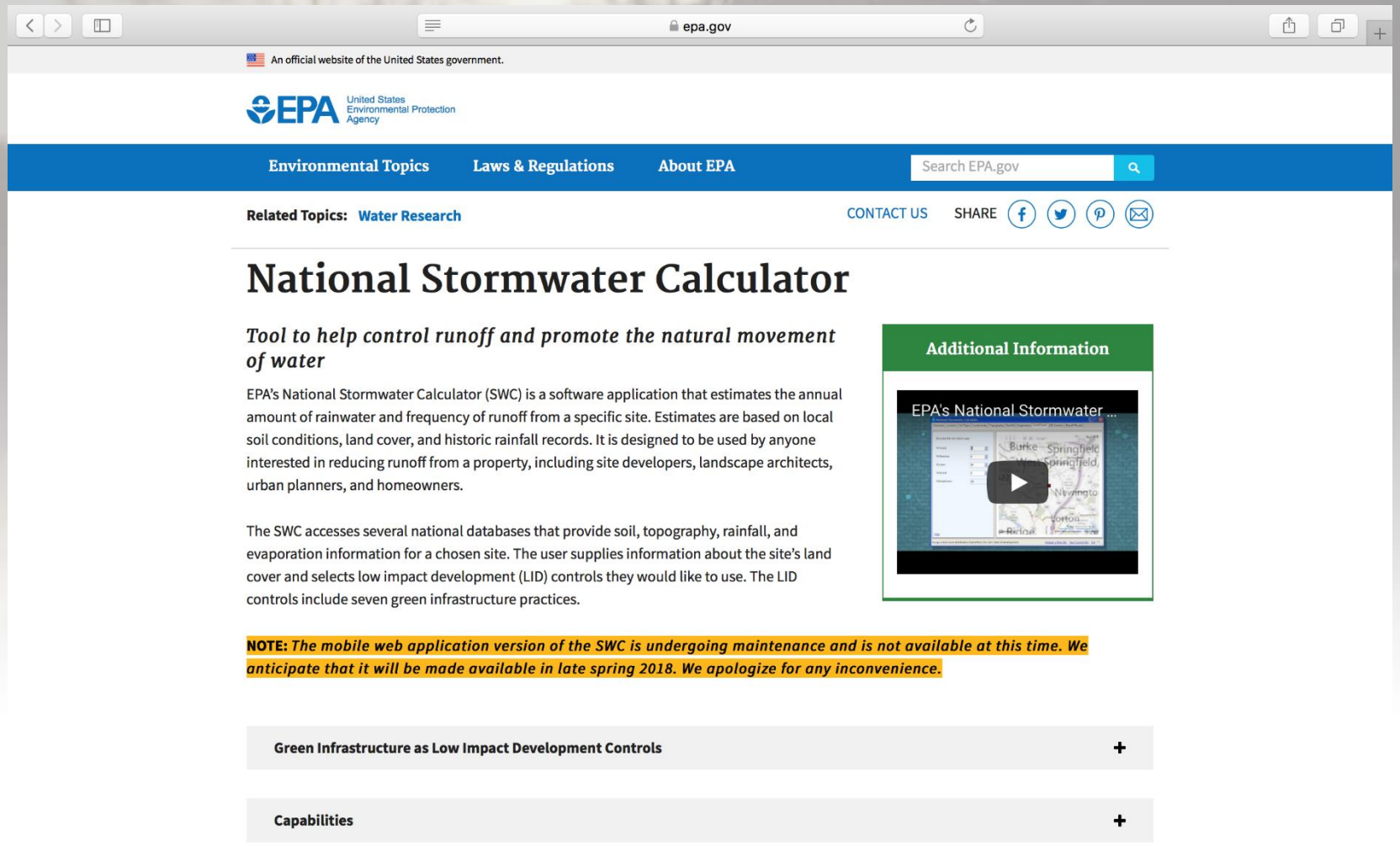
Tools and Case Studies for Green-Gray Lifecycle Cost Analysis

Ohio Stormwater Conference May 2018

Justin Kerns

ms consultants

EPA National Stormwater Calculator



Low Impact Development (LID) Controls

Included LID Controls

- Disconnection (rooftop downspouts)
- Rain Harvesting (rain barrel or cistern)
- Rain Gardens
- Green Roofs
- Street Planters
- Infiltration Basins
- Permeable Pavement

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- Disconnection (rooftop downspouts)
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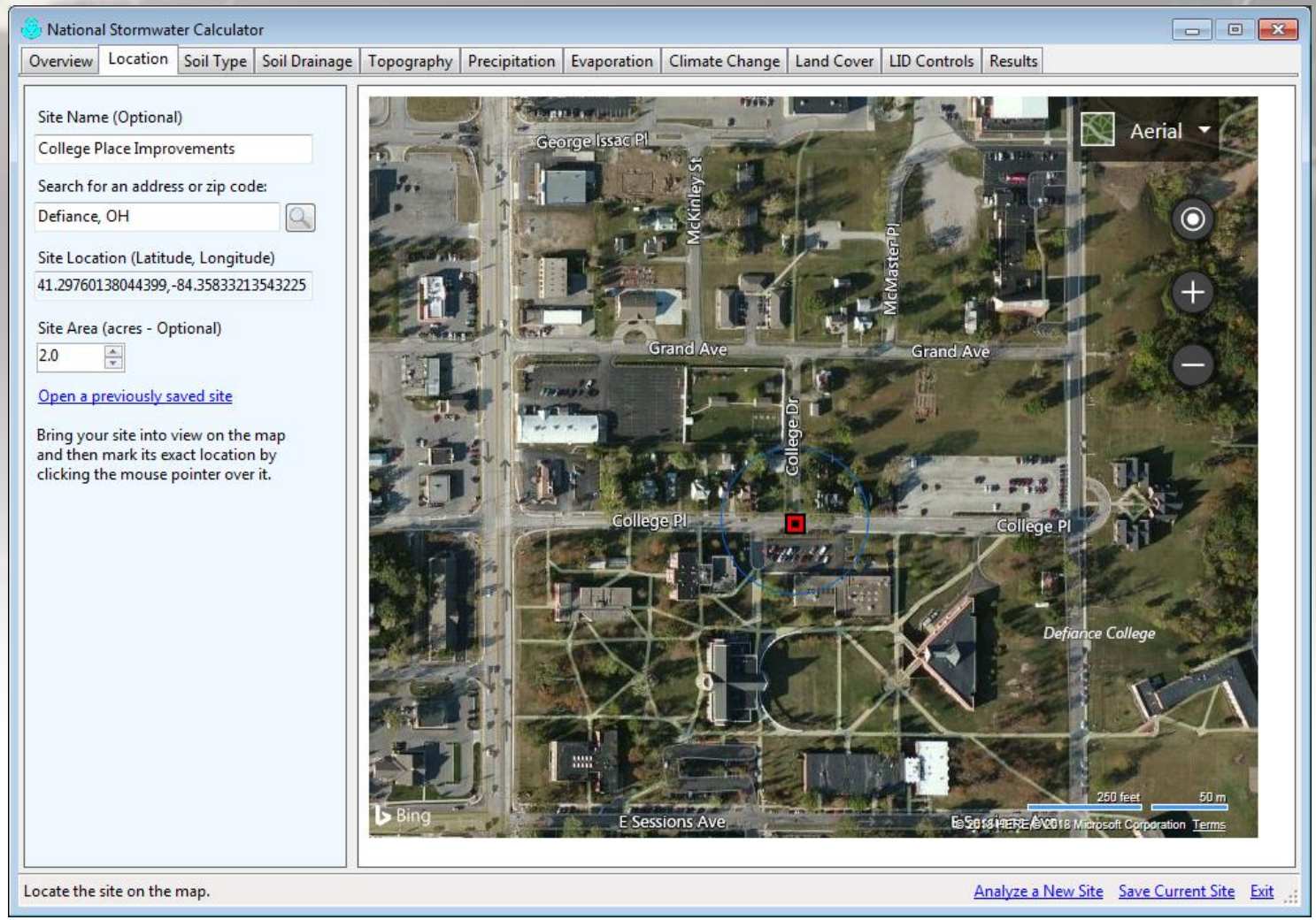
- Infiltration Basins
- Permeable Pavement

Modeling Capabilities

- Hydrologic Analysis
- Cost Analysis
- Climate Scenarios

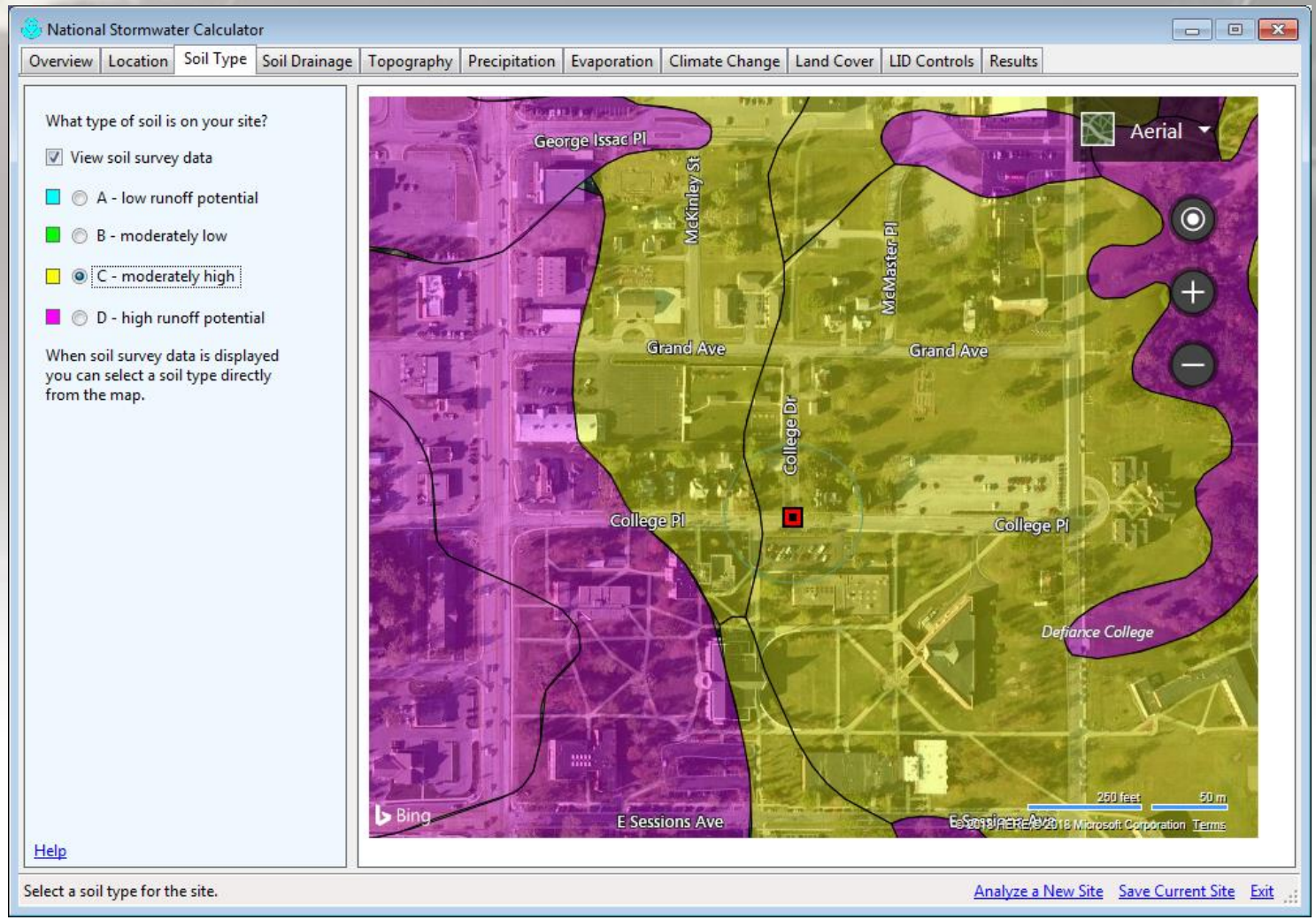
Location and Project Information

- Site Name
- Search for Site Location
- Site Area



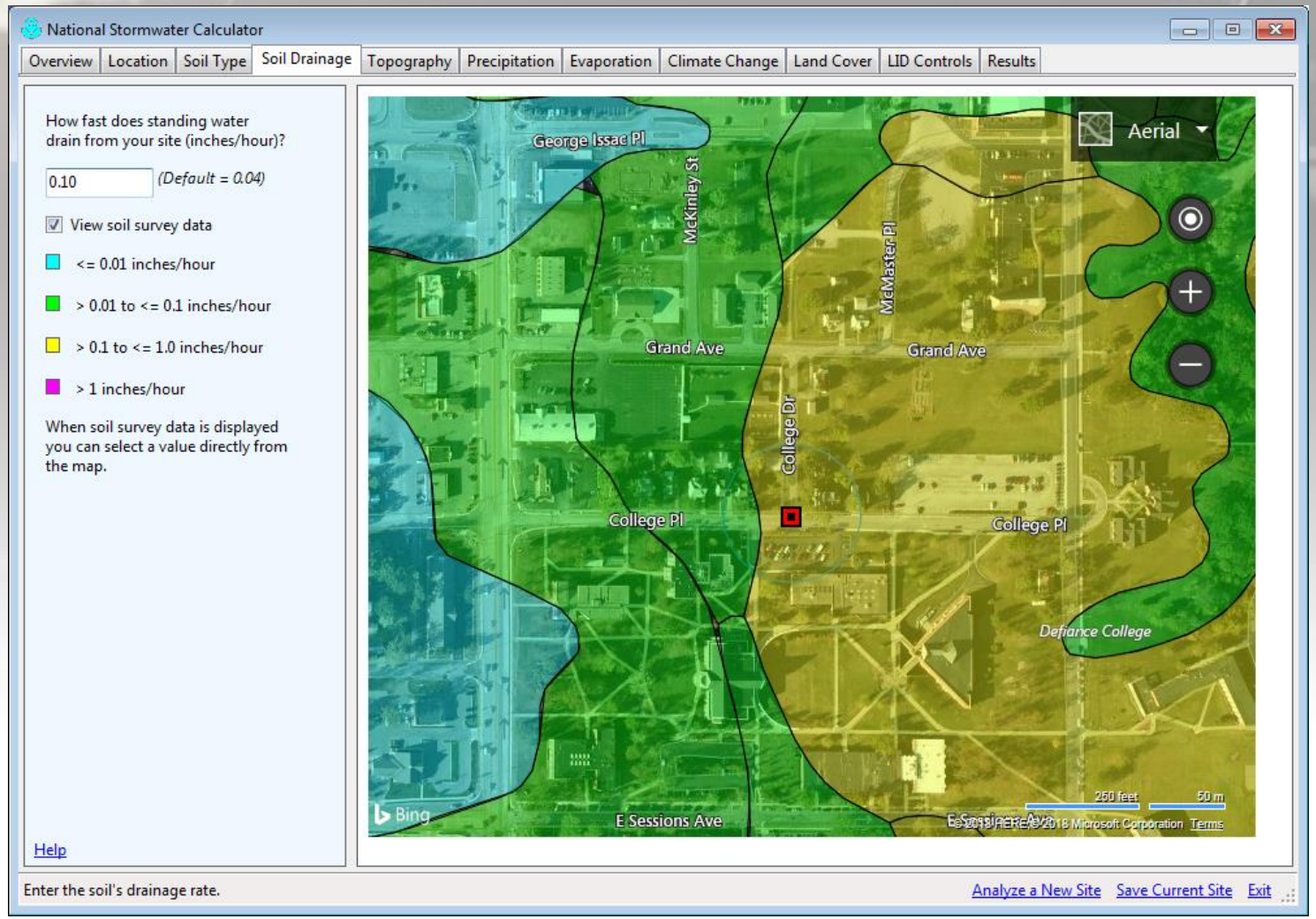
Soil Type

- NRCS Web Soil Survey
- Defined by Hydrologic Soil Group
  - Group A – Sand
  - Group B – Sandy Loam
  - Group C – Clay Loam
  - Group D – Clay



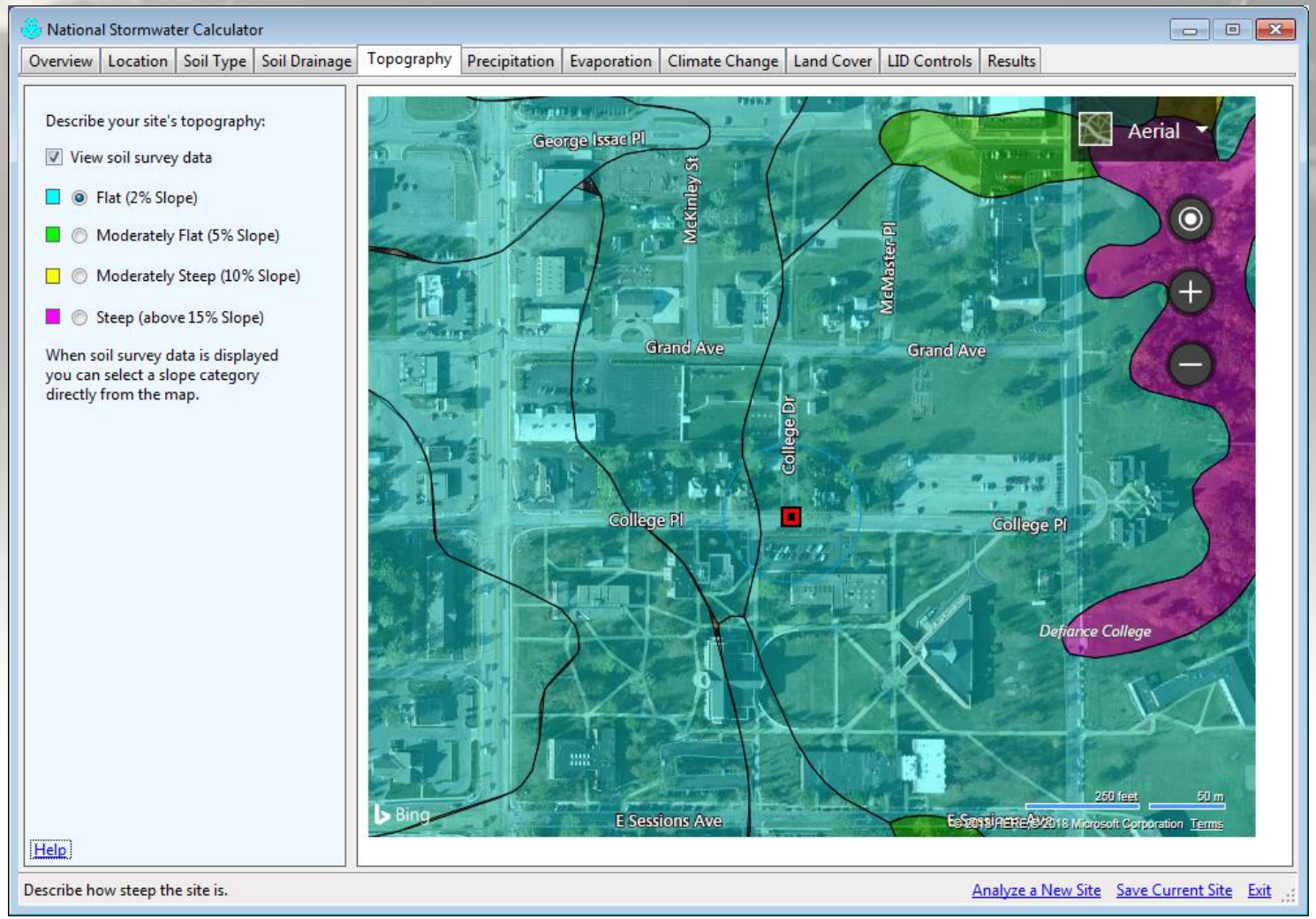
Soil Drainage

- NRCS Web Soil Survey
- Saturated Hydraulic Conductivity



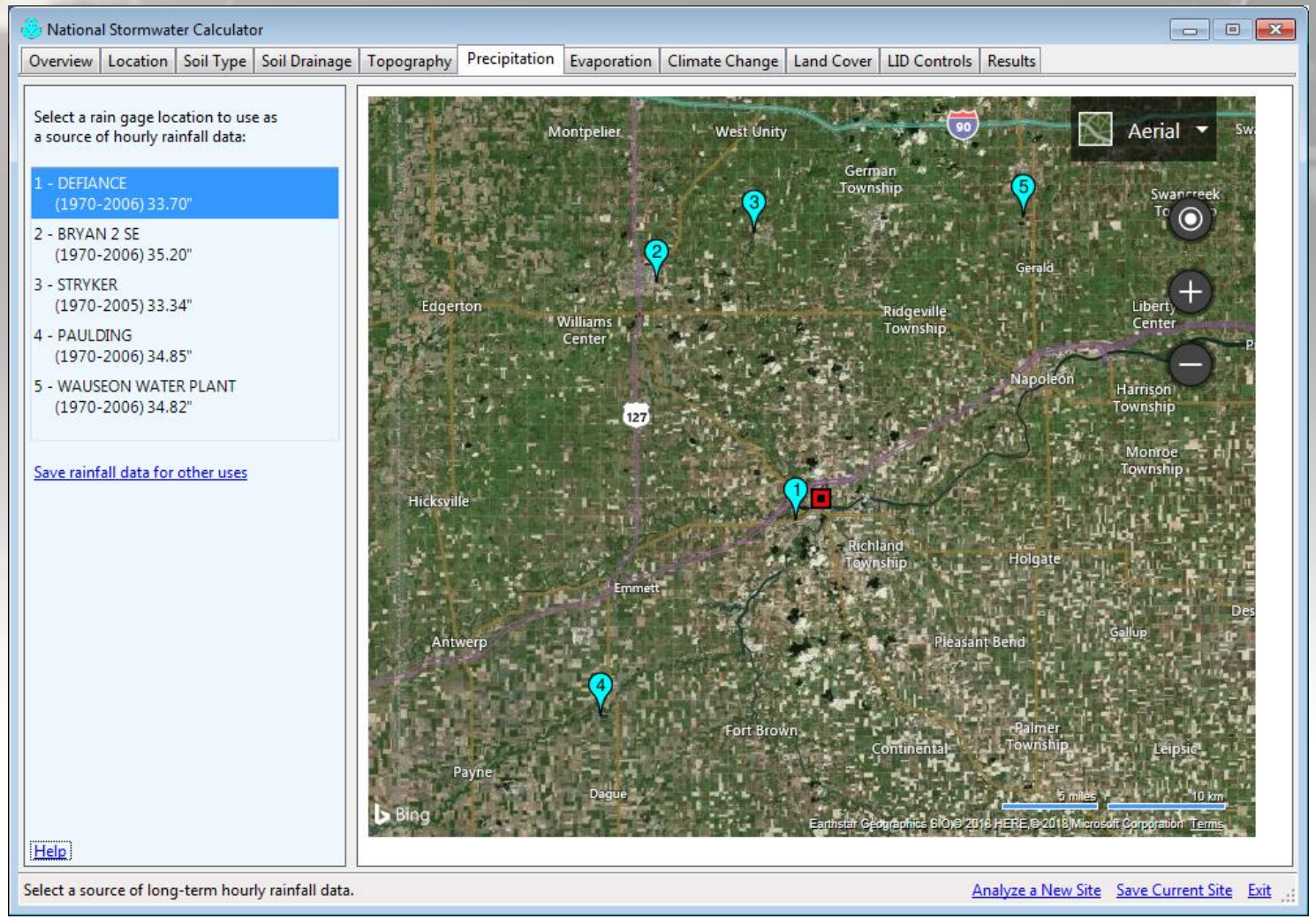
Topography

- NRCS Web Soil Survey
- Surface Slope



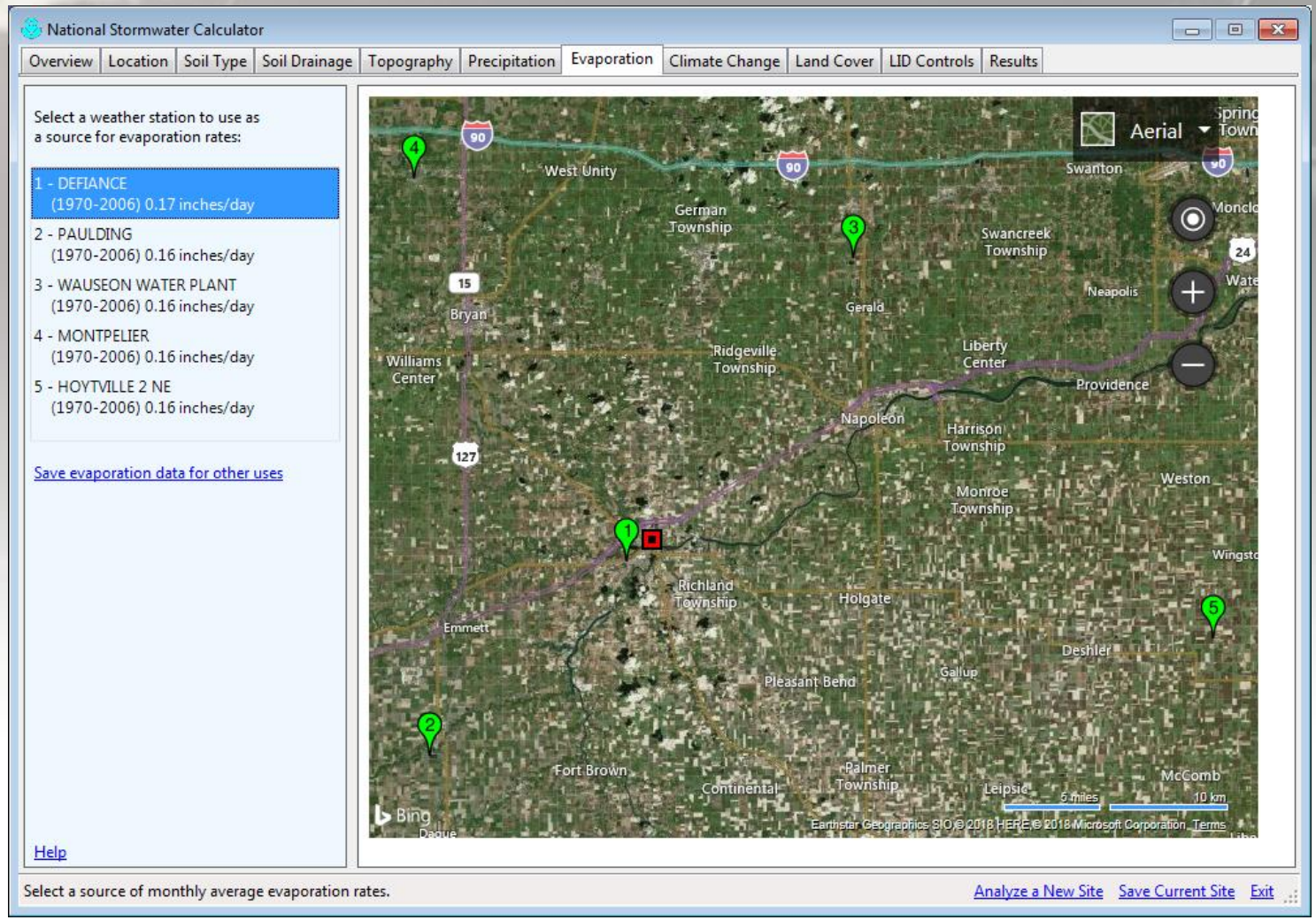
Precipitation

- Measured at nearby National Weather Service rain gage
- Average annual rainfall based on long-term historical data



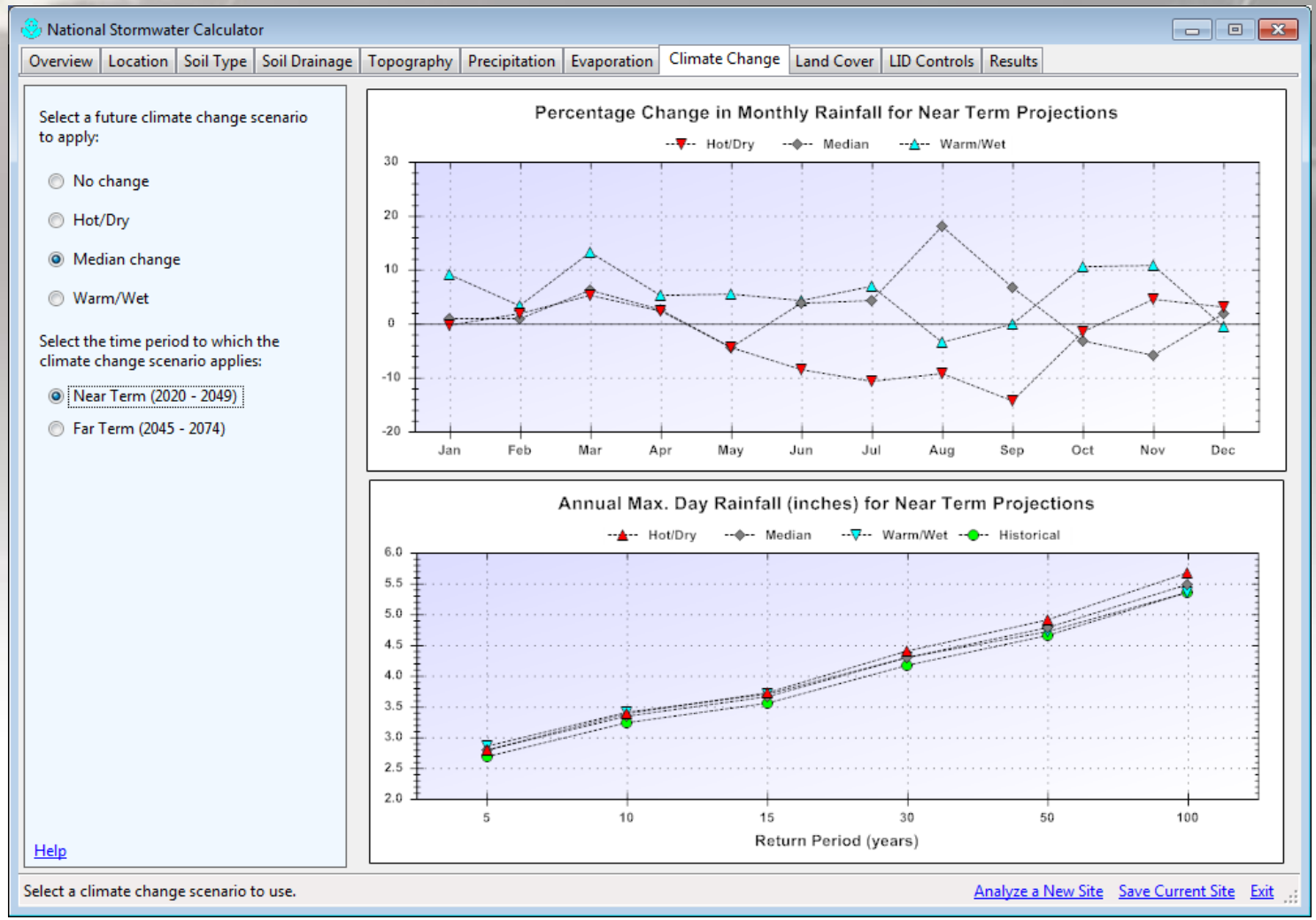
Evaporation

- Measured at nearby National Weather Service weather station
- Monthly evaporation rates calculated from long-term historical data



Climate Scenarios

- Climate projections produced by the World Climate Research Programme (WCRP)
- Scenarios model future changes in temperature and precipitation

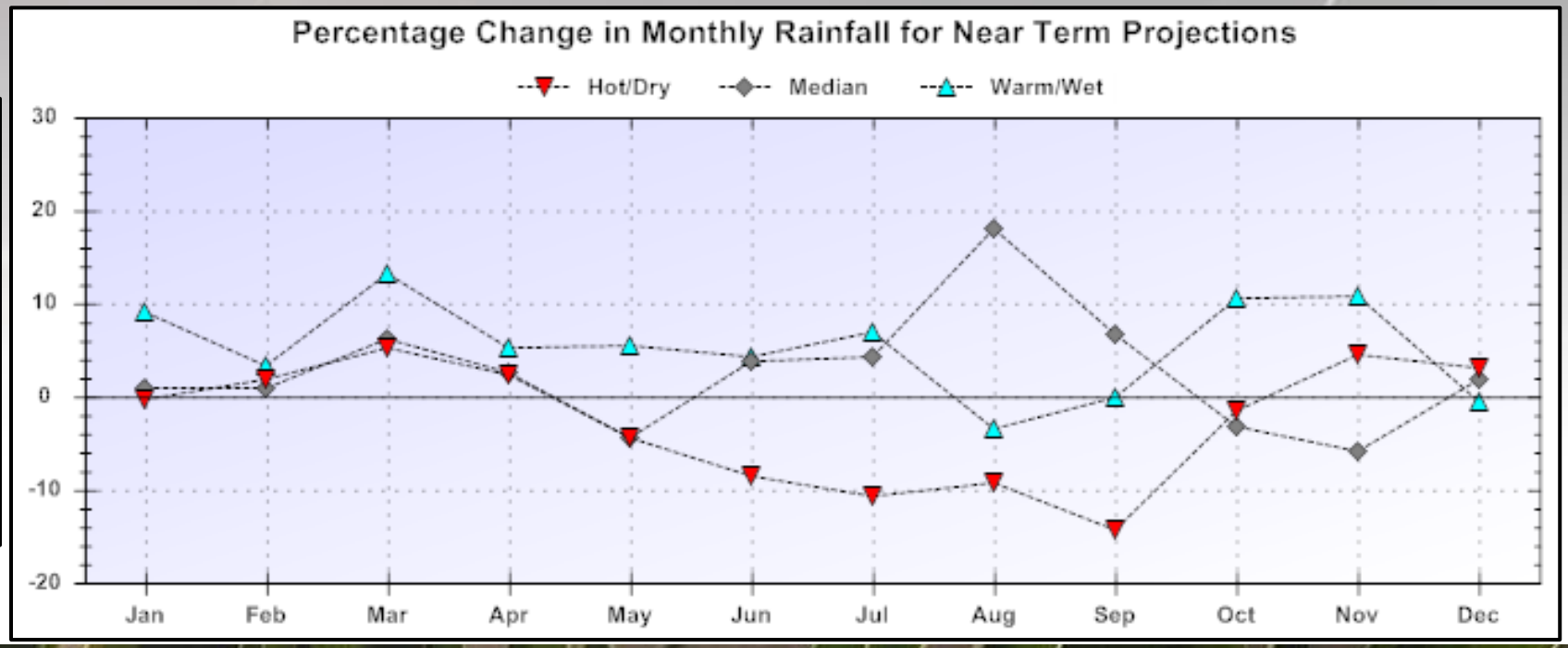


Climate Scenarios

- Climate projections affect the average monthly rainfall
- Three scenarios
- Two time periods

Select a future climate change scenario to apply:

- (•) No change
- ( ) Hot/Dry
- ( ) Median change
- ( ) Warm/Wet

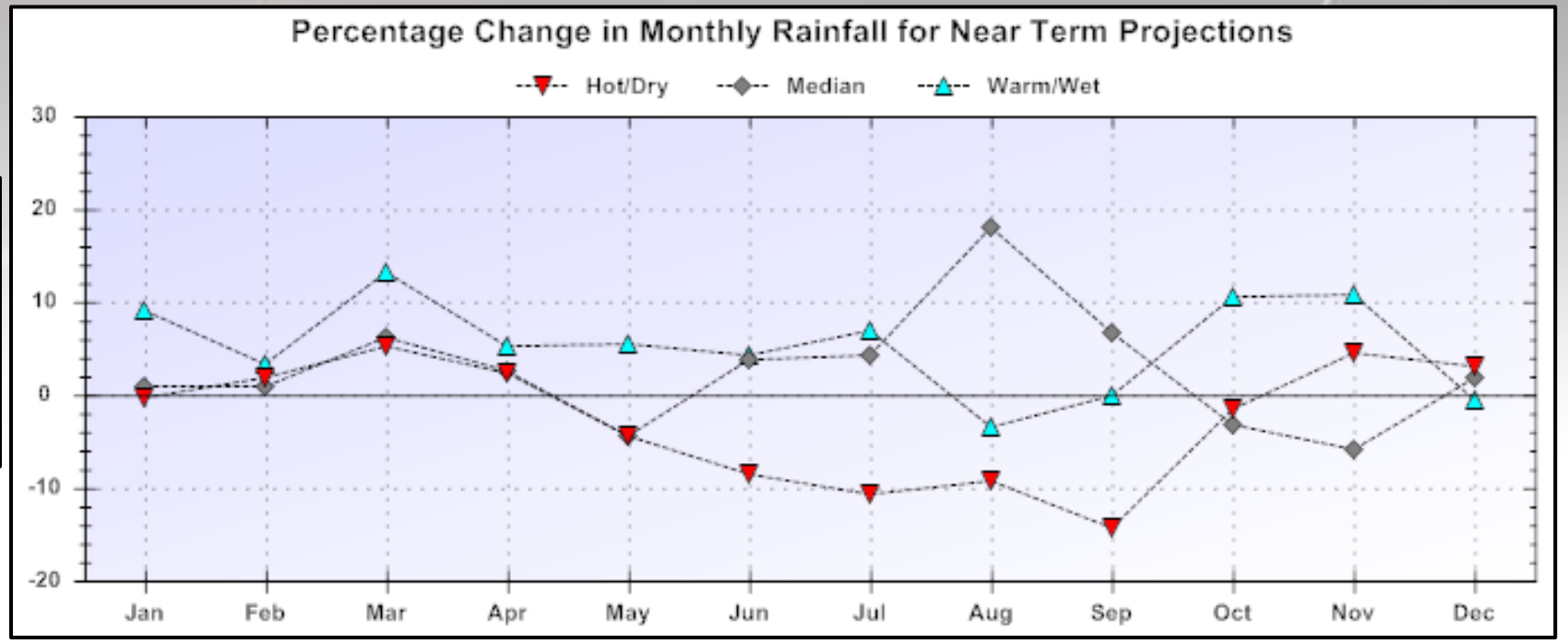


Climate Scenarios

- Climate projections affect the average monthly rainfall
- Three scenarios
- Two time periods

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

- (●) Near Term (2020 - 2049)
- ( ) Far Term (2045 - 2074)



Climate Scenarios

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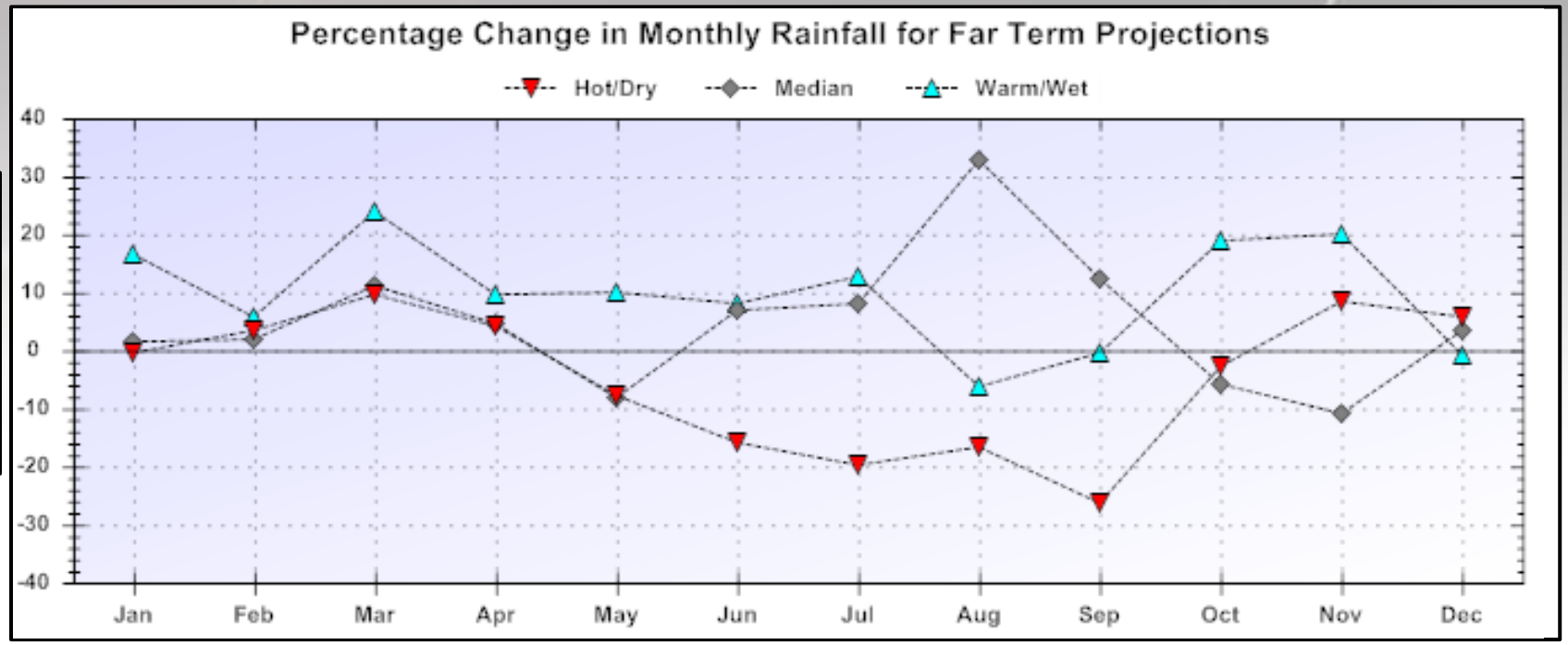
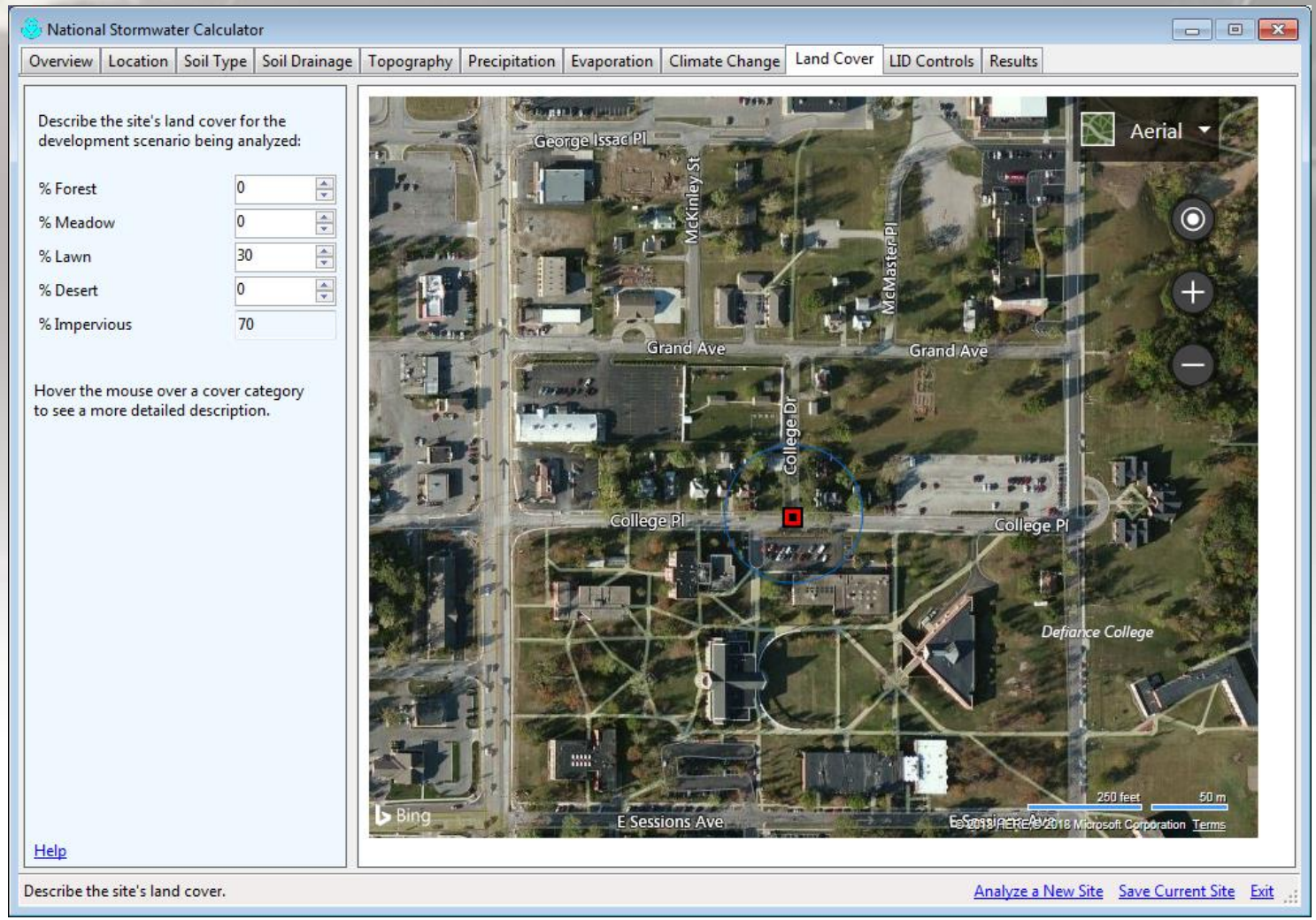


Land Cover

Select the percent of site area covered by:

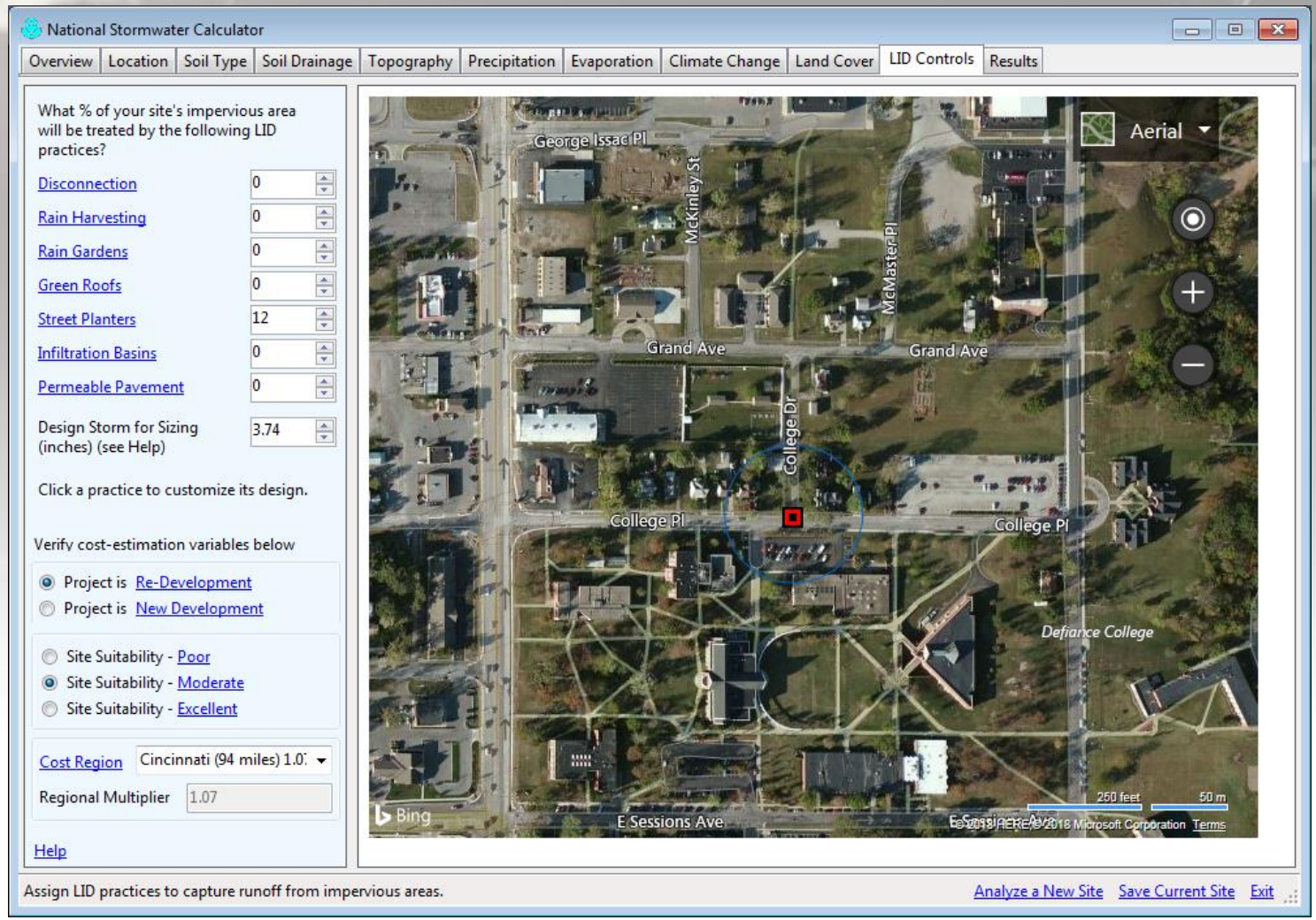
- Forest
- Meadow
- Lawn
- Desert
- Impervious



Low Impact Development (LID) Controls

Select percent of impervious area to be treated by each LID type

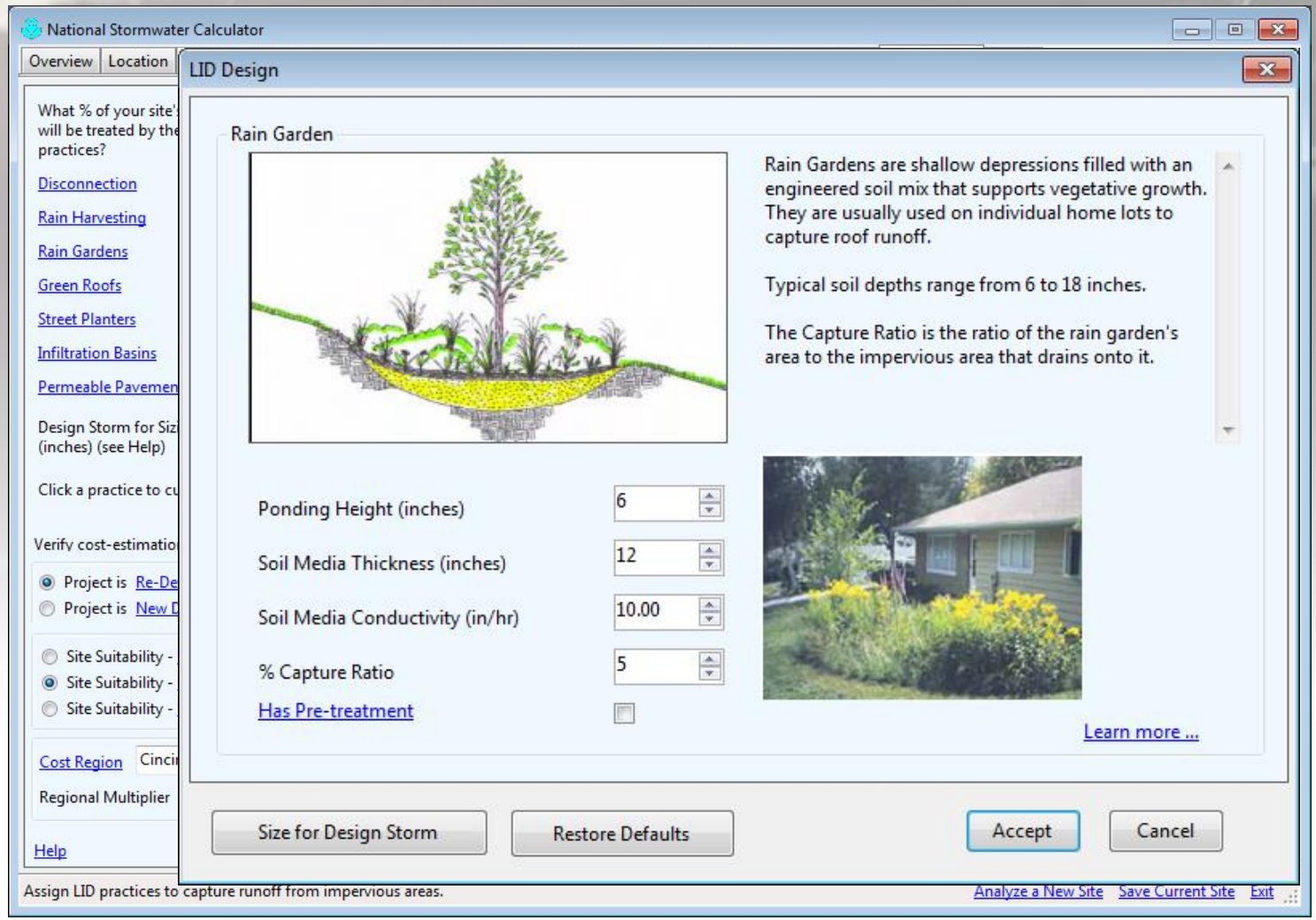
Enter design storm to be used for LID sizing



LID Controls

Rain Gardens

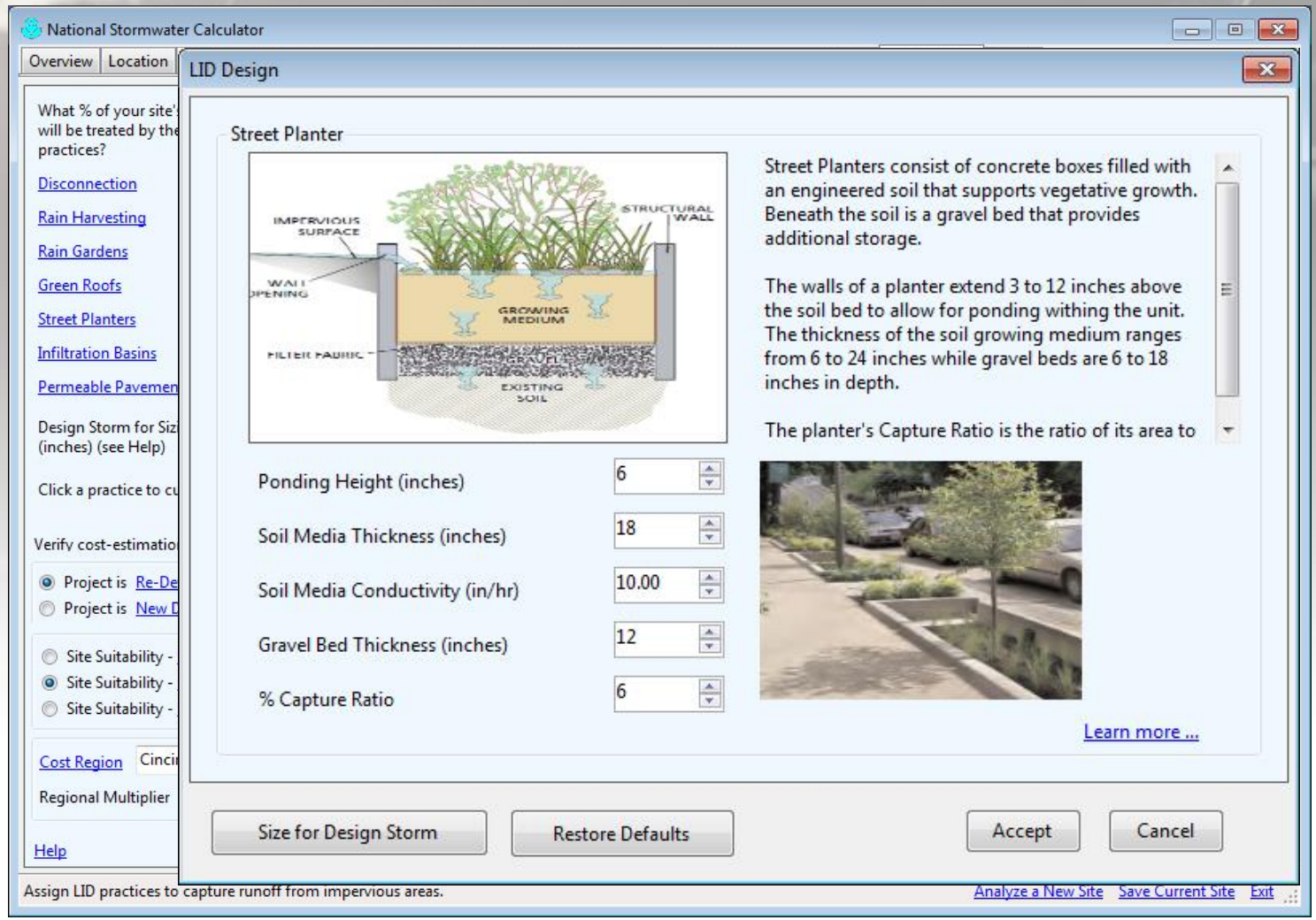
- Ponding Height
- Soil Media Thickness
- Soil Media Conductivity
- % Capture Ratio (ratio of LID area to desired captured area)



LID Controls

Street Planter

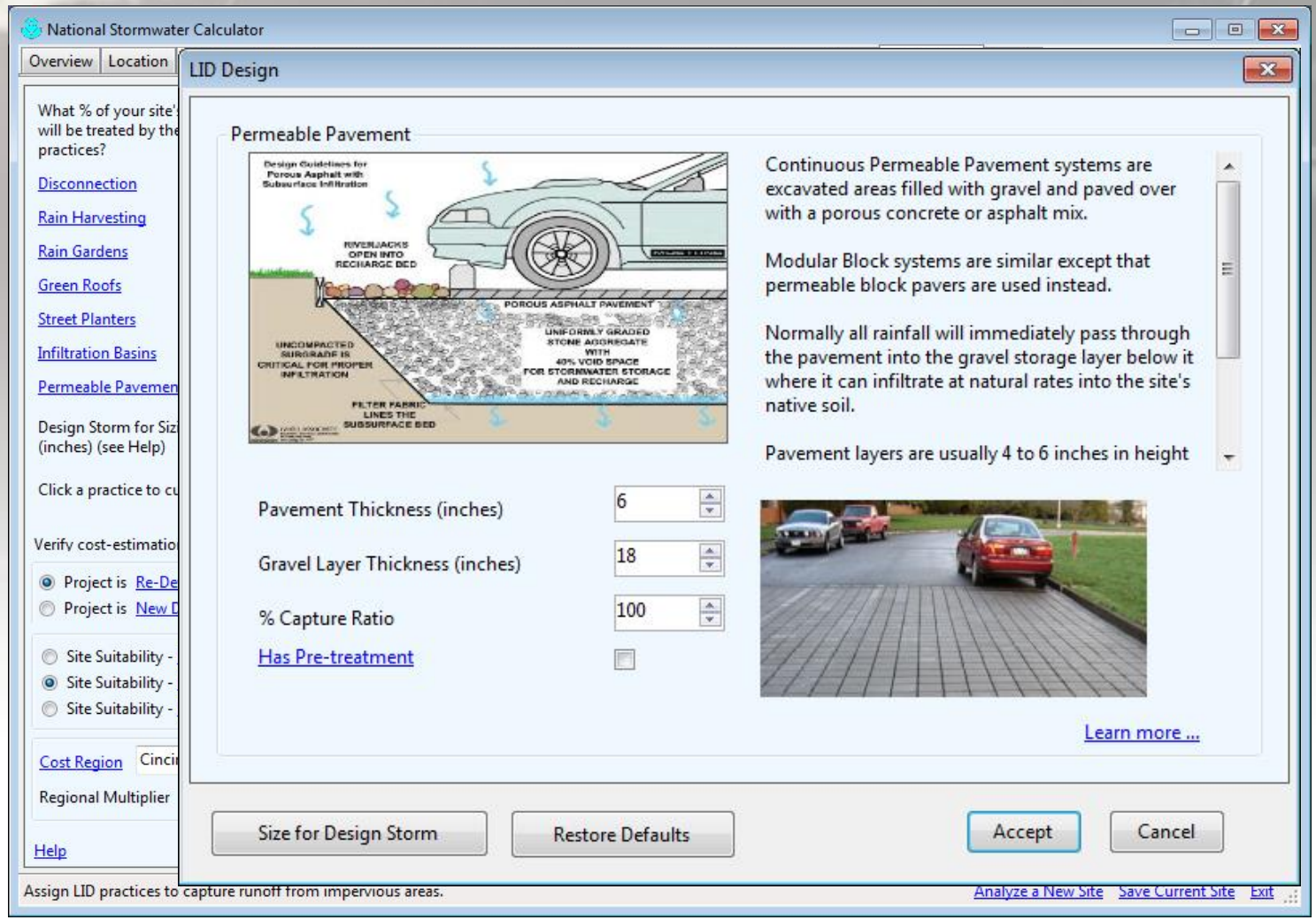
- Ponding Height
- Soil Media Thickness
- Soil Media Conductivity
- Gravel Bed Thickness
- % Capture Ratio (ratio of LID area to desired captured area)



LID Controls

Permeable Pavement

- Pavement Thickness
- Gravel Layer Thickness
- % Capture Ratio (ratio of LID area to desired captured area)



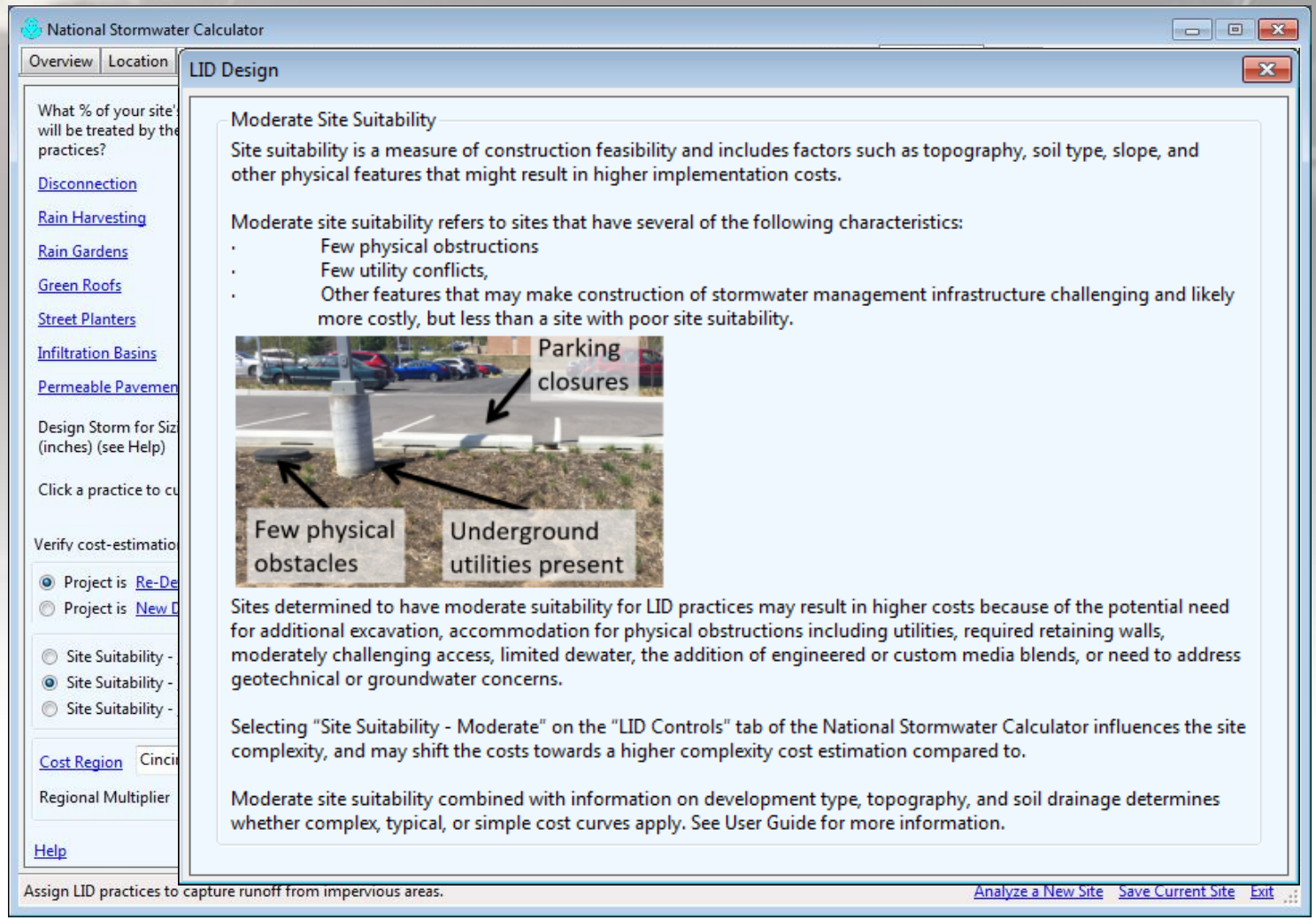
LID Controls

Site Suitability

- Physical Obstructions
- Utility Conflicts
- Ease of Access

Impacts

- Construction Cost
- Maintenance Cost

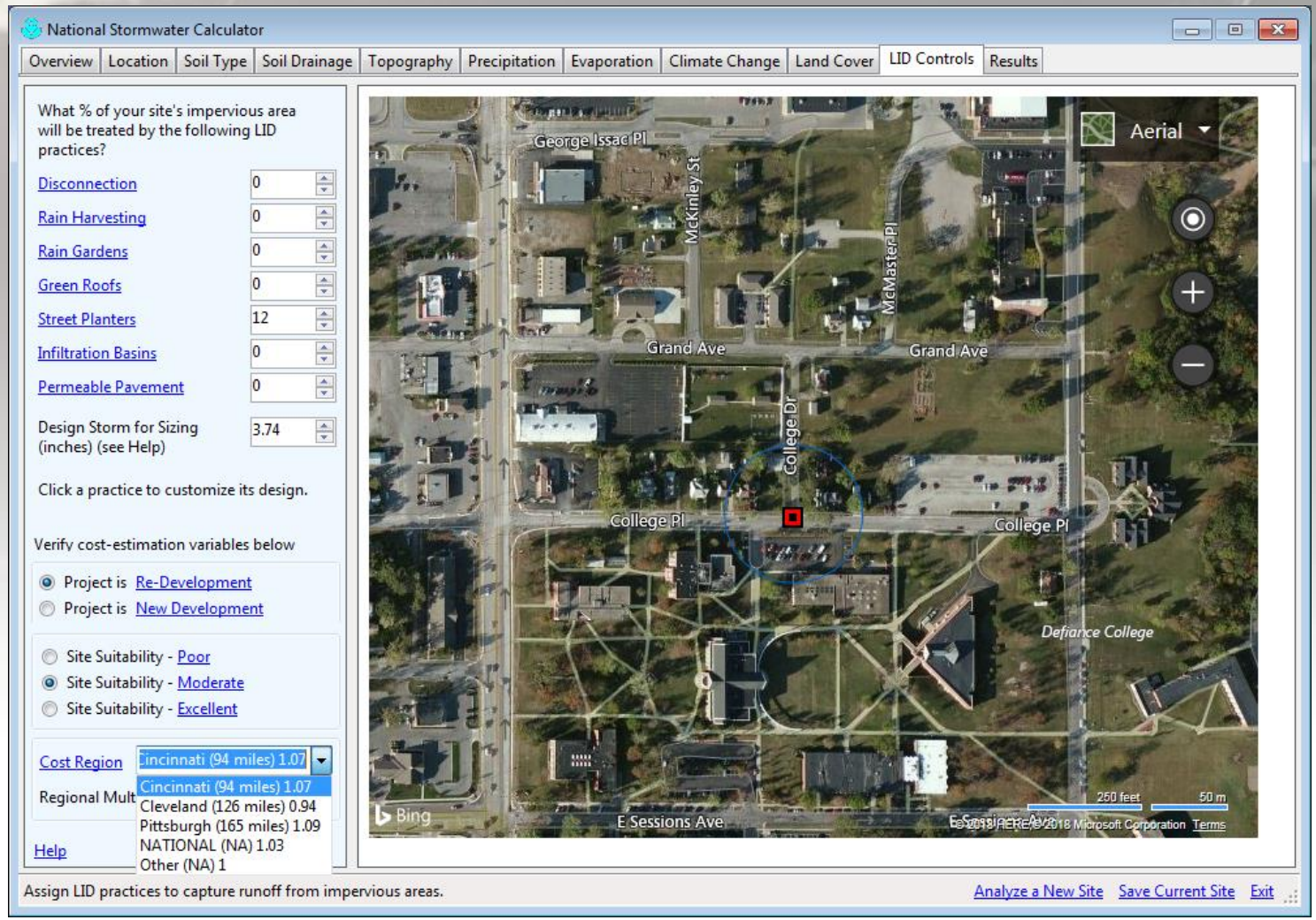


LID Controls

Select cost region

Impacts

- Construction Cost
- Maintenance Cost



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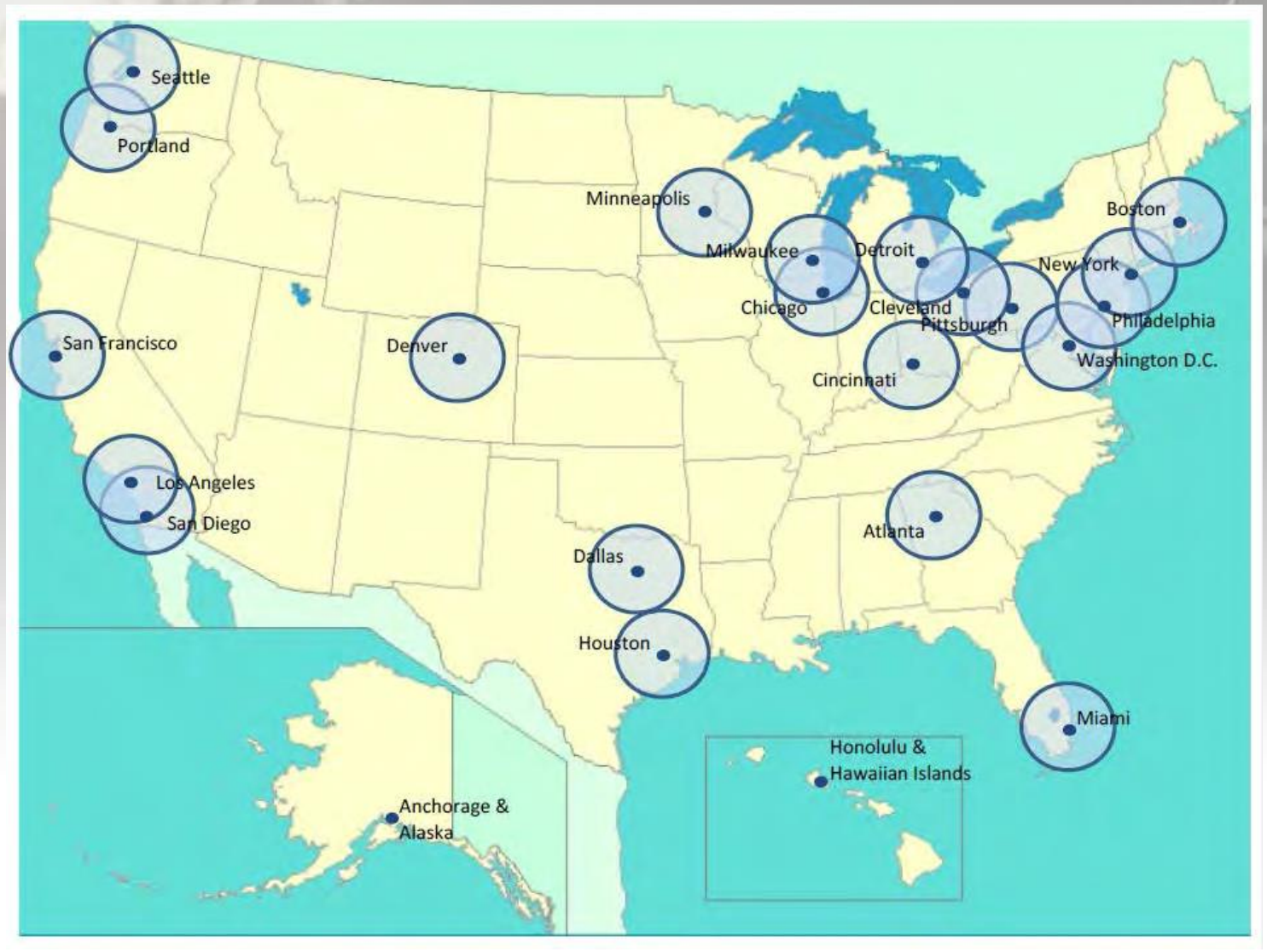
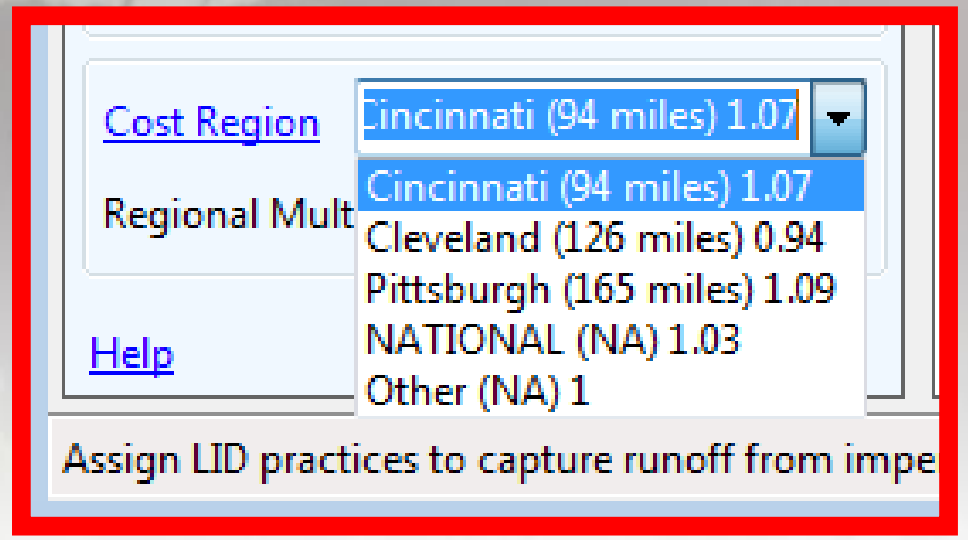
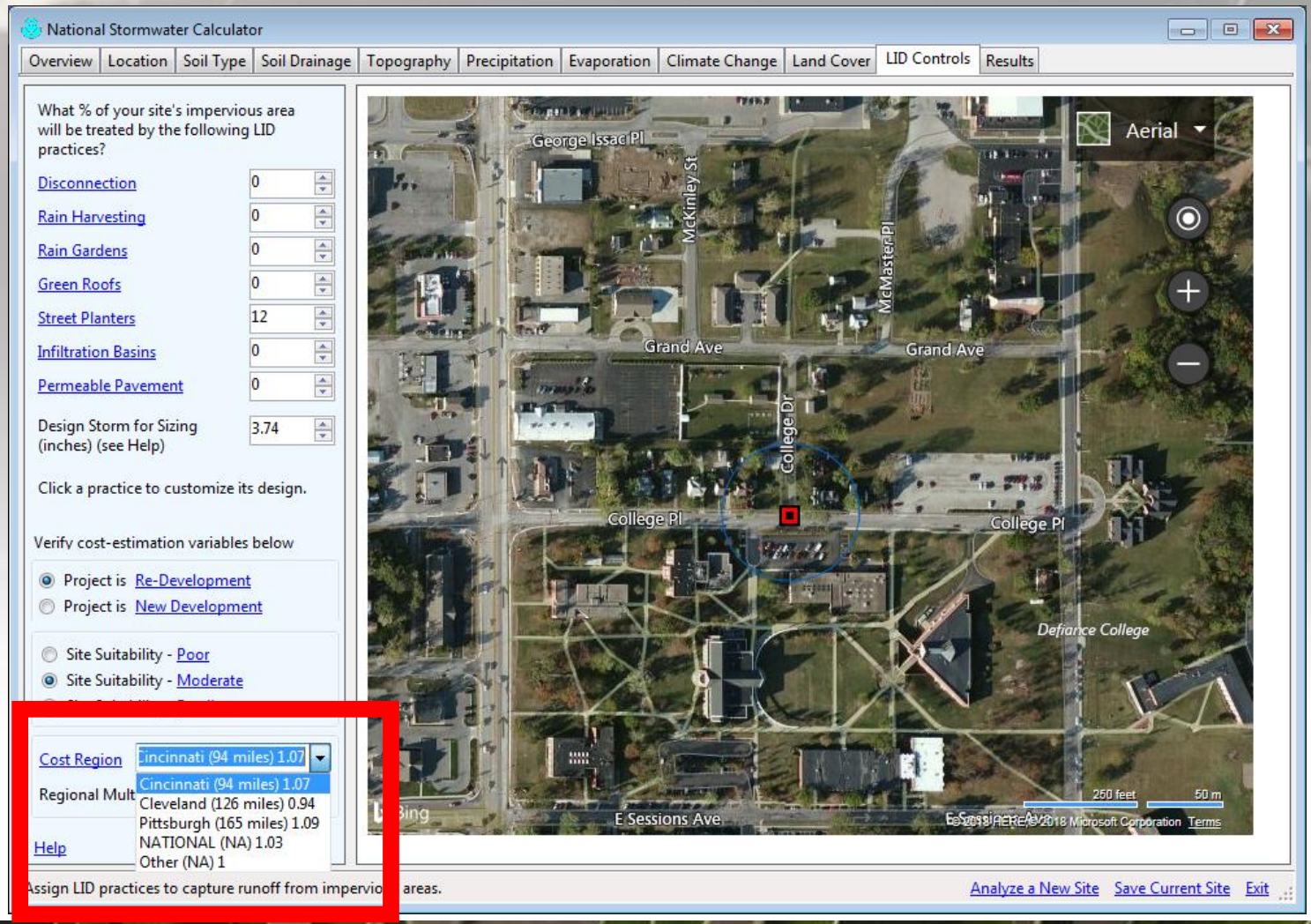


LID Controls

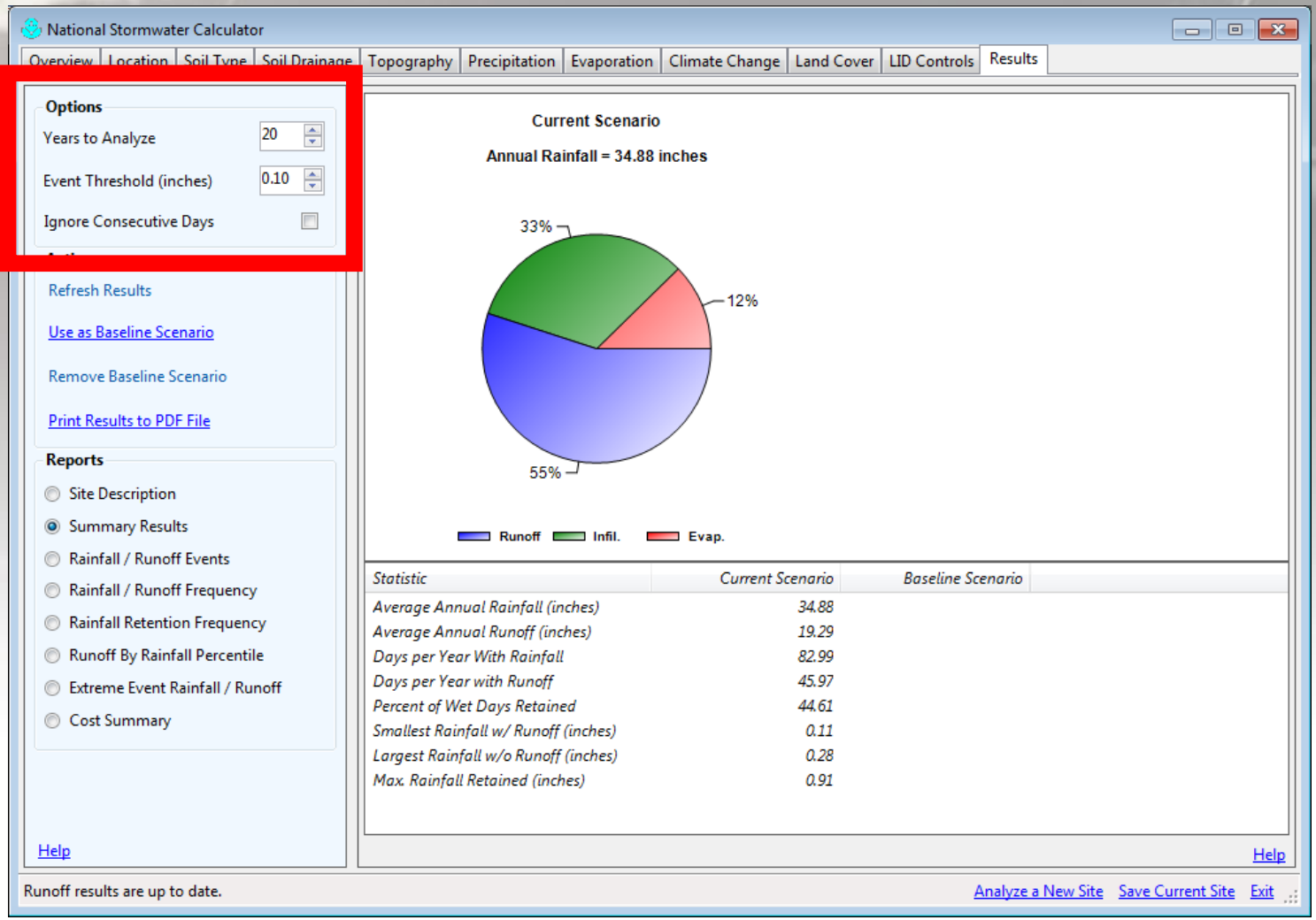
Select cost region





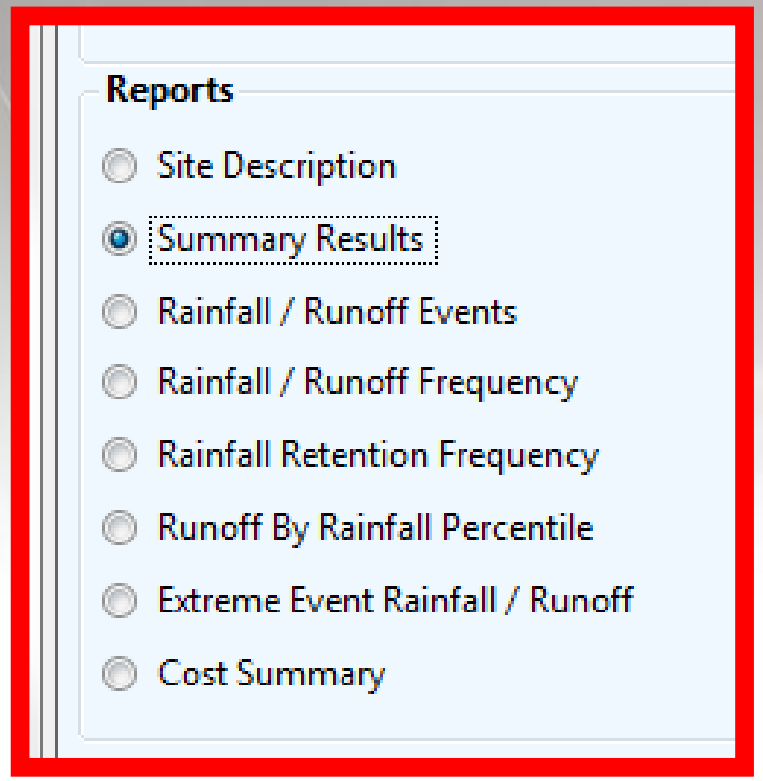
Model Options

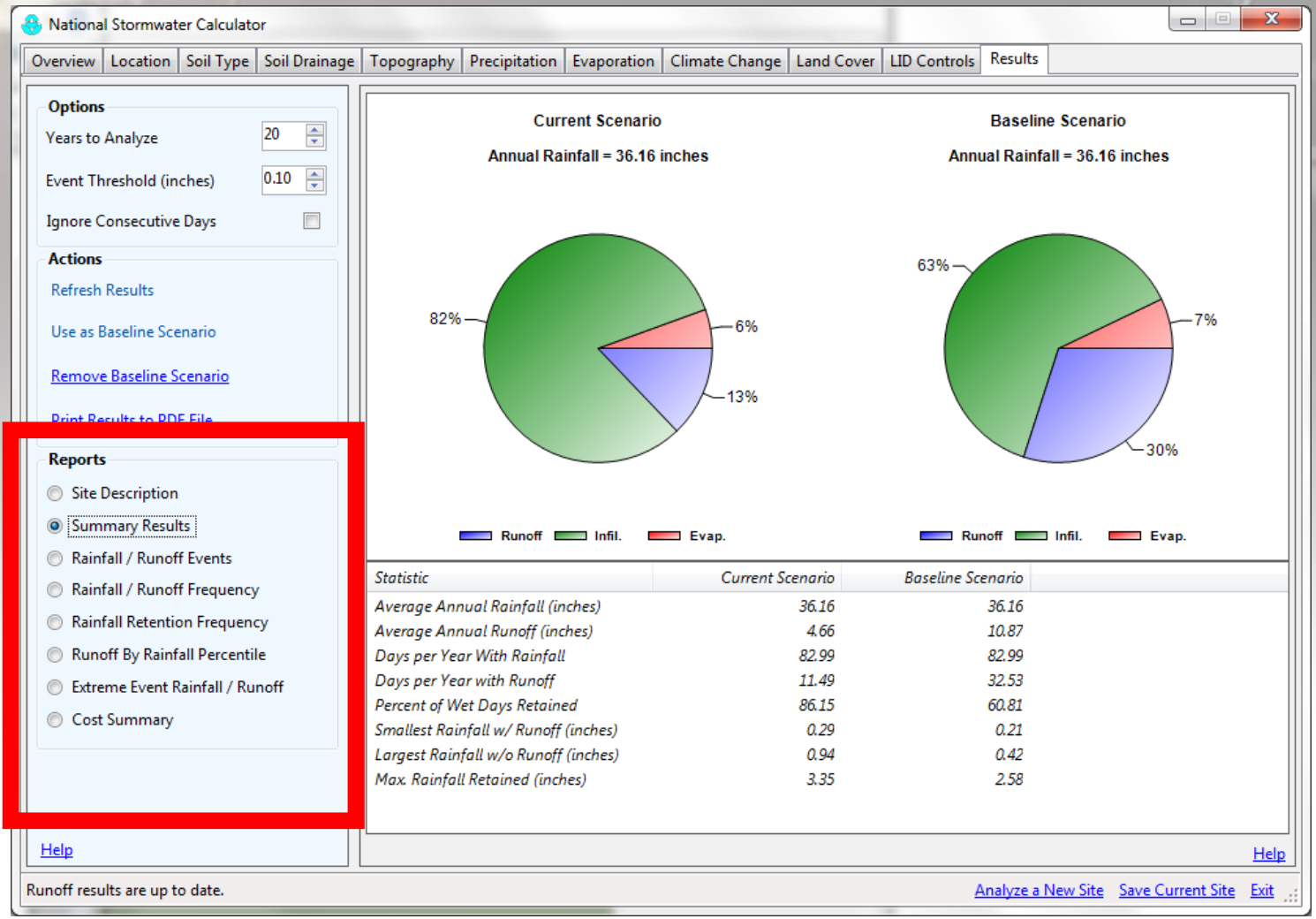
- Select number of years to analyze
- Enter event threshold
- Consecutive Days



Results

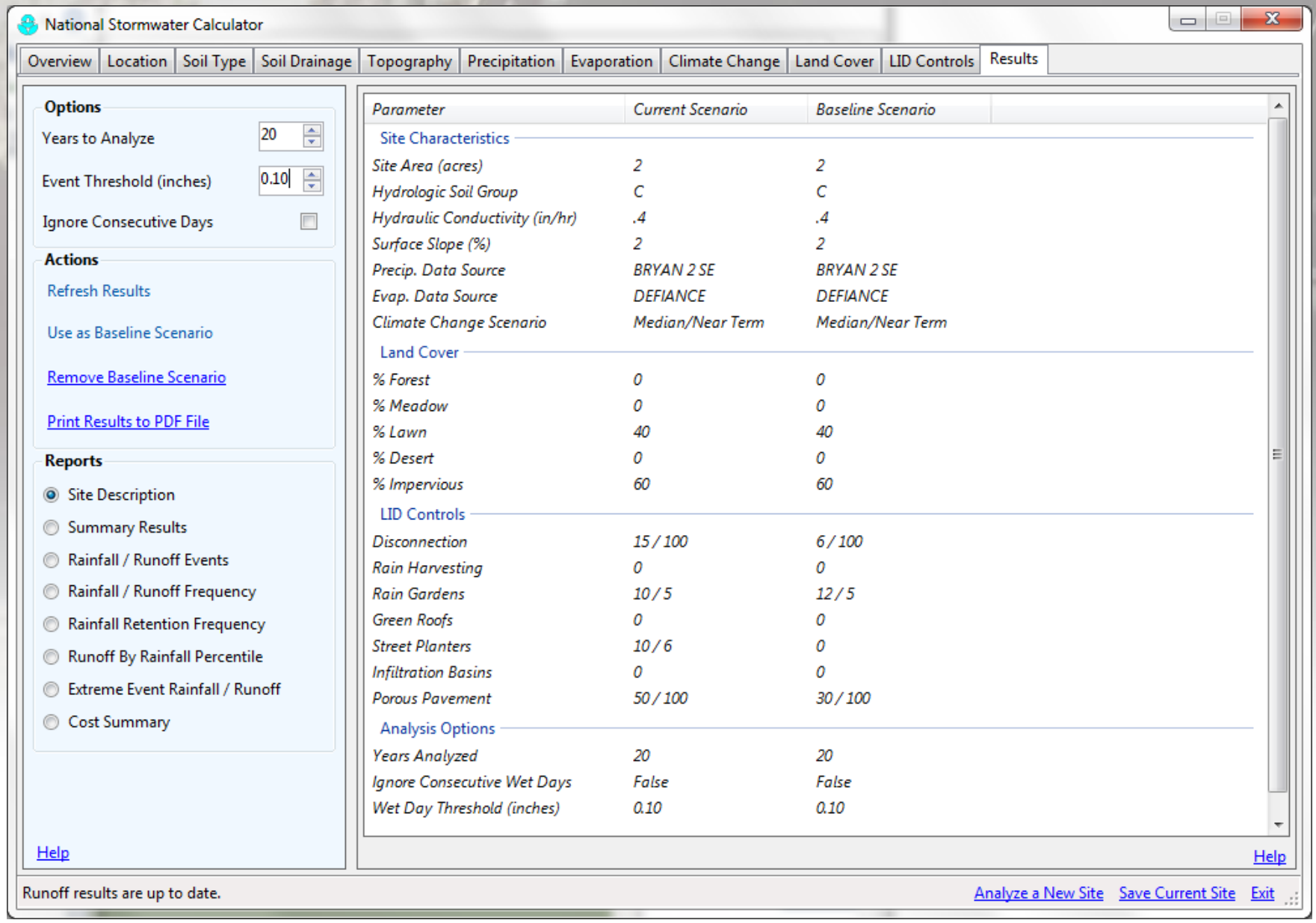
- Compare multiple scenarios at once





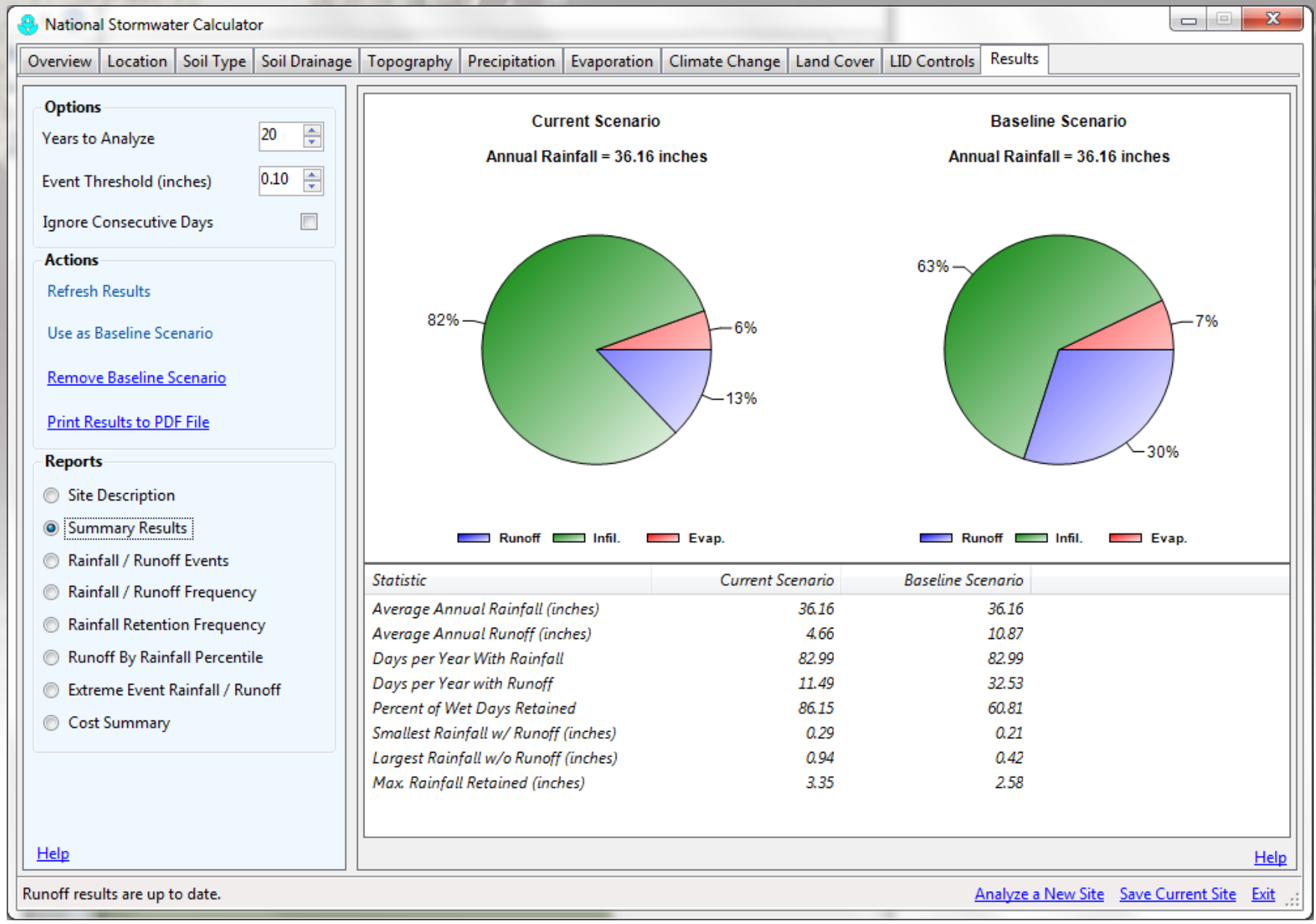
Results

Site Description



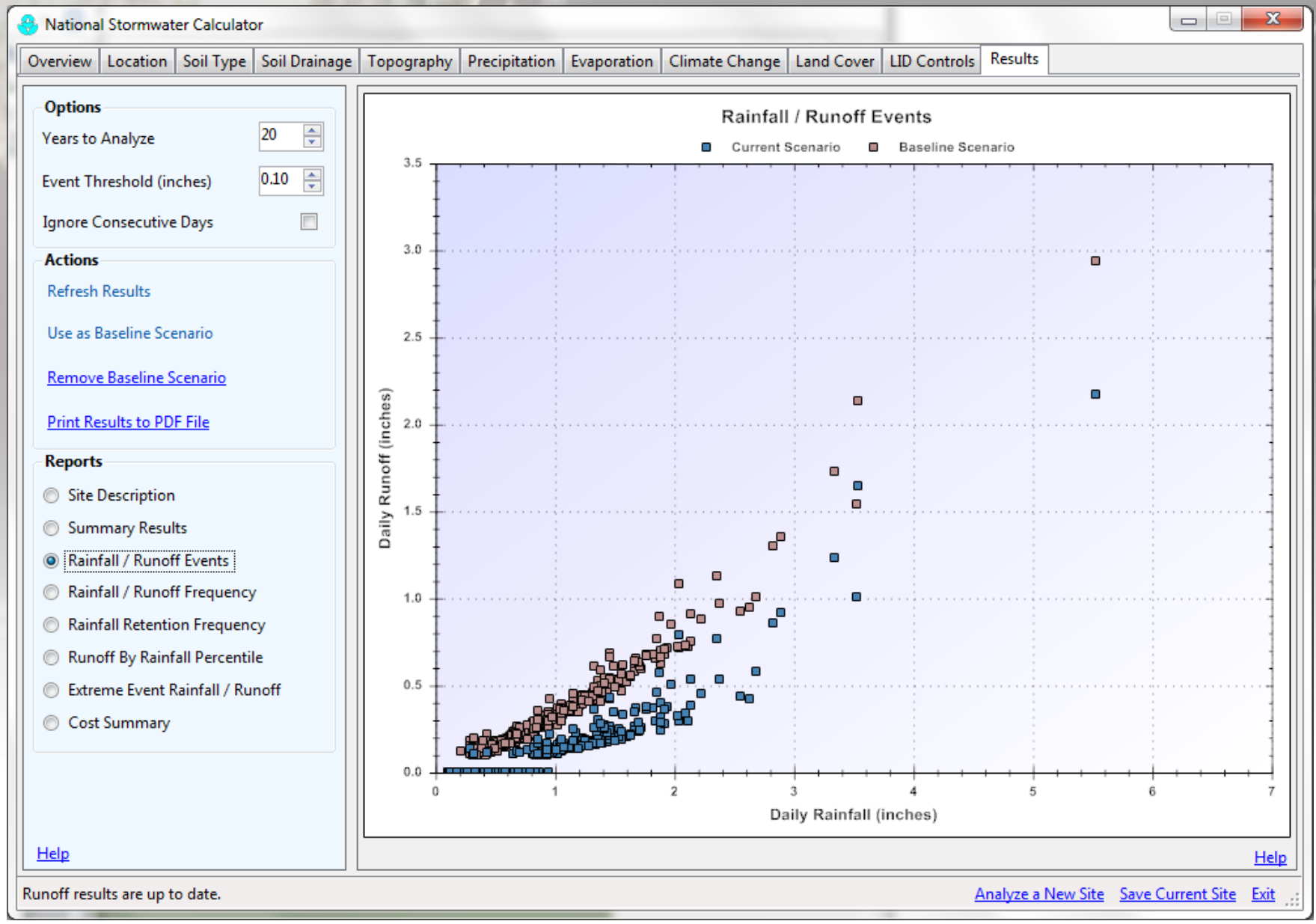
Results

Summary



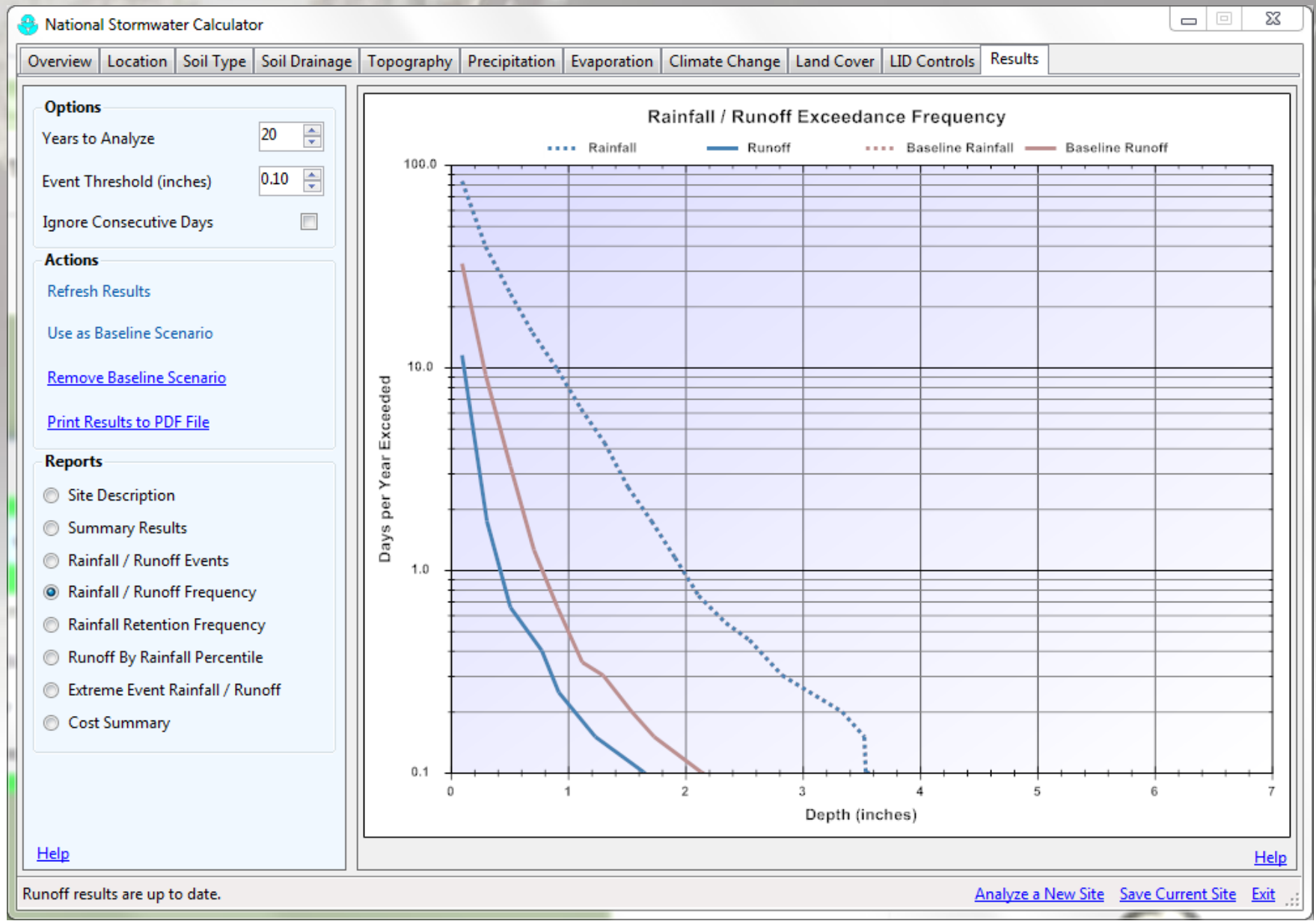
Results

Rainfall / Runoff Events



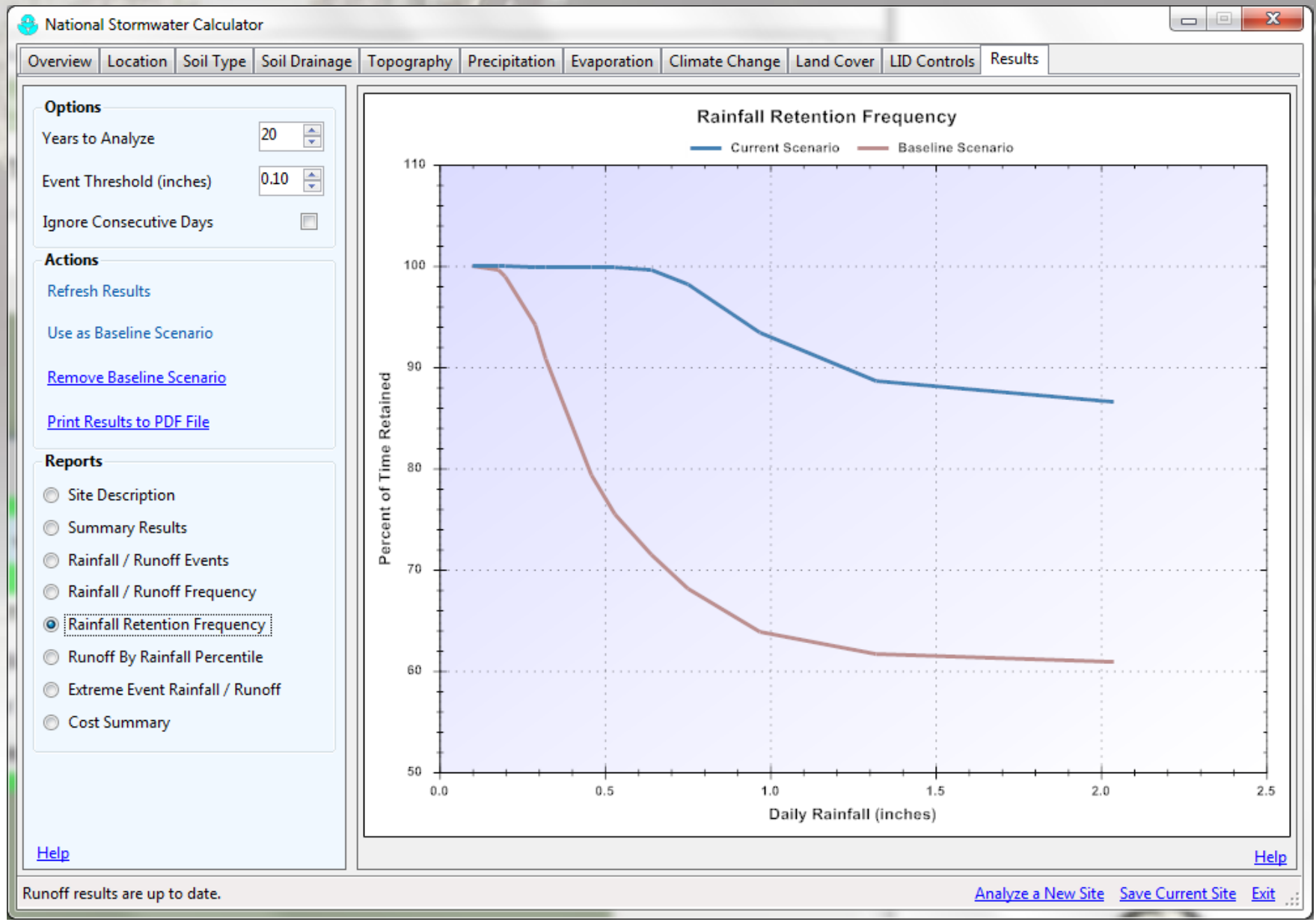
Results

Rainfall / Runoff Frequency



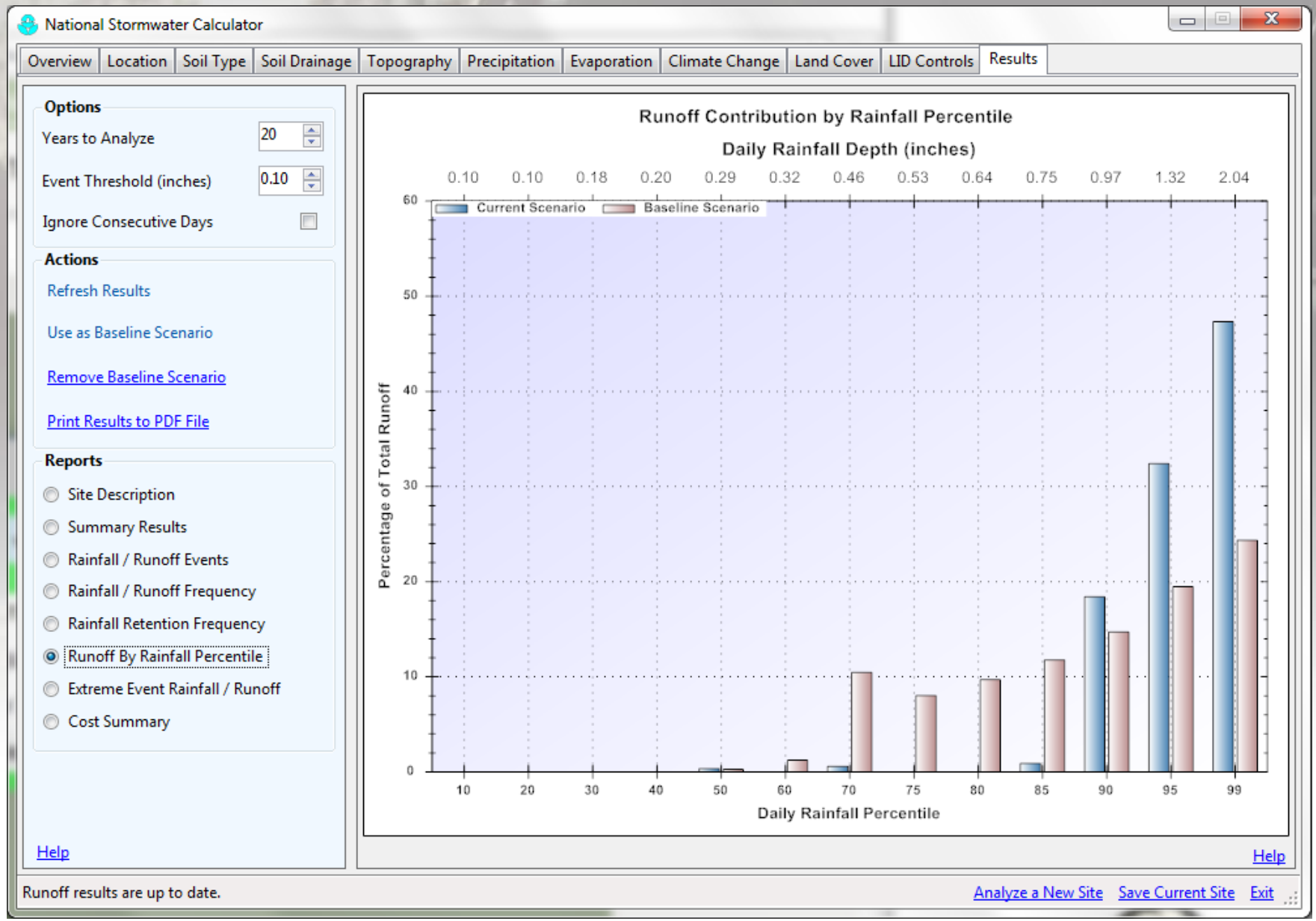
Results

Rainfall / Retention Frequency



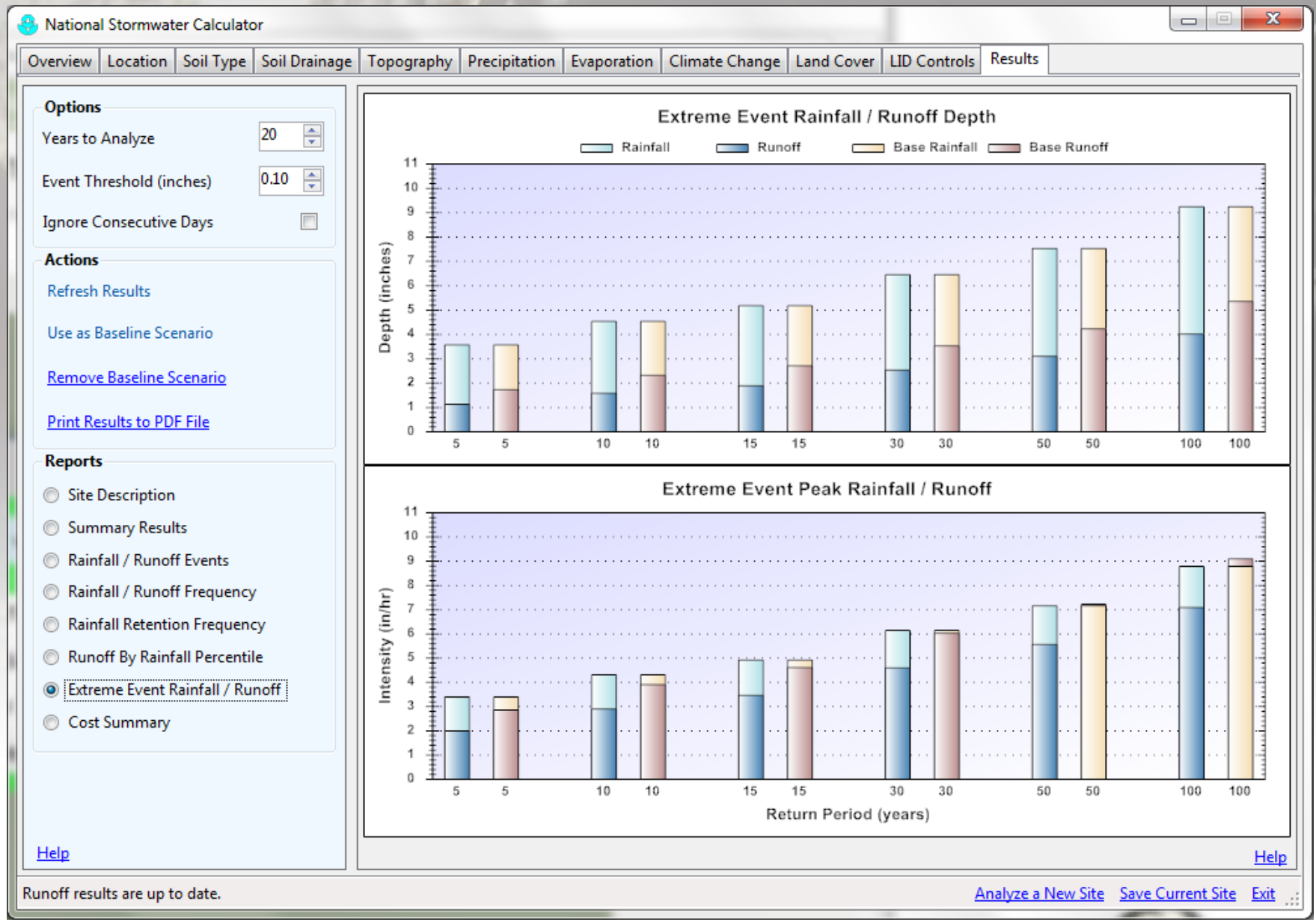
Results

Runoff by Rainfall Percentile



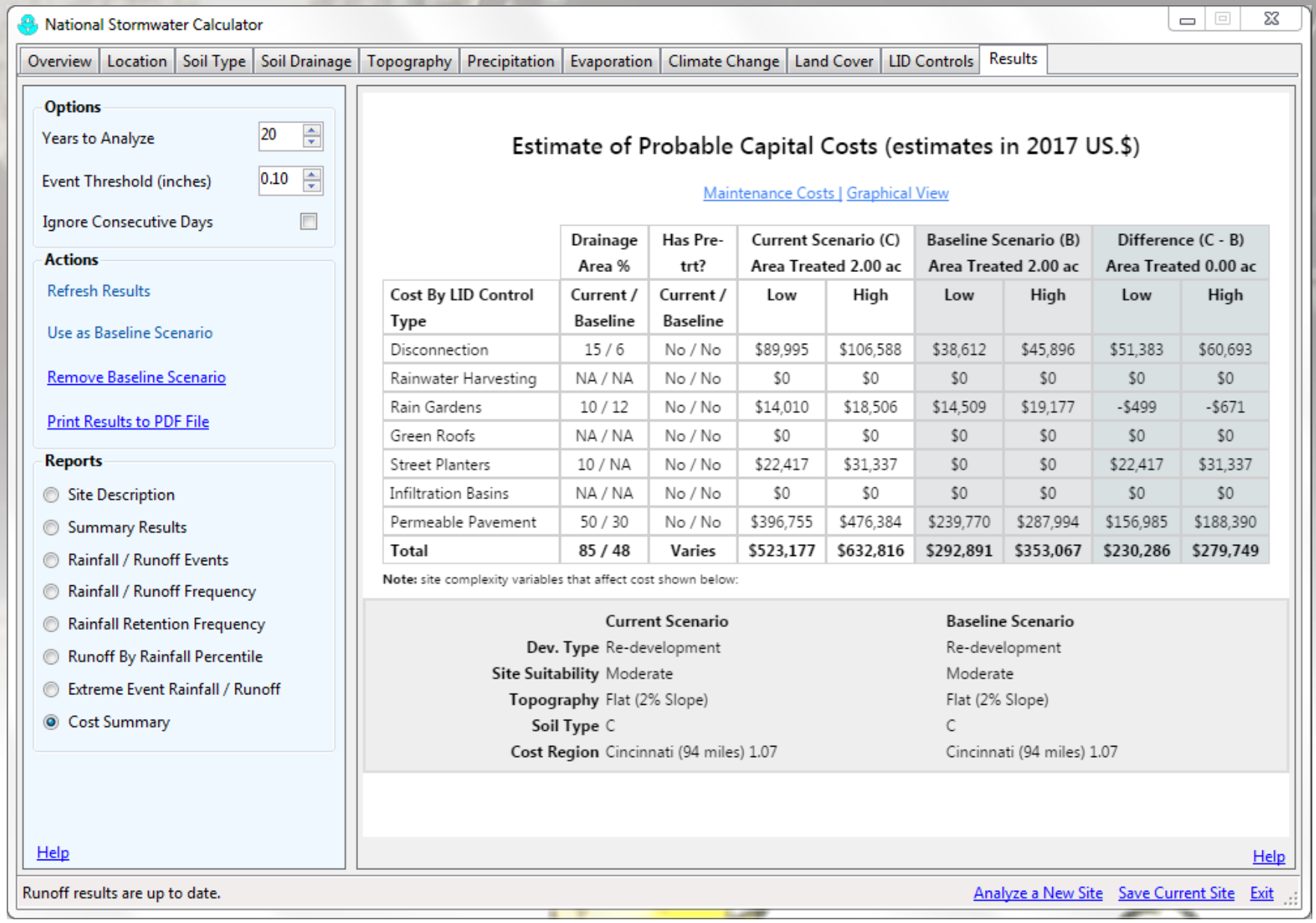
Results

Extreme Event Rainfall / Runoff



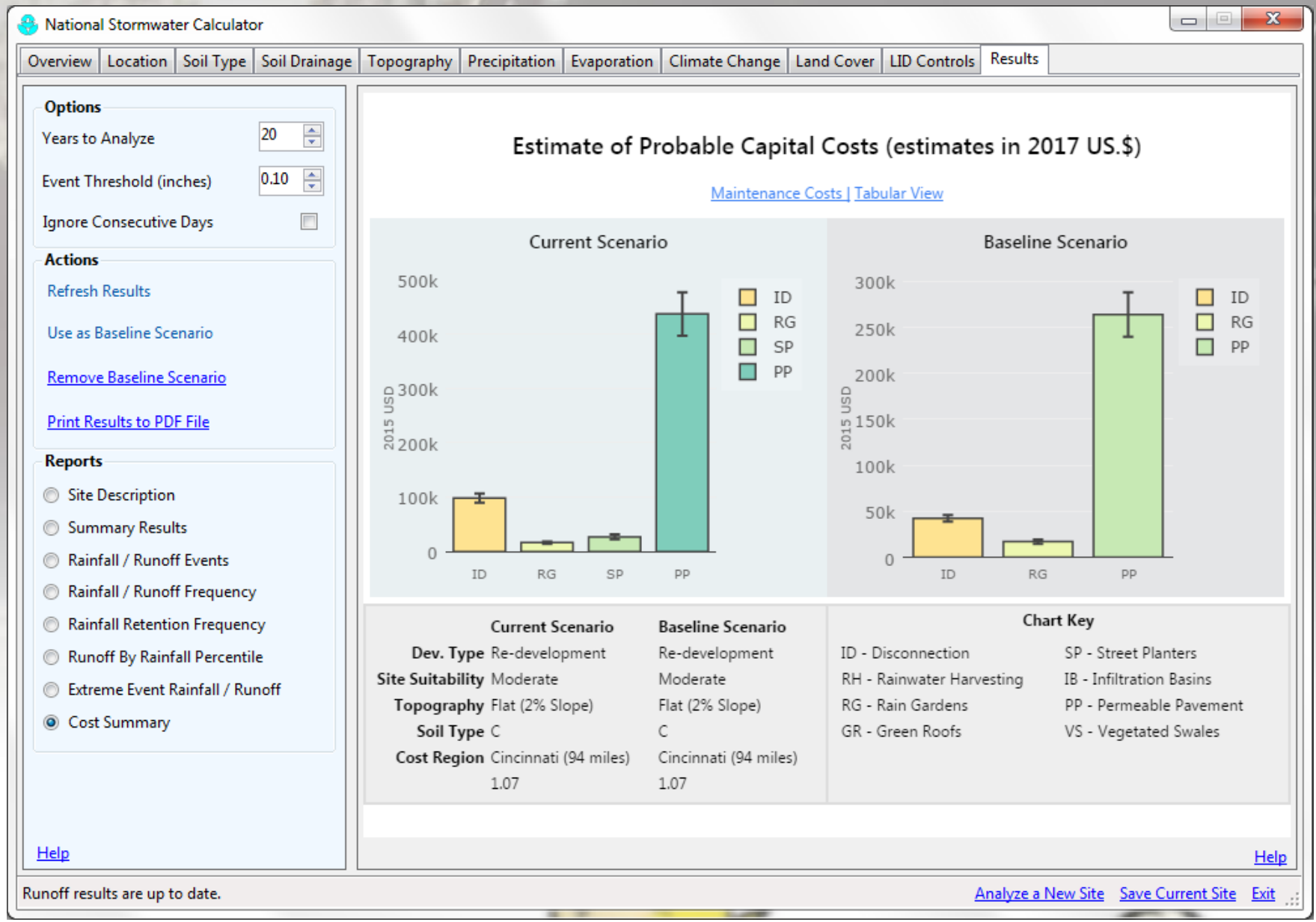
Results

Capital Cost (tabular)



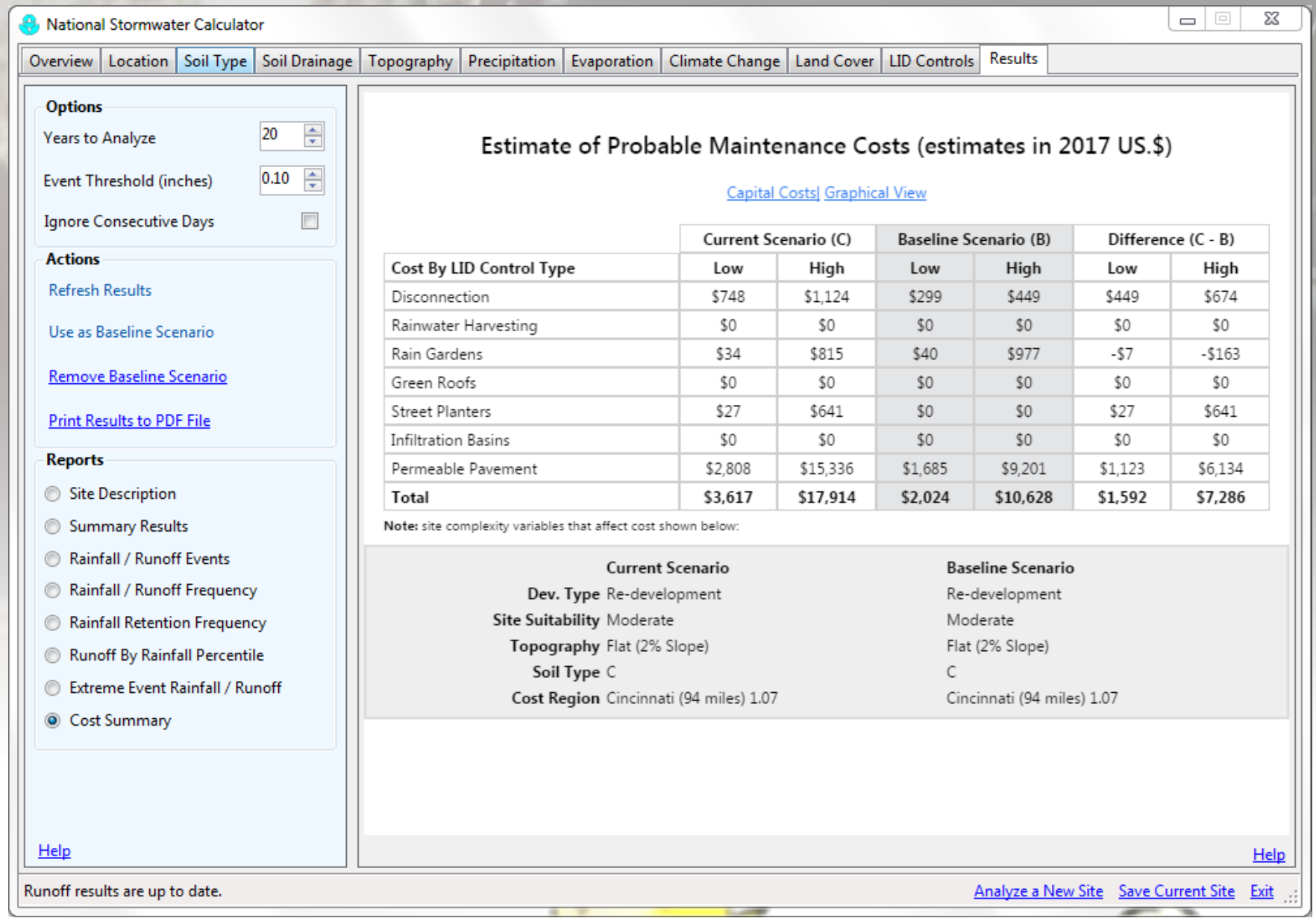
Results

Capital Cost (graphical)



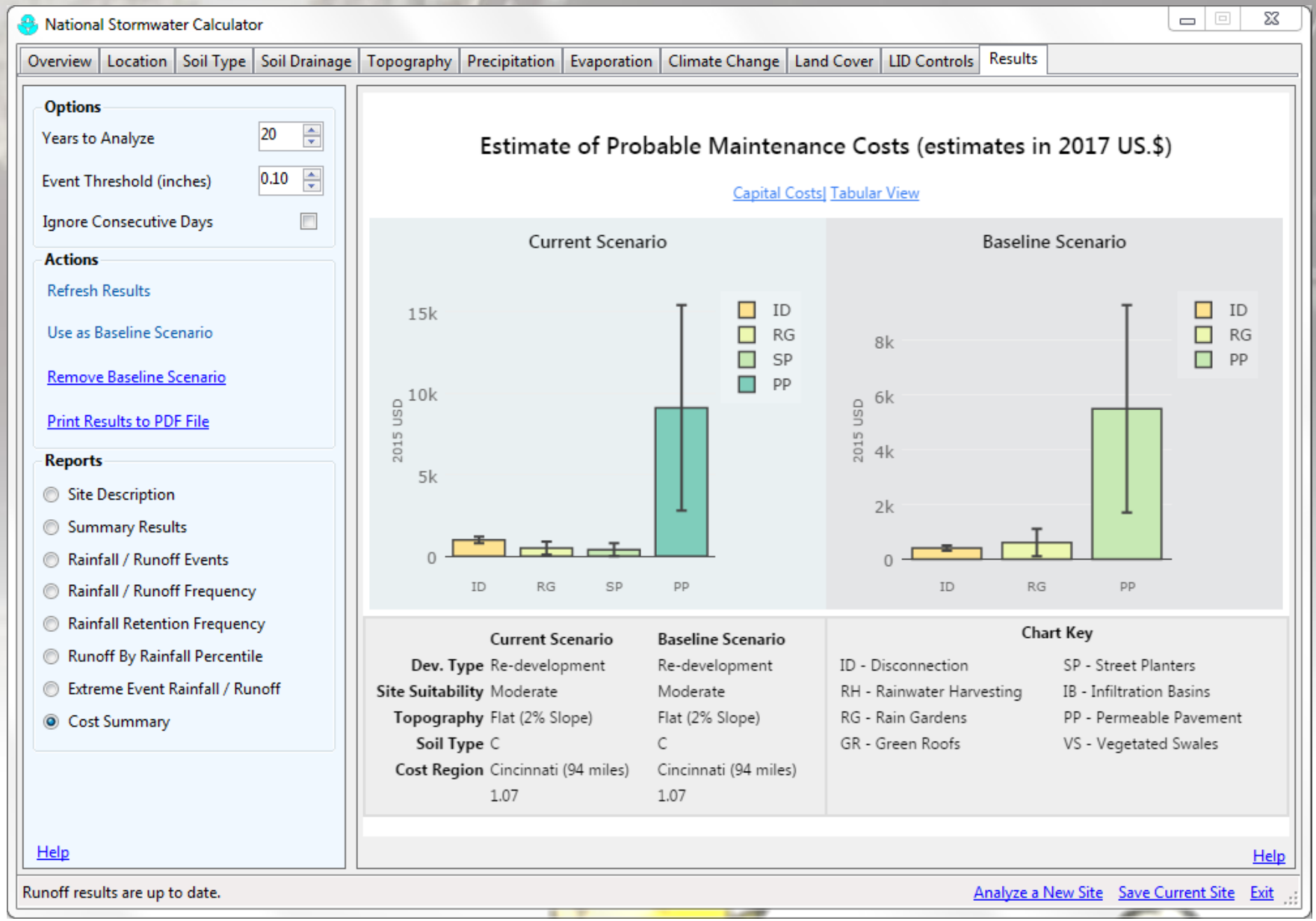
Results

Maintenance Cost (tabular)



Results

Maintenance Cost (graphical)



Quantifying Costs

Traditional Costs

- Capital Costs
- Maintenance Costs

Indirect Costs

- R/W Acquisition Costs
- Treatment Plant Costs
- Snow removal
- Water Re-Use
- Energy Savings
- Tax Incentives / Utility Fees

Quantifying Costs

Traditional Costs

- Capital Costs
- Maintenance Costs

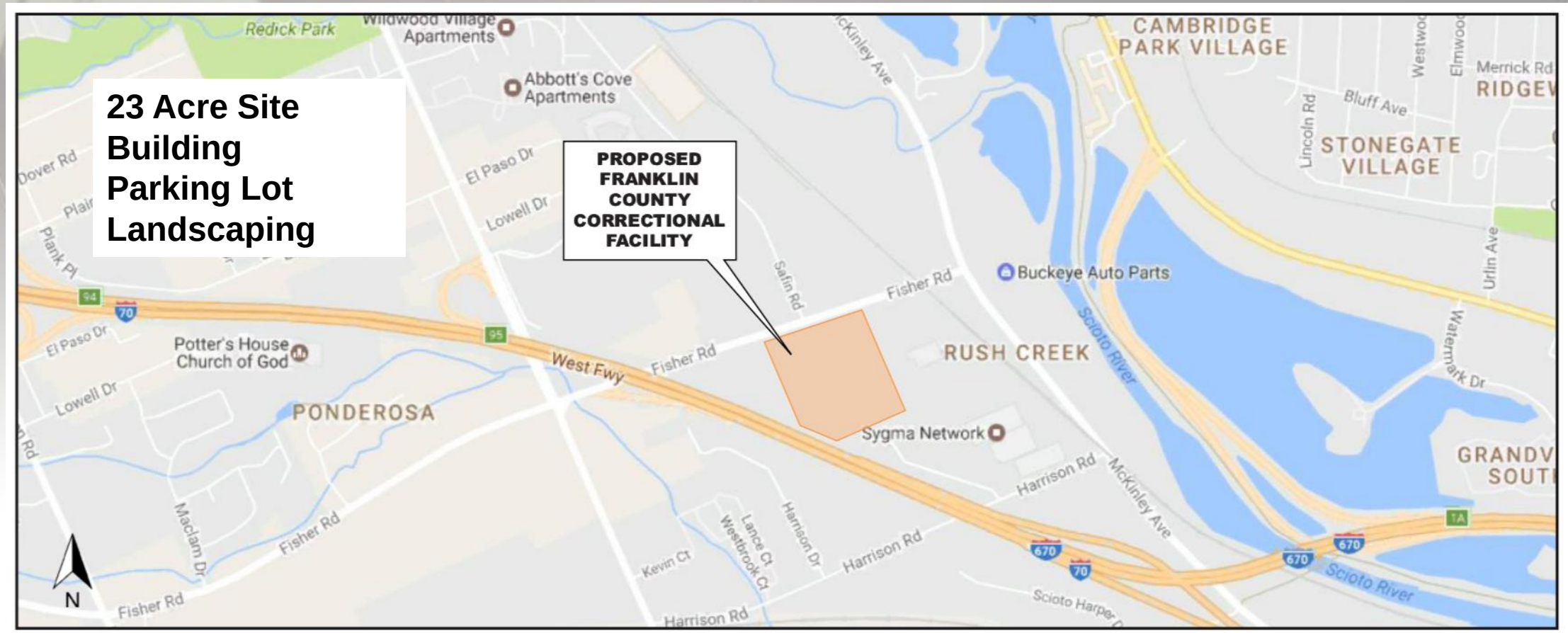
Non-Monetary Costs

- Air Quality
- Water Quality
- Habitat Quality

Indirect Costs

- R/W Acquisition Costs
- Treatment Plant Costs
- Snow removal
- Water Re-Use
- Energy Savings
- Tax Incentives / Utility Fees

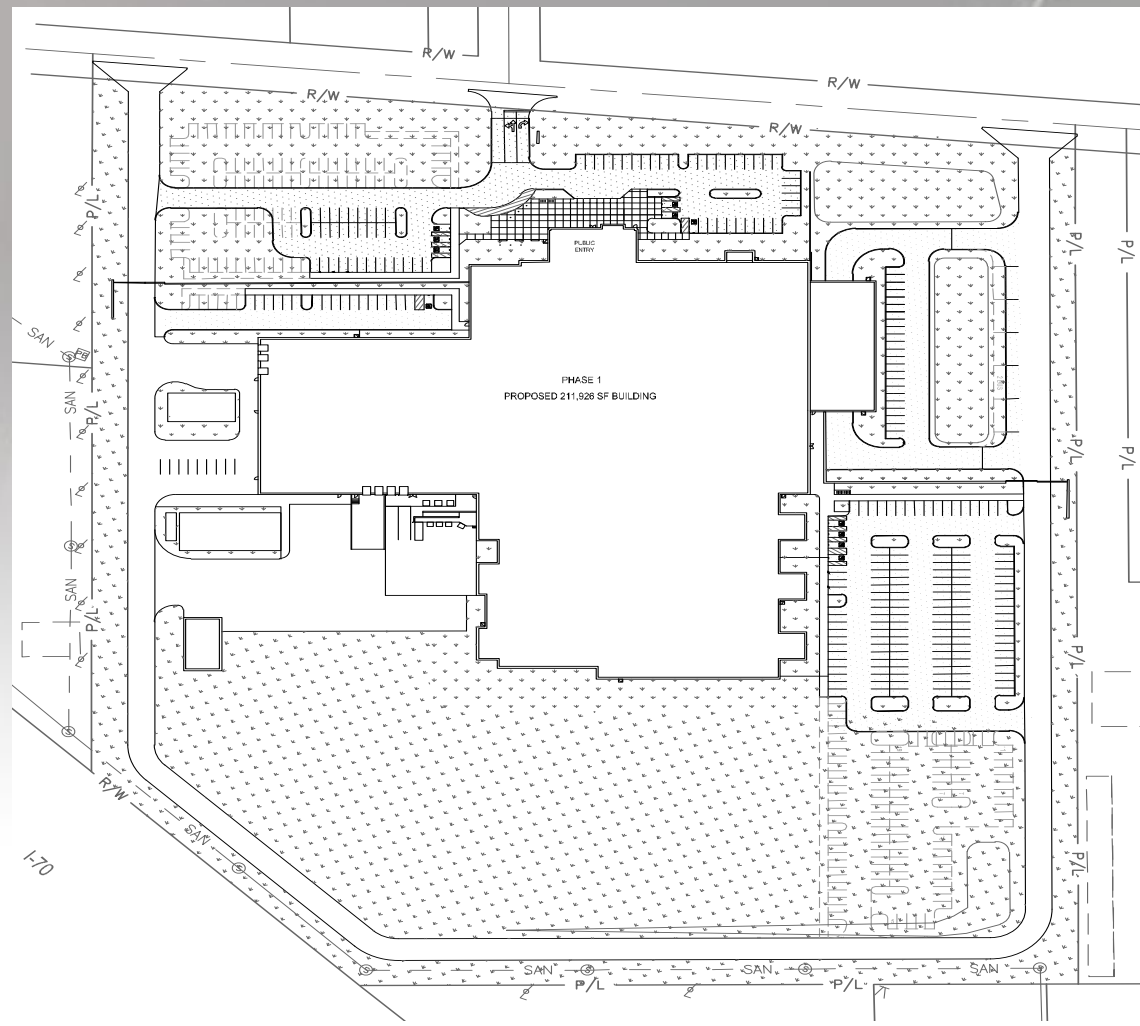
Franklin County Correctional Facility



Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Asphalt Parking Lot
- Storm Sewer
- Catch Basins
- Detention Basin
- Maintenance (30 Years)



Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Asphalt Parking Lot
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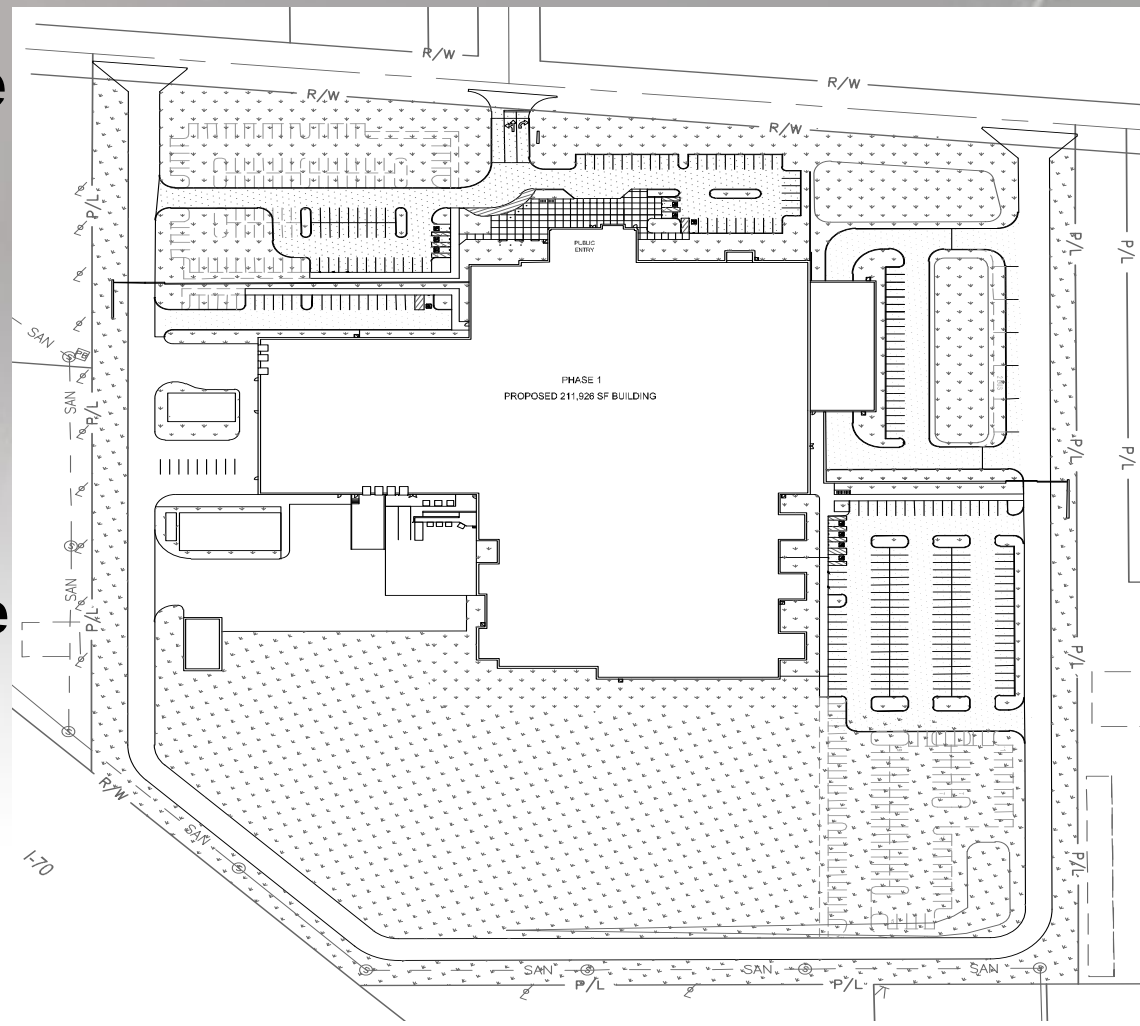
Low Impact Development Green Infrastructure

- Permeable Pavers
- Storm Sewer
- Catch Basins
- Detention Basin
- Maintenance (30 Years)



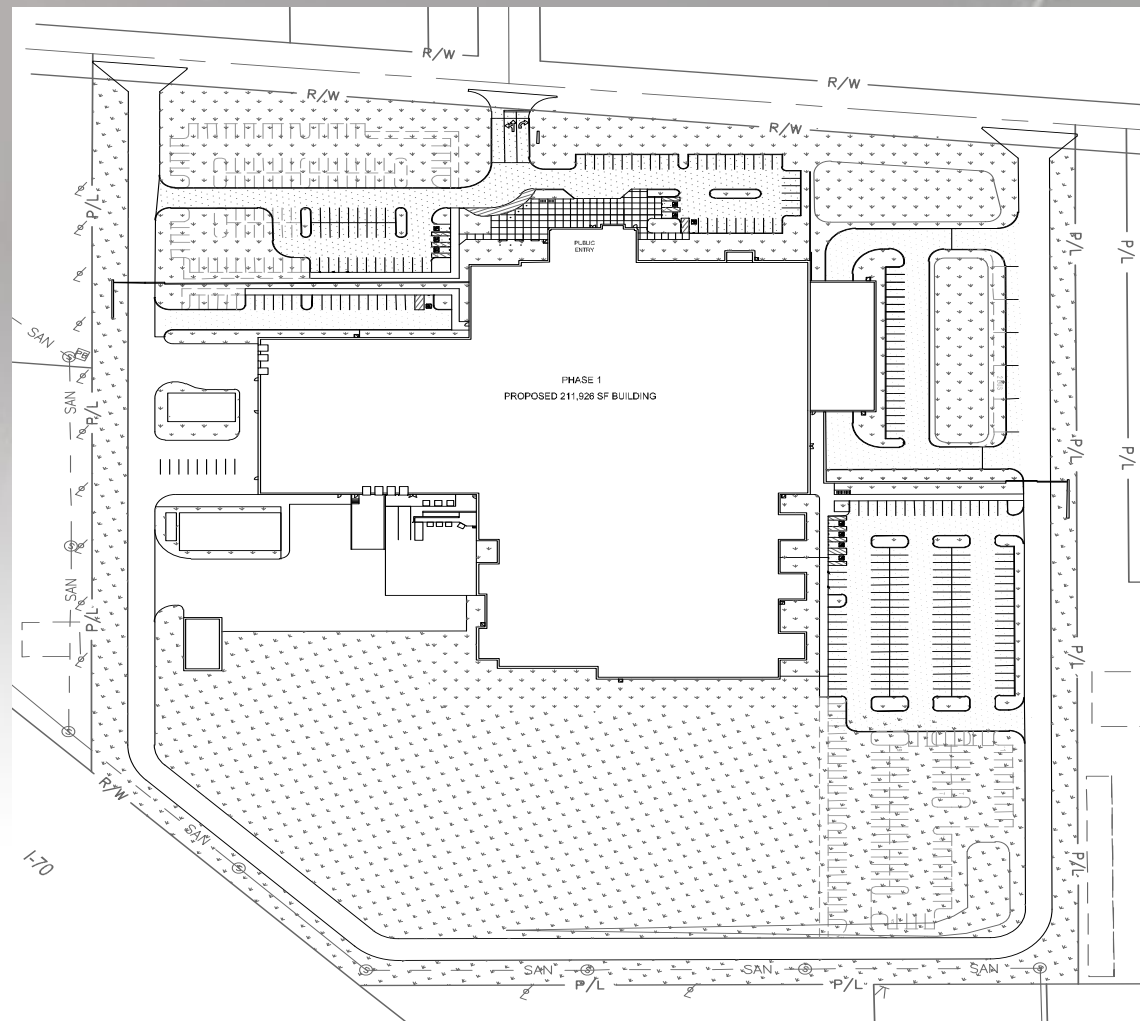
Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Capital Cost = $1,350,000
- Maintenance Cost (30 years) = $430,000
- **Total = $1,780,000**

Low Impact Development Green Infrastructure

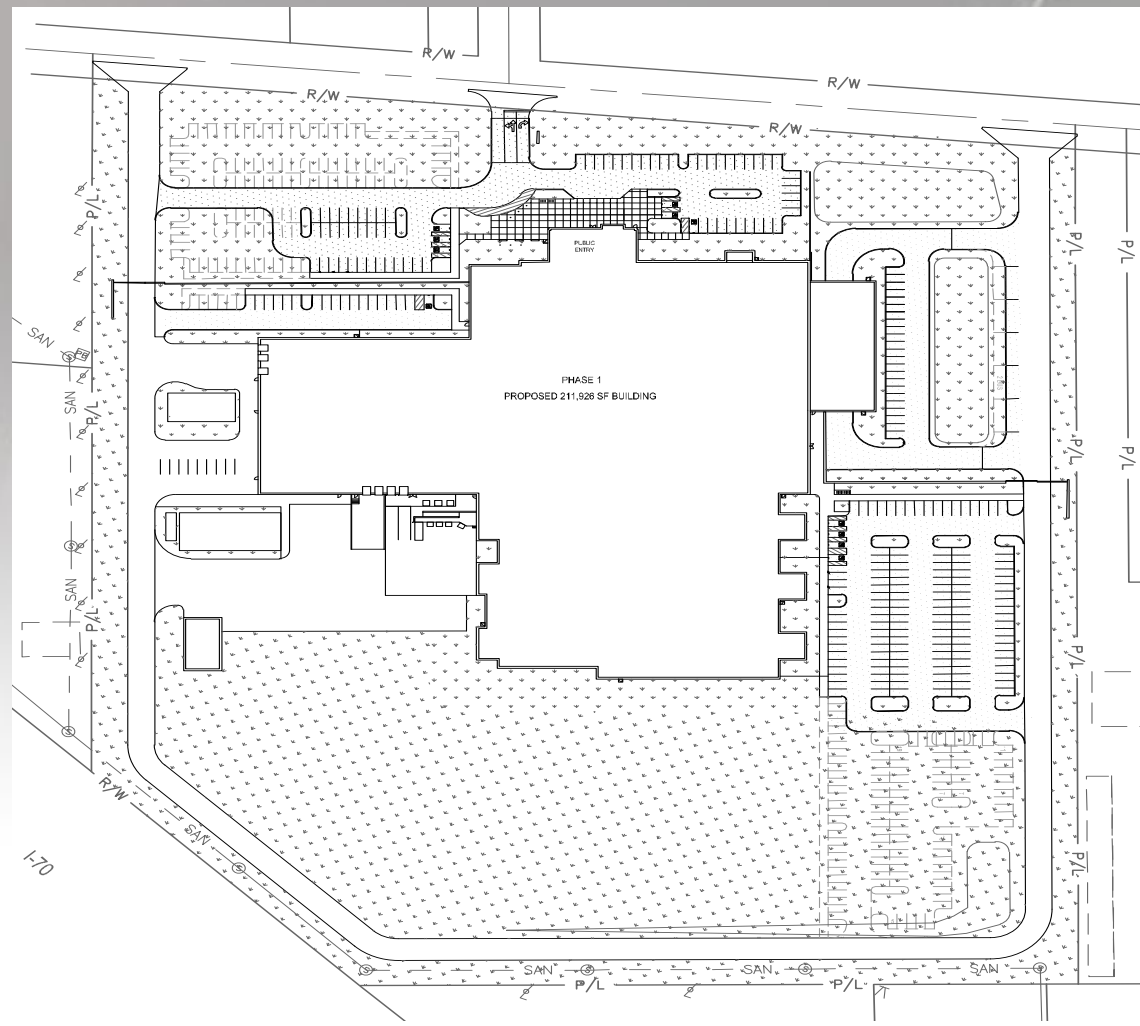
- Capital Cost = $1,710,000
- Maintenance Cost (30 years) = $380,000
- **Total = $2,090,000**



Lifecycle Cost Analysis

City of Columbus Stormwater Utility Fee

- Based on property's contribution to stormwater runoff
- 2,000 SF Impervious Area = 1 ERU (Equivalent Residential Unit)
- 23 Acres Impervious = 500 ERU
- Annual Stormwater Fee = $27,040
- 30 Year Fee = $811,200
- GI used to meet all water quantity and quality requirement = 100% credit



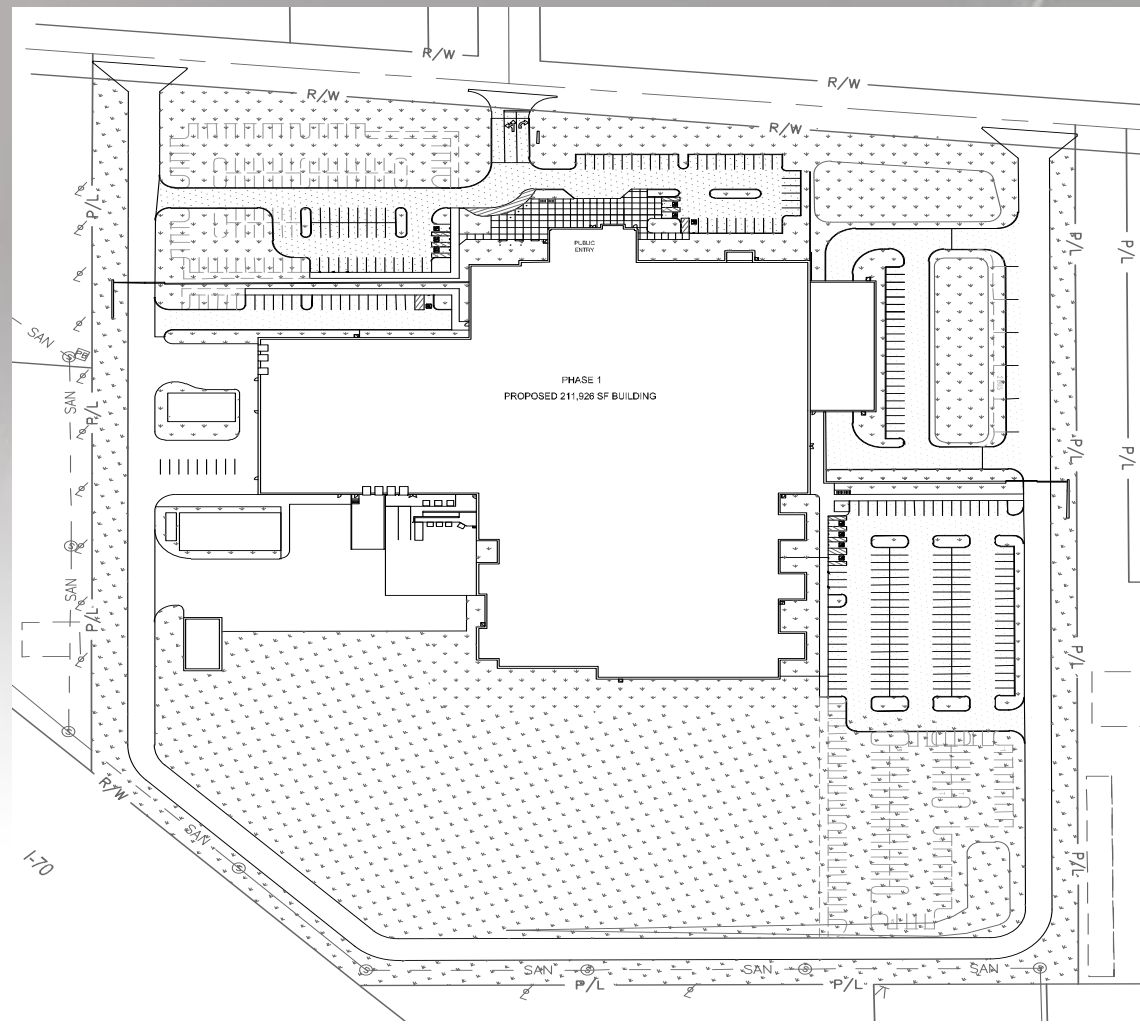
Lifecycle Cost Analysis

Traditional Stormwater Gray Infrastructure

- Capital Cost = $1,350,000
- Maintenance Cost (30 years) = $430,000
- **Stormwater Fee (30 years) = $811,000**
- **Total = $2,590,000**

Low Impact Development Green Infrastructure

- Capital Cost = $1,710,000
- Maintenance Cost (30 years) = $380,000
- **Total = $2,090,000**



Questions?

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