Introductory Tutorial for the GI Implementation Forms

This Introductory Tutorial will guide the user through the Oregon State University Extension Service's **Green Infrastructure** (**GI**) Implementation Forms. The tutorial is meant to be read in order, but you may click on a link in the Table of Contents to be taken to that page.

For more information beyond this Introductory Tutorial, see the Continued Tutorials below.

Table of Contents:

The **Continued Tutorials** found below contain further information:

Continued Tutorial: New Development Site

Manages Catchments #2-5 from this site. Contains examples of additional BMP worksheets and ways to overcome challenging soil conditions.

- Catchment 2: (Stormwater Planter)
- Catchment 3: (Vegetated Roofs, Downspout Disconnection)
- Catchment 4: (Lined Stormwater Planter, slow-draining soils)
- Catchment 5: (Vegetated Filter Strip, expansive clay soils)

Continued Tutorial: Redevelopment Site

Manages an example redevelopment of an office site in eastern Oregon. Contains examples of retrofit and pavement removal BMPs.

- Redevelopment Site: (Soakage Trench, Porous Pavement, Vegetated Roofs, Minimal Excavation)

About the GI Implementation Forms

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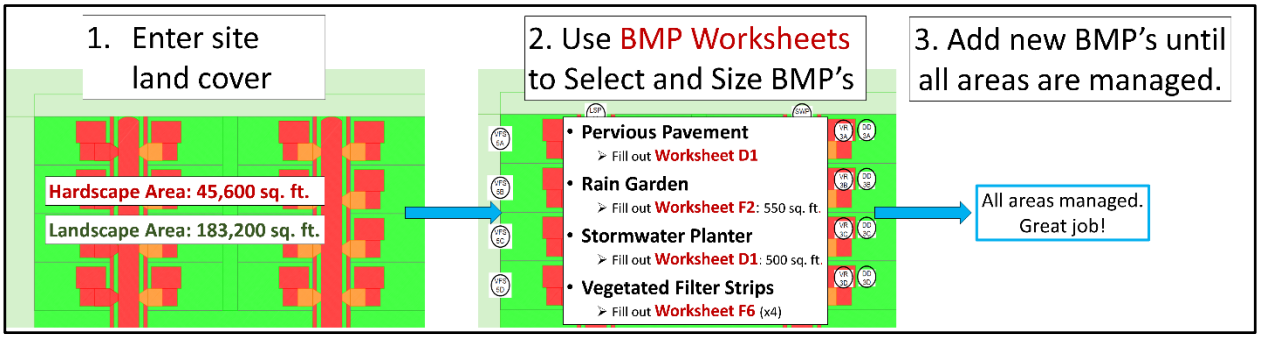
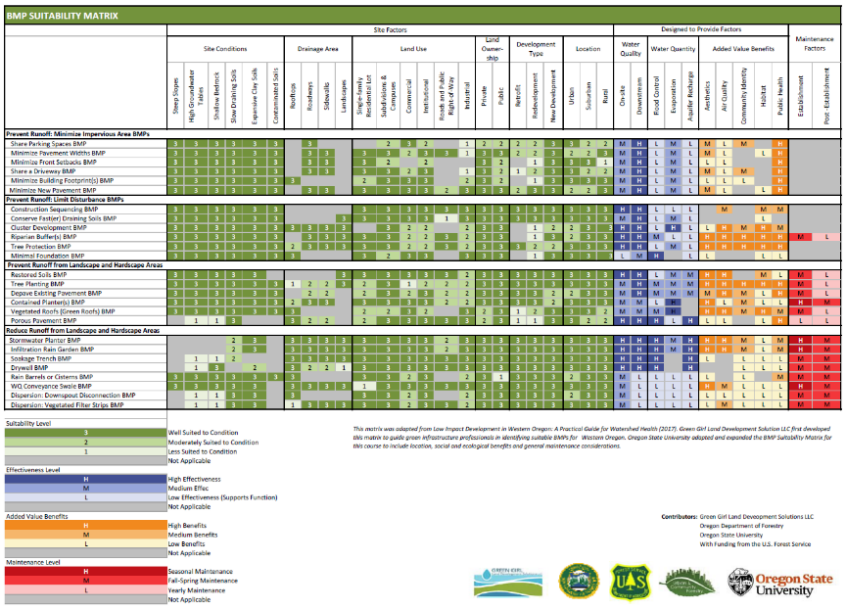
These **GI Implementation Forms** (link) were developed by Oregon State University Extension Service as a methodology to allow GI **Best Management Practices** (**BMPs**) (tree plantings, rain gardens, vegetated roofs, etc.) to fulfill local stormwater management requirements. Municipalities across Oregon may adopt these forms into their own requirements.

Steps to Complete GI Implementation Forms:



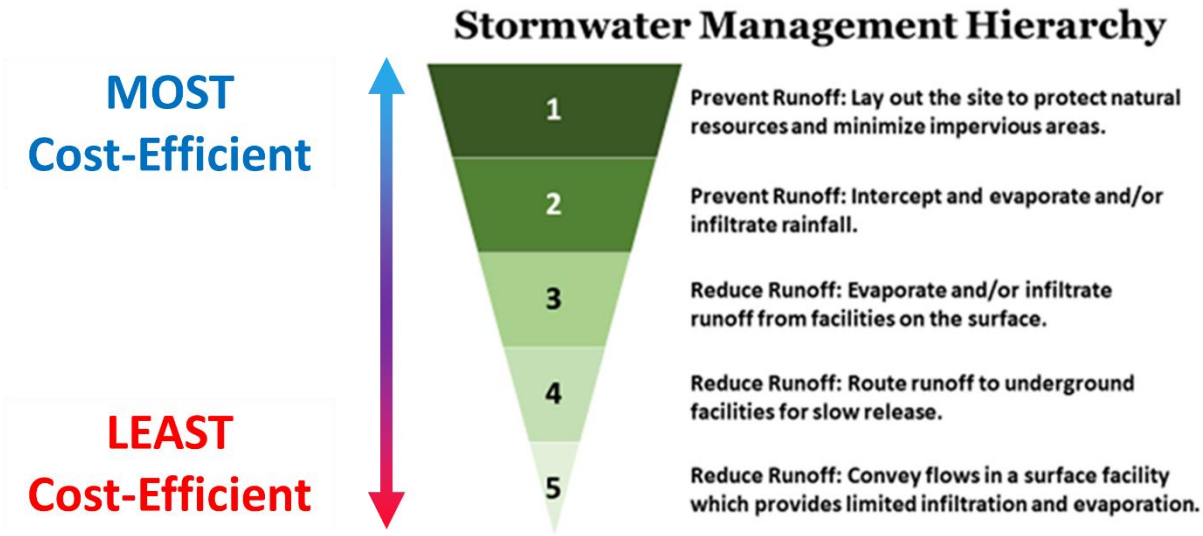
The GI Implementation Forms calculate the numbers and sizes of BMPs needed to fulfill the local stormwater requirements based on the site's land cover.

BMP Suitability Matrix



The **BMP Suitability Matrix** (link) guides the optimal BMP type selection based on the local soils, topography, and treatment goals. These BMPs in the Matrix may each be selected for the site using the GI Implementation Forms.

Stormwater Management Hierarchy



The **Stormwater Management Hierarchy** (link) orders the BMPs in the GI Implementation Forms according to cost efficiency. Whenever site conditions allow, it is recommended to implement BMPs that prevent runoff and perform infiltration. You will see the Stormwater Management Hierarchy used to guide the selection of BMPs throughout this tutorial.

New Development Site

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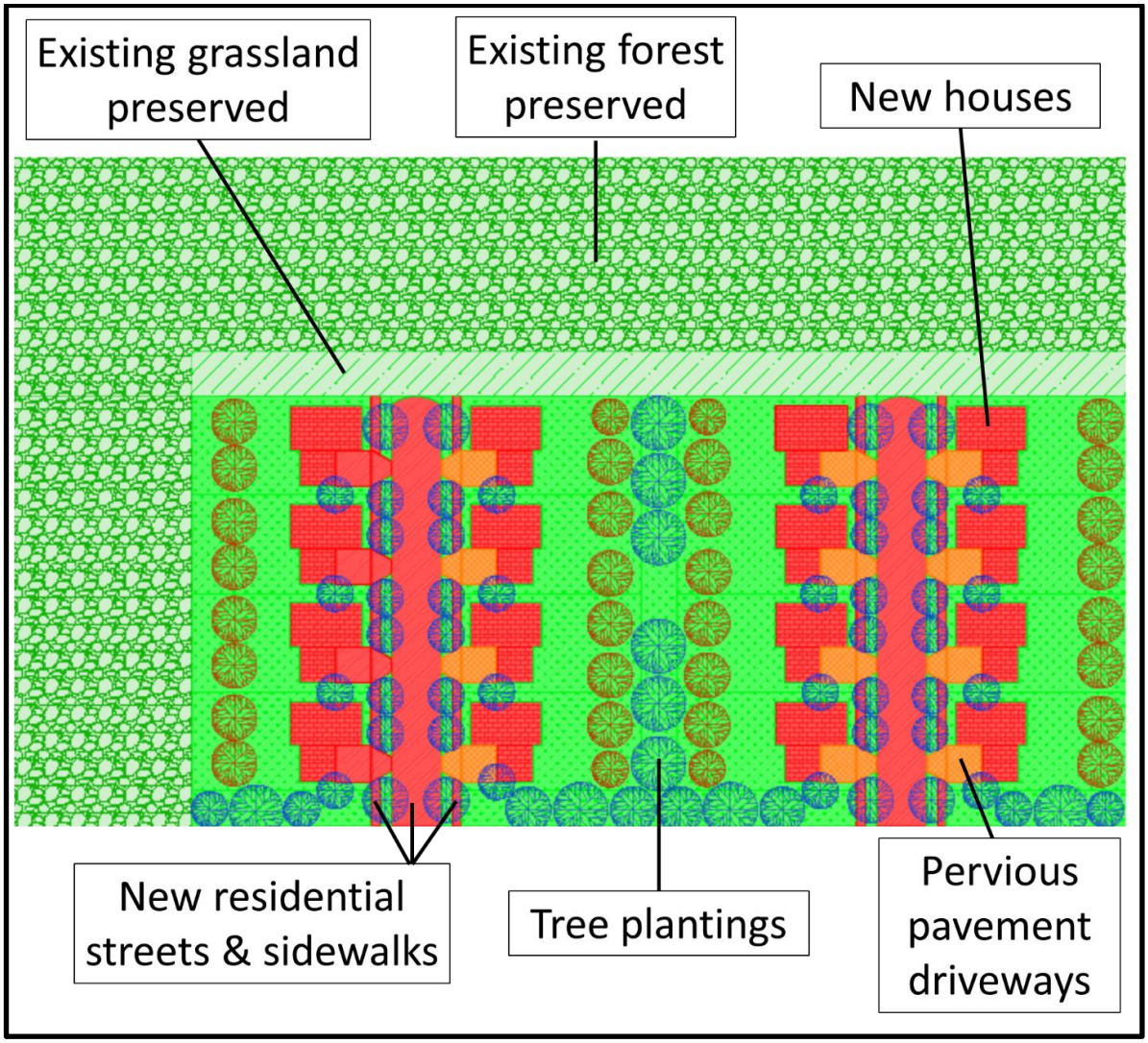
In this example, we have a mock design for a new residential development.

There are 16 single-family houses being built in an old agricultural field in western Oregon. The surrounding forest and some of the grassland along the edge of the farm field will be preserved and may be used for recreation. Each house is 2 stories, includes an attached garage (required by code), and sits on a 1/8-acre lot (minimum allowed by code). The driveways are constructed with porous pavement where site conditions allowed. Trees will be planted along the edge of the streets, in the backyards, and in the common areas.

The developers wish to maintain a good reputation with the local municipality and so have agreed to manage stormwater onsite according to the GI Implementation Forms. This tutorial will walk through using the GI Implementation Forms to design this site.

Example site:



Before Starting the GI Implementation Forms

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1. Check Rainfall Depth Requirements (OSU Extension link) (NOAA Link)

Jurisdictions generally require stormwater designs to manage the rainfall depth of a specific **design storm** (i.e. 10-year 24-hour storm, 25-year 24-hour storm, etc.).

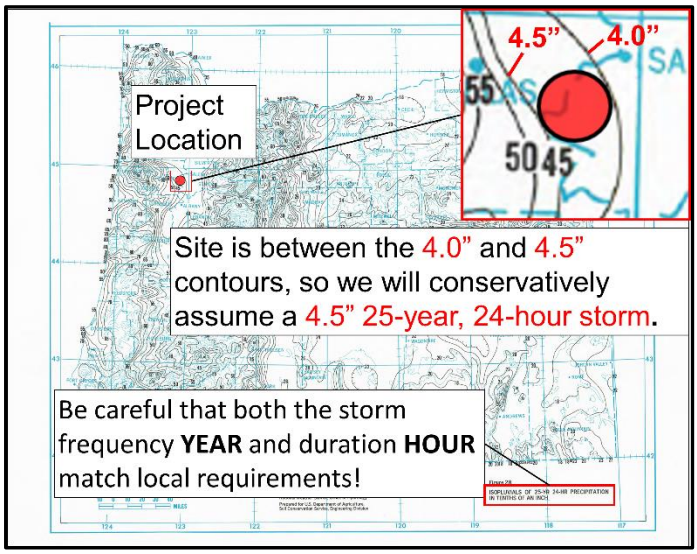
To find out the design storm requirements for your project, review the municipality's local stormwater code or check with the municipal staff. If not given by the municipality, the rainfall depth associated with different design storms can be found below:

Design Storm Depth Links:

- 25-Year (24-Hour) Storm Depths in Oregon: (OSU Extension Link)
- 2 to 100-Year (24-Hour) Storm Depths in Oregon (see pages 30-35): NOAA Link

In this example project, the developers have agreed to manage the 25-year, 24-hour storm. A rainfall design storm depth of **4.5”** for the project location is found from the NOAA map.

We will use this rainfall depth later when we are filling out the BMP Worksheets.

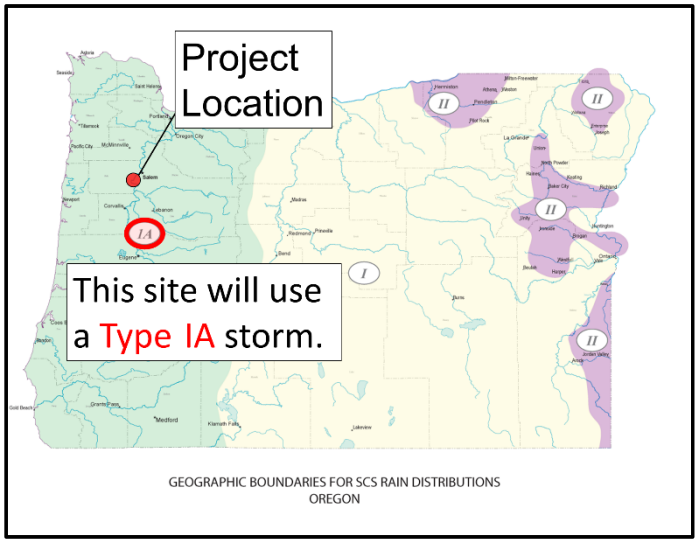


2. Check NRCS/SCS Storm Type (link)

The NRCS/SCS **Storm Type** determines the design storm precipitation timing and intensity.

Storm Types I, IA, and II each have a different GI Implementation Form spreadsheet package. We must find the Storm Type for this project so that we know which spreadsheet package to use.

This site falls within the **Type 1A** storm region, so we will need to use the Type 1A GI Implementation Form package (link).

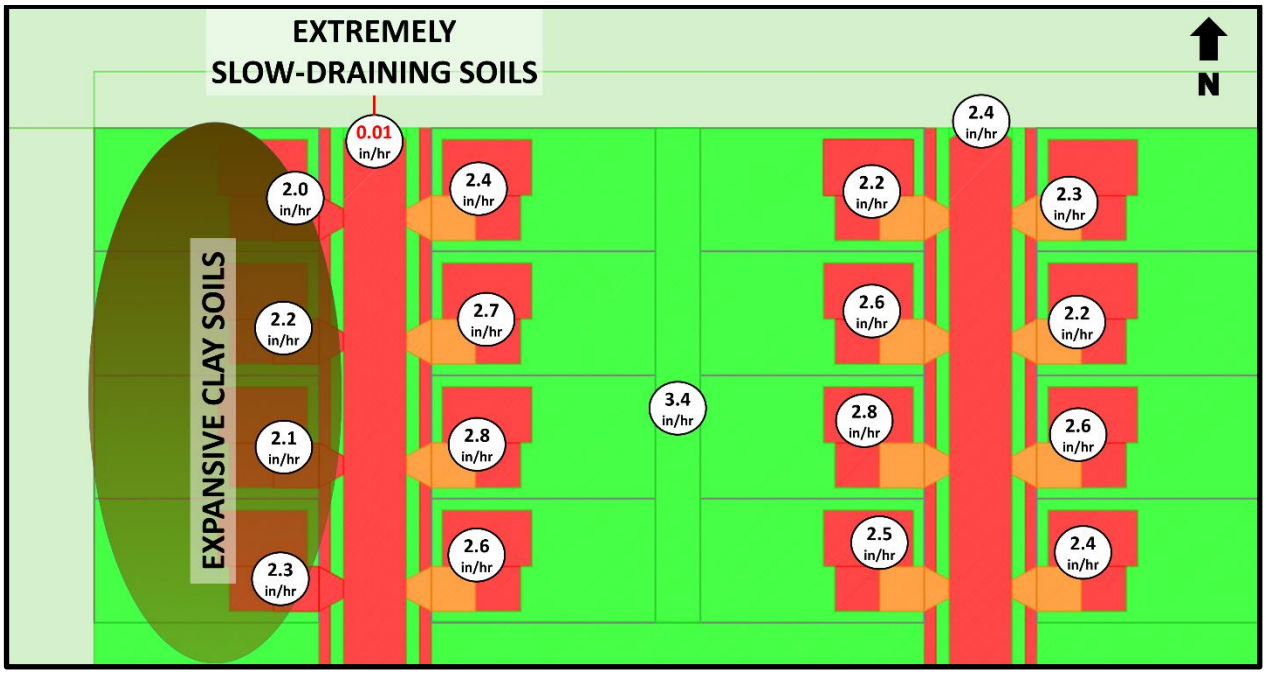


3. Perform Soil Infiltration Testing (link)

The types of BMPs available and the sizes required depend on the **infiltration rate** of local soils.

Infiltration testing should be performed at or very near the proposed location and depth of each stormwater BMP. Infiltration testing methods provided by OSU Extension (link) can be used by either homeowners or professionals.

Example Site Infiltration Testing



Local soils testing in this example site was performed for each proposed BMP location. Besides one isolated area of slow-draining soils in the northwest corner of the site, the infiltration rates tested varied from 2.0 to 3.4 inches/hour. There were also some noted expansive clay soils along the W edge of the site. This information will be used later when choosing and sizing the BMPs.

Site Layout

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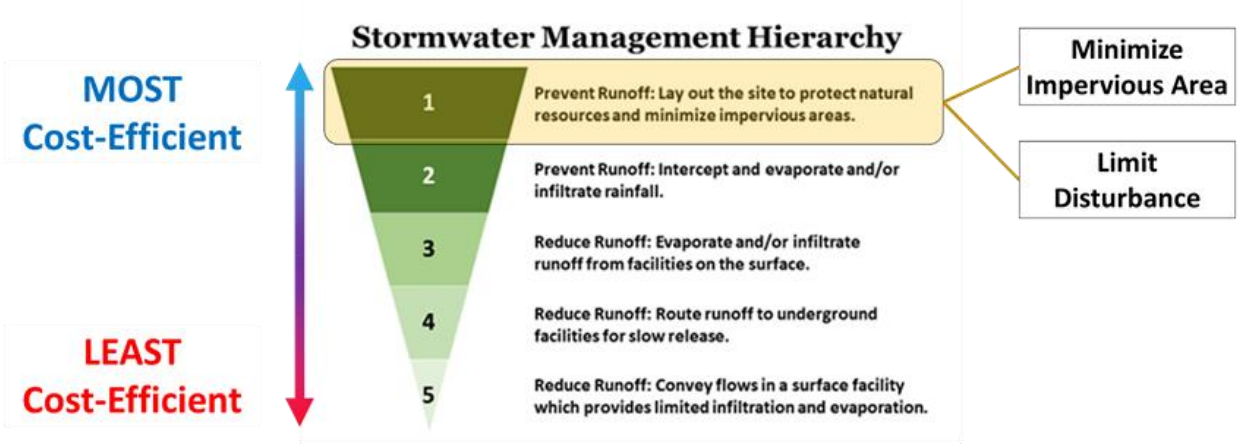
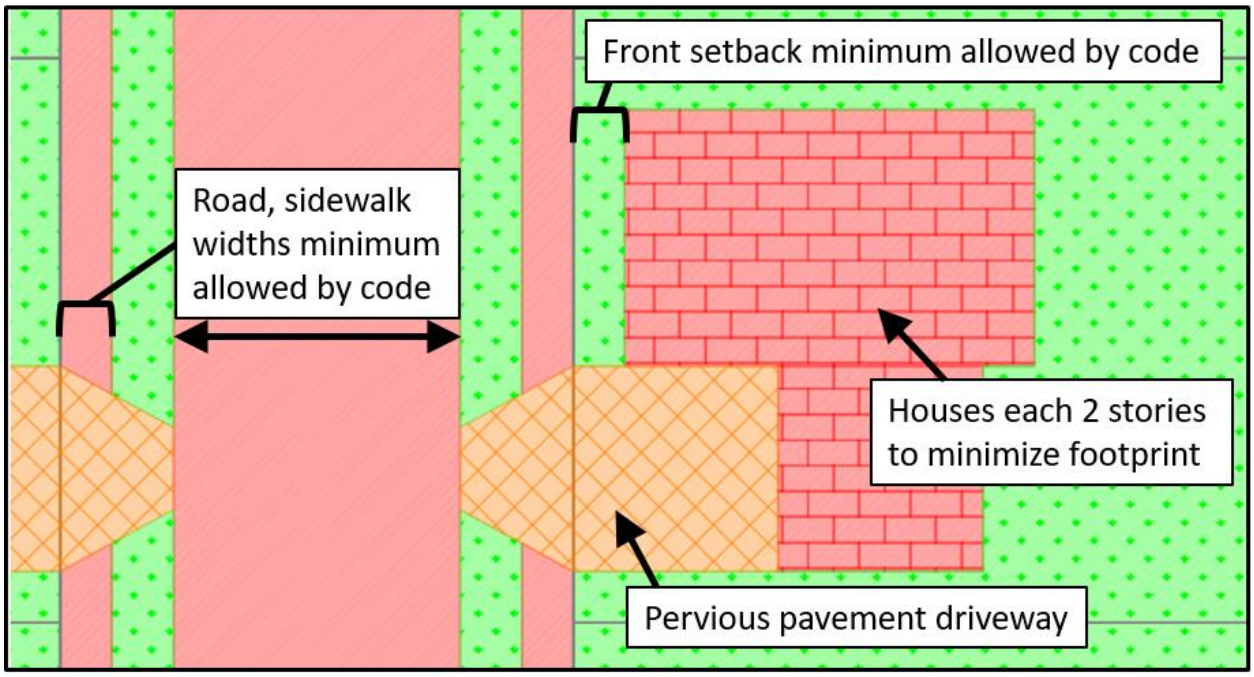
We will now open up the **Type IA GI Implementation Form** (link) and begin filling it out.



First, fill out the **Site Layout** form to see what practices can be implemented to minimize impervious area and limit disturbance. These practices are among the most cost-efficient ways to manage stormwater (see the **Stormwater Management Hierarchy** below). Implementing as many of these practices as possible helps avoid costly treatment alternatives and may even earn a developer incentive bonus in certain municipalities.

In this example, the road, sidewalk, and front setback widths were all set to the minimum allowed by code. The driveways are made of porous pavement and the houses are each 2 stories to minimize footprint.



In the **Site Layout** form**,** we enter our practices to minimize impervious area and limit disturbance.

Site Form: Steps to an LID Site & Sizing Facilities

Complete Sections A-B in tabs, "Instructions & Site Layout", "Site Landscape Areas", and "Site Hardscape Areas" once for ENTIRE SITE

A. CREATE SITE LAYOUT & LID STRATEGY (ENTIRE SITE)

Minimize Impervious Area

These practices reduce the drainage area to be managed by Runoff BMPs and reduce stormwater management costs (and some of them also reduce overall project costs). If not incorporated, provide justification.

	Incorporated	Not Feasible	Not Applicable	Justification if not incorporated
1. **Shared parking spaces BMP**		X		Code requires garage for each house
2. **Minimize Pavement Widths BMP**	X			
3. **Minimize Front Setbacks BMP**	X			
4. **Share a Driveway BMP**		X		Driveway sizes minimized instead
5. **Minimize Building Footprint(s) BMP**	X			
6. **Minimize Roadway Cross Section(s) BMP**				
7. **Minimize New Pavement BMP**	X			
Limit Disturbance				
8. **Construction Sequencing BMP**	X			
9. **Conserve Fast(er) Draining Soils BMP**	X			

Site Landscape Areas

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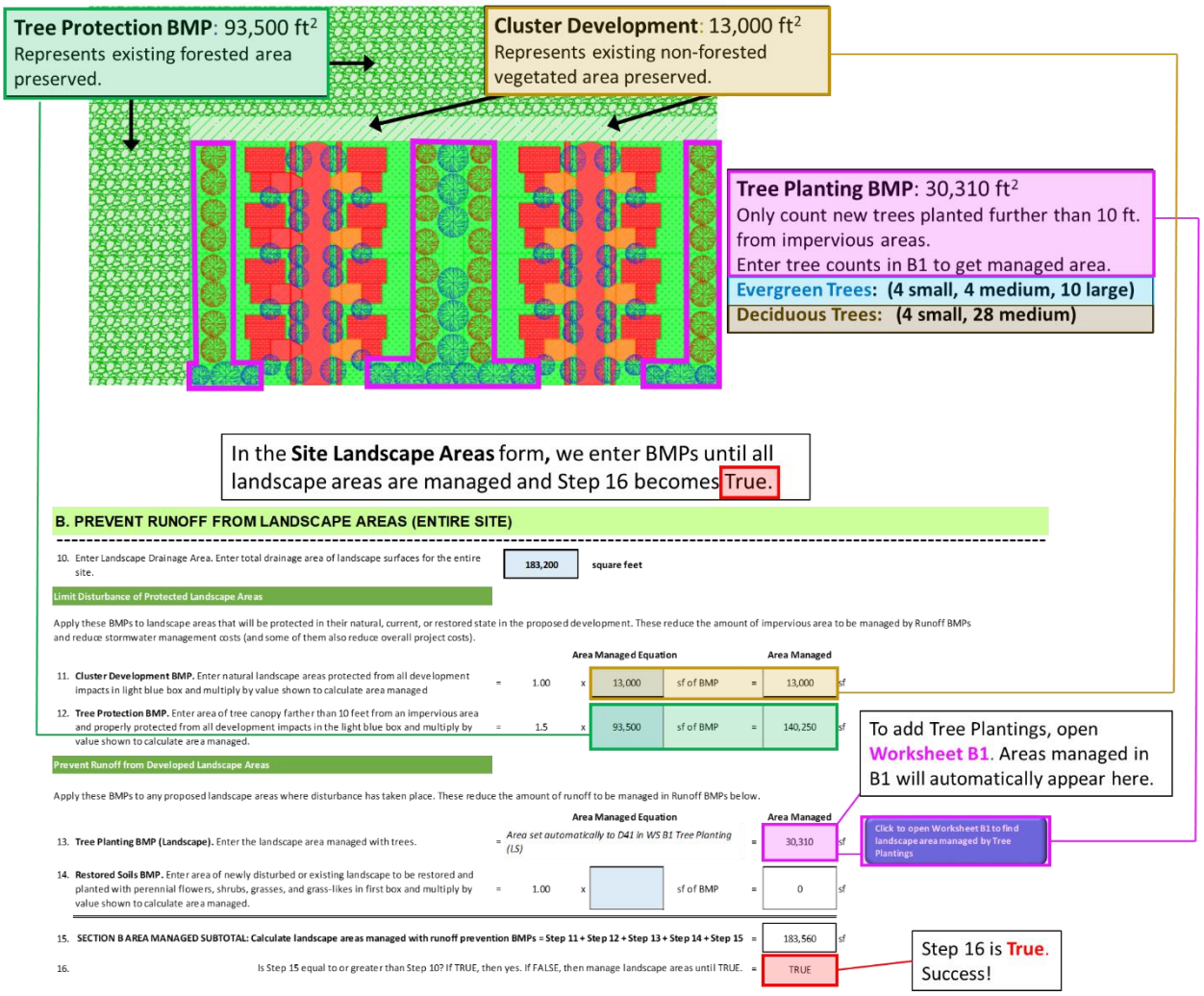
In the **Site Landscape Areas** form, we will manage the runoff from the site's vegetated areas.



The total landscape area of the site includes any existing or proposed lawns, meadows, forests, grasses, shrubs, etc. First, enter the original vegetation areas preserved during construction with protective fencing: **Tree Protection BMP** for forested areas or **Cluster Development BMP** for non-forested areas. Then, enter the new plantings on the developed area: **Restored Soils BMP** for shrubs, grasslands, or perennial flowers and **Tree Planting BMP** for trees. You will need to open **Worksheet B1** to calculate the area managed by tree plantings. Note: only count new trees planted further than 10 ft. from hardscape surfaces. Continue to add new plantings until Step 16 in the Site Landscaping Areas form shows "True".

In **Worksheet B1**, we enter **Evergreen** and **Deciduous** Tree Plantings to count towards the **Site Landscape Areas** managed.

WORKSHEET B1. TREE PLANTING (LANDSCAPE AREA) BMP WORKSHEET

[View BMP Factsheet] [View BMP Suitability Matrix]

Use this form to determine:
1. The maximum landscape area that may be managed with newly planted/proposed trees.
2. The landscape area managed by trees that may be entered in Site Landscape Areas for both deciduous and evergreen trees.

a. Specify if the Tree Plantings will take place on the **Entire Site** or within specific **Catchment #**'s: **Entire Site**

b. Did you put the right tree in the right place? In other words, are all conditions met (especially soil volume) to plant tree(s) in a location where the tree(s) can grow to full maturity? If Yes, continue to step c. If No, then this location is unsuitable for newly planted trees, so enter 0 in Step 13 of the Site Landscape Areas Form. **Yes** Enter Yes or No

Determine available proposed canopy of evergreen trees to manage landscape areas:

Evergreen (Landscape). Calculate the total mature canopy for multiple evergreen trees to manage landscape area runoff. (If desired, trees within 10 feet of hardscape areas may be used to prevent runoff from hardscape using Worksheet E1 instead.)

c.	Small Canopy (for trees with small mature canopy area spreads including small trees and many trees with upright canopies with a canopy diameter measuring about 20 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	315 square feet	x	4	# of small proposed trees	=	1260	sf
d.	Medium Canopy (for trees with medium mature canopy area spreads with a tree canopy diameter measuring about 25 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	490 square feet	x	4	# of med proposed trees	=	1960	sf
e.	Large Canopy (for trees with large mature canopy area spreads with a tree canopy diameter measuring about 30 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	700 square feet	x	10	# of large proposed trees	=	7000	sf
f.	Calculate available proposed evergreen canopy = Step c. + Step d. + Step e.							10220	sf
g.	Calculate landscape area that could be managed by proposed evergreen trees = Step f. x value shown.	=	1.50	x	10220	square feet	=	**15330**	**sf**

Determine available proposed canopy of deciduous trees to manage landscape areas:

Deciduous (Landscape). Calculate the total mature canopy for multiple deciduous trees to manage landscape area runoff. (If desired, trees within 10 feet of hardscape areas may be used to prevent runoff from hardscape using Worksheet E1 instead.)

h.	Small Canopy (for trees with small mature canopy area spreads including small trees and many trees with upright canopies with a canopy diameter measuring about 20 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	315 square feet	x	4	# of small proposed trees	=	1260	sf
i.	Medium Canopy (for trees with medium mature canopy area spreads with a tree canopy diameter measuring about 25 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	490 square feet	x	28	# of med proposed trees	=	13720	sf
j.	Large Canopy (for trees with large mature canopy area spreads with a tree canopy diameter measuring about 30 feet). Enter number of trees in the blue box and multiply by assumed canopy area.	=	700 square feet	x		# of large proposed trees	=	0	sf
k.	Calculate available proposed deciduous canopy = Step h. + Step i. + Step j.							14980	sf
l.	Calculate landscape area that could be managed by proposed deciduous trees = Step k. x value shown.	=	1.00	x	14980	square feet	=	**14980**	**sf**
m.	Calculate the total landscape area managed by proposed evergreen and deciduous trees = Step g. + Step l.						=	**30310**	**sf**

Determine area managed to enter on LID Implementation Form

Area Managed from **Worksheet B1** here will automatically be added to the **Site Landscape Areas** form.

n. Enter the actual landscape area where trees will be planted = 76700 sf

o. The smaller of the values in Step m. and Step n. will be ente = 30310 **sf** *Used to determine "Area Managed" on Site Landscape Areas form*

Site Hardscape Areas

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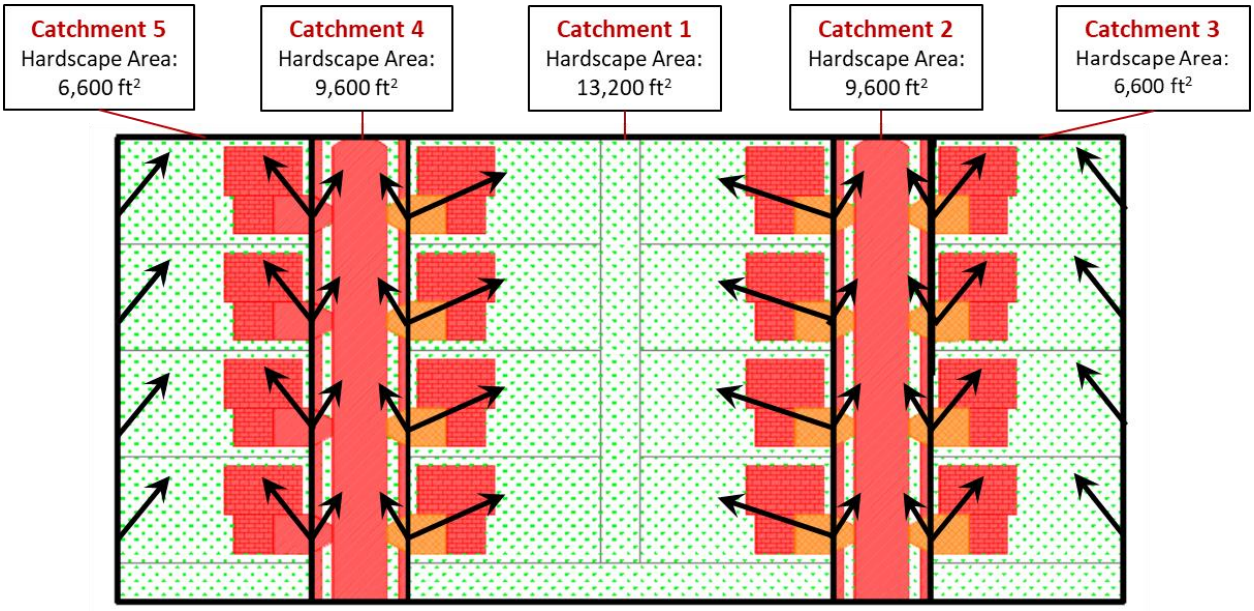
In the **Site Hardscape Areas** form, we will take an inventory of the new and existing hardscape areas in each catchment (also known as a "drainage area").

In this example, we have 5 catchments with new hardscape areas, but no existing hardscape. Hardscape areas include roofs, gravel, roads, sidewalks, asphalt, porous pavement, and any other type of pavement. The boundaries of each catchment are determined by local topography and/or site design elevation grading (link for tutorial on determining catchment area boundaries).



In the **Site Hardscape Areas** form, we enter the total # of catchments and the hardscape areas for each catchment.

INVENTORY OF SITE HARDSCAPE AREAS

Enter # of Catchments (drainage areas) in site 5

1. Enter total # of catchments here to get the rows below to appear.

Enter total hardscape area for each catchment
(rows appear when # of Catchments is entered above)
• Hardscape areas include any pavement (including porous pavemen

2. Enter in hardscape areas.

For each catchment, click to open a new Catchment Form

	Existing Hardscape		New Hardscape		Total Hardscape	
Catchment 1	0	sf	13,200	sf	13,200	sf
Catchment 2	0	sf	9,600	sf	9,600	sf
Catchment 3	0	sf	6,600	sf	6,600	sf
Catchment 4	0	sf	9,600	sf	9,600	sf
Catchment 5	0	sf	6,600	sf	6,600	sf

In the next step, we will click here to open up a **Catchment Form** for Catchment #1.

Catchment Form

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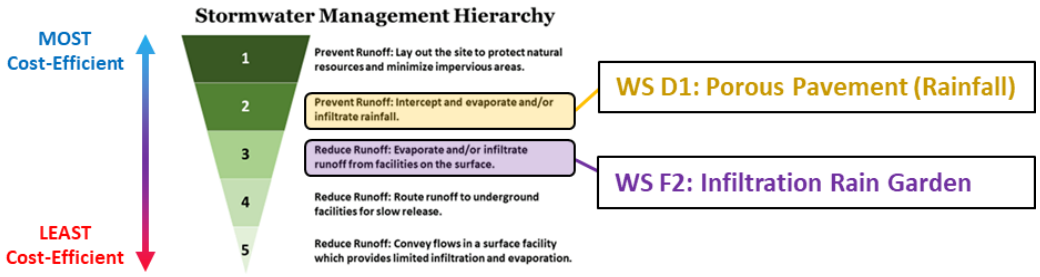
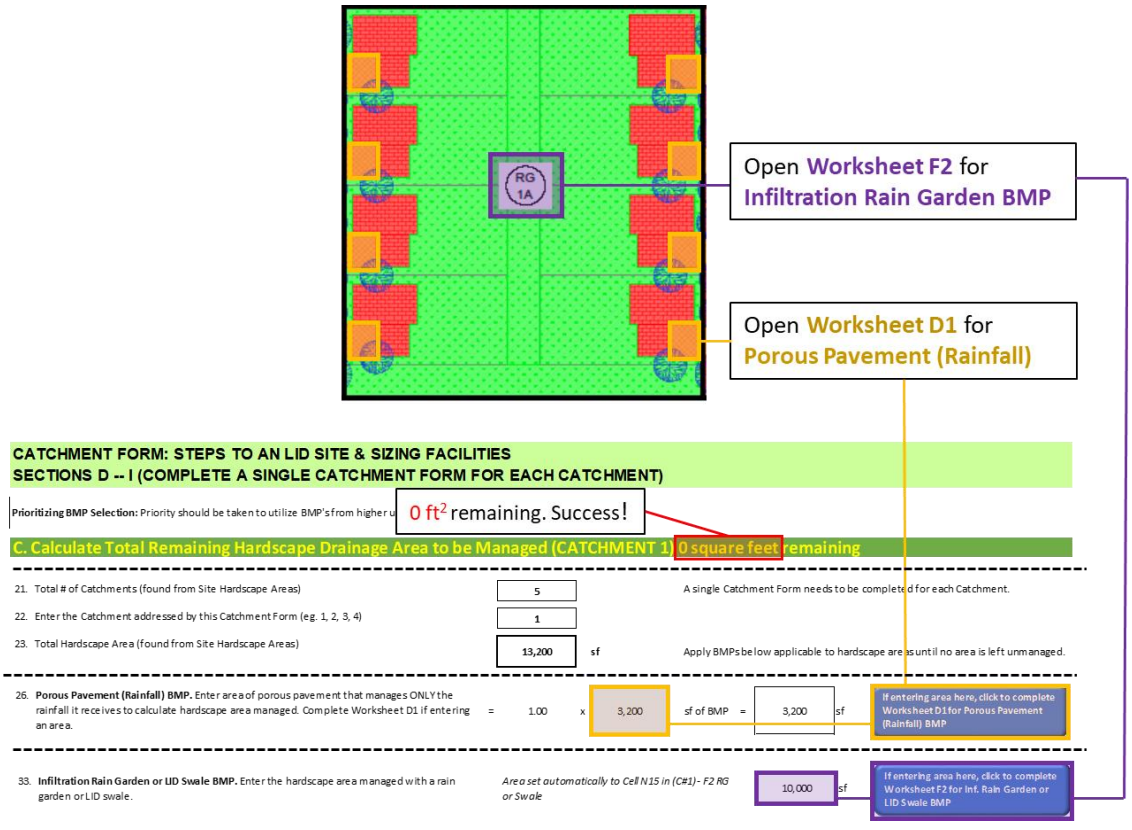
To manage the hardscape areas for Catchment #1, open a new **Catchment Form** by clicking on the blue button in the Site Hardscape Areas. Note that the cells for Catchment ID and Remaining Hardscape Area are automatically populated.

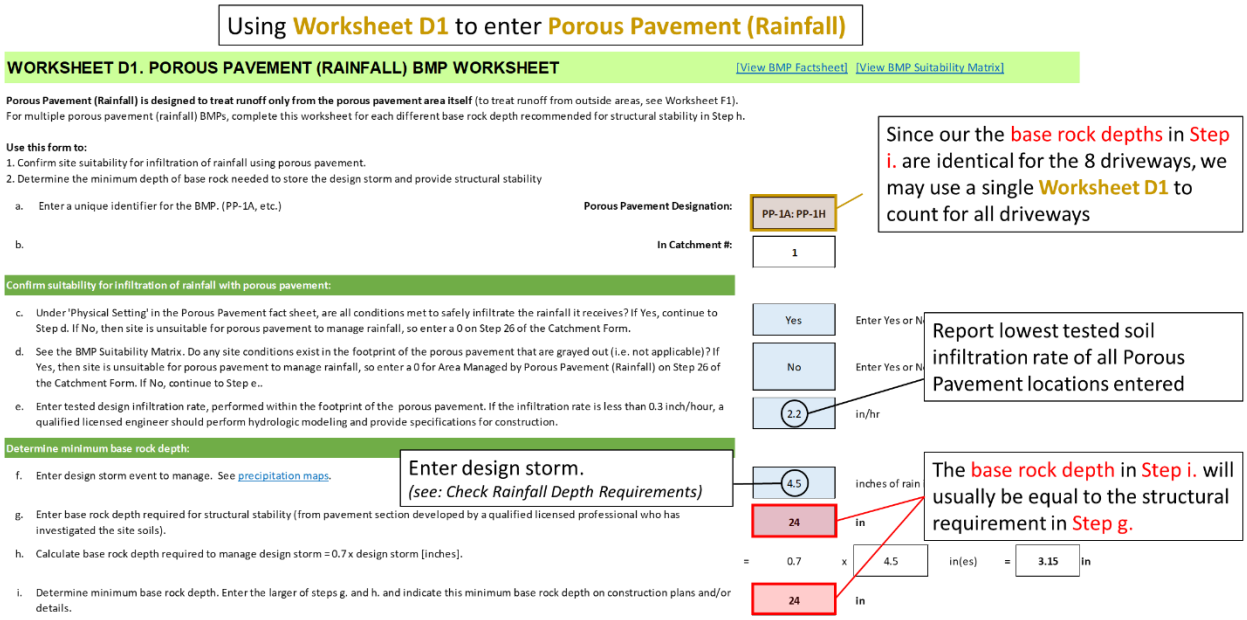
The BMPs listed in the Catchment Form are ordered according to the **Stormwater Management Hierarchy**, so try to use the BMPs listed higher up whenever possible.



Catchment #1 consists of two rows of housing lots with a grassed common area abutting each backyard. All 8 driveways utilize Porous Pavement (Rainfall) and there will be an Infiltration Rain Garden in the common area.

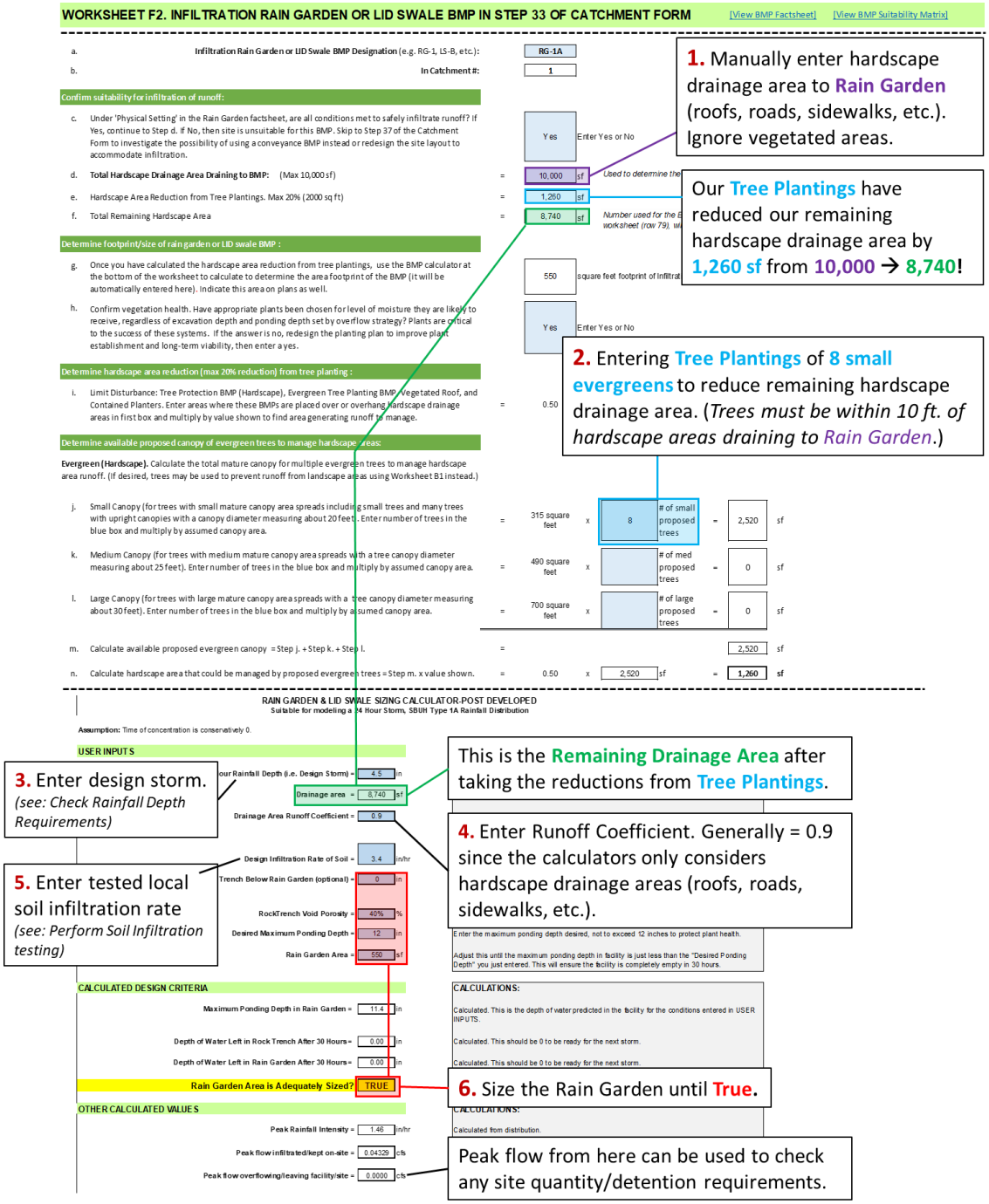


In the Catchment Form, first enter the area managed by the **Porous Pavement (Rainfall) BMPs** on the driveways. Then, open **Worksheet D1** with the blue button to design the BMP. Since all the driveways require identical base rock depths, we may use a single Worksheet D1 for all driveways. If you need multiple forms, click on the blue button again to open an additional copy of the worksheet.



Next, open **Worksheet F2** using the blue button on the Catchment Form to enter information on the **Infiltration Rain Garden BMP**. First, we enter the 10,000 ft^2 hardscape drainage area (max 10,000 ft^2 for this BMP) from the 8 houses draining to the Rain Garden (*we do NOT enter the porous pavement areas since we have already managed those)*. Then, we enter our 8 small evergreen tree plantings that are within 10 ft. of the houses. These tree canopies overhang the hardscape area to reduce the runoff sent to our BMP. As a result, our drainage area is reduced from 10,000 ft^2 to 8,740 ft^2 (maximum 20% area reduction allowed), allowing us to reduce the size of our BMP. Finally, we must adjust the rock trench and rain garden area. To manage this drainage area, the Rain Garden Area needs to be at least 550 ft^2.

Using **Worksheet F2** to enter **Infiltration Rain Garden BMP**



Our hardscape area managed from Worksheet F2 will be automatically linked back to our Catchment Form. Now we see that our Catchment Form displays 0 square feet remaining of hardscape area to manage, we are done with Catchment #1!

To continue designing Catchments #2-5 of this site, see Continued Tutorial: New Development Site. To look at a Redevelopment site, see Continued Tutorial: Redevelopment Site.