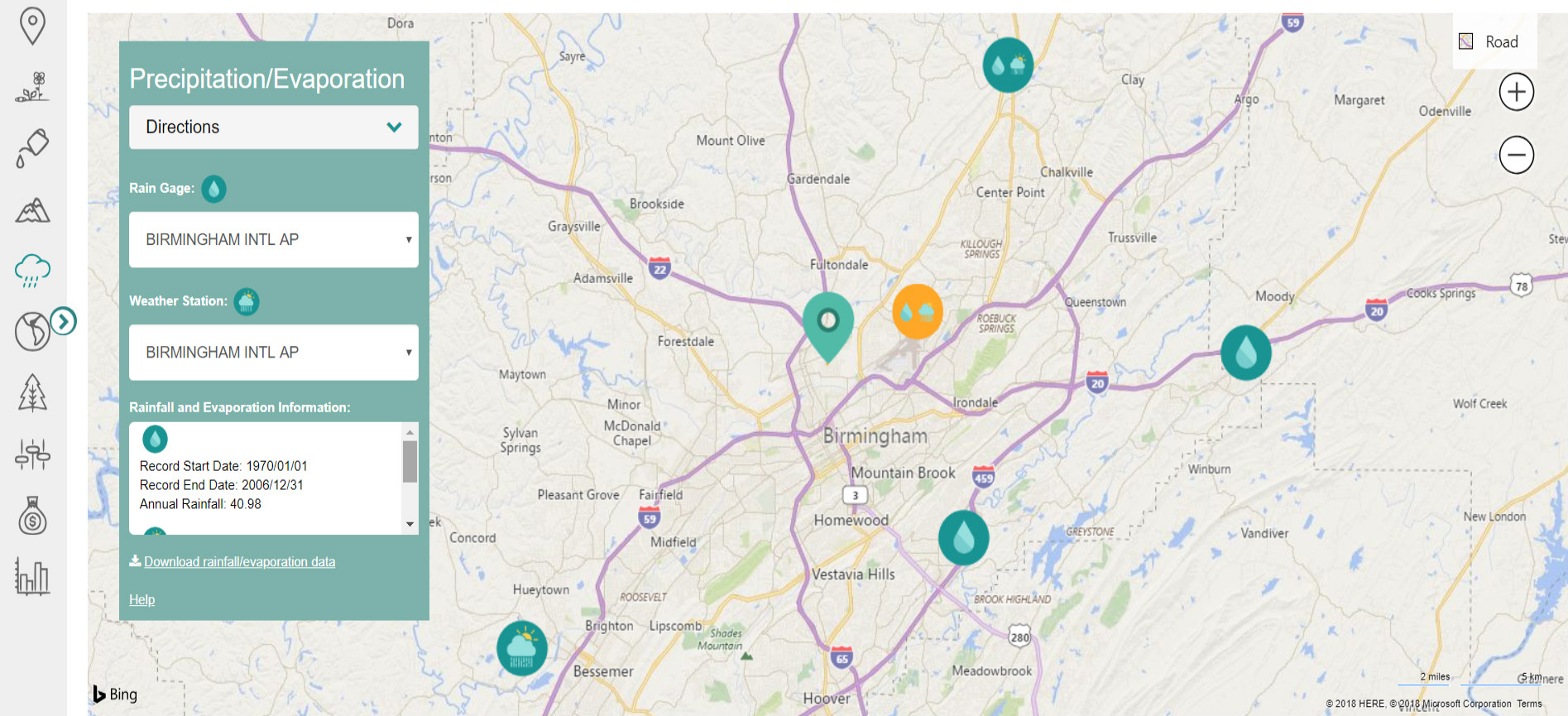
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Collegeville



50 feet 20 m

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Historical Weather (precipitation & evaporation):



Climate Change Scenarios & Extreme Storm Events:

Climate Change

Directions

Helpful Resources

[Scenarios for Climate Assessment and Adaptation - Regions](#)
[GlobalChange.gov - Regions & Topics](#)
[US Environmental Protection Agency - Future of Climate Change](#)
[World Climate Research Programme](#)

Select a future climate change scenario to apply:

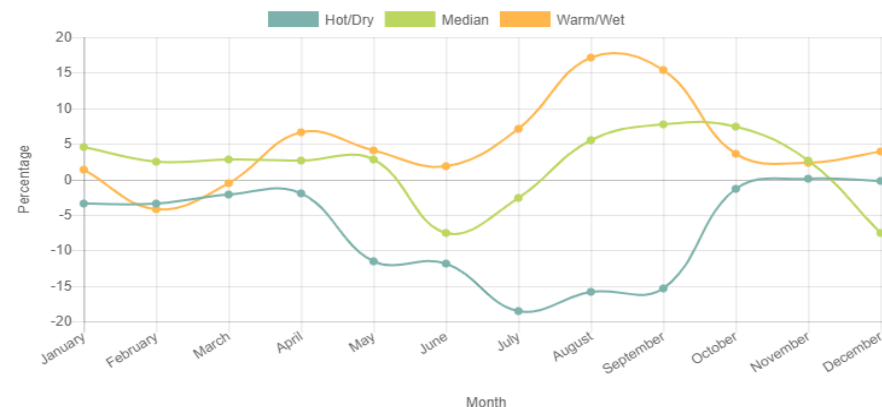
- ☒ No Change
☐ Hot/Dry
☐ Median Change
☐ Warm/Wet

Select the time period to which the climate change scenario applies:

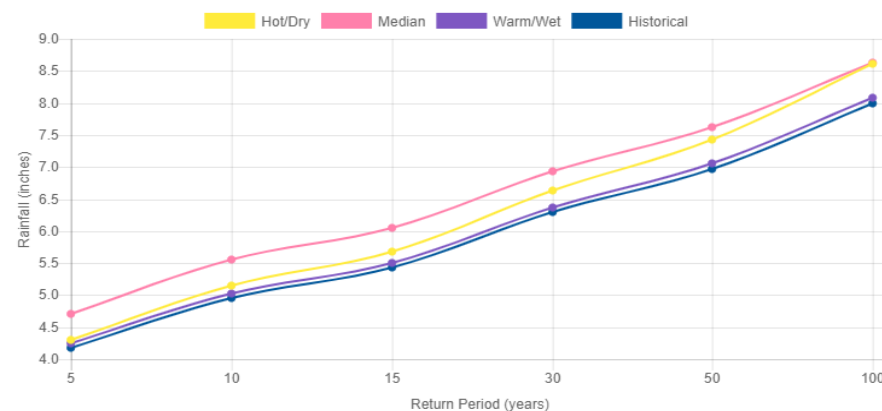
- ☒ Near Term (2020 - 2049)
☐ Far Term (2045 - 2074)

Print Charts to PDF
File

Percentage Change in Monthly Rainfall for Near Term Projections



Annual Max. Day Rainfall (inches) for Near Term Projections



Land Cover:



Land Cover

Directions

Describe the site's land cover for the development scenario being analyzed.

Click on a category to see a more detailed description.

Forest:	<input type="range"/>	2	%
Meadow:	<input type="range"/>	0	%
Lawn:	<input type="range"/>	23	%
Desert:	<input type="range"/>	0	%
Impervious:		75	%

[Help](#)



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Collegeville

LID Controls:

LID Controls

Directions

Enter the percentage of your site's impervious area you would like to be treated by the listed LID Controls.

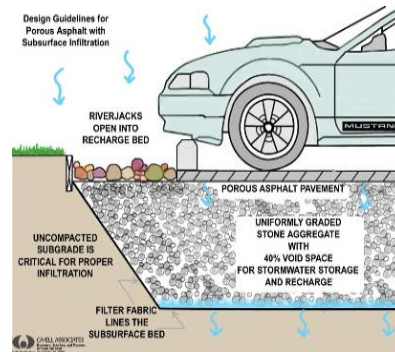
Click a practice to learn more about it or to

Disconnection:	<input type="range"/>	30	%
Rain Harvesting:	<input type="range"/>	0	%
Rain Gardens:	<input type="range"/>	15	%
Green Roofs:	<input type="range"/>	0	%
Street Planters:	<input type="range"/>	0	%
Infiltration Basins:	<input type="range"/>	0	%
Permeable Pavement:	<input type="range"/>	20	%

Design Storm for Sizing: 0.75 in.

Help

Permeable Pavement



Continuous Permeable Pavement systems are excavated areas filled with gravel and paved over with a porous concrete or asphalt mix.

Modular Block systems are similar except that permeable block pavers are used instead.

Normally all rainfall will immediately pass through the pavement into the gravel storage layer below it where it can infiltrate at natural rates into the site's native soil.

Pavement layers are usually 4 to 6 inches in height while the gravel storage layer is typically 6 to 18 inches high.

The Capture Ratio is the percent of the treated area (street or parking lot) that is replaced with permeable pavement.

[Learn More](#)

Pavement Thickness: 6 in.

Gravel Layer Thickness: 18 in.

% Capture Ratio: 11 %

☒ Pre-Treatment


Size for Design Storm

Save and Return

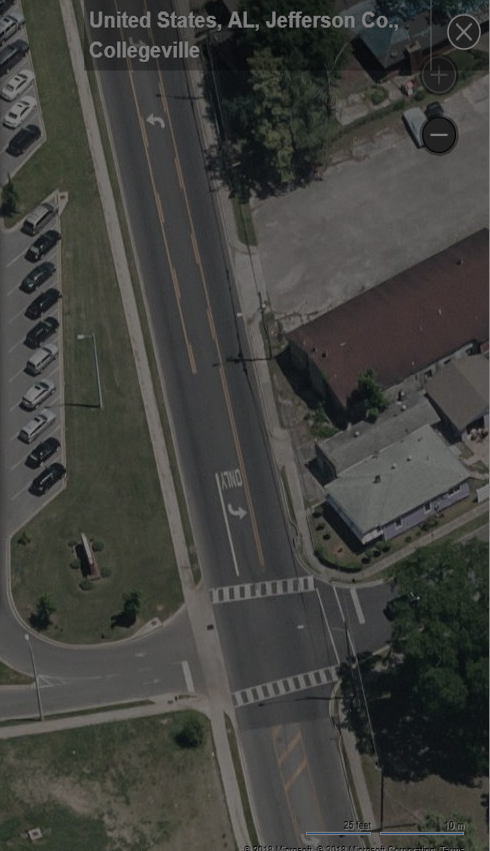
Restore Defaults

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Project Cost (Development Type):

 National Stormwater Calculator

NEW SAVE OPEN RESOURCES CONTACT



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Project Cost

Directions

Verify cost estimation variables below. Click on each option to learn more.

Choose a Project Type

- ☒ Re-Development
- ☐ New Development

Choose your Site Suitability

- ☐ Poor
- ☒ Moderate
- ☐ Excellent

Choose your Cost Region

Cost Region:

Atlanta(140 miles)


Regional Multiplier:

0.92


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.



before



after

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 "Project Cost" 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.

Close

Project Cost (Site Suitability):

Project Cost

Directions

Verify cost estimation variables below. Click on each option to learn more.

Choose a Project Type

- ☐ Re-Development
- ☐ New Development

Choose your Site Suitability

- ☐ Poor
- ☒ Moderate
- ☐ Excellent

Choose your Cost Region

Cost Region:

Atlanta(140 miles)

Regional Multiplier:

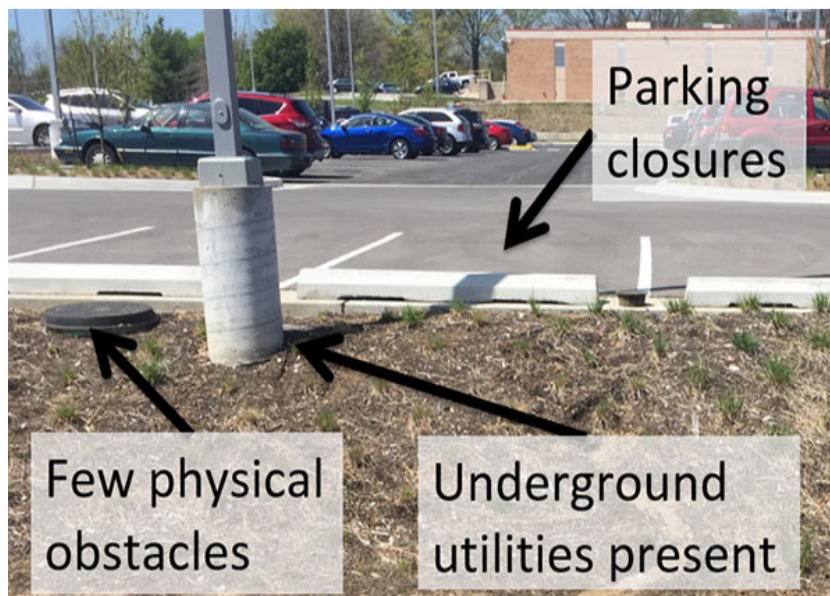
0.92

Moderate Site Suitability

Site suitability is a measure of construction feasibility and includes factors such as topography, soil type, slope, and other physical features that might result in higher implementation costs.

Moderate site suitability refers to sites that have several of the following characteristics:

- Few physical obstructions,
- Few utility conflicts,
- Other features that may make construction of stormwater management infrastructure challenging and likely more costly, but less than a site with poor site suitability.




Sites determined to have moderate suitability for LID practices may result in higher costs because of the potential need for additional excavation, accommodation for physical obstructions including utilities, required retaining walls, moderately challenging access, limited dewater, the addition of engineered or custom media blends, or need to address geotechnical or groundwater concerns.

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Project Cost (Bureau of Labor Statistics Cost Region):

*Regional cost data available from Atlanta;
Birmingham within 200 mile radius.

 National Stormwater Calculator

Project Cost

Directions

Verify cost estimation variables below. Click on each option to learn more.

Choose a Project Type

Re-Development

New Development

Choose your Site Suitability

Poor

Moderate

Excellent

Choose your Cost Region

Cost Region:

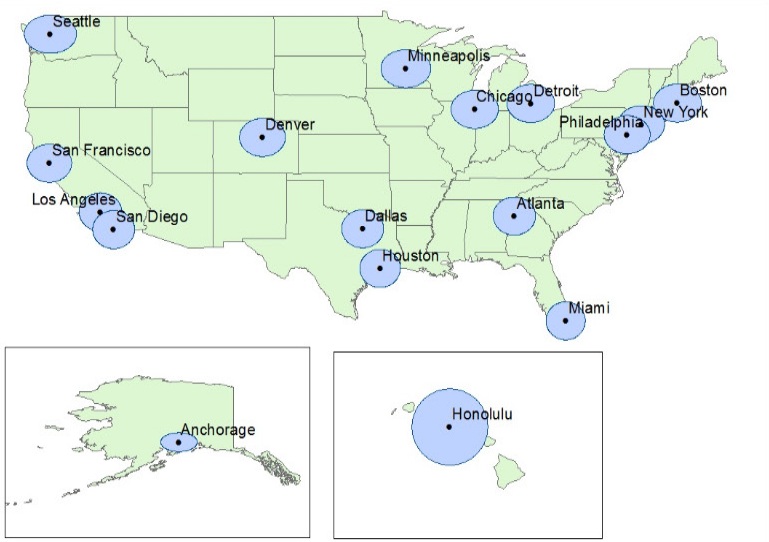
Atlanta(140 miles)

Regional Multiplier:

0.92

Cost Regions

Your "region" has been determined from the Location tab. Using data from the Bureau of Labor Statistics (BLS) a multiplier has been computed representing the relative regional differences in costs for your nearest region (unless "National" is shown) compared to National costs. Three regions are reported from 20 of the major cities for which BLS data is available. Users can select another region or select "National" to apply a multiplier of 1, representing a national average. If you prefer to apply your own multiplier, select "Other" and enter the multiplier in the Regional Multiplier field (a multiplier >1 would adjust above the National average, while a multiplier < 1 would adjust below the National average). The default multiplier for your region is shown in the Regional Multiplier box. The light blue circles in the figure below represent areas within a 100-mile radius of each major city. See User Guide for more information.



Close


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25 feet

10 ft

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 United States Environmental Protection Agency

25

Results (Summary):

Results

Directions

The Results page is where the site's hydrologic response to a long term period of historical hourly rainfall is computed and reported on. Statistics for both annual and daily rainfall/runoff are presented.

The user controls on this page are grouped together in three sections:

1. Options

The Options section allows you to specify how the rainfall record should be analyzed with respect to:

- The number of most recent years of rainfall record to use,
- The minimum amount of daily rainfall or runoff that will constitute a measurable event,
- Whether subsequent days of back to back daily events should be counted or not.

2. Actions

The Actions section contains commands that allow you to:

- Refresh results after site data have changed.
- Use the most current results as a baseline scenario that can be compared with results from subsequent runs.

3. Reports

The Reports section allows you to select how the rainfall/runoff results generated for the site should be displayed.

Options:

Years to Analyze:

20

Event Threshold:

0.05

☐ Ignore Consecutive Days

Actions:

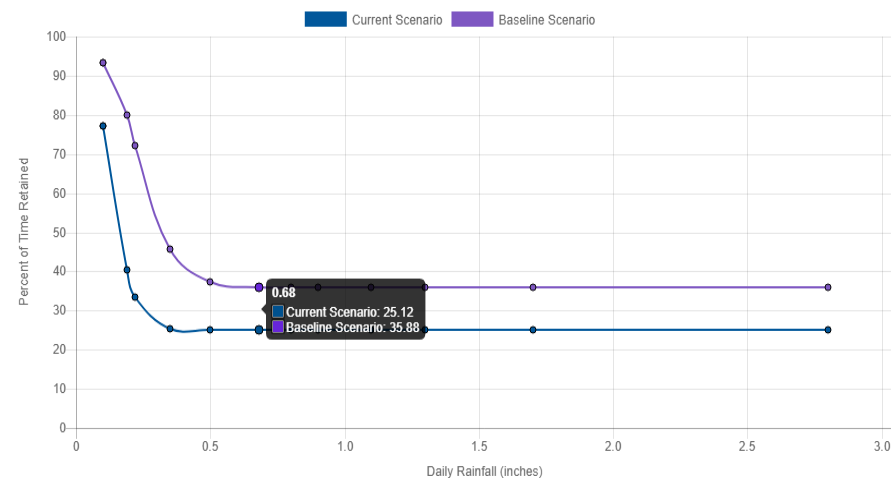
Refresh Results

Use as Baseline
Scenario

Remove Baseline
Scenario

Print Results to PDF
File

Rainfall Retention Frequency



Results (Capital Costs):

Results

Directions

Options:

Years to Analyze:

20

Event Threshold:

0.05

☐ Ignore Consecutive Days

Actions:

Refresh Results

Use as Baseline Scenario

Remove Baseline Scenario

Print Results to PDF File

Reports:

- ☐ Site Description
- ☐ Summary Results
- ☐ Rainfall / Runoff Events
- ☐ Rainfall / Runoff Exceedance Frequency
- ☐ Rainfall Retention Frequency
- ☐ Runoff Contribution by Rainfall Percentile
- ☐ Extreme Event Rainfall / Runoff
- ☒ Cost Summary

Cost Summary

Estimate of Probable Capital Costs (estimates in 2017 US.\$)

[Maintenance Costs | Graphical View](#)

Cost By LID Control Type	Drainage Area %	Has Pre-Treatment?	Current Scenario (C)		Baseline Scenario (B)		Difference (C - B)	
	Current / Baseline	Current / Baseline	Low	High	Low	High	Low	High
Disconnection	0 / 30	No / No	\$0.00	\$0.00	\$35,156.76	\$41,758.21	\$-35,156.76	\$-41,758.21
Rainwater Harvesting	0 / 0	No / No	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Rain Gardens	0 / 15	No / No	\$0.00	\$0.00	\$10,217.77	\$13,473.73	\$-10,217.77	\$-13,473.73
Green Roofs	0 / 0	No / No	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Street Planters	0 / 0	No / No	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Infiltration Basins	0 / 0	No / No	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Permeable Pavement	0 / 20	No / No	\$0.00	\$0.00	\$6,641.52	\$7,763.00	\$-6,641.52	\$-7,763.00
Total	0 / 65	Varies	\$0.00	\$0.00	\$52,016.04	\$62,994.94	\$-52,016.04	\$-62,994.94

Note: site complexity variables that affect cost shown below:

	Current Scenario	Baseline Scenario	Chart Key	
Dev. Type	Re-Development	Re-Development	D - Disconnection	IB - Infiltration Basins
Site Suitability	Moderate	Moderate	RH - Rain Harvesting	PP - Permeable Pavement
Topography	Flat (2% Slope)	Flat (2% Slope)	RG - Rain Gardens	
Soil Type	C	C	GR - Green Roofs	
Cost Region	Atlanta(140 miles) 0.92	Atlanta(140 miles) 0.92	SP - Street Planters	

*Estimated project cost \$85,548 (MS4 2016 Annual Report, City of Birmingham)

Results (Annual Maintenance Costs):

Results

Directions

Options:

Years to Analyze:

20

Event Threshold:

0.05

☐ Ignore Consecutive Days

Actions:

Refresh Results

Use as Baseline Scenario

Remove Baseline Scenario

Print Results to PDF File

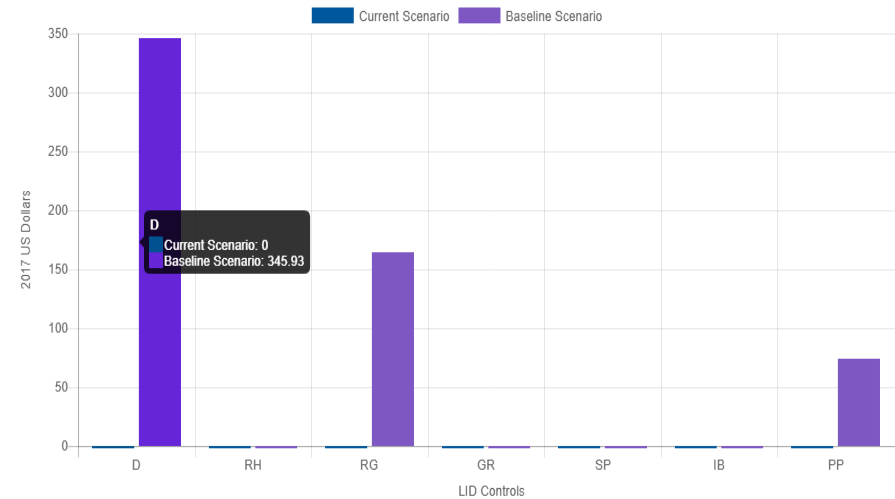
Reports:

- ☐ Site Description
- ☐ Summary Results
- ☐ Rainfall / Runoff Events
- ☐ Rainfall / Runoff Exceedance Frequency
- ☐ Rainfall Retention Frequency
- ☐ Runoff Contribution by Rainfall Percentile
- ☐ Extreme Event Rainfall / Runoff
- ☒ Cost Summary

Cost Summary

Estimate of Annual Probable Maintenance Costs

[Capital Costs](#) | [Tabular View](#)



Note: site complexity variables that affect cost shown below:

	Current Scenario	Baseline Scenario
Dev. Type	Re-Development	Re-Development
Site Suitability	Moderate	Moderate
Topography	Flat (2% Slope)	Flat (2% Slope)
Soil Type	C	C
Cost Region	Atlanta(140 miles) 0.92	Atlanta(140 miles) 0.92

Chart Key

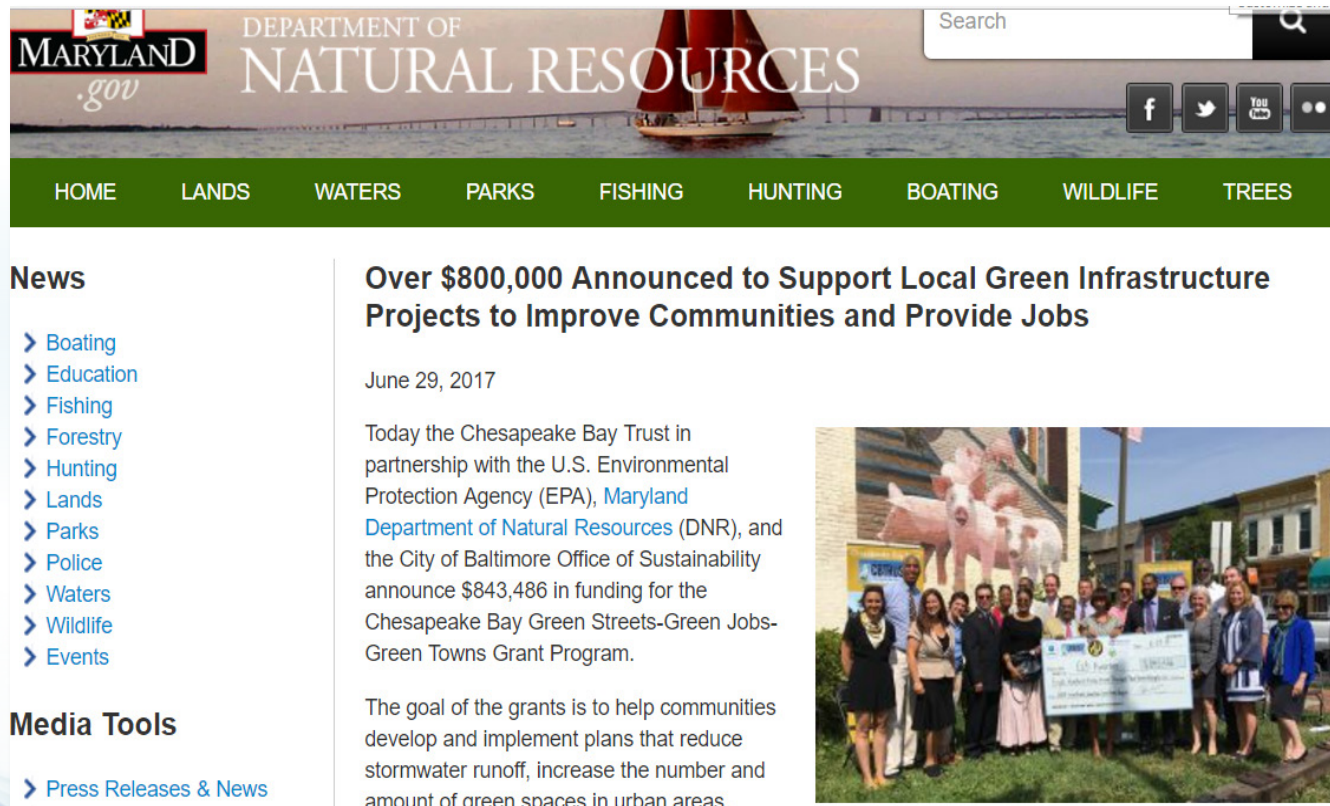
D - Disconnection	IB - Infiltration Basins
RH - Rain Harvesting	PP - Permeable Pavement
RG - Rain Gardens	
GR - Green Roofs	
SP - Street Planters	

Interpreting the Results

- Informing next steps for finalizing costs of stormwater projects and construction plans/designs
- Comparing the relative magnitude of planning level costs for different stormwater management solutions
 - Finding least cost option(s) while meeting performance goals
- Comparisons may be made between national and regional cost estimates:
 - Using local knowledge in selection of regional BLS cost multipliers

SWC Analysis: Potential Next Steps

- Sharing planning results with decision-makers
- Applying for funding
- Developing construction plans/designs



The screenshot shows the Maryland Department of Natural Resources (DNR) website. The header includes the Maryland state logo, the text "MARYLAND .gov", and "DEPARTMENT OF NATURAL RESOURCES". A search bar is in the top right, and social media icons for Facebook, Twitter, YouTube, and a general share icon are below it. A green navigation bar contains links: HOME, LANDS, WATERS, PARKS, FISHING, HUNTING, BOATING, WILDLIFE, and TREES. The main content area features a "News" section on the left with a list of topics: Boating, Education, Fishing, Forestry, Hunting, Lands, Parks, Police, Waters, Wildlife, and Events. The featured news article is titled "Over \$800,000 Announced to Support Local Green Infrastructure Projects to Improve Communities and Provide Jobs", dated June 29, 2017. The article text states that the Chesapeake Bay Trust, in partnership with the U.S. Environmental Protection Agency (EPA), the Maryland Department of Natural Resources (DNR), and the City of Baltimore Office of Sustainability, announced \$843,486 in funding for the Chesapeake Bay Green Streets-Green Jobs-Green Towns Grant Program. A photograph shows a group of people standing in front of a large pink pig sculpture. The article's goal is to help communities develop and implement plans that reduce stormwater runoff, increase the number and amount of green spaces in urban areas.

News

- › Boating
- › Education
- › Fishing
- › Forestry
- › Hunting
- › Lands
- › Parks
- › Police
- › Waters
- › Wildlife
- › Events

Media Tools


- › Press Releases & News

Over \$800,000 Announced to Support Local Green Infrastructure Projects to Improve Communities and Provide Jobs

June 29, 2017

Today the Chesapeake Bay Trust in partnership with the U.S. Environmental Protection Agency (EPA), [Maryland Department of Natural Resources](#) (DNR), and the City of Baltimore Office of Sustainability announce \$843,486 in funding for the Chesapeake Bay Green Streets-Green Jobs-Green Towns Grant Program.

The goal of the grants is to help communities develop and implement plans that reduce stormwater runoff, increase the number and amount of green spaces in urban areas.



<http://news.maryland.gov/dnr/2017/06/29/over-800000-announced-to-support-local-green-infrastructure-projects-to-improve-communities-and-provide-jobs/>



Case Study with Actual Costs:

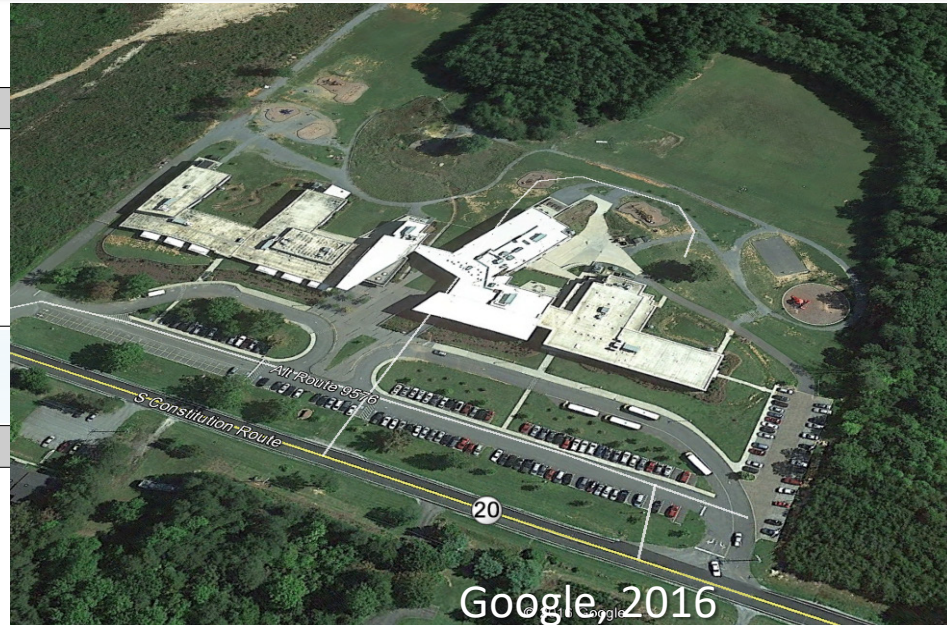
Buckingham Elementary School, Dillwyn, VA

Site Characteristics:

Variable	Value
Total Area (acres)	10.5
Estimated Imperviousness (%)	31.0
Site Soils	Type C
Soil Drainage (inches/hour)	0.01
Topography	moderately flat

LID Controls:

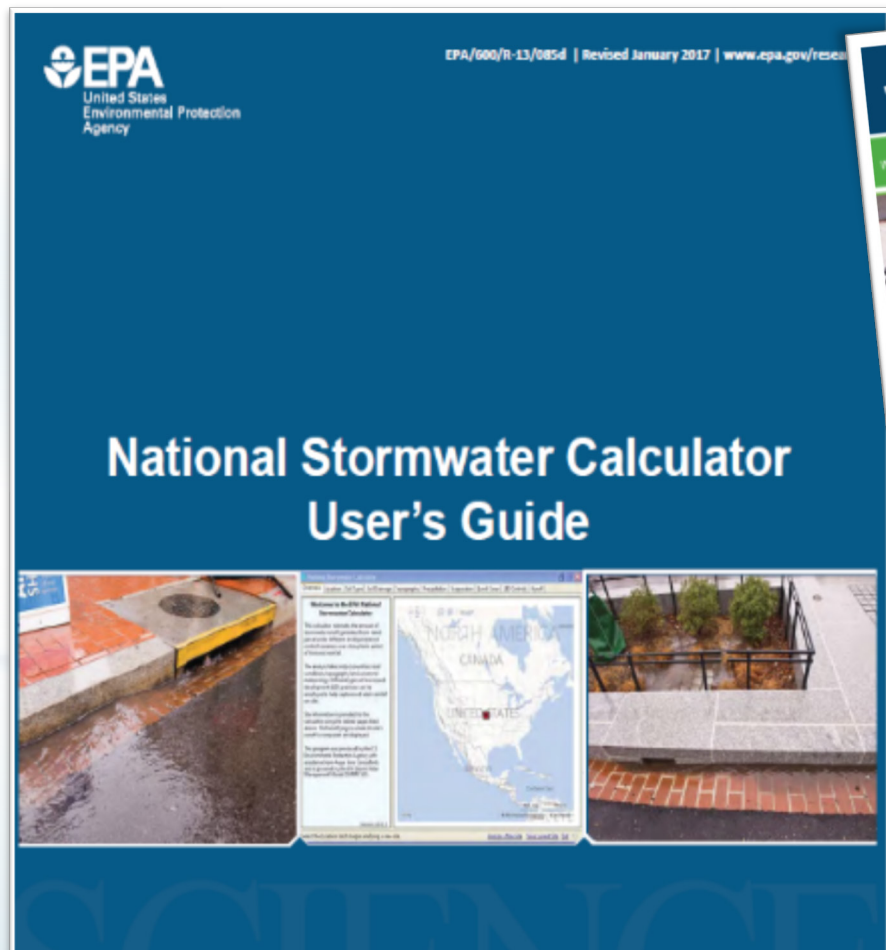
Practice	Percent of Impervious Area Treated (%)
Disconnection	5
Rainwater harvesting	19
Rain gardens	5
Permeable pavement	5



Cost Summary: Estimated VS. Actual:

LID Control	Capital Cost Range	Maintenance Cost Range
Disconnection	\$83,500 – 107,600	\$1,100 – 1,700
Rain Harvesting	\$29,600 – 40,873	\$3,400 – 8,200
Rain Gardens	\$5,375 – 10,412	\$100 – 1,800
Permeable Pavement	\$107,300 – 143,400	\$1,300 – 6,900
Total Cost (2015 \$)	\$225,700 – 302,200	\$5,900 – 18,500
Actual Project Cost (2014\$)	\$268,662	Not Available

Training and Outreach Materials: User's Guide & Fact Sheet



Discussion and Questions

Thank You!

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National Stormwater Calculator Website:

<https://www.epa.gov/water-research/national-stormwater-calculator>

Contact: SWC@epa.gov

SWC:

Site Parameters and Embedded GIS Data-sets

- **Location:** Bing Maps
- **Soils:** NRCS SSURGO (*web service*)
- **Slope:** NRCS SSURGO
- **Hydraulic Conductivity:** NRCS SSURGO
- **Precipitation and Temperature:** National Climate Center (NCDC)-NOAA (*EPA's BASINS Model*)
- **Evaporation:** Calculation based on meteorological data
- **Climate Change Future Scenarios:** Precipitation & evaporation (*EPA's CREAT 2.0*)
- **Land-Cover/Use:** User provided
- **LID Practices (*new costing module available*):** User provided