



# EPA NATIONAL STORMWATER CALCULATOR

# Background

- Many states have developed post-construction SW standards that include quantitative retention requirements

Massachusetts

New Hampshire

Vermont

New Jersey

New York

Delaware

Maryland

Pennsylvania

West Virginia

Florida

South Carolina

Tennessee

Wisconsin

Montana

California

Alaska

Oregon

District of Columbia

- Example: In DC, sites that disturb 5,000 sf or more will be required to retain the stormwater from a 1.2 inch storm

# Background

- Continuous simulation modeling offers many advantages in designing sites that meet these new standards
  - Can assess compliance with a range of standards (capture depth, % capture of annual runoff volume, % capture of annual storm events)
  - Accounts for sequence of precipitation events and antecedent moisture
- But continuous simulation modeling is challenging
  - Data requirements
  - Modeling expertise

# Goals

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- Analyze site hydrology over a continuous, long-term meteorological record
- Be intelligible to users without prior modeling experience or hydrology expertise
- Require only a minimum amount of readily available site information
- Produce technically sound and defensible results for screening level analysis

# Basic Features

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- SWMM modeling engine
- Simple map-based user interface
- Automated retrieval of meteorological, soil, slope data
- Automated calculation of rainfall and runoff statistics

# Inputs

- Soil and slope data retrieved from Natural Resource Conservation Service (NRCS) SSURGO database.
- Precipitation retrieved from NWS rain gages. The Calculator can access data for 8,159 stations.
- Evaporation estimated based on temperature and precipitation data from NWS rain gages. The Calculator can access estimates for 5,236 stations.
- Climate change projections from EPA CREAT.
- Land cover data and BMP parameters input by user.

# Outputs

- Average annual rainfall/runoff
- Partitioning of rainfall among runoff/infilt/evap
- Runoff by rainfall percentile
- Extreme event rainfall/runoff

1217 First St NE



NEW! Street View - Jun 2008



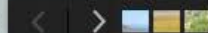
Currently shown: Jun 2008

2008 2012



Back to Map

Google





1217 First St NE



NEW! Street View - Jul 2009



Currently shown: Jul 2009

2008

2012



Back to Map

Google





1215 First St NE



NEW! Street View - Aug 2011



Currently shown: Aug 2011

2008

2012



Hampton Garden Inn



Back to Map

Google



Image capture: Aug 2011

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# Step 2: Set Soil Group

National Stormwater Calculator

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

What type of soil is on your site?

☒ View soil survey data

☐ A - low runoff potential

☐ B - moderately low

☐ C - moderately high

☒ D - high runoff potential


When soil survey data is displayed you can select a soil type directly from the map.

[Help](#)

Select a soil type for the site.

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

# Step 3: Set Soil Drainage

 National Stormwater Calculator

Overview

Location

Soil Type

Soil Drainage

Topography

Precipitation

Evaporation

Climate Change

Land Cover

LID Controls

Results

How fast does standing water drain from your site (inches/hour)?

0.060 (Default = 0.01)

☒ View soil survey data

<= 0.01 inches/hour

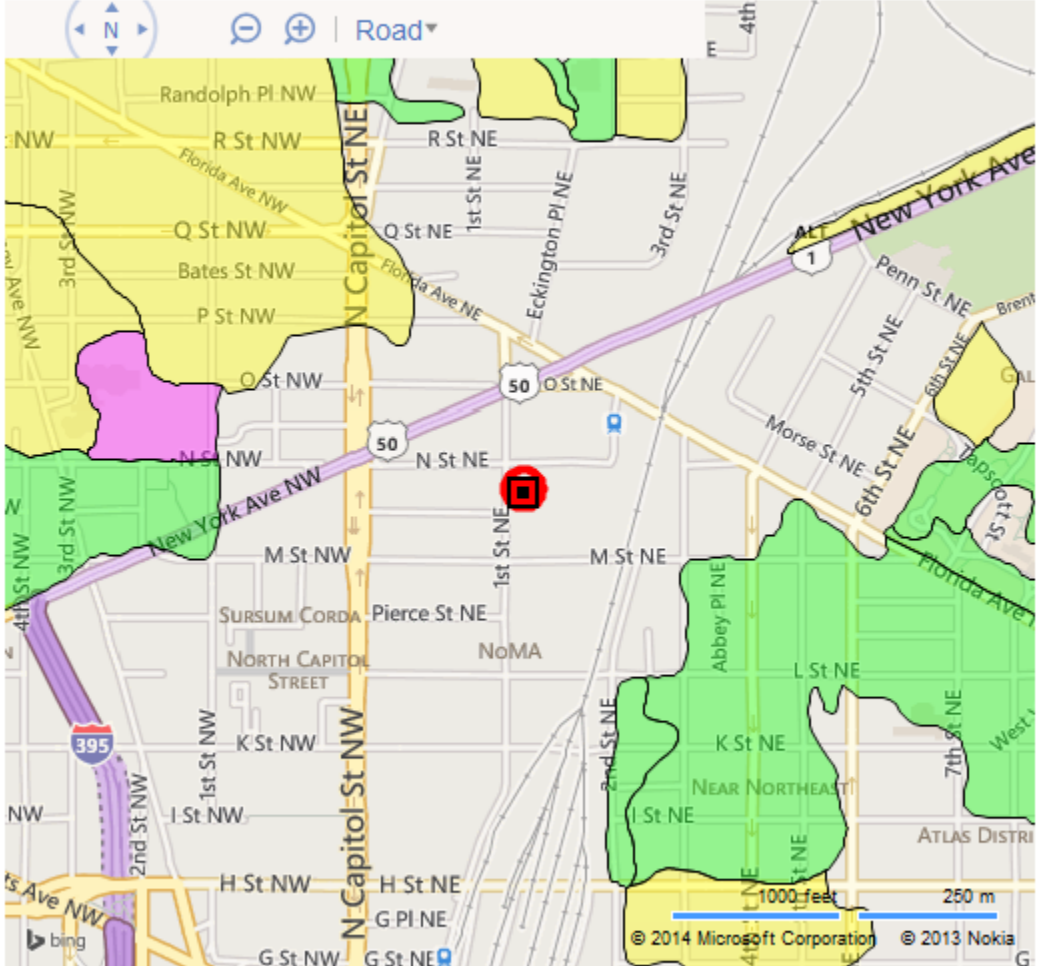
> 0.01 to <= 0.1 inches/hour

> 0.1 to <= 1.0 inches/hour

> 1 inches/hour

When soil survey data is displayed you can select a value directly from the map.

[Help](#)



Enter the soil's drainage rate.

Analyze a New Site

Save Current Site

Exit

# Step 4: Set Slope

National Stormwater Calculator

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

Describe your site's topography:

☒ View soil survey data

☐ Flat (2% Slope)

☒ Moderately Flat (5% Slope)

☐ Moderately Steep (10% Slope)

☐ Steep (above 15% Slope)

When soil survey data is displayed you can select a slope category directly from the map.

[Help](#)

Describe how steep the site is.

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



# Step 5: Select Precipitation Record

National Stormwater Calculator

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

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

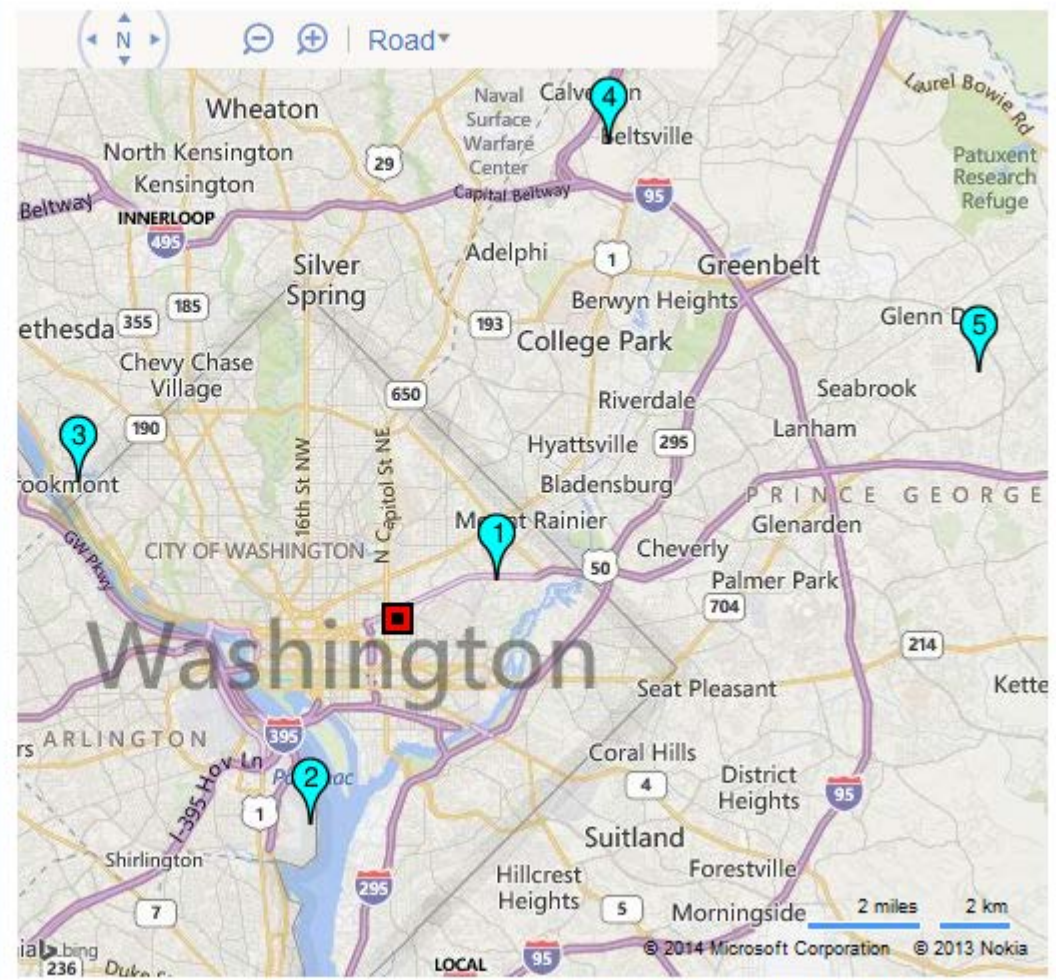
- 1 - NATIONAL ARBORETUM DC (1970-2006) 44.50"
- 2 - WASHINGTON REAGAN NATIONAL AIR (1970-2006) 39.63"
- 3 - DALECARLIA RESERVOIR (1970-2006) 45.85"
- 4 - BELTSVILLE (1970-2006) 43.30"
- 5 - GLENN DALE BELL STATION (1970-2006) 45.14"

[Save rainfall data for other uses](#)

[Help](#)

Select a source of long-term hourly rainfall data.

Analyze a New Site Save Current Site Exit





# Step 6: Select Evaporation Record

National Stormwater Calculator

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

Select a weather station to use as a source for evaporation rates:

- 1 - NATIONAL ARBORETUM DC (1970-2006) 0.18 inches/day
- 2 - WASHINGTON REAGAN NATIONAL AIR (1970-2006) 0.18 inches/day
- 3 - DALECARLIA RESERVOIR (1970-2006) 0.15 inches/day
- 4 - BELTSVILLE (1970-2006) 0.24 inches/day
- 5 - GLENN DALE BELL STATION (1970-2006) 0.17 inches/day

[Save evaporation data for other uses](#)

[Help](#)

Washington

2 miles 2 km

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Select a source of monthly average evaporation rates.

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

# Step 7: Set Land Cover

National Stormwater Calculator

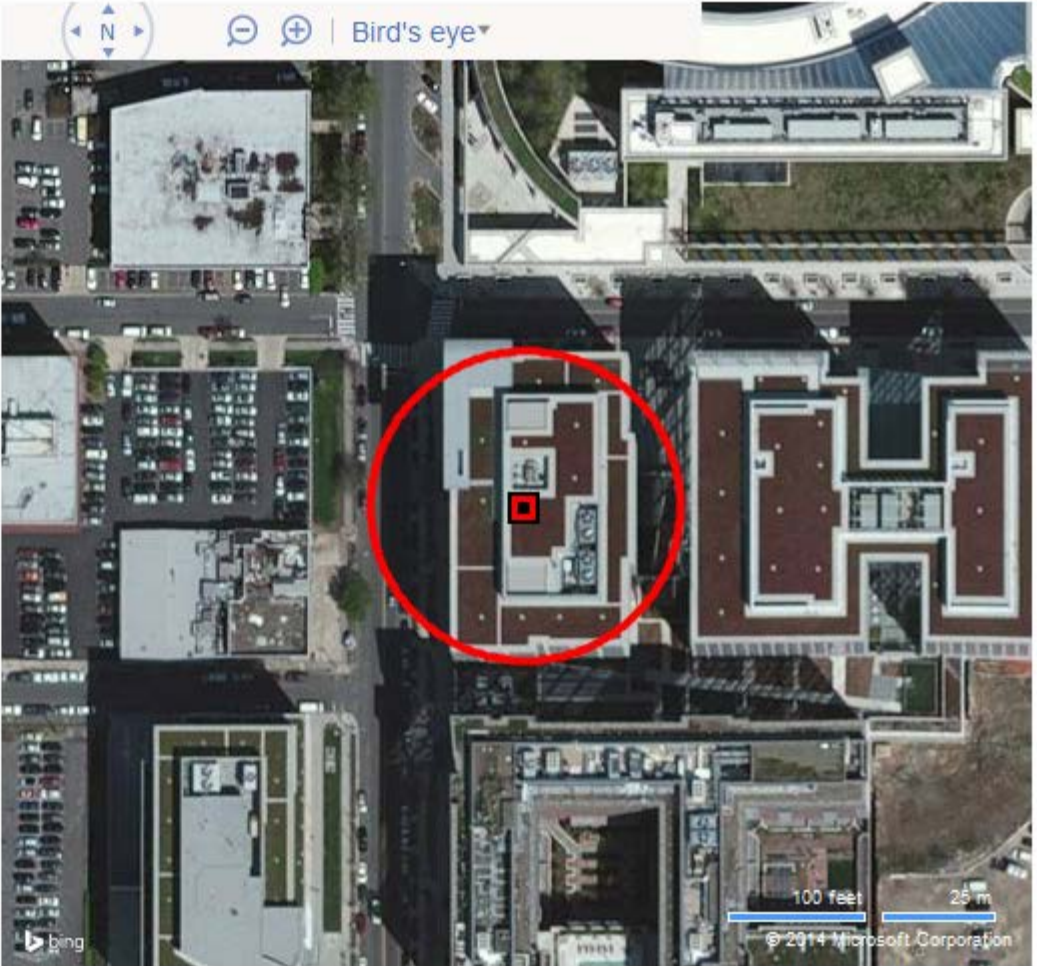
Overview Location Soil Type Soil Drainage Topography Precipitation Evaporation Climate Change **Land Cover** LID Controls Results

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

% Forest	0
% Meadow	0
% Lawn	5
% Desert	0
% Impervious	95

Hover the mouse over a cover category to see a more detailed description.

[Help](#)



Describe the site's land cover.

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



# Step 8: Set LID Controls

National Stormwater Calculator

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

What % of your site's impervious area will be treated by the following LID practices?

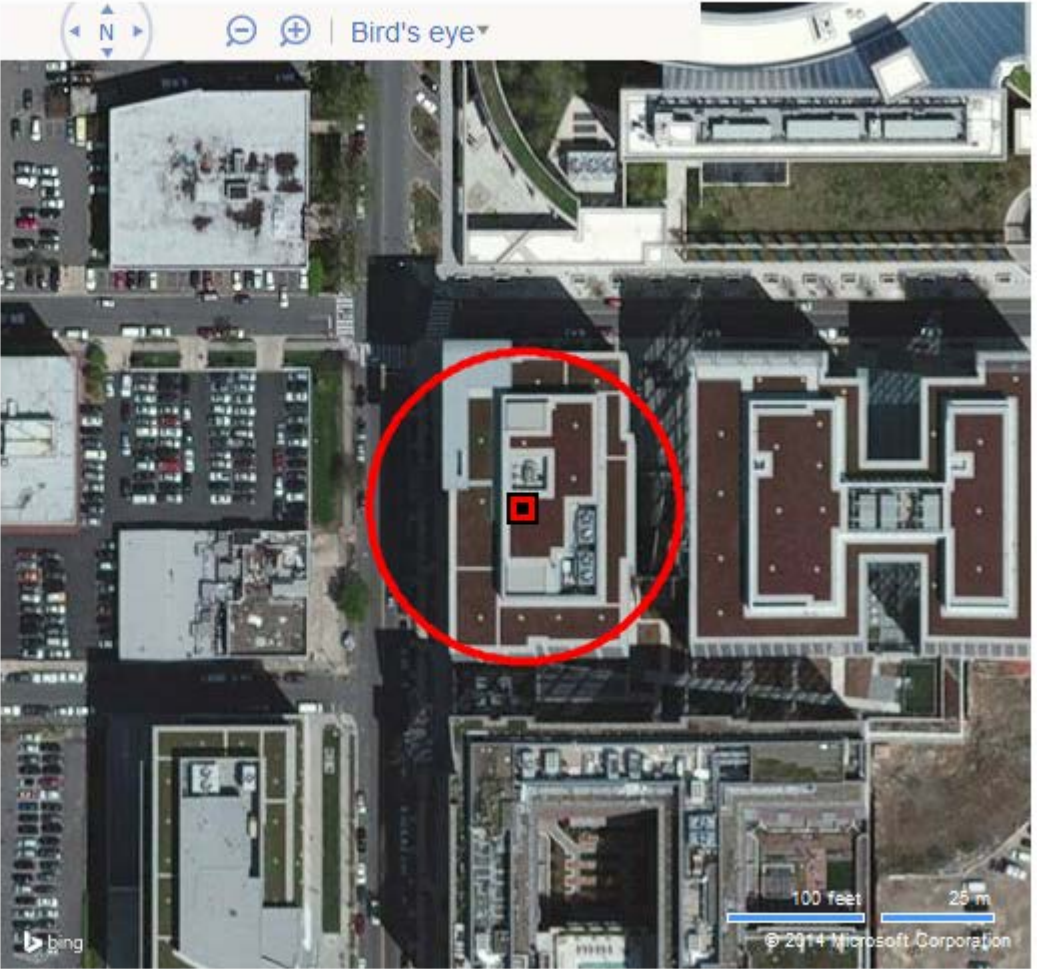
<a href="#">Disconnection</a>	0
<a href="#">Rain Harvesting</a>	0
<a href="#">Rain Gardens</a>	0
<a href="#">Green Roofs</a>	0
<a href="#">Street Planters</a>	0
<a href="#">Infiltration Basins</a>	0
<a href="#">Permeable Pavement</a>	0

Design Storm for Sizing (inches) (see Help) 0.00

Click a practice to customize its design.

[Help](#)

Bird's eye



100 Feet 25 m

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Assign LID practices to capture runoff from impervious areas.

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

# Disconnection

LID Design

Disconnection



% Capture Ratio

100

Disconnection refers to the practice of directing runoff from impervious areas, such as roofs or parking lots, on to pervious areas such as lawns or vegetative strips, instead of directly into storm drains. This gives the runoff an opportunity to infiltrate into the soil before leaving the site.

The Capture Ratio is the ratio of the pervious area receiving the runoff (such as a lawn area) to the impervious area that generates the runoff.

For example, if 5,000 sq. ft. of roof area is directed onto 3,000 sq. ft. of lawn area then the Capture Ratio would be 3,000 / 5,000 or 60%.

[Learn more ...](#)

Size for Design Storm

Restore Defaults


Accept

Cancel

# Rainwater Harvesting

LID Design

Rain Harvesting



Cistern Size (gallons)

Emptying Rate (gallons/day)

Number per 1,000 sq ft

100


50

4.0

Rain harvesting systems collect runoff from rooftops and convey it to a cistern tank where it can be used for non-potable water uses and on-site infiltration.

The harvesting system is assumed to consist of a given number of fixed-sized cisterns per 1000 square feet of rooftop area captured.

The water from each cistern is withdrawn at a constant rate and is assumed to be consumed or infiltrated entirely on-site.



[Learn more ...](#)

Size for Design Storm

Restore Defaults

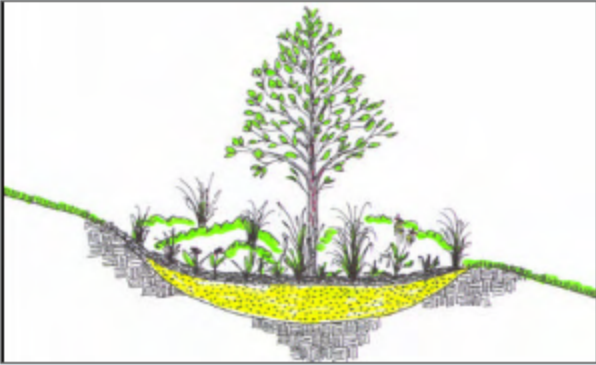
Accept

Cancel

# Rain Garden

LID Design


### Rain Garden



Rain Gardens are shallow depressions filled with an engineered soil mix that supports vegetative growth. They are usually used on individual home lots to capture roof runoff.

Typical soil depths range from 6 to 18 inches.

The Capture Ratio is the ratio of the rain garden's area to the impervious area that drains onto it.



[Learn more ...](#)

Ponding Height (inches)	12
Soil Media Thickness (inches)	18
Soil Media Conductivity (in/hr)	10.00
% Capture Ratio	30

Size for Design Storm

Restore Defaults

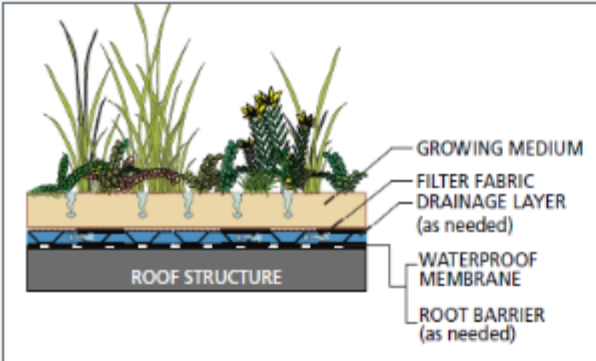
Accept

Cancel

# Green Roofs

LID Design

Green Roof



GROWING MEDIUM  
FILTER FABRIC  
DRAINAGE LAYER (as needed)  
WATERPROOF MEMBRANE  
ROOT BARRIER (as needed)  
ROOF STRUCTURE

Soil Media Thickness (inches)


12

Soil Media Conductivity (in/hr)

10.00

Green Roofs (also known as Vegetated Roofs) are bio-retention systems placed on roof surfaces that capture and temporarily store rainwater in a soil growing medium. They consist of a layered system of roofing designed to support plant growth and retain water for plant uptake while preventing ponding on the roof surface.

The thickness used for the growing medium typically ranges from 3 to 6 inches.



[Learn more ...](#)

Size for Design Storm

Restore Defaults

Accept

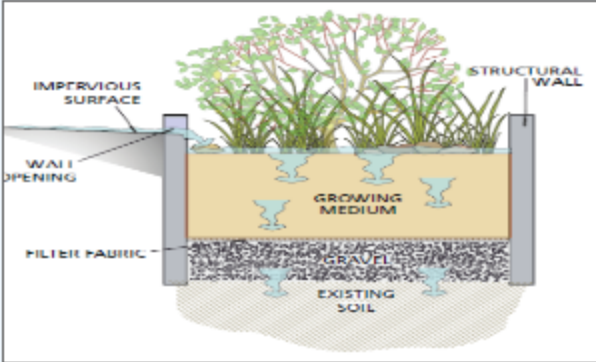
Cancel



# Street Planters

LID Design


### Street Planter



Street Planters consist of concrete boxes filled with an engineered soil that supports vegetative growth. Beneath the soil is a gravel bed that provides additional storage.

The walls of a planter extend 3 to 12 inches above the soil bed to allow for ponding within the unit. The thickness of the soil growing medium ranges from 6 to 24 inches while gravel beds are 6 to 18 inches in depth.

The planter's Capture Ratio is the ratio of its area to



Ponding Height (inches)

Soil Media Thickness (inches)

Soil Media Conductivity (in/hr)

Gravel Bed Thickness (inches)

% Capture Ratio

[Learn more ...](#)

Size for Design Storm

Restore Defaults

Accept

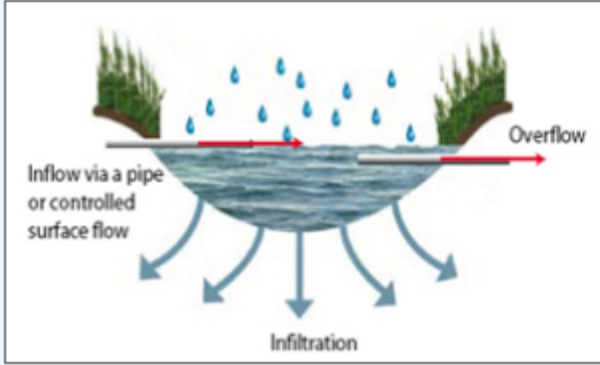
Cancel



# Infiltration Basin

LID Design

### Infiltration Basin



Inflow via a pipe or controlled surface flow

Overflow

Infiltration


Basin Depth (inches)

% Capture Ratio

Infiltration basins are shallow depressions filled with grass or other natural vegetation that capture runoff from adjoining areas and allow it to infiltrate into the soil.

The calculator assumes that the infiltration rate from the basin is the same as for site's native soil.

The basin's Capture Ratio is the area of the basin relative to the impervious area whose runoff it captures.



[Learn more ...](#)

Size for Design Storm

Restore Defaults

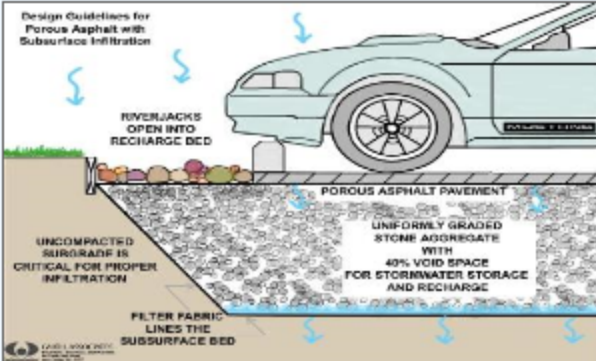
Accept

Cancel

# Permeable Pavement

LID Design

## Permeable Pavement



Design Guidelines for Porous Asphalt with Subsurface Infiltration

OVERLAYS OPEN INTO RECHARGE BED

POROUS ASPHALT PAVEMENT

UNIFORMELY GRADED STONE AGGREGATE WITH 40% VOID SPACE FOR STORMWATER STORAGE AND RECHARGE

UNCOMPACTED SUBGRADE IS CRITICAL FOR PROPER INFILTRATION


FILTER FABRIC LINES THE SUBSURFACE BED

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



[Learn more ...](#)

Pavement Thickness (inches)

Gravel Layer Thickness (inches)

% Capture Ratio

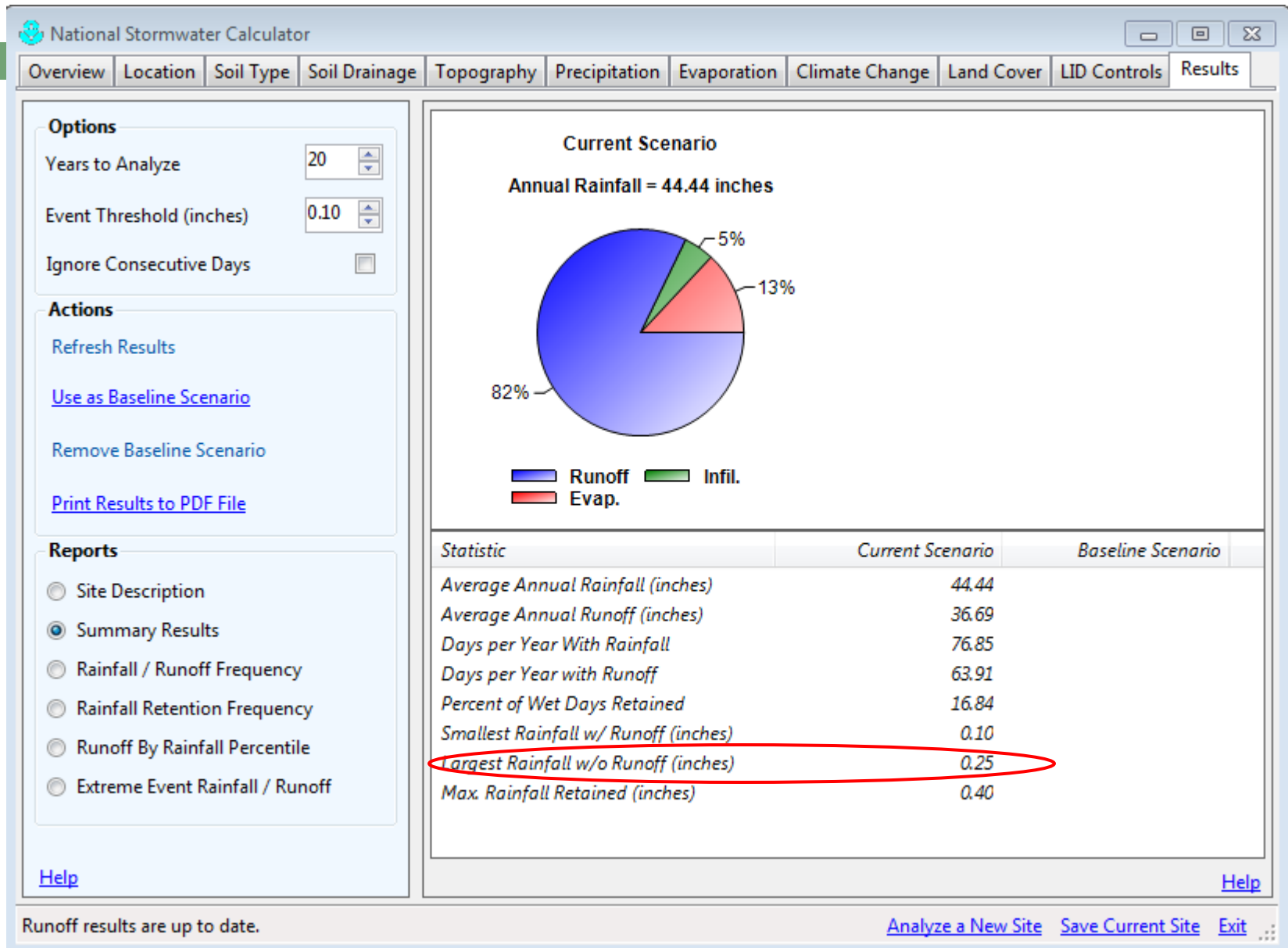
Size for Design Storm

Restore Defaults

Accept

Cancel

# Step 9: Compute Runoff Results



# Example with LID Controls

National Stormwater Calculator

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

What % of your site's impervious area will be treated by the following LID practices?

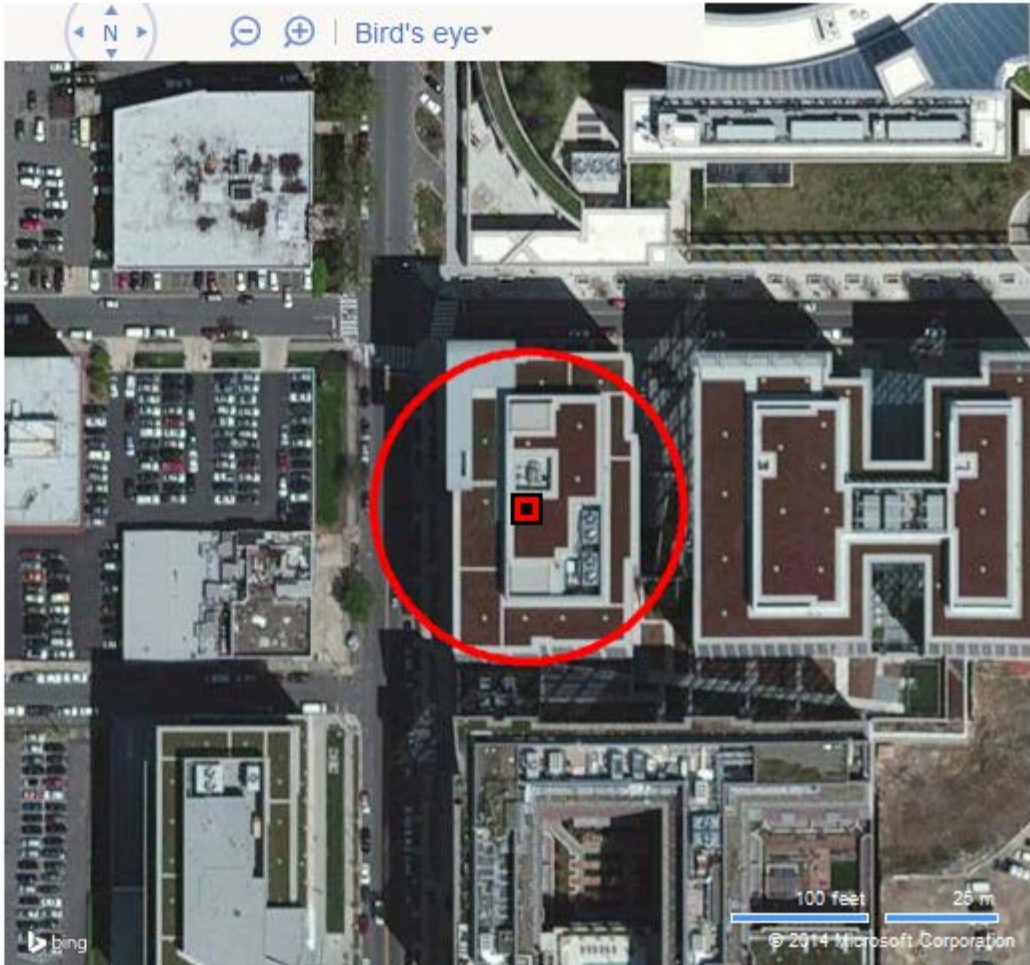
<a href="#">Disconnection</a>	0
<a href="#">Rain Harvesting</a>	0
<a href="#">Rain Gardens</a>	0
<a href="#">Green Roofs</a>	70
<a href="#">Street Planters</a>	30
<a href="#">Infiltration Basins</a>	0
<a href="#">Permeable Pavement</a>	0

Design Storm for Sizing (inches) (see Help) 0.00

Click a practice to customize its design.

[Help](#)

Bird's eye



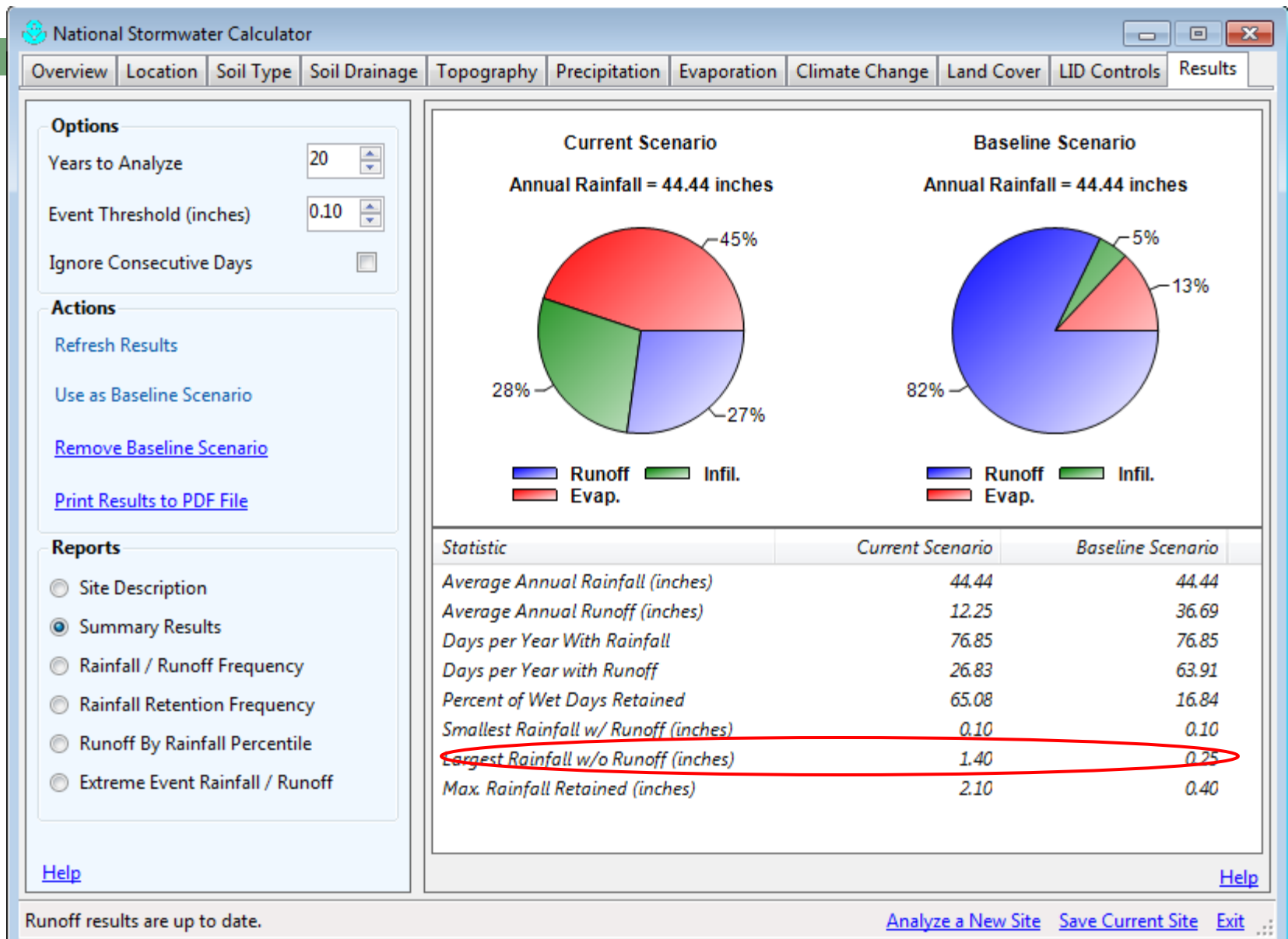
100 feet 25 m

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Assign LID practices to capture runoff from impervious areas.

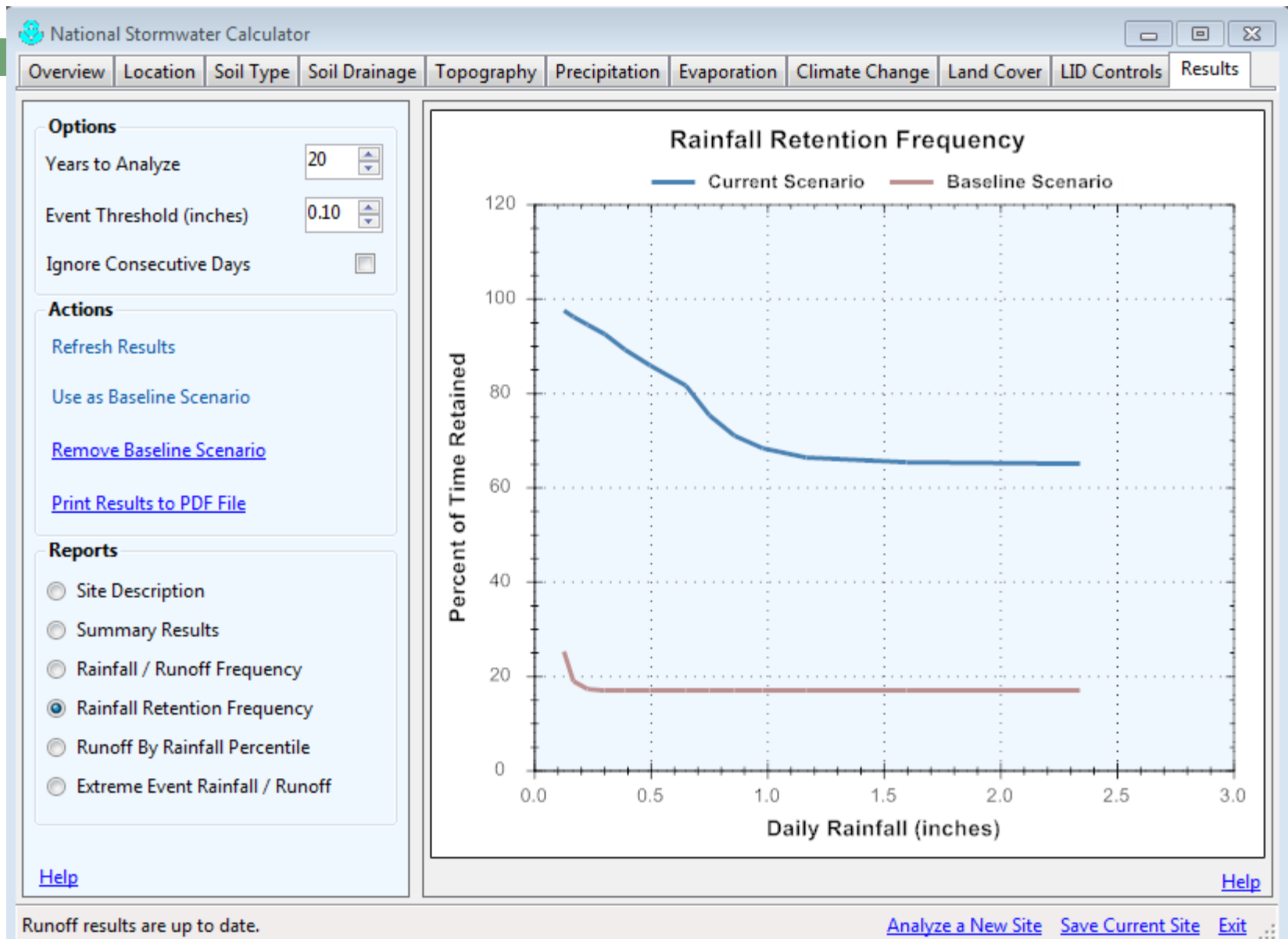
[Analyze a New Site](#) [Save Current Site](#) [Exit](#)

# With LID vs Without LID

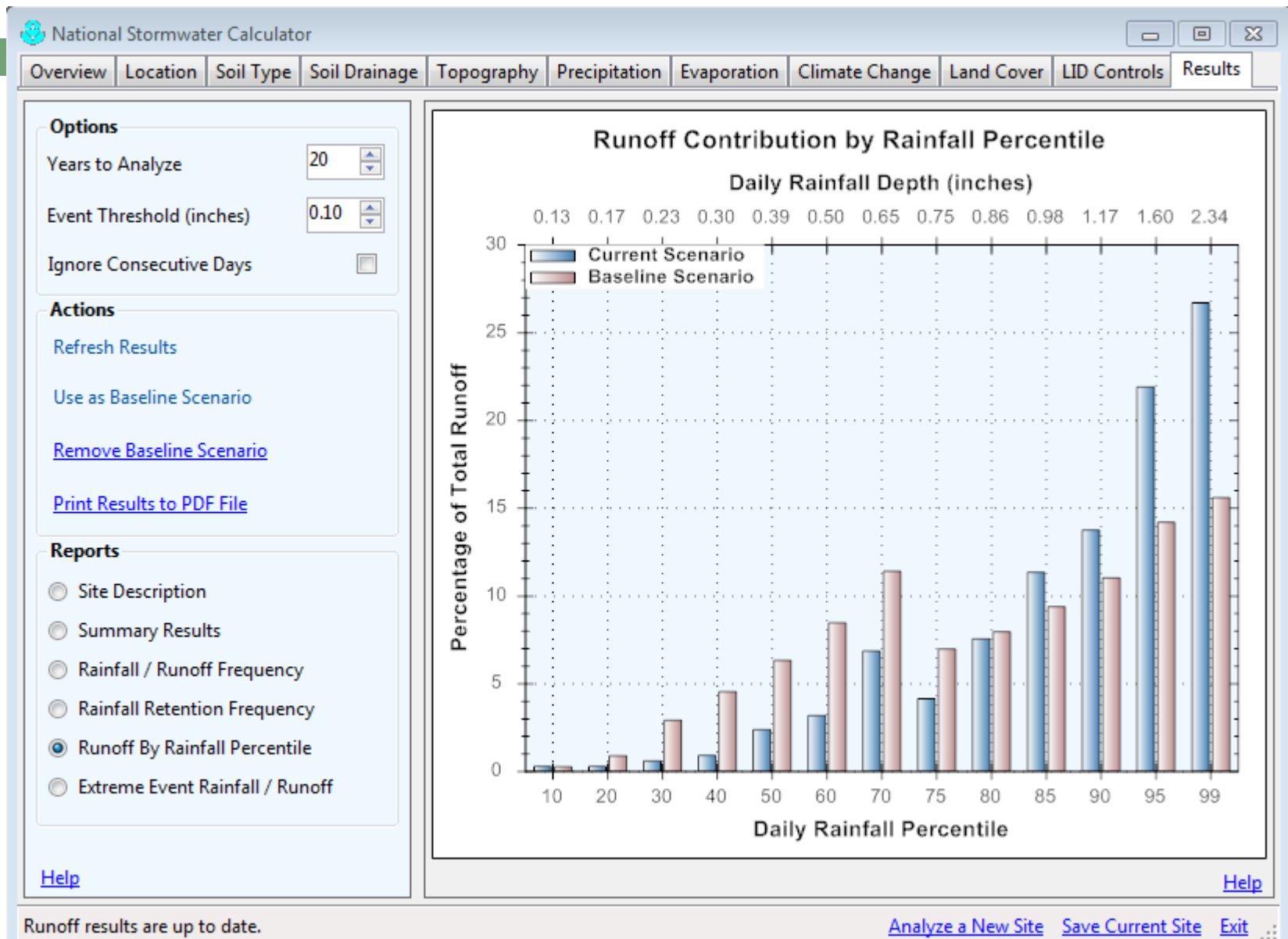




# With LID vs. Without LID



# With LID vs. Without LID

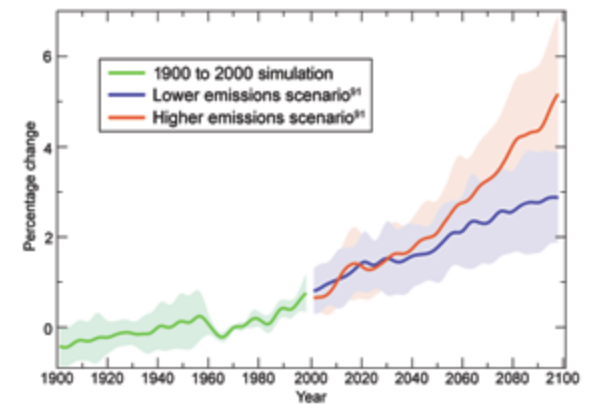


# Climate Change Extension

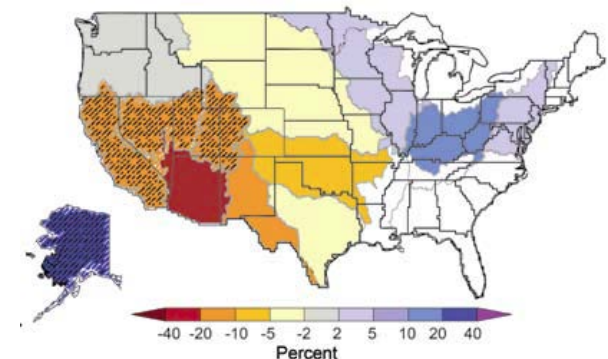
11

- The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) states that the earth's climate is unequivocally changing.
- The resulting impacts on small scale hydrology include:
  - changes in seasonal precipitation patterns
  - more frequent occurrence of high intensity storm events
  - changes in evaporation rates
- A climate change component has been added to the calculator to help assess how resilient source controls will be to future meteorological conditions.

Global Increase in Heavy Ppt. Events



Projected Changes in Annual Runoff





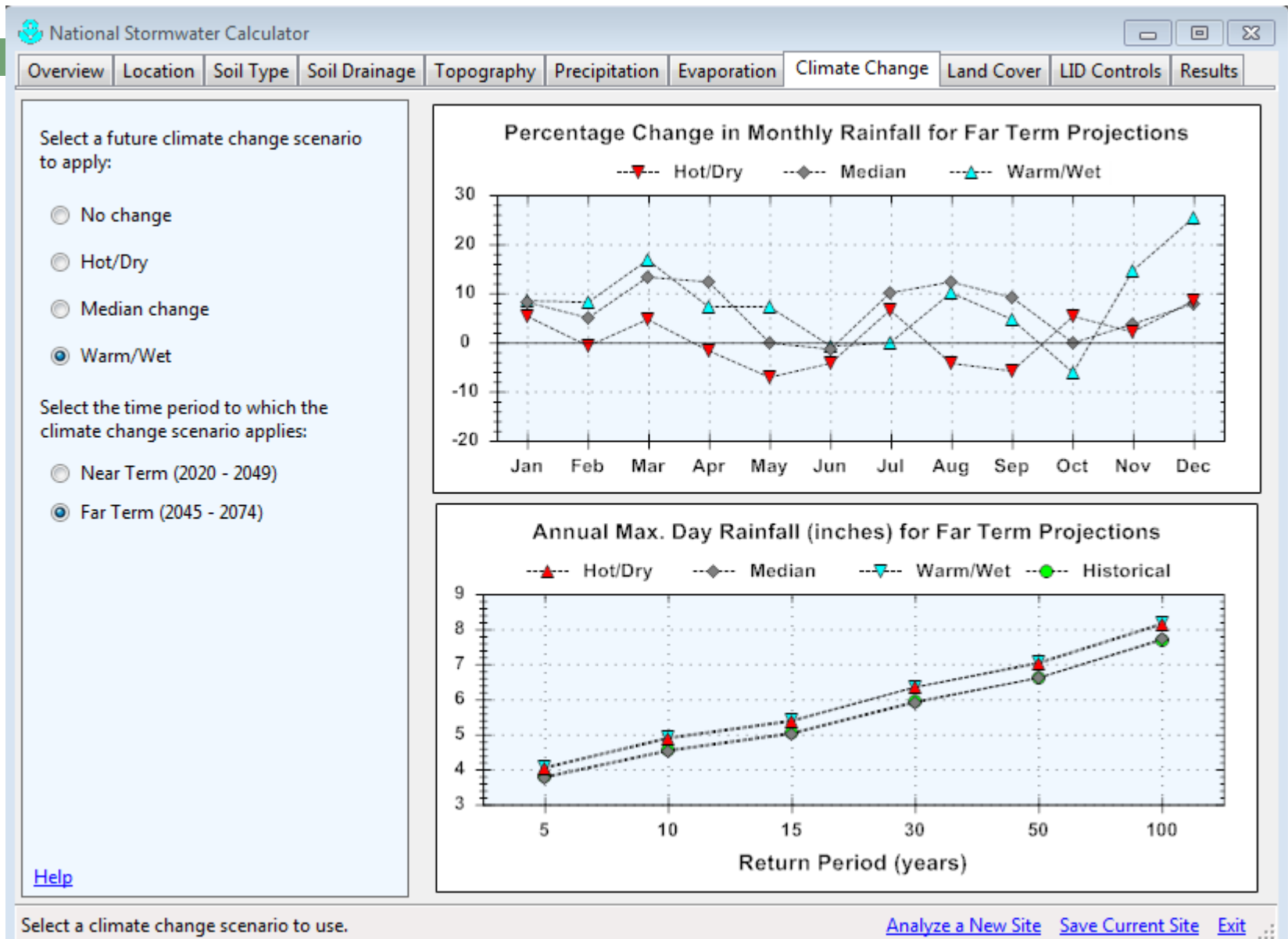
# Climate Change Extension

33

- Climate change scenarios are taken from EPA's CREAT tool (based on downscaled CMIP3 GCM results used in the IPCC AR4).
- Calculates the long-term hydrologic response of the site to a modified rainfall record
- Also calculates the response of the site to the climate-induced max. 24-hour rainfall at different return periods.

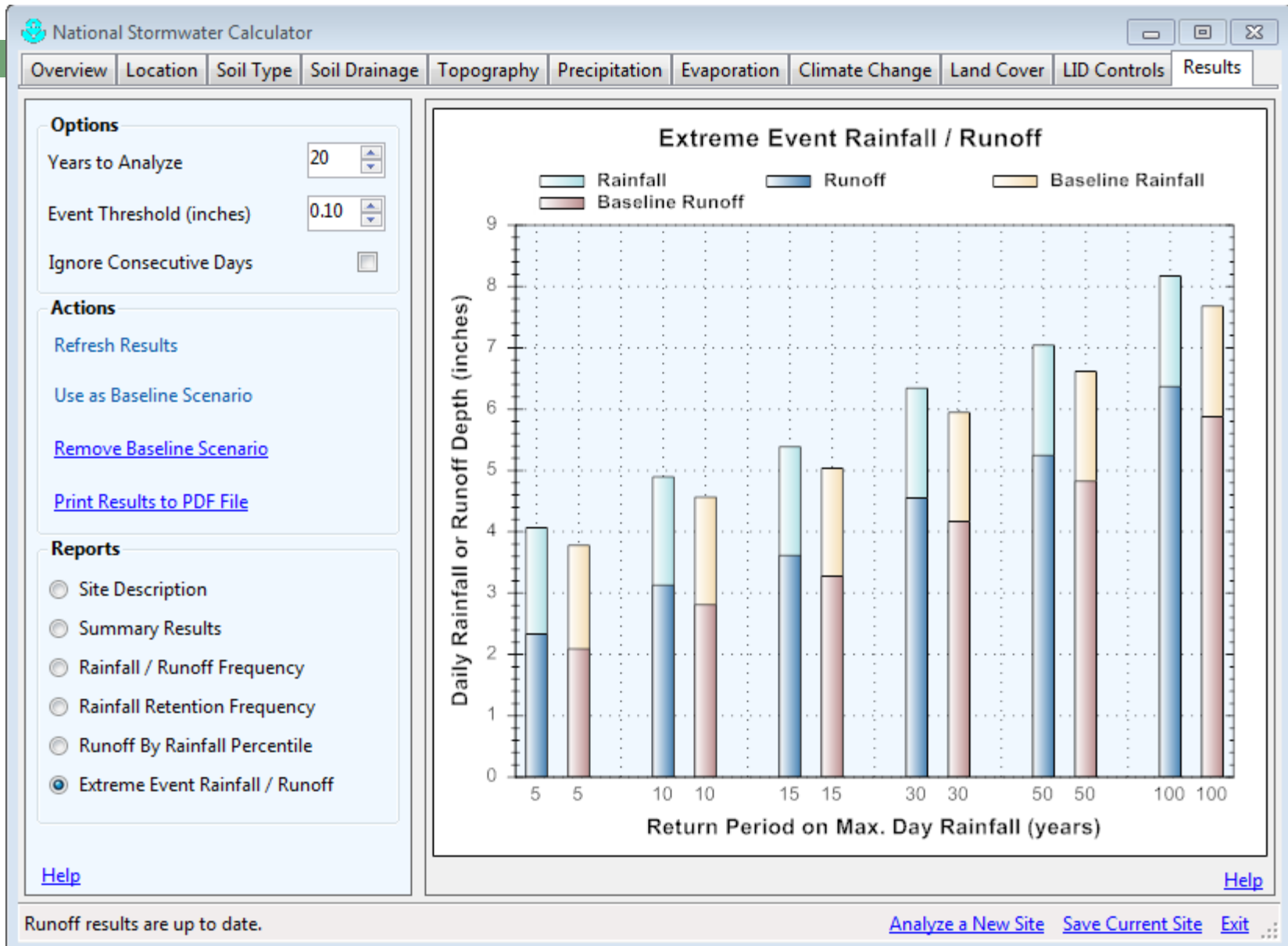
# Example with Climate Change

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# With vs. Without Climate Change

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