Stormwater Calculator: Guide and Application

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Course Author: Roman Titov

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1. Introduction

The National Stormwater Calculator (https://www.epa.gov/water-research/national-stormwater-calculator) is a simple to use tool for computing hydrology for sites up to 12 acres for any location within the US. It estimates the amount of stormwater runoff generated from a site under different development and control scenarios over a long-term period of historical precipitation. The analysis considers local soil conditions, slope, land cover, and meteorology. Different types of low impact development (LID) practices (also known as green infrastructure) can be employed to help capture and retain rainfall on-site. Future climate change scenarios from internationally recognized climate change projections are also available. The calculator provides planning level estimates of capital and maintenance costs which will allow planners and managers to evaluate and compare effectiveness and costs of LID controls.

The calculator's primary focus is informing site developers and property owners on how well they can meet a desired stormwater retention target. It can be used to answer such questions as the following:

- What is the largest daily rainfall amount that can be captured by a site in either its pre-development, current, or post-development condition?
- To what degree will stormwater runoffs of different magnitudes be captured on site?
- What mix of LID controls can be deployed to meet a given stormwater retention target?
- How well will LID controls perform under future meteorological projections made by global climate change models?
- What are the relative costs (capital and maintenance) differences for various mixes of LID controls?

The calculator accesses several national databases to provide local soil and meteorological data for a site. The user supplies land cover information that reflects the state of development they wish to analyze and selects a mix of LID controls to be applied. After this information is provided, the site's hydrologic response to a long-term record of historical hourly precipitation, possibly modified by a particular climate change scenario, is computed. This allows a full range of meteorological conditions to be analyzed, rather than just a single design storm event. The resulting time series of rainfall and runoff are aggregated into daily amounts that are then used to report various runoff and retention statistics. In addition, the site's response to extreme rainfall events of different return periods is also analyzed.

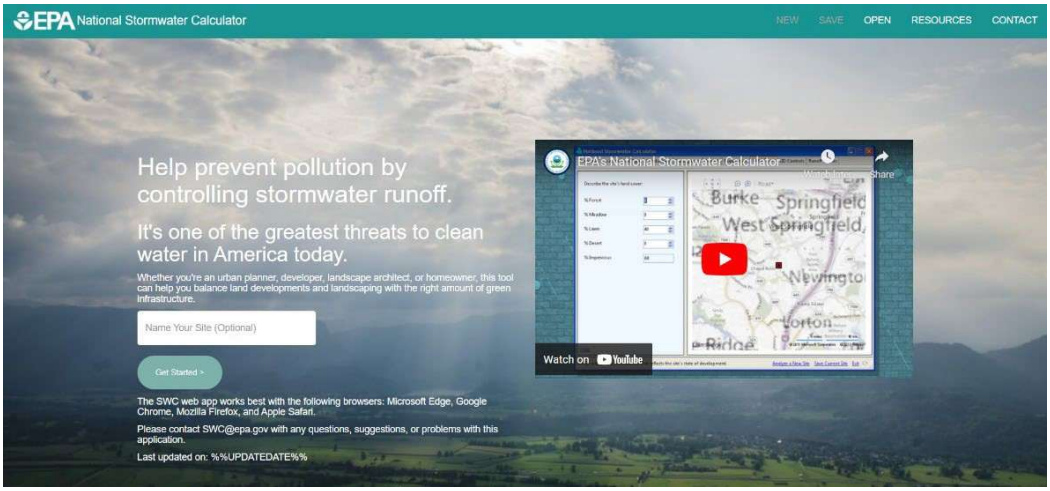
The calculator uses the EPA Storm Water Management Model (SWMM) as its computational engine (https://www.epa.gov/water-research/storm-water-management-model-swmm). SWMM is a well-established, EPA developed model that has seen continuous use and periodic updates for 40 years. Its hydrology component uses physically meaningful parameters making it especially well-suited for application on a nation-wide scale. SWMM is set up and run in the background without requiring any involvement of the user.

The calculator is most appropriate for performing screening level analysis of small footprint sites up to 12 acres in size with uniform soil conditions. The hydrological processes simulated by the calculator include evaporation of rainfall captured on vegetative surfaces or in surface depressions, infiltration losses into the soil, and overland surface flow. No attempt is made to further account for the fate of infiltrated water that might eventually transpire through vegetation or re-emerge as surface water in drainage channels or streams.

The remaining sections of this guide discuss how to install the calculator, how to run it, and how to interpret its output. An example application is presented showing how the calculator can be used to analyze questions related to stormwater runoff, retention, and control. Finally, a technical description is given of how the calculator performs its computations and where it obtains the parameters needed to do so.

2. How to Run the Calculator

The National Stormwater Calculator mobile web app is an HTML5, platform neutral and responsive mobile version of the desktop version of the calculator. The mobile version supports the existing functionality of the desktop version of the calculator. It may be used with publicly available internet browsers on laptop and desktop computers, smartphones, and tablets—you must have an internet connection to run the calculator. The mobile web app functions best on the following web browsers: Google Chrome, Microsoft Edge, Apple Safari, and Mozilla Firefox. The mobile web app may be accessed from the following web page: https://www.epa.gov/water-research/national-stormwater-calculator. The opening and main windows of the calculator are displayed in Figure 1. The main window uses a series of tabbed pages to collect information about the site being analyzed and to run and view hydrologic results. A Bing Maps display allows you to view the site's location, its topography, selected soil properties and the locations of nearby rain gages and weather stations.



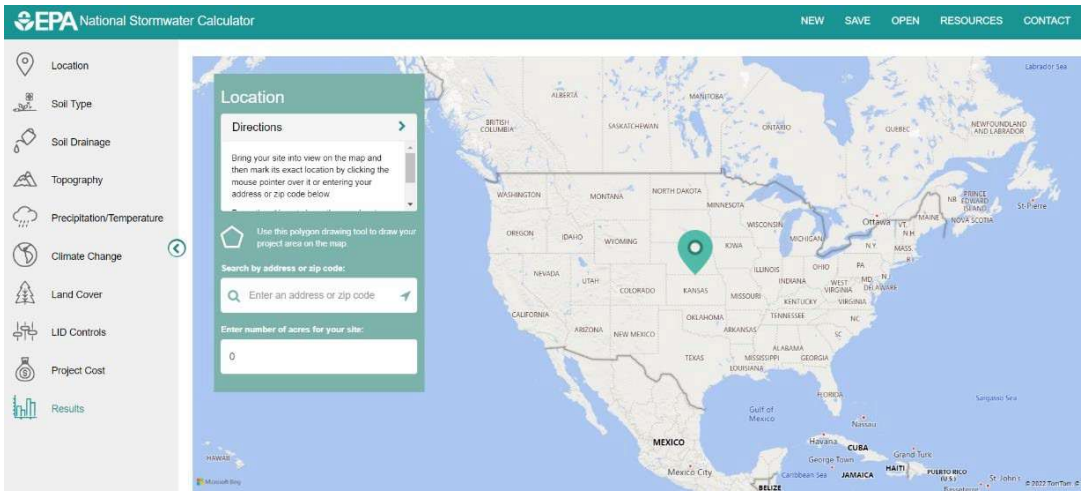


Figure 1. The calculator's (a) Opening page and (b) Location icon page.

The various pages of the calculator are represented by icons and used as follows:

1. **Location** icon - establishes the site's location.
2. **Soil Type** icon - identifies the site's soil type.
3. **Soil Drainage** icon - specifies how quickly the site's soil drains.
4. **Topography** icon - characterizes the site's surface topography.
5. **Precipitation/Temperature** icon - selects a nearby rain gage to supply hourly rainfall data and a nearby weather station to supply temperature data.
6. **Climate Change** icon – selects a climate change scenario to apply.
7. **Land Cover** icon - specifies the site's land cover for the scenario being analyzed.
8. **LID Controls** icon - selects a set of LID control options, along with their design features, to deploy within the site and specifies site and project considerations for cost estimation purposes.
9. **Project Costs** icon - specifies site and project considerations for cost estimation purposes.
10. **Results** icon - runs a long-term hydrologic analysis and displays the results including estimates of capital costs and average annual maintenance costs.

Six commands shown in the top panel of the web app can also be used at any time:

1. U.S. EPA logo: takes you back to the homepage of the web app.

2. New: discards all previously entered data and takes you back to the **Location** page where a new site can be selected. You will first be prompted to save the data you entered for the current site.

3. Save: saves the information you have entered for the current site to a disk file. The saved file can be re-opened in a future session of the calculator by selecting the *Open* command.

4. Open: allows you to open a previously saved site.

5. Resources: shows you helpful resources, such as this User's Manual, general LID, green infrastructure, and climate change information from the U.S. EPA.

6. Contact: provides the SWC@epa.gov email address.

You can move back and forth between the calculator's icon pages to modify your selections. Most of the pages have a *Help* command available that will display additional information about the page when selected. Underlined text can be clicked to display more information. After an analysis has been completed on the **Results** icon page, you can choose to designate it as a "baseline" scenario, which means that its results will be displayed side-by-side with those of any additional scenarios that you choose to analyze. Each of the calculator's icon pages will now be described in more detail.

Location

The **Location** icon page of the calculator is shown in Figure 2. You are asked to identify where in the U.S. the site is located. This information is used to access national soils and meteorological databases as well as Bureau of Labor Statistics (BLS) data for cost estimation purposes. It has an address lookup feature that allows you to easily navigate to the site's location. You can enter an address or zip code in the Search box and either click on the Search icon or press the *Enter key* to move the map view to that location. You can also use the map's pan and zoom controls to hone in on a particular site. Once the site

has been located somewhere within the map's viewport, move the mouse pointer over the site and then *left-click* the mouse to mark its exact location with a drop-down point.

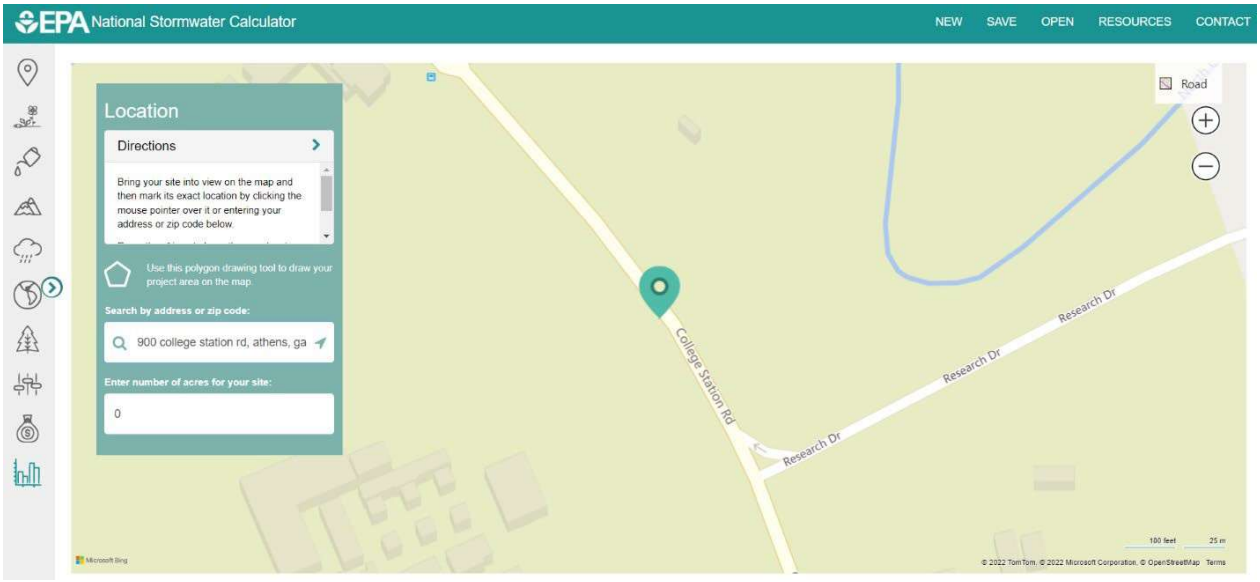


Figure 2. The calculator's Location icon page.

The map display can be toggled between a standard road, aerial, bird's eye, and streetside views. Figure 3 shows the site located in Figure 2 with a zoomed-in aerial view selected with the site bounded by an orange circle. You can specify the area of the site, which will result in a bounding orange circle, or a polygon being drawn on the map. Figure 4 illustrates how a user may click on the polygon draw tool to draw out polygon points that create a connected polygon boundary around the project site. The project area cannot be larger than 12 acres. Entering the size of your site is optional because the calculator makes all of its computations on a per unit area basis.

You can also click on *Open a previously saved site* to read in data for a site that was previously saved to a file to continue working with those data (every time you begin analyzing a new site or exit the program the calculator asks if you want to save the current site to a file). Once you open a previously saved site, the calculator will be populated with its data.

Purchase this course to see the remainder of the technical materials.