EPA Stormwater Calculator
Demonstration for Planning Boards

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As a planning board member you are called upon to evaluate how proposed projects may affect abutting land, properties in the neighborhood and the town in general. Among the issues you should consider is increased runoff that will result from the construction of buildings, driveways, other impervious areas and the conversion of fields and woods to lawns. Not all towns in Lincoln County have the same regulations. Some towns require that the rate of off-site runoff after completion of the project not be greater than the pre-development condition. To accomplish this, the developer might install detention ponds, berms and other structures to "slow" the rate of runoff (but not necessarily reduce the overall volume of runoff). Other towns simply require that runoff not be directed to adjacent properties or they may use some similar subjective standard. Furthermore, some towns use different standards to apply to subdivisions vs. site plan developments or they may simply ignore runoff altogether.

Over the last several decades we have seen that storms have become more intense and more frequent, resulting in increased stormwater flows, and with a warming climate, these trends will likely grow. That is, any existing deficiencies in handling runoff that now exist on individual properties, within neighborhoods and within municipal culverts, ditches and pipes will be exacerbated. While the planning board has little or no authority to deal with existing problems, it does have the ability through either existing or future ordinances to ensure that new development does not further contribute to stormwater problems in the community.

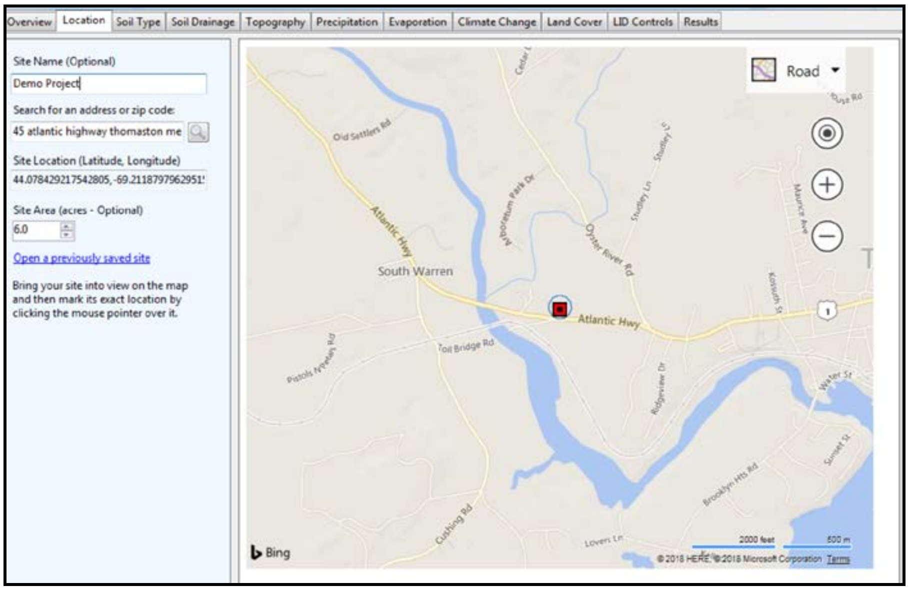
The purpose of this memo is to demonstrate the impact of converting land cover and increasing impervious surfaces on runoff and the beneficial effects of applying Low Impact Development (LID) practices on reducing runoff. To do this we have prepared this demonstration of the USEPA National Stormwater Calculator. In spite of its name, it is a user friendly tool that uses a lot of readily available site-specific data on soils type, topography, rainfall and drainage. While it can be used mostly by a developer in the pre-engineering phase of a project, it is also very useful for a planning board wishing to better understand what happens to runoff when a site is developed and what the effects of employing specific LID practices might be. The Stormwater Calculator is at http://www.epa.gov/nrmrl/wswrd/wq/models/swc/. Go to Software and Documentation, and download Desktop version. It requires a Windows computer and internet connection (a mobile app is currently in the final stages of development). Once the program is downloaded it will appear on your Start menu. The User Guide is at http://nepis.epa.gov/Adobe/PDF/P100GOQX.pdf.

The following is a demonstration of how the Stormwater Calculator is used on a hypothetical development scenario. To make it more realistic, we have selected a 5.7 ac commercial property currently on the market on Route 1 in Thomaston with a half-acre of existing impervious area and the balance wooded. For the purposes of this demonstration, we will assume that the site will be developed with a building, driveway and parking lot totaling 1.8 ac of impervious area.

<u>Existing Conditions Scenario</u>

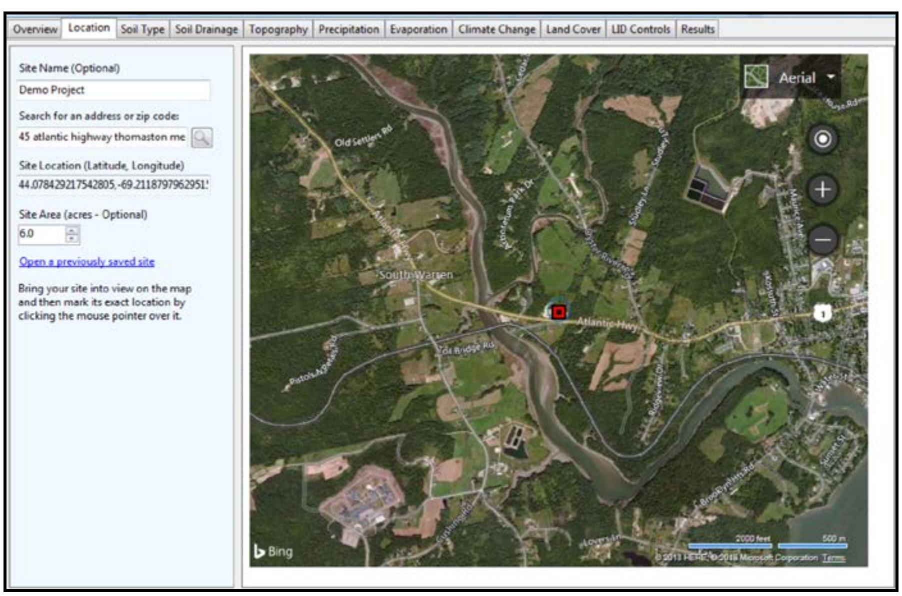
Step 1 – Enter Site Location

The 5.7 acre site is located at 45 Atlantic Highway, Thomaston. Enter this information as shown below and search. Click the parcel to center the “red box” on the property and enter 6 acres for area. Be careful not to randomly click on the screen as it may change the location of the property to be studied.



Step 2 Existing Site Conditions

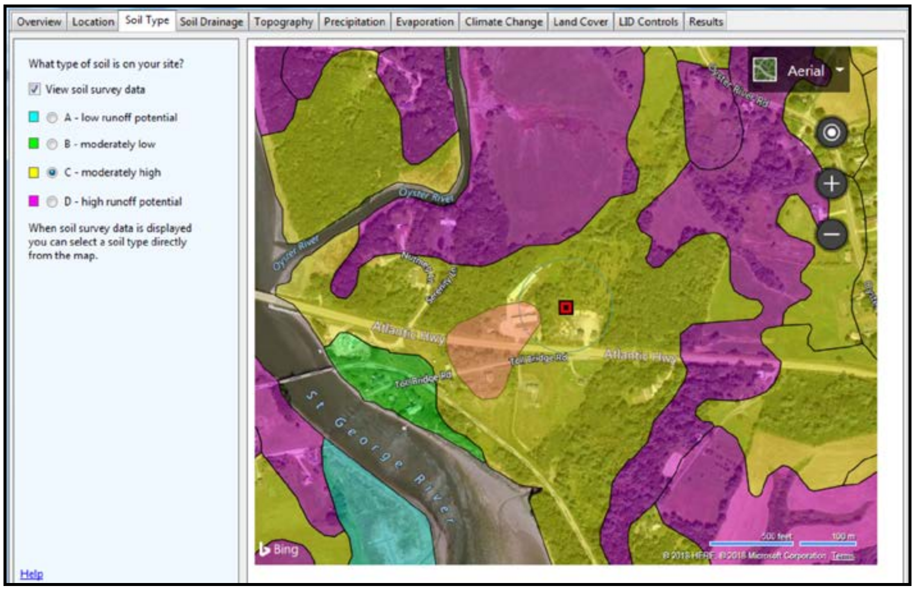
In order to see existing site conditions click the menu in the upper right corner of the map and select “aerial” (note – you can switch back and forth between road and aerial views as you navigate through the program).



The site has several small buildings, a driveway, gravel parking and storage areas with the rest forested. The site plan submitted by the applicant should have existing the impervious/gravel/building areas calculated but for purposes of this demonstration assume 0.5 ac. This means the property is about 10% impervious and 90% forested. Save this information for step 9.

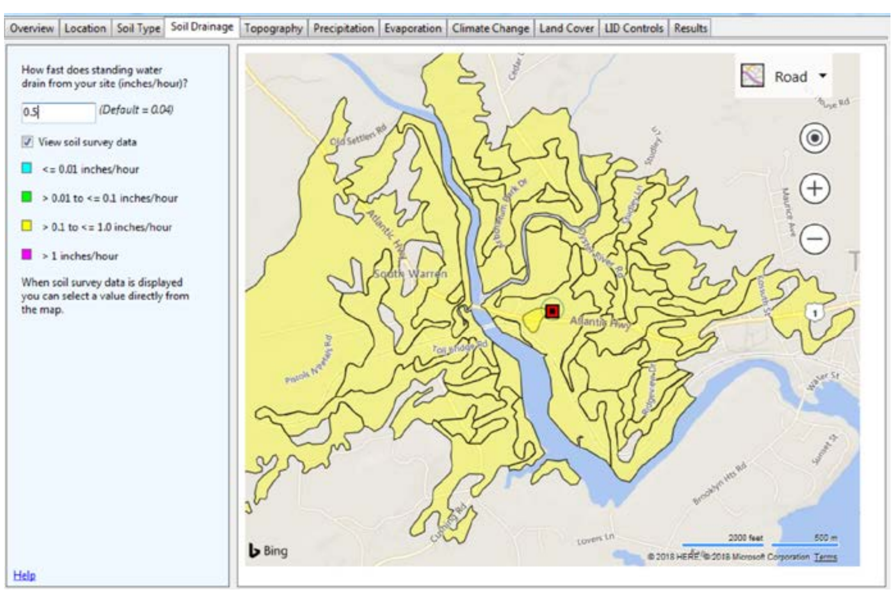
Step 3 Soil Conditions

Click on the Soils Type tab and click "View soil survey data". As you can see from the graphic below, the site has a moderately high runoff potential (in yellow) so click that box.



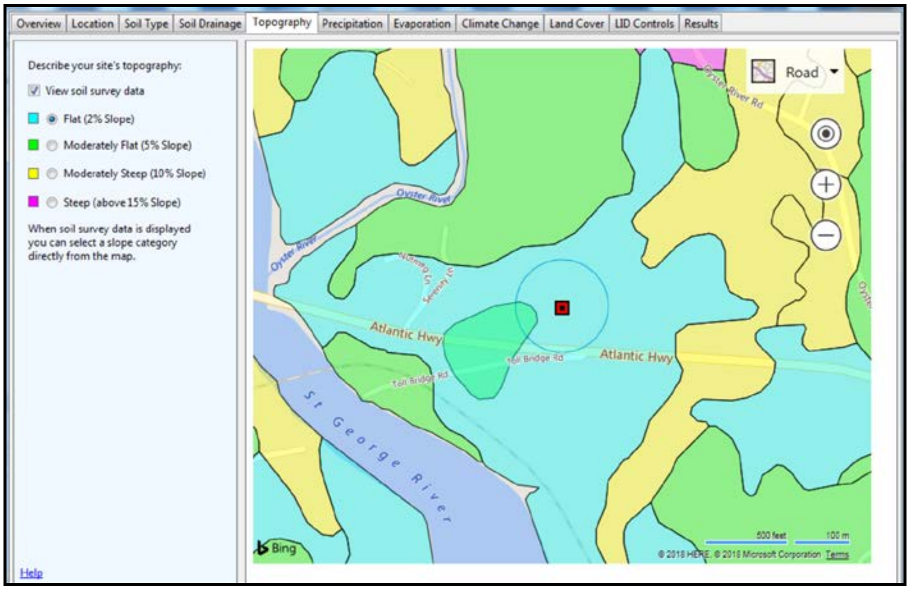
Step 4 Soil Drainage

Return to "Road" view and in the Soil Drainage tab click "View soil survey data" and enter a value in the dialog box. For purposes of this demonstration enter 0.5.



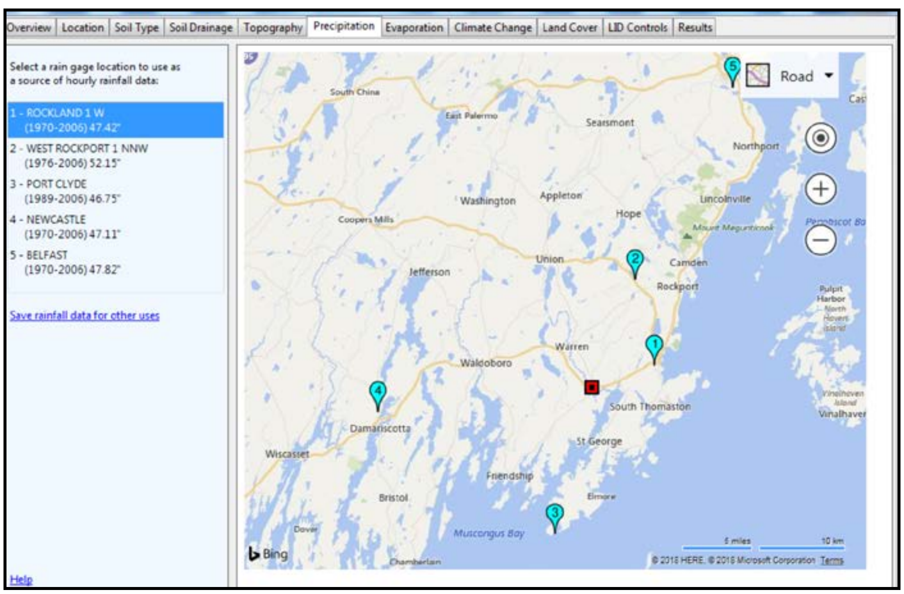
Step 5 Topography

Click on the Topography tab and click "View soil survey data". The siteappears to be mostly "flat" so click that box.



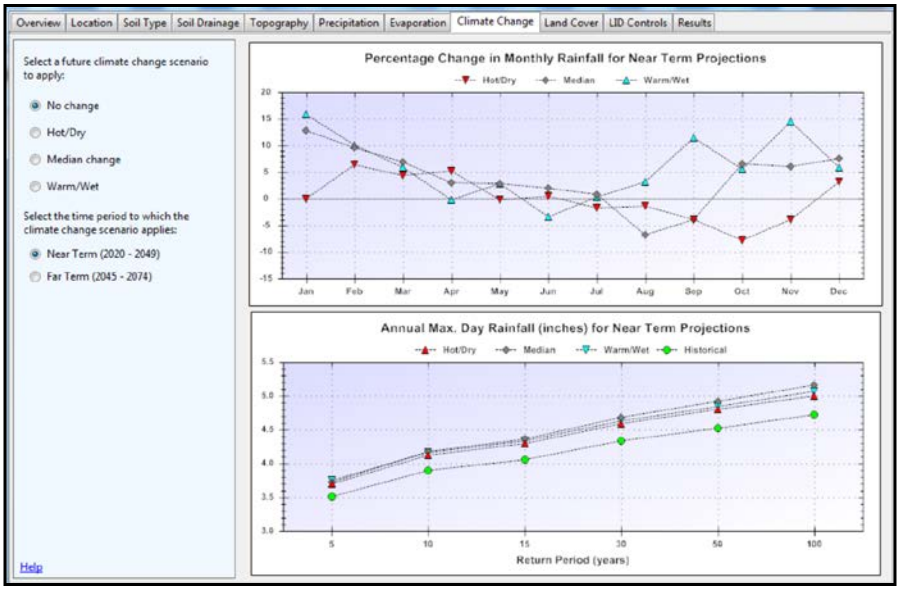
Steps 6 & 7 Precipitation and Evaporation

For the next two tabs, select "Rockland" as this is the closest location to the site.



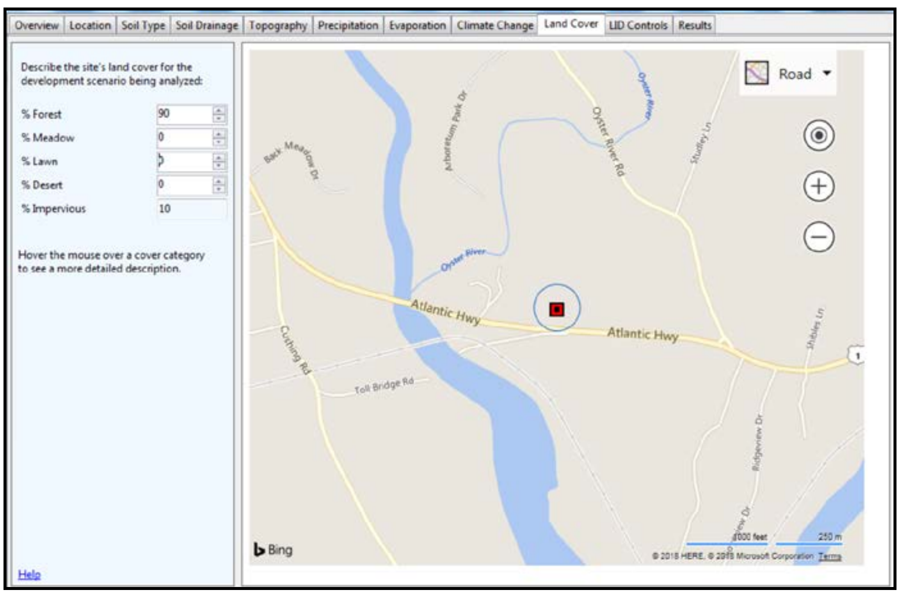
Step 8 Climate Change

You have the option of selecting four future climate scenarios and a time frame for the selected scenario. This tab should elicit an interesting discussion of what the future might hold for our coastal Maine climate but for the purpose of this demonstration, "no change" and "near term" are selected (note – selecting warm/wet could significantly affect the results of this analysis).



Step 9 Land Cover

Enter the existing land cover percentages estimated in step 2 (90% forested). The program will automatically calculate impervious area.

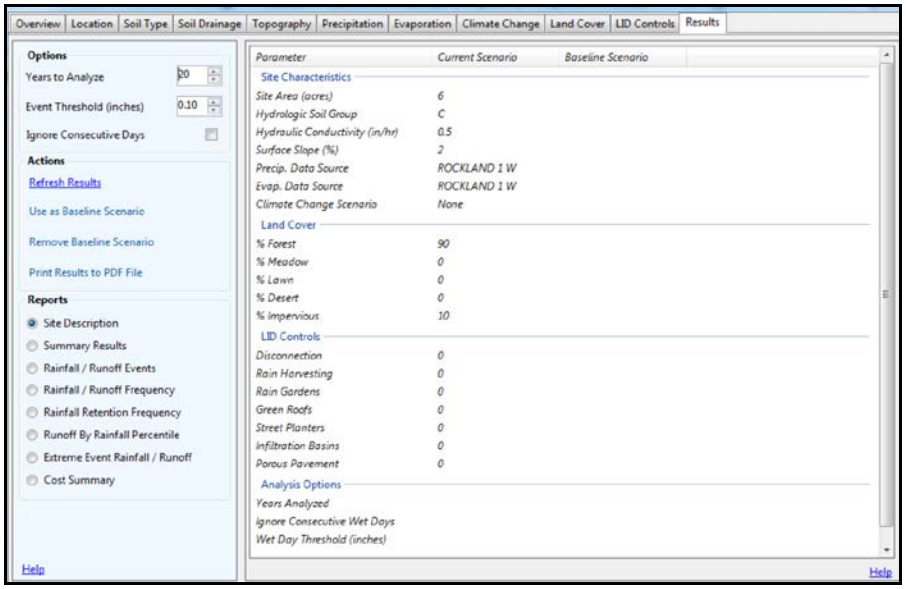


Step 9 LID Controls

Because this is a pre-project scenario, no LID practices are selected at this time.

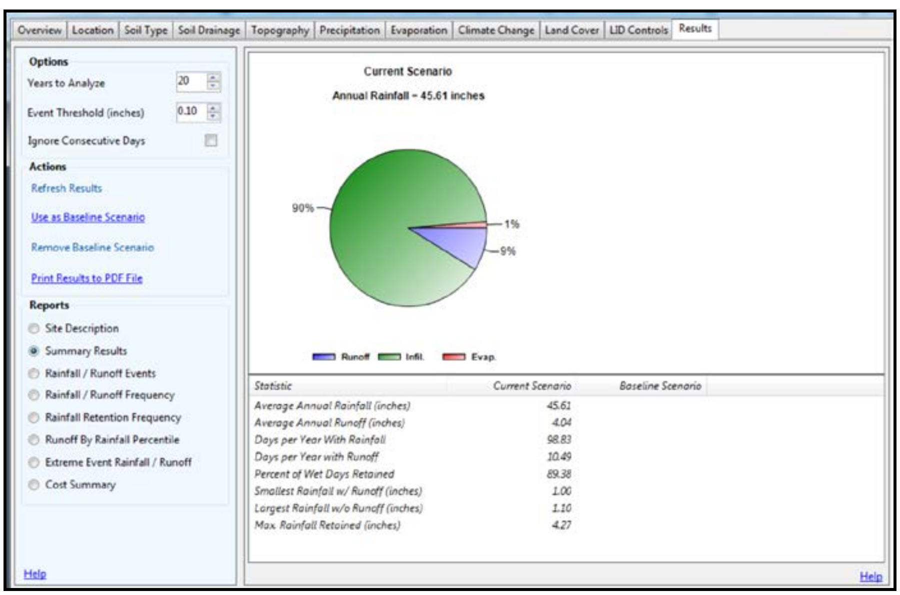
Step 10 Results

Clicking "Site Description" allows review of the data that has been entered and which can be changed by going back to previous steps.



The program uses past rainfall data so select the number of years back to be analyzed. The program also needs to know the minimum amount of rain in a day that is to be considered as a rainfall event. For purposes of the demonstration enter 20 years and 0.10 inches then click “results” and then “summary results” under reports.

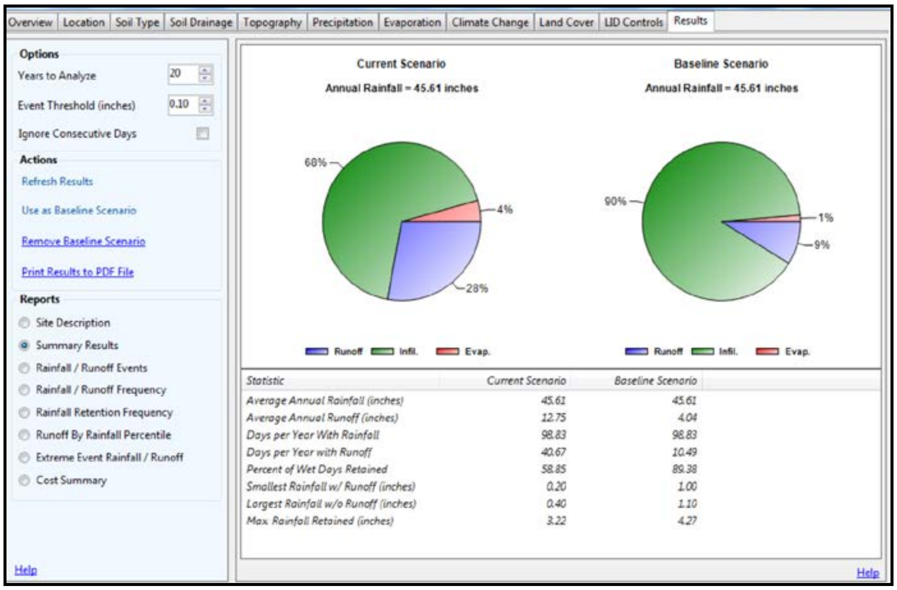
Don’t click “Ignore Consecutive Days”. Normally this wouldn’t be selected as it will produce a less realistic representation of the site’s hydrology. By checking “Ignore Consecutive Days”, a day with measurable rainfall must be preceded by at least two days with no rainfall for it to be counted. This would exempt extreme storm events from stormwater retention requirements. Clicking “Summary Results” and then “Refresh Results” produces an analysis of the site conditions as they now exist.



The program calculates that, under existing pre-development conditions, of the 45.61 inches of annual rainfall, 9% or 4.04 inches will be runoff leaving the site, off-site runoff will occur on 10.49 days per year and the largest rainfall without runoff will be 1.10” (other reports are available by clicking the various boxes). These values – 4.04 inches, 10.49 days and 1.10” – are the baseline conditions, which are used to compare what will occur when the site is redeveloped without considering runoff and also when LID practices are employed on the redevloped site. Click “Use as Baseline Scenario”. If you wish to save these results as well as those associated with proposed development with no LIDs and Proposed Development with LIDs that will be calculated later in this demonstration, click “Print Results to PDF File” for each scenario.

Proposed Development Scenario with no LIDs

Because no LIDs are being selected in this scenario, the only change to make to the program will be in the land cover tab. Assume that the proposed development will consist of a total 30,000 sf retail building and 50,000 sf of paved driveway and parking and 40,000 sf of lawn with the rest to remain forested. This means that 32% of the site will be impervious (vs. 10% currently) and 16% lawn. This will result in a reduction in forest cover from 90% to 52%. Enter this in the Land Cover tab and click “refresh results” in the Results tab. The proposed development with no LIDs results appear as the current scenario.



As can be seen in the graphic above, the proposed development without any LID practices will result in a more than three fold increase in annual runoff leaving the site, from 4.04” to 12.75”. There will also be a significant increase in the number of days per year when runoff leaves the site, from 10.49 days to 40.67 days per year. Furthermore, under curent conditions the laregest rainfall without runoff is 1.10 inches whereas with the proposed development, rain events of as little as 0.40” will result in runoff.

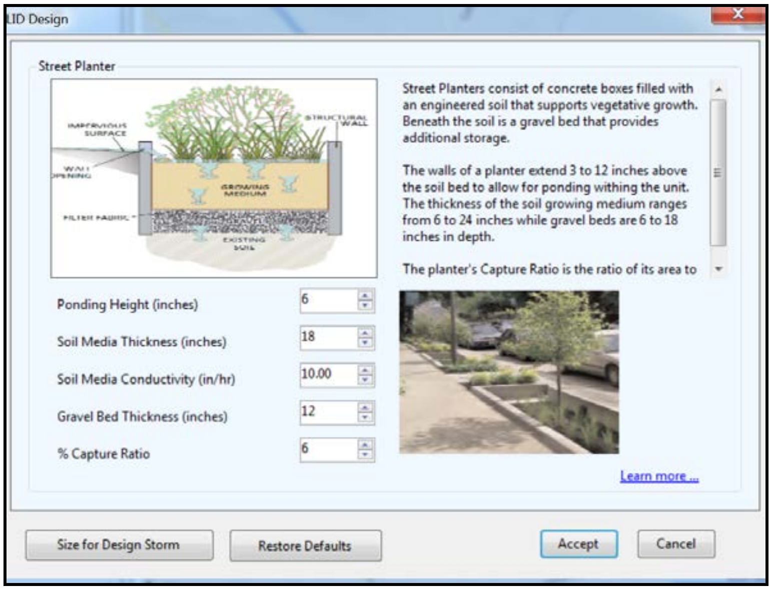
Proposed Development Scenario with LIDs

Step 1 Select LID Practices

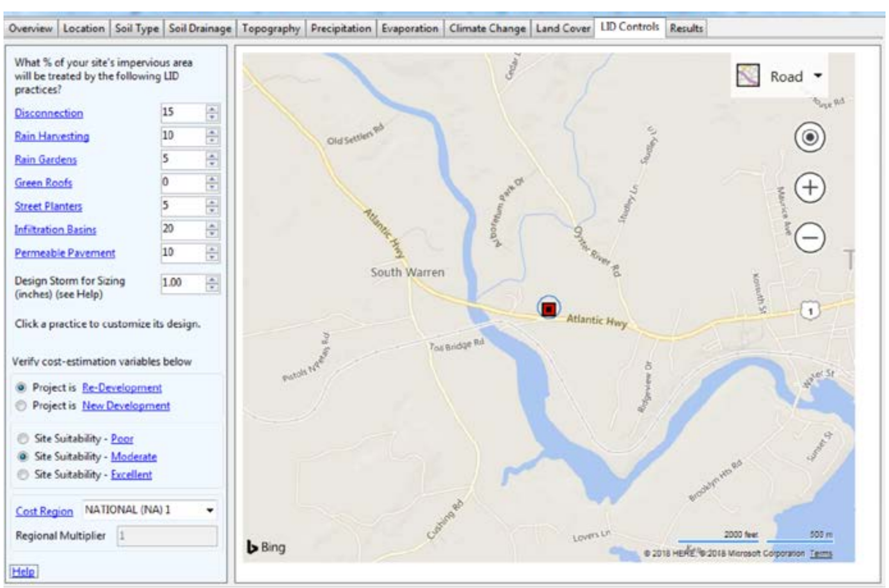
In this scenario, LID practices will be selected and applied to the proposed development so the only change to be made to the program will be in the LID tab. The LID tab has seven LID practices that can be selected and applied in a mix if desired (vegetative swales and infiltration trenches are not included because their effectiveness is dependent upon their location within the site, which is beyond the scope of the calculator).

The first step is to select the “design storm”, which is a rain event whose magnitude, rate, and intensity do not exceed the design load for a storm drainage system. For purposes of this demonstration enter 1.00”. This value will be automatically incorporated into the LIDs selected in the next step.

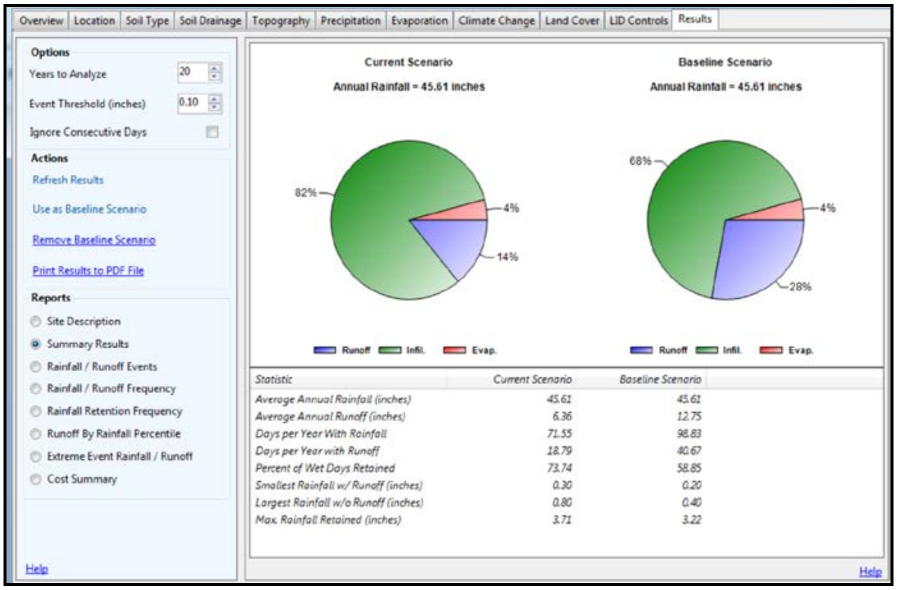
The simplest way to incorporate the LID practices into the proposed development is to select the percentage of the site's *impervious* area that will be treated by each LID practice. Selecting a LID will provide an explanation of the technique while also permitting some additional modifications to the sizing and effectiveness of the practice. While modifying the design parameters of individual LIDs is beyond the scope of this demonstration, the following is an example of the design options available for an individual LID.



The following graphic shows that, for the purposes of this demonstration, 15% of the impervious area will be treated by disconnection, 10% by rain harvesting, 5% by rain gardens, 5% by street planters, 20% by infiltration basins and 10% by permeable pavement. The 35% of runoff from impervious areas that is not accounted for will not be treated and will exit the site via culvert, ditch or stormwater basin. Also, since the site is already partly developed and we previously determined that runoff potential is moderately high, select "Re-Development" and "Moderate" soil suitability. Finally, in order to estimate costs select "National" cost region. The closest listed cost region is Boston but it is likely costs in that metropolitan area will be less representative of costs in Maine.



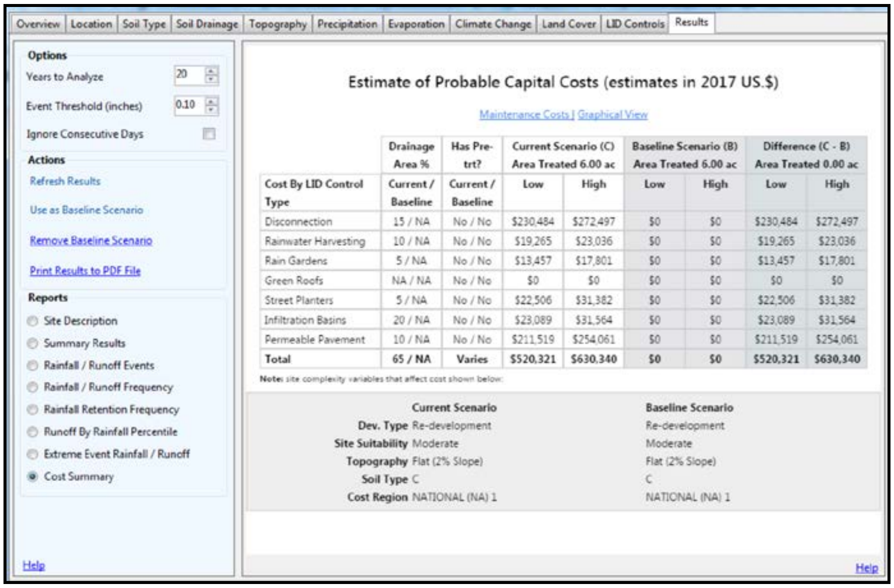
Before clicking “Renew Results” in the Results tab, click “Remove Baseline Scenario” and then “Use as Baseline Scenario” to move the “Proposed Development with No Lids” results to baseline scenario. By then clicking the “Results” tab and “Refresh Results”, the updated scenario with the selected LIDs appears under “Current Scenario”. It reveals that average annual runoff from the site without LIDs has been reduced by half with the application of the selected LID practices. In addition, the number of days per year when runoff leaves the site has been reduced from 40.67 to 18.79 days and the largest rainfall that does not result in runoff from the site has doubled. Runoff can be further reduced by directing more runoff from impervious areas to these practices, changing the design characteristis of the LIDs or by employing additional practices.



Note that while implementation of selected LIDs will significantly reduce runoff from a proposed development, even with LIDs, the developed site will still generate more runoff that in it’s existing, pre-development condition.

	Existing Condition	Development without LIDs	Development with LIDs
Annual Runoff	4.04"	12.75"	6.36"
Days per Year with Runoff	10.49 days	40.67 days	18.79 days
Largest Rainfall Event without Runoff	1.10"	0.40"	0.80"

Finally, by clicking “Cost Summary”, estimates of the cost of each LID are calculated as shown below. Rainwater harvesting and infiltration basins can be quite cost effective, especially compared to disconnection, permeable pavement and green roofs. Vegetative swales and infiltration trenches, which were not included in the LID menu because their effectiveness is highly dependent on location within a site, are generally low-cost and effective LIDs and should be considered in an engineered drainage plan.



	Drainage Area %	Has Pre-trt?	Current Scenario (C) Area Treated 6.00 ac		Baseline Scenario (B) Area Treated 6.00 ac		Difference (C - B) Area Treated 0.00 ac	
Cost By LID Control Type	Current / Baseline	Current / Baseline	Low	High	Low	High	Low	High
Disconnection	15 / NA	No / No	$230,484	$272,497	$0	$0	$230,484	$272,497
Rainwater Harvesting	10 / NA	No / No	$19,265	$23,036	$0	$0	$19,265	$23,036
Rain Gardens	5 / NA	No / No	$13,457	$17,801	$0	$0	$13,457	$17,801
Green Roofs	NA / NA	No / No	$0	$0	$0	$0	$0	$0
Street Planters	5 / NA	No / No	$22,506	$31,382	$0	$0	$22,506	$31,382
Infiltration Basins	20 / NA	No / No	$23,089	$31,564	$0	$0	$23,089	$31,564
Permeable Pavement	10 / NA	No / No	$211,519	$254,061	$0	$0	$211,519	$254,061
Total	**65 / NA**	**Varies**	**$520,321**	**$630,340**	**$0**	**$0**	**$520,321**	**$630,340**

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	NATIONAL (NA) 1	NATIONAL (NA) 1

It is important to note that this Stormwater Calculator will not subsitute for the preparation of a drainage study by the developer's engineer. The study is required to properly size and design all LID practices but the Styormwater Calculator does provide the planning board as well as a property owner a much better understanding of the benefits of addressing stormwater on the site rather than allowing it to exit the site as runoff.