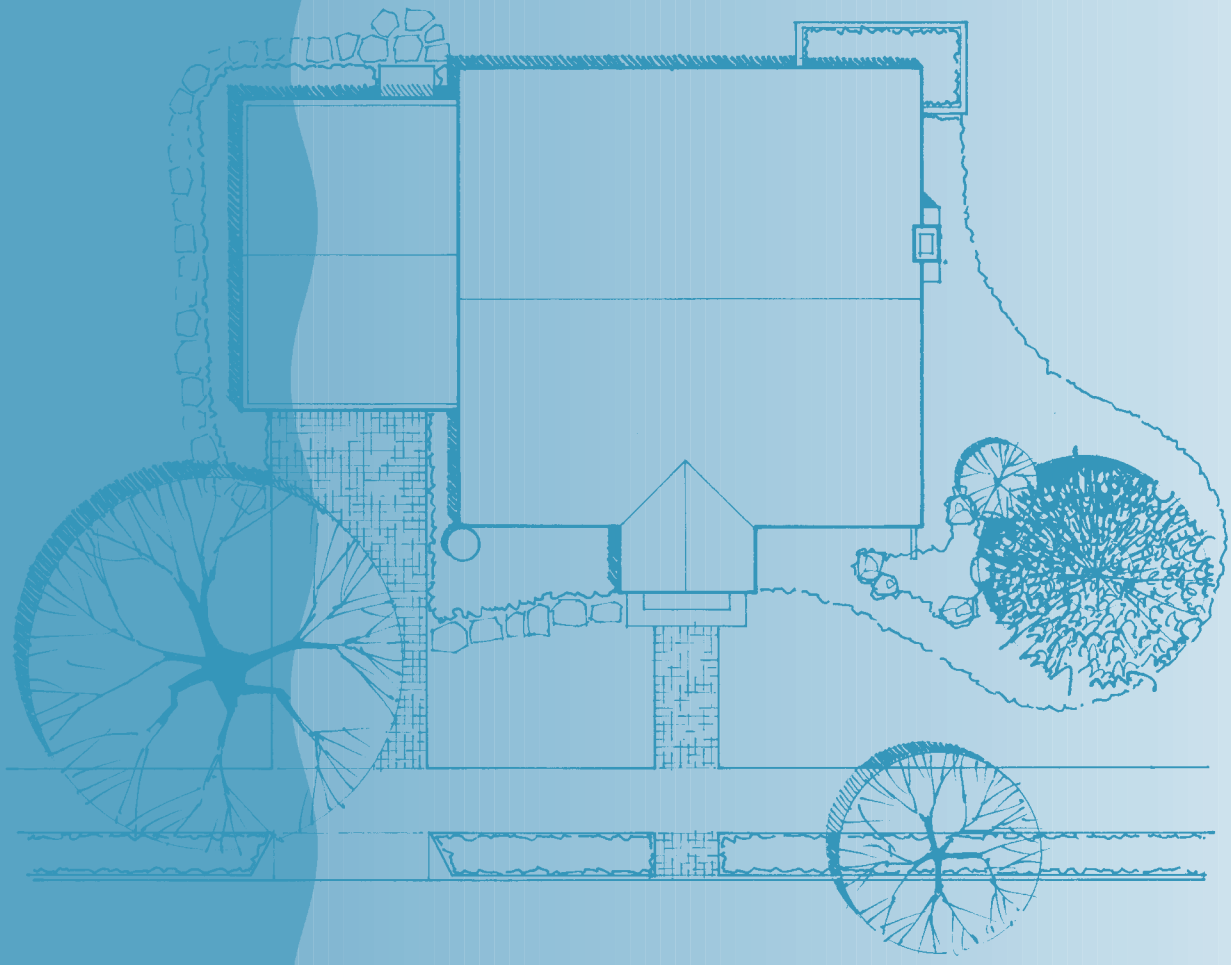
Stormwater Management Facilities

Site Assessment Guide



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BS 0604 July 2006

Introduction

Most home and business sites are designed to collect and carry stormwater runoff away from the site as quickly as possible. This quick release of water can damage rivers and streams and stop natural flows into groundwater. Modifying, or retrofitting, your site to manage stormwater in ways that mimic nature can prevent or minimize the negative impacts of runoff. This guide will help you assess the site, choose the right retrofit options, and prepare for final design and installation.

Contents

Site Assessment

The first step is to identify conditions on your property that could interfere with stormwater management facility function. You will need either a fairly accurate drawing of your site or an aerial photo to make notes on. PortlandMaps.com is a good source for free aerial photos. Type in your address and look under "maps" for the aerial option. Right click on the image to save and print it. Make sure you print a copy that is large enough to draw on.

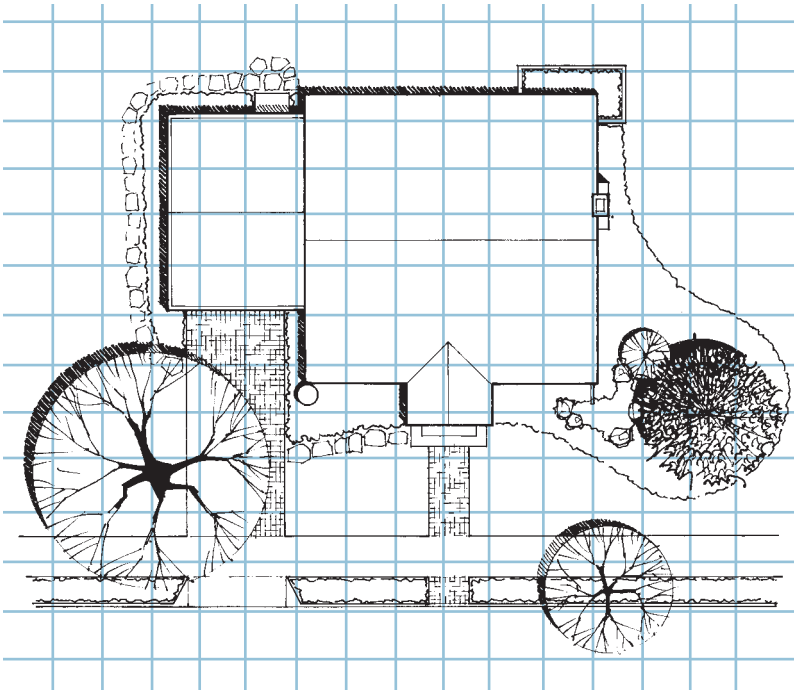
Step 1 - Parts of your site that generate runoff

Stormwater retrofitting should mimic the way nature manages rainfall. The goal is to create surfaces that soak up rain and direct runoff to those surfaces.

The surfaces on your property are generally either hard, or impervious, areas where water runs off (roof, driveway, parking lots), and soft, or pervious, areas where the water soaks in (lawns, planting beds, trees). Estimate the square footage of each type of surface and where they are located on your property.

Draw the general layout of the buildings on your property. Add impervious areas like your driveway, sidewalks or parking areas. Use a tape measure to measure the length and the width of the areas, then multiply the two together to get your area. Note the measurements on your map.

EXAMPLE Site drawing: (Page 19 has a blank grid for your use)



Step 2 - How the water moves (Slopes And Surfaces)

Slope is a measure of how steep a hill or incline is. Gravity moves water, so the steeper the slope, the faster the water will flow downhill. Water is more likely to sit still on flat surfaces. There may be many different slopes on your property that you may have never noticed. The slopes determine where your water goes and how long it stays there.

Start by finding the sources of runoff.

Roofs

Locate the downspouts that drain water from your roof. Most downspouts connect to an underground pipe or drywell. As you walk around your building, mark downspout locations on the map of your building.

If you don't see any downspouts, your building may have an internal drainage system. That will make retrofitting much more difficult and you will need the help of a licensed professional.

Other impervious areas

Now look at the other impervious areas on your site. Since water won't soak in there, runoff will move somewhere. Try to figure out where runoff from these areas goes. If it isn't raining, use your hose to find out where water flows. Use arrows to note on your map the direction the water runs.

Pervious areas

Finally, look at the rest of the surfaces on your property. On your map, mark any noticeable hills or dips. Use the same sort of arrows you did in the step above, and note areas in your yard that stay wet and muddy.

Step 3 - How well it soaks in (Soils)

Soil type has a lot to do with how well rainwater soaks into the ground. Sandy, loamy soil soaks up water very quickly. Heavier soils with clay don't soak up water as well. In general, soils east of the Willamette River are more likely to be sandy and loamy, and soils on the west side and on the buttes tend to have more clay. If you want a better idea, check the Multnomah County Soil Survey at http://ice.or.nrcs.usda.gov/website/multnomah/viewer.htm.

Identify your site on the map. Then read the instructions and look up the soil's "Hydrologic Group" under Soil Data Explorer/ Soil Properties and Qualities/Soil Qualities and Features. Soils in groups A and B drain well while soils in groups C and D have slower infiltration rates.

Soil survey information is also available at http://websoilsurvey.nrcs.usda.gov/app/-WebSoilSurvey.aspx.

If you are still unsure, dig a hole at least 12 inches deep in one of your green spaces, fill it with a hose, let it drain and fill it a second time. If the water on the second run does not drop at least two inches in an hour, your soils may not drain well enough to consider using an infiltration facility. It's likely you could still do a flow-through facility.

Step 4 - How much retrofit space is available (Setbacks)

You'll need to locate your property lines to determine how much space you have for a stormwater facility and for any permit applications you may need. Knowing how much space you have to work with will also help you decide which stormwater management facility will work best on your property. Your retrofit must meet general building code safety rules, such as keeping facilities at least five or ten feet back from property lines so your retrofit won't impact neighboring property.

Pre-design

There are lots of options for stormwater retrofit facilities. Before you choose a facility, think about how you will divert stormwater runoff into it. Make sure runoff goes into a stormwater management facility that can handle the volume.

Check the Stormwater Solutions Handbook for detailed information on installation, cost, siting and maintenance of these facilities:

Downspout/ Splashblock Disconnection
Rain Barrels
Cisterns
Ecoroofs
Roof Gardens
Trees
Contained Planters
Vegetated Swales
Vegetated Infiltration Basins
Flow-Through Planters
Infiltration Planters
Pervious Pavers
Pervious Pavement
Turf Block
Drywells
Soakage Trenches

Choosing a Facility

Review the facilities chart on page 8 to determine if your site's soils and slopes will work with the facility type you're interested in. Also consider some general siting guidelines:

- A residential surface facility must be at least two feet away from crawl spaces and slab foundations, and six feet away from basements.
- A surface commercial facility must be 10 feet away from the building.
- Surface facilities should be set back at least five feet from property lines.

Your project may require city building code appeals or professional engineer approval.

Pre-design plan

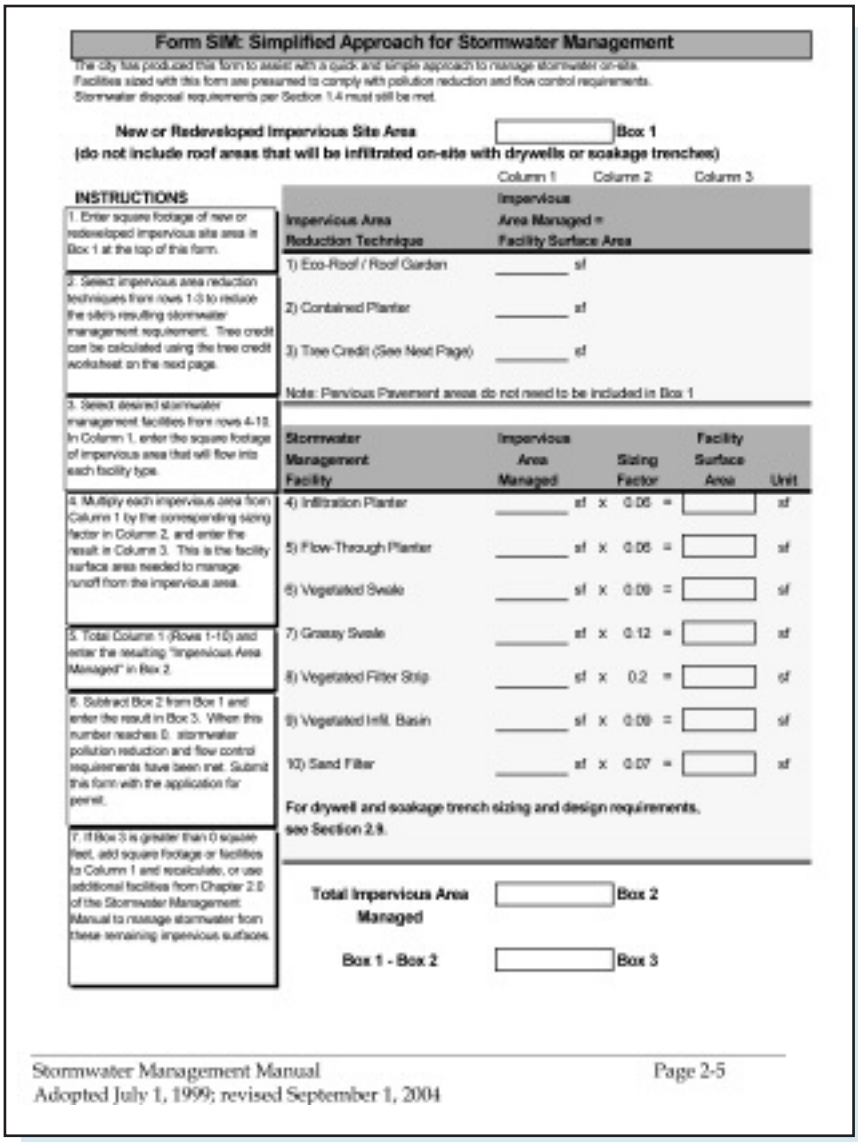
The pre-design site plan is a first rough draft of what will become a full stormwater management design plan for your site.

Using the copies of your site map or aerial with all the information on your surfaces, slope, soil, and space represented on it, sketch some ideas of what you want to do with your site. Keep in mind the considerations listed above when choosing and placing your facility.

You may have to reroute drainage systems to get water to where there is enough space to install the stormwater management facility you choose. For roof top drainage, consider rehanging gutters, replumbing downspouts, extending piping or using aerial gutters/scuppers. For ground-based surfaces, consider berms, curb cuts, valley-channels or trench drains to direct flows. See the examples on pages 10-16 for general ideas on how to reroute runoff.

Facility Sizing

Sizing a facility is usually based on facility volume and the size of the area drained. The city's Stormwater Management Manual has a simplified sizing form (Form SIM) to help you determine if your property is large enough for an adequately sized stormwater facility.



Form SIMI: Simplified Approach for Stormwater Management

The city has produced this form to assist with a quick and simple approach to manage stormwater on-site. Facilities sized with this form are presumed to comply with pollution reduction and flow control requirements. Stormwater disposal requirements per Section 1.4 must still be met.

New or Redeveloped Impervious Site Area ____ **Box 1**
(do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)

INSTRUCTIONS

1. Enter square footage of new or redeveloped impervious site area in Box 1 at the top of this form.
2. Select impervious area reduction techniques from rows 1-3 to reduce the site's resulting stormwater management requirement. Tree credit can be calculated using the tree credit worksheet on the next page.
3. Select desired stormwater management facilities from rows 4-10. In Column 1, enter the square footage of impervious area that will flow into each facility type.
4. Multiply each impervious area from Column 1 by the corresponding sizing factor in Column 2, and enter the result in Column 3. This is the facility surface area needed to manage runoff from the impervious area.
5. Total Column 1 (Rows 1-10) and enter the resulting "Impervious Area Managed" in Box 2.
6. Subtract Box 2 from Box 1 and enter the result in Box 3. When this number reaches 0, stormwater pollution reduction and flow control requirements have been met. Submit this form with the application for permit.
7. If Box 3 is greater than 0 square feet, add square footage or facilities to Column 1 and recalculate, or use additional facilities from Chapter 2.0 of the Stormwater Management Manual to manage stormwater from these remaining impervious surfaces.

Impervious Area Reduction Technique	Column 1: Impervious Area Managed = Facility Surface Area	Column 2	Column 3
1) Eco-Roof / Roof Garden	____ sf		
2) Contained Planter	____ sf		
3) Tree Credit (See Next Page)	____ sf		

Note: Pervious Pavement areas do not need to be included in Box 1

Stormwater Management Facility	Impervious Area Managed		Sizing Factor		Facility Surface Area	Unit
4) Infiltration Planter	____ sf	x	0.05	=		sf
5) Flow-Through Planter	____ sf	x	0.05	=		sf
6) Vegetated Swale	____ sf	x	0.09	=		sf
7) Grassy Swale	____ sf	x	0.12	=		sf
8) Vegetated Filter Strip	____ sf	x	0.2	=		sf
9) Vegetated Infil. Basin	____ sf	x	0.09	=		sf
10) Sand Filter	____ sf	x	0.07	=		sf

For drywell and soakage trench sizing and design requirements, see Section 2.9.

Total Impervious Area Managed ____ **Box 2**

Box 1 - Box 2 ____ **Box 3**

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Adopted July 1, 1999; revised September 1, 2004

Many facilities will also require approved disposal points such as a pipe, ditch or waterway.

Before you Build- Designs and Permitting

Once you have a pre-design and understand how your site works, you are ready to create a final design that will be functional and meet city code requirements.

Final Design

During final design, determine if the facility you choose is cost effective. The following chart lists rough cost ranges of various public and large private facilities built by licensed contractors in Portland in the last ten years. The costs are not adjusted for inflation. **Single family homeowners will likely be able to build many of these facilities for less than the listed costs by doing the work themselves.**

General factors that influence stormwater management facilities selection

After assessing the surfaces, slopes, soils, and setbacks on your property, you will be able to get an idea on which facilities are best for you and the best place to put them. Keep in mind that these charts are a general guideline, and that there will always be exceptions. If you want a specific type of facility, a professional designer could probably create a design that would be approved by City permitting processes. The best solution may be a combination of more than one of these facilities.

Constraints When selecting an appropriate facility, it is important to assess your site for soil type, slope, amount of space, and proximity to your foundation and your neighbor's property. For example, infiltration facilities do not perform well in soils that do not drain well (such as clay) or on sites that have steep slopes due to erosion concerns.

	Rain Barrels / Cisterns	*Ecoroofs / Roof Gardens*	*Trees*	*Vegetated Swales*	*Vegetated Infiltration Basin*	*Flow-through Planter*	*Infiltration Planter*	*Pervious Pavement Systems*	*Soakage Trenches*	*Drywells*
Space limitations	●	●	●	◓	○	●	◓	●	●	●
Poorly-draining soils	●	●	●	◓	○	●	○	○	○	○
Steep slopes	●	●	●	○	○	●	○	○	○	○
Retrofit use	●	◓	●	●	●	◓	◓	◓	●	◓

Benefits Some facilities are best for flow control (reducing total volume and/or velocity), other facilities are better for cleansing and filtering pollutants, some facilities do both, and some facilities achieve cooler air and water temperatures.

Water Quality	○	●	◓	●	●	●	●	◓	○	○
Flow Control	◓	●	◓	●	●	◓	●	◓	◓	●

Costs Facilities can have different costs explained different ways - as cost per foot to build the facility and cost per acre or amount of footage managed. (Costs based on Portland public and private projects build over last 6-10 yrs)

Per Sq. Ft. of Facility (or by unit)	$35-$150 per unit	$1 to $16	$35-$150 per tree	$0.45 to $22.50	$21.35 to $88.50	$34. to $60.	$0.95 to $5	$20-30 a cubic foot	$1,200	
Per Sq. Ft. of Area Managed	$0.09 to .38	$1 to $16	$0.09 to .38	$0.05 to $6.40	$1.50 to $14.40	$0.35 to $0.28	$0.95 to $5	$3.24-$5.40	$0.60	

● Most appropriate ◓ Moderately appropriate ○ Least appropriate

Stormwater Facility Setbacks

Facility Type	Property line setback (ft)	Building foundation setback (ft)	Other setbacks	Sizing (part of IA*)
Infiltration Planter	5 feet	10 feet		6%
Flow-Through Planter	5 feet (unless planter height less than 30 inches)	None		6%
Swales (Vegetated or Grassy)	5 feet	10 feet (unless facility is lined)		9% vegetated 12% grassed
Vegetated Infiltration Basins **Rain Garden**	5 feet	2 feet from slab/crawl space 6 feet from basement	Must be 100 feet from slopes of 10%; add 5 feet for each additional % of slope up to 30%	9%
Soakage Trenches	5 feet	10 feet	5 feet from public utility lines	East: 24 feet (LF per West: 27 feet 1,000 sq ft IA)
Drywells	5 feet	10 feet	20 feet from existing cesspools	Unit size
Splashblock / Downspout Disconnection	5 feet	2 feet from slab/crawl space 6 feet from basements		10%
Ecoroof or Porous Pavement	NA	NA	NA	100%

* IA=Impervious Area
LF=Lineal feet

Examples

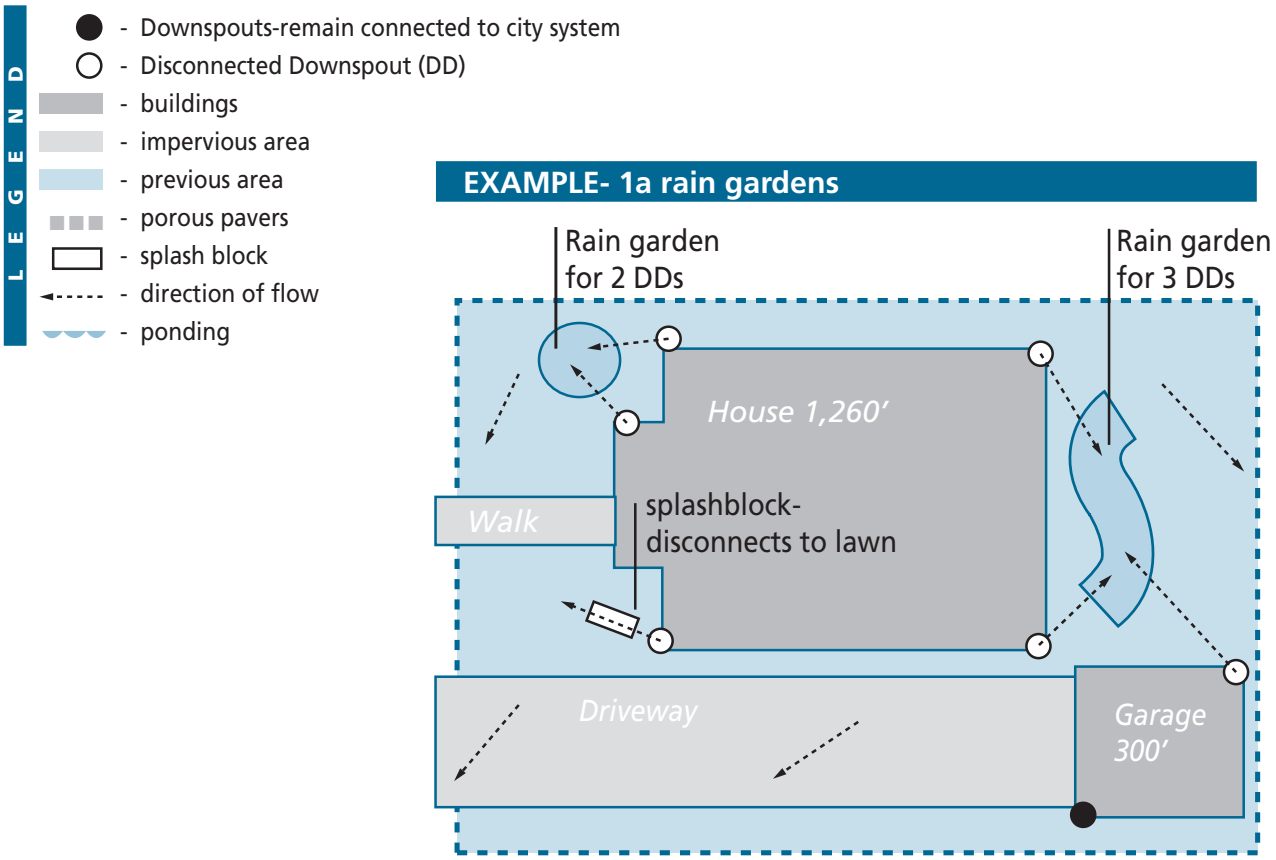
These examples highlight issues covered in this guide and describe hypothetical and actual retrofit opportunities.

Residential Examples

Residential Retrofit - Example 1a

In this example, the roof area is 1,200 square feet and the front porch is 60 square feet. The front splashblock disconnection manages one quarter of the roof area, or 300 square feet. That requires 10% of 300 square feet (30 square feet) of ground area for the water to soak in. That comes out to roughly a six foot by five foot area on the ground.

The front rain garden manages flow from one quarter of the roof and the front porch. One quarter of 1,200 is 300 feet plus the porch (60 square feet) for a total of 360 square feet. To figure the land area for the rain garden, use a 9% sizing factor (see the SIM form). 360 square feet times 0.09 equals about 32.5 feet. Round it up to 33 square feet, or roughly a seven foot by five foot area.



The back rain garden takes drainage from the full back half of the roof and also half of the garage roof. That's 600 square feet of house roof plus 150 square feet of garage roof for a total of 750 square feet. The rain garden needs to be 9% of that area or 67.5 square feet. Round it up to 68, and a 4 foot by 17 foot rectangular space will work.

The other garage downspout is left in place because there isn't enough room to disconnect safely due to size limitations and setbacks. So that downspout stays on the system.

Costs

To estimate costs, multiply the total square footage of each facility type (rain garden or splashblock disconnection) by a figure somewhere in the facility's cost range per square foot listed on the chart on page 8. If you construct the facility yourself by hand digging, then choose a cost that is about half of the lowest end of the range. For this example, the rain garden range is $21.35 to 88.50. We will use $10.50 for round numbers.

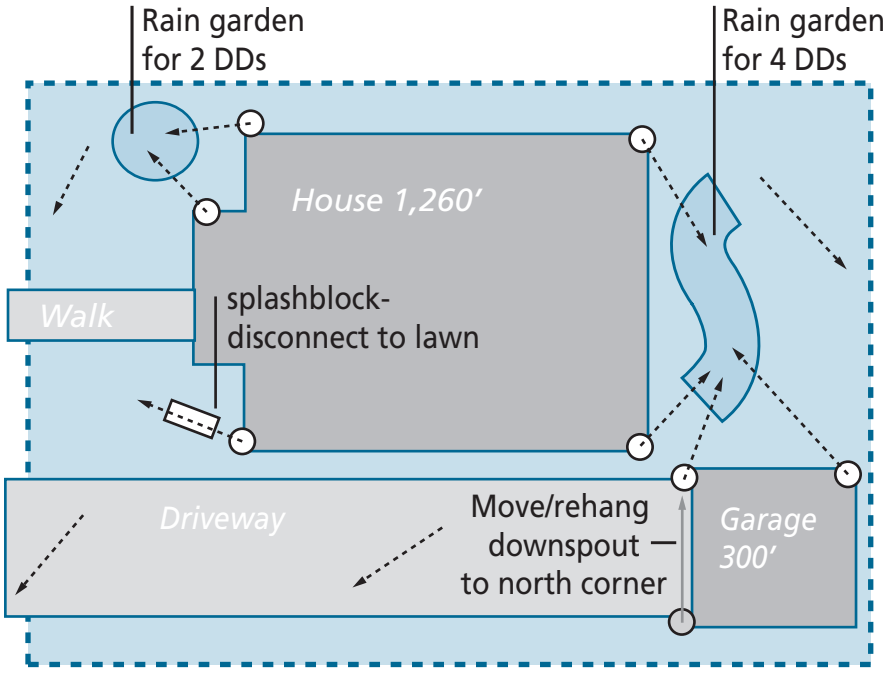
In this example, two rain gardens totaling 101 square feet multiplied by $10.50 equals $1,060.50. Add the cost for the splashblock disconnection ($53), of permits ($200) for the new facilities for a total of $1,313.50.

Now compare those costs to your savings in the discount program. Using the residential discount calculator available at www.CleanRiverRewards.com, the site in this example receives only two thirds of the credit because of the one garage downspout still connected. At that rate, these facilities save $4.67 a month or just over $56 dollars a year. Given the initial costs, that is a payback period of 23 years.

Residential Example 1b

Getting that last downspout on the garage off the system will earn you more credit. To do it, you can rehang the gutter in a creative way to direct water into the back rain garden facility, because you can't get credit if you direct runoff onto the driveway. The extra 150 feet of roof means we need to up the facility size just a bit, so the size needs to increase from 68 square feet to 82 square feet. Making the facility 5 feet wide instead of 4 feet wide and keeping the length at 17 feet long does the trick.

EXAMPLE- 1b rain gardens and replumb



Example 1b will cost a little more. Rehanging the gutter will cost about $100, and upsizing the rain garden ($10.50 times the additional 14 square feet) will cost $147, for a total new cost of $1,560.50.

Running the new information through the residential discount calculator shows that the site qualifies for the full discount, which saves almost $7 a month or almost $84 dollars a year. For investing an extra $250, the payback period drops from 23 years to 18 years.

Residential Example 1c

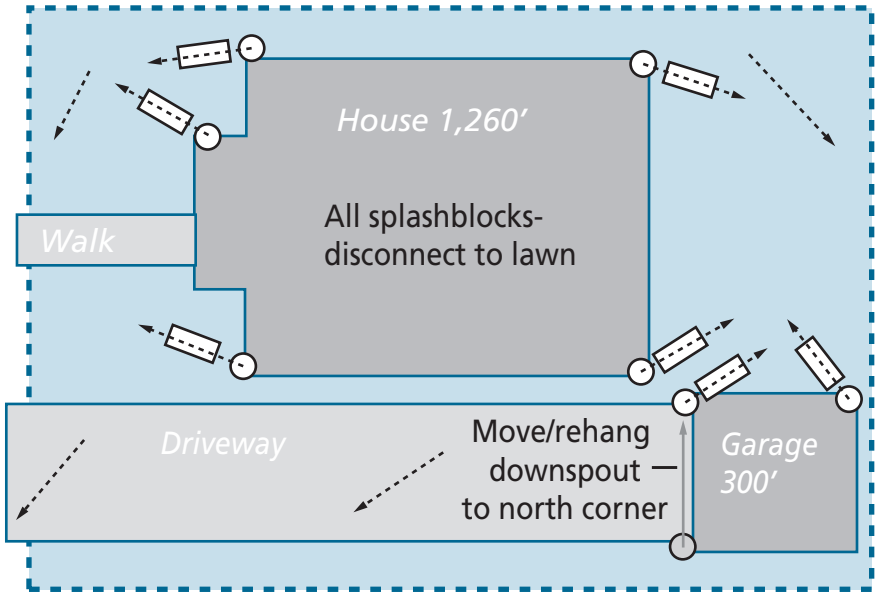
Substituting different types of facilities can reduce costs and the payback period even more. Splashblock disconnections take more room, but are cheaper than rain gardens and require no digging. Splashblock disconnections for this roof require 156 square feet compared to the rain garden requirement of 145 square feet.

These facilities will qualify you for the full discount and cost significantly less. You will spend $53 for each disconnection instead of $10.50 a square foot for a rain garden. The total cost, including the garage rehang, comes to $418, which makes the payback period less than 5 years instead of 18 years.

So try a few different types of facilities to see what works best for your site.

Areas on the west side of the Willamette River and on the buttes in east Portland are more difficult to retrofit because of slope and soil issues. The next examples look at more complicated options, when use of an outside contractor is likely.

EXAMPLE- 1c all splashblock disconnection



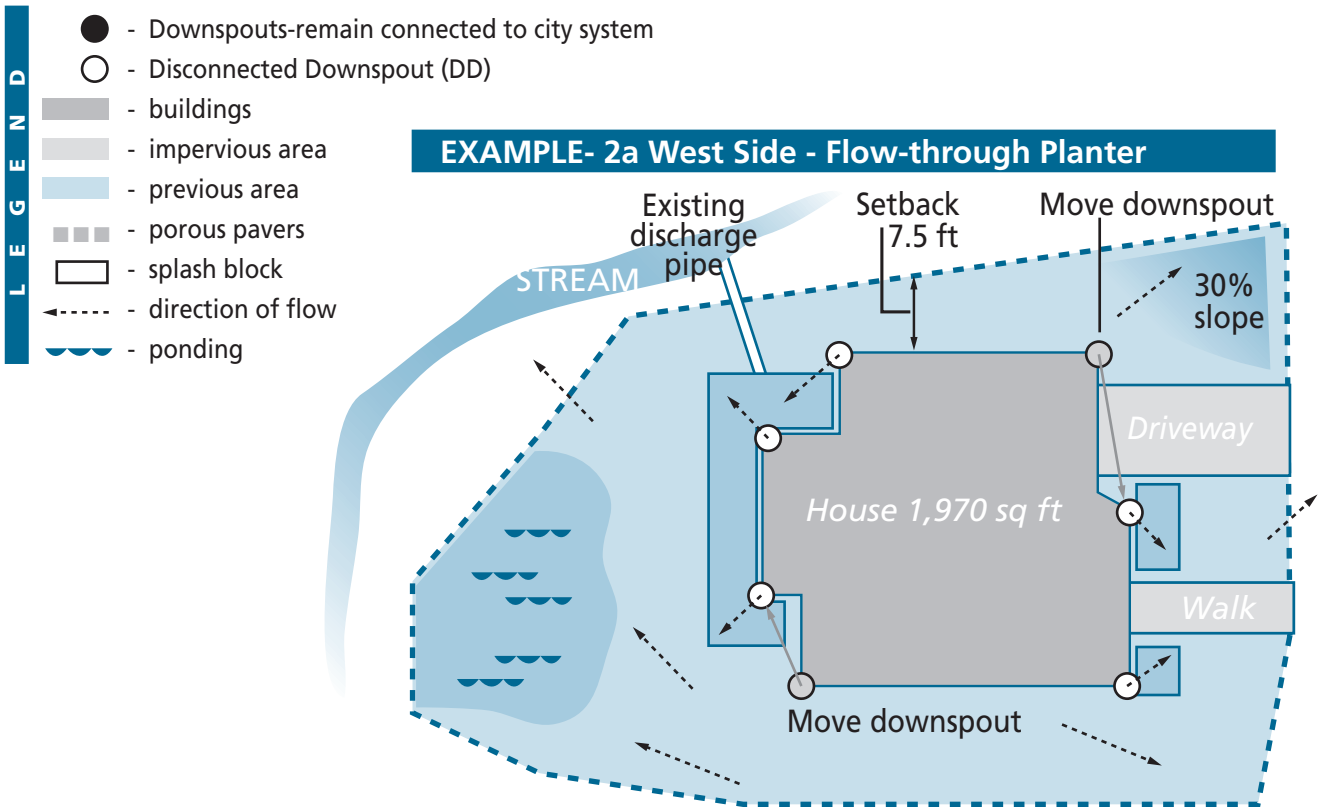
Difficult Site Example 2a

This example is in southwest Portland near Arnold Creek. The tax record map on PortlandMaps.com shows that this property has a two story house with 1,409 square feet on the main floor and a 561 square foot attached garage. So the building footprint and the amount of impervious area on the site are 1,970 square feet.

The site drains into Arnold Creek through an underground pipe. The house is on a 20-foot long slope that drops six feet to the northwest corner of the property. That makes it a 30% slope.

This design example uses two flow-through stormwater planters in the front and a large one in the back to manage the flow. It also requires some replumbing of two downspouts to direct water into the planters.

The three downspouts in the front drain about 300 square feet each or 900 square feet of roof area. Planters need to be 6% of the size of area they are treating. We will use two planters-one on either side of the front walkway. So the front planters need to be 18 square feet (3 feet by 6 feet) and 36 square feet (3 feet by 12 feet). The large back planter will manage 1,070 square feet, so it needs to be 64 square feet (16 feet by 4 feet). So this property requires a total of 118 square feet of planter. Assuming a cost of $40 per square foot (about one third of the cost range), these planters will cost $4,270 for a contractor to install. Materials, construction and permits for this design will cost about $5,220. Not all the water directed to the planters soaks into the ground. The facilities hold water for re-release, so they are eligible for only two thirds of the available discount. These facili-



ties save $4.67 a month or $56.04 a year. Given the high cost of installation, the payback period for these facilities is 93 years.

Difficult Site Example 2b

This example on the same property uses less costly facilities. Because there is a creek behind the house and the slopes are not steep, simple splashblock downspout disconnections could manage stormwater from the back of the house. There is less room in the front and no suitable disposal point. A soakage trench is a good way to dispose of water onsite on marginal slopes.

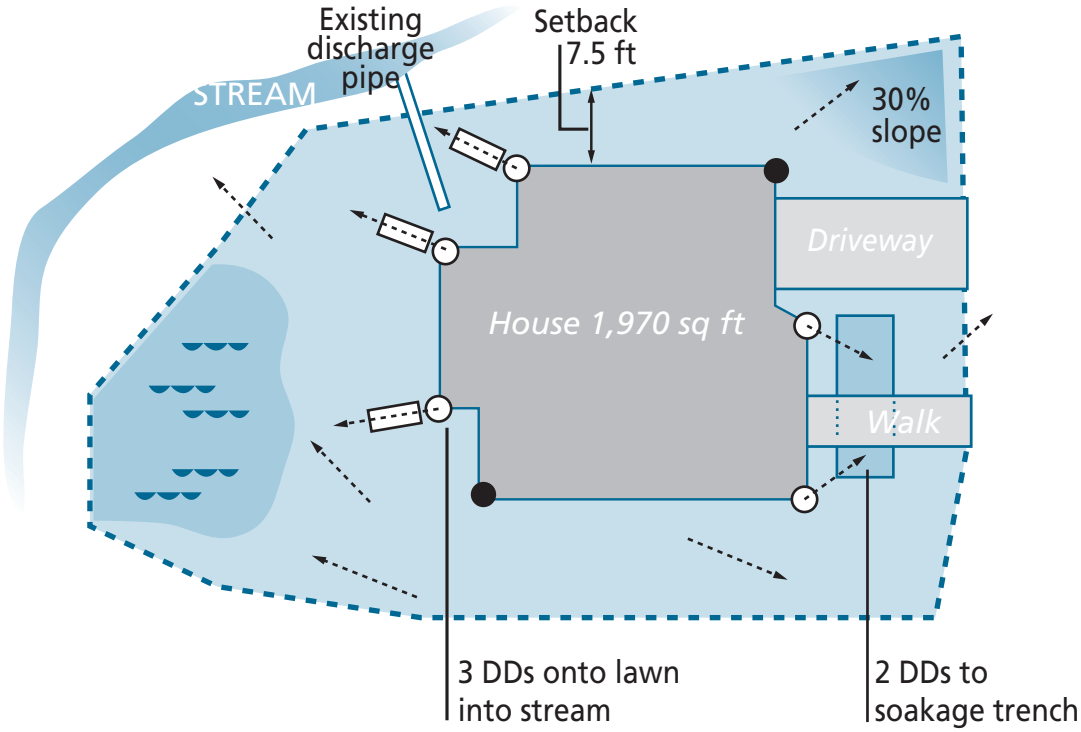
Note that downspouts on the northeast, and southwest corners of this property are left connected to the stormwater line because they cannot be safely disconnected.

The soakage trench needs to be large enough to manage stormwater from 600 square feet of roof. Using the west side trench sizing criteria of 27 lineal feet for every 1,000 feet of roof area, the trench needs to be 16.25 feet long. At a price of $25 a foot, the trench will cost about $400.

Behind the house, the three splashblock disconnects at $53 each will total $159. There is ample room for the discharge on the property and the existing stream will be the disposal point.

Adding in permit costs, the total for this design option is $759. These facilities will save the same amount of money as the previous example, but reduce the payback time to 13 years.

EXAMPLE- 2b West Side - Soakage Trench with DDs



Commercial Examples

Commercial Example 3a

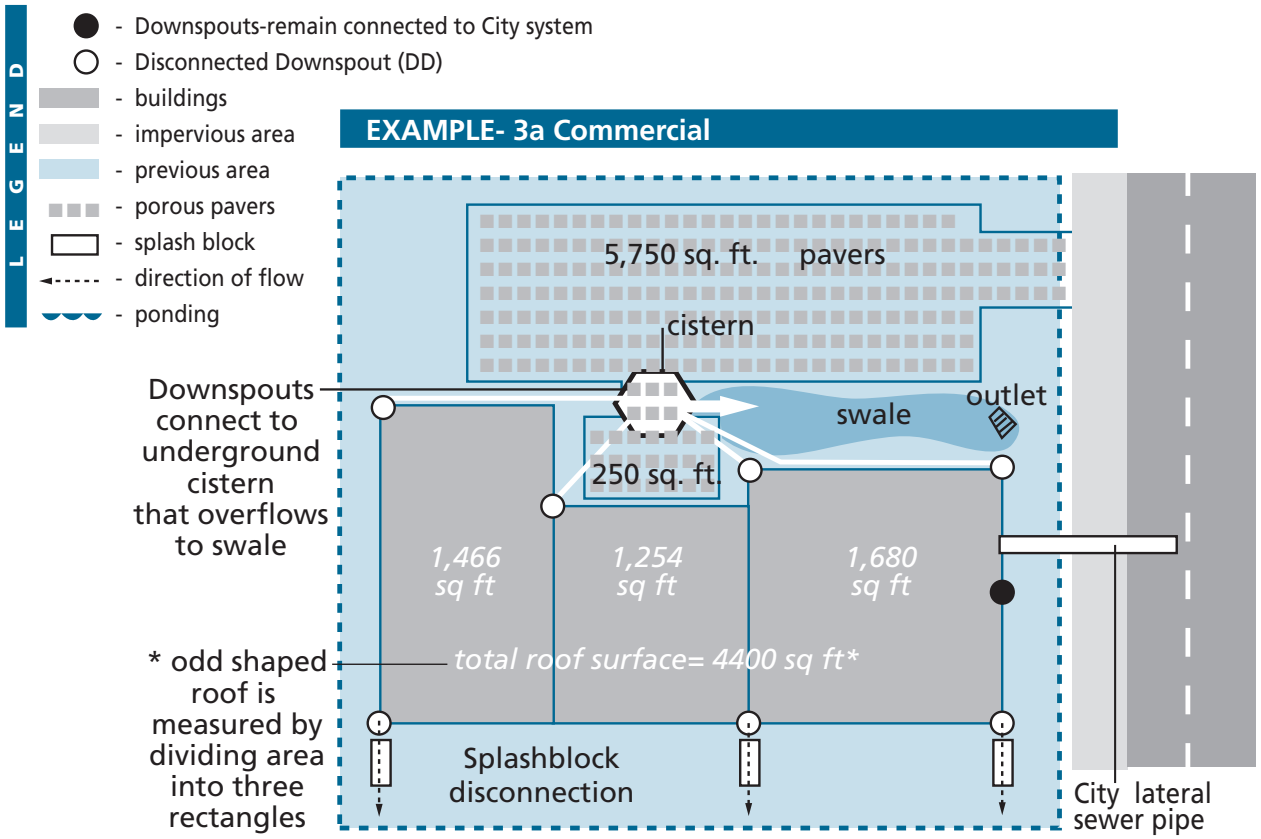
This example is from a real retrofit. The site is a fairly standard commercial office space for a company that has a very strong environmental ethic. The property owner wanted to replace a worn parking lot and add sustainable stormwater management facilities.

The company replaced a large section of pavement at the building entry with more graceful walkways. They removed the parking lot and replaced it with porous pavers. The pavers on this property replace the entire 5,750 square foot parking area surface and the 250 square foot patio area for a total of 6,000 square feet.

The front portions of the building drain about 3,200 square feet into a cistern that overflows into a swale. Based on the building's reuse rate, the cistern has a 1,700 gallon capacity. The cistern is designed to overflow into a swale that allows water to soak into the ground. The swale is vegetated, so the ground space it requires is 9% of the 3,200 square foot roof area, or 288 square feet.

The three back downspouts drain to the adjacent vegetated area through simple splashblock disconnections. The disconnects need to drain to an area about 10% the size of the roof area for safe flow management. The downspouts drain 1,000 square feet, which requires 100 square feet of vegetated area on the ground. That comes out to about 34 square feet at the end of each downspout. A downspout draining 200 square feet at the east side of the building facing the street is not disconnected.

Compute the costs by multiplying the total square footage for each facility type by a cost



from within the cost range per square foot of facility on the chart on page 8. For this example, the swale range is $0.45 to $22.50. We will use a higher value of $20 per square foot because of demolition required to install the swales. The pavers, cistern and splashblock disconnections bring the total cost to about $43,570.

This project also qualifies for 88% of the allowable discount rate and saves $27.93 a month, or $335.16 a year. The long payback period (130 years) indicates the property owner was motivated primarily by a concern for the environment rather than by economics.

This project is one of several stormwater retrofit case studies posted at www.portlandonline.com/bes under Sustainable Stormwater Program.

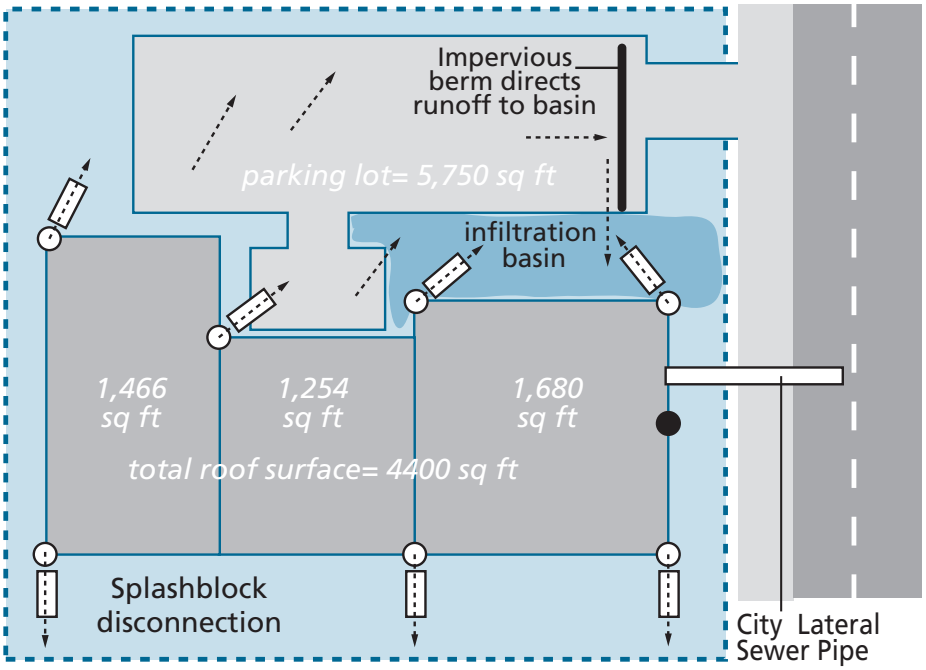
Commercial Example 3b

There are less costly options for managing runoff on this site. Instead of porous pavers, this site is also suitable for a vegetated infiltration basin. Water could either sheet flow into the facility, or a berm could direct water to it. The infiltration basin will manage flows from the 6,000 square feet of paving and the 3,200 square feet of rooftop for a total of 9,200 square feet of drainage area. The receiving area needs to be about 9% of the total size, or 828 square feet.

Pavement removal, minor excavation, berm construction and disconnections will cost about $5,450 (some actual and some estimated costs). The work will involve removing 900 square feet of pavement ($1,325 from the actual project budget) and minor excavation to create a depression for the runoff ($3,200 from the actual project). Adding a berm (estimated at $500) and $53 each for the eight disconnects brings the cost to $5,449.

This project also qualifies for 88% of the allowable discount rate and saves $27.93 a month, or $335.16 a year. But the payback period drops to 16 years.

EXAMPLE- 3b Commercial



Resources

Cost Resources

- Clean River Rewards Discount Calculator- Check www.CleanRiverRewards.com to determine what potential stormwater utility discount is available for your facility installation. Commercial and residential calculators are available.

Reviewing

Check if there are any City zoning or building standards that make your facility choice unreasonable:

- Review site maps for zoning overlays. Check PortlandMaps.com to identify any zoning overlays. Most pertain to building a structure and not stormwater facilities. But some zones, like environmental overlays, limit what you can do on your site.
- Check your site use. This applies mainly to commercial sites regulated by specific land use requirements. If you are unsure about your site, visit the city's permit center for help identifying zoning and building code issues. For example, some commercial zones and conditional uses have specific parking requirements that could limit your ability to remove pavement for site facilities.
- Check design and safety standards. You will need technical details to help develop a final plan. See the resources below.

Technical Resources

- City of Portland Stormwater Management Manual - This technical manual contains design information for all the facilities discussed in this guide. Download it from www.portlandonline.com/bes or call 503-823-1371 to get the manual on compact disc or to purchase a paper copy. Paper copies are $35 each. Compact discs are free.
- City of Portland Stormwater Solutions Handbook - This handbook contains simplified descriptions of various stormwater management facilities. Download the handbook from www.portlandonline.com/bes or call 503-823-1371 for a free copy.

Professional Contractors and Engineers

Working with a professional can ensure that your project is safe and functional. Some professionals have attended city-sponsored stormwater retrofit training. A list of contractors who attended the training is available at www.CleanRiverRewards.com or by calling 503-823-13710. You can also find landscape architects, engineers, and contractors in the telephone directory.

If you finish your design and think a stormwater retrofit is a viable option, you will need to complete the design calculations, plan layout and permit application package.

Permitting

Your stormwater retrofit project is likely to require a city permit before you start work.

To help identify which permits you may need, prepare a site plan packet for permit review. The packet should contain:

- A short description of your project. Use the term "Stormwater Retrofit" on permit applications. Describe the type and location of the facility.
- A site sketch of your proposed facility.
- Sizing calculations for your facility.

- A written description of where water will go if it overflows the facility, i.e. will it flow into the street, or into an existing drain. Be specific.
- If planning a vegetated facility, list the plant types and quantities you plan to use.

Make four copies of your plans and application materials and submit them to the city Permit Center at 1900 SW 4th Avenue. A site plan checklist is available at www.portlandonline.com/bds.

See the Stormwater Solutions Handbook for permit requirements for specific stormwater facilities.

Installation and Maintenance

All stormwater facilities must be installed correctly and maintained regularly to function properly. Before you install a facility, make sure you have the resources necessary for ongoing maintenance. As part of the permitting process, most facilities will require an operations and maintenance plan that is attached to the property deed. The recording ensures that future property owners will know there is a stormwater management facility onsite and that they have to maintain it.

The most common installation problem for stormwater retrofits is poor soil quality. Consider mixing topsoil with sand and compost to enhance infiltration. Assure all plantings are well established before routing stormwater to facilities. Consider excavating in the summer, planting in the fall and disconnecting downspouts and routing water into facilities the following spring.

The most common maintenance problem is system components clogged by leaves, trash, dirt and other debris. Make sure you regularly clean inlets and curb cuts, remove invasive plants and check for erosion control.

Phones and Websites

City of Portland Environmental Services:
Clean River Rewards Program
503-823-1371
www.CleanRiverRewards.com

half inch grid to aid site drawing