Photo: Candace Stoughton, East Multnomah Soil and Water Conservation District

An established rain garden in Portland, Oregon.

LOW-IMPACT DEVELOPMENT FACT SHEET

RAIN GARDENS

Maria Cahill, Derek C. Godwin, and Jenna H. Tilt

A rain garden doesn't "grow" rain, but it does provide an attractive, effective way to manage runoff. Learn what it takes to make your own rain garden in a low-impact design landscape.

A rain garden is a sunken garden bed that collects and treats stormwater runoff from rooftops, driveways, sidewalks, parking lots, streets, and lawns. It is a landscaped area in a basin shape designed to capture runoff and settle and filter out sediment and pollutants. Runoff is piped, channeled, or directed to the basin, where it is temporarily stored until it slowly seeps into the soil.

Other common names for rain gardens include bioretention basins and vegetated basins. Swales with check dams or berms that allow water to back up behind them function like rain gardens and are referred to as water-quality swales. Similarly, stormwater planters have been described as "rain gardens in a box." What they all have in common is that they retain water in an area with plants and soil, where it passes through the plant roots and the soil column.

FILTRATION VS. INFILTRATION RAIN GARDENS

In general, there are two kinds of rain gardens. Rain gardens that cleanse, detain, and reduce runoff volumes by allowing water to seep into the surrounding soils are

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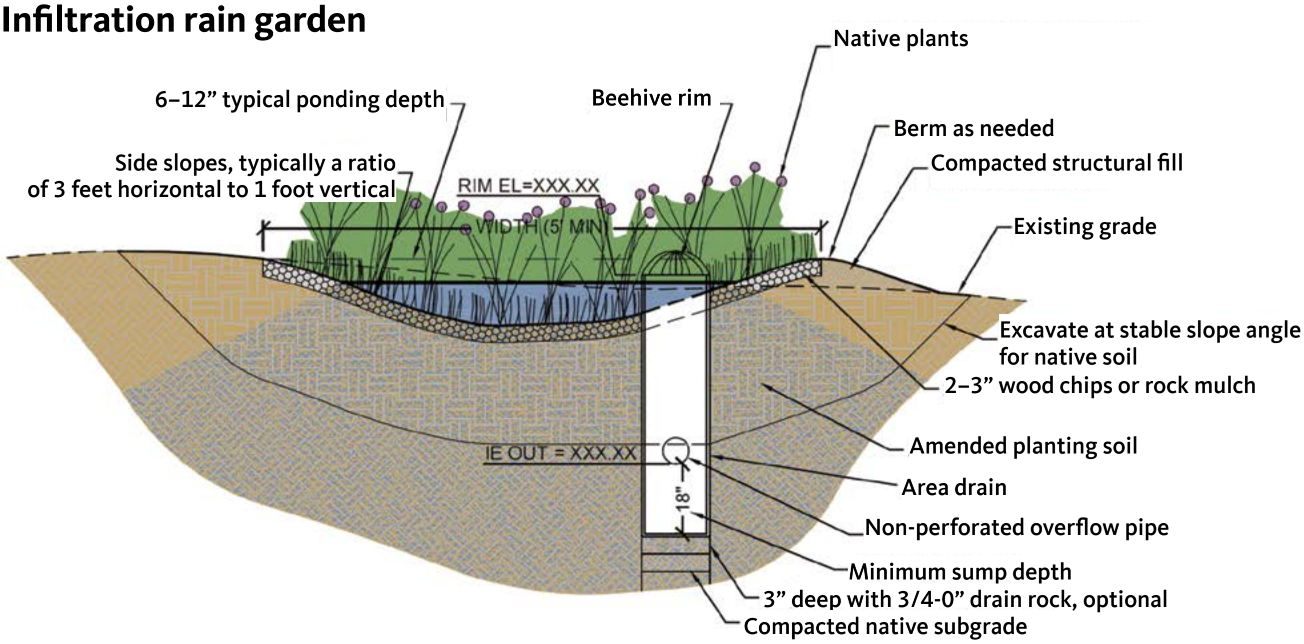
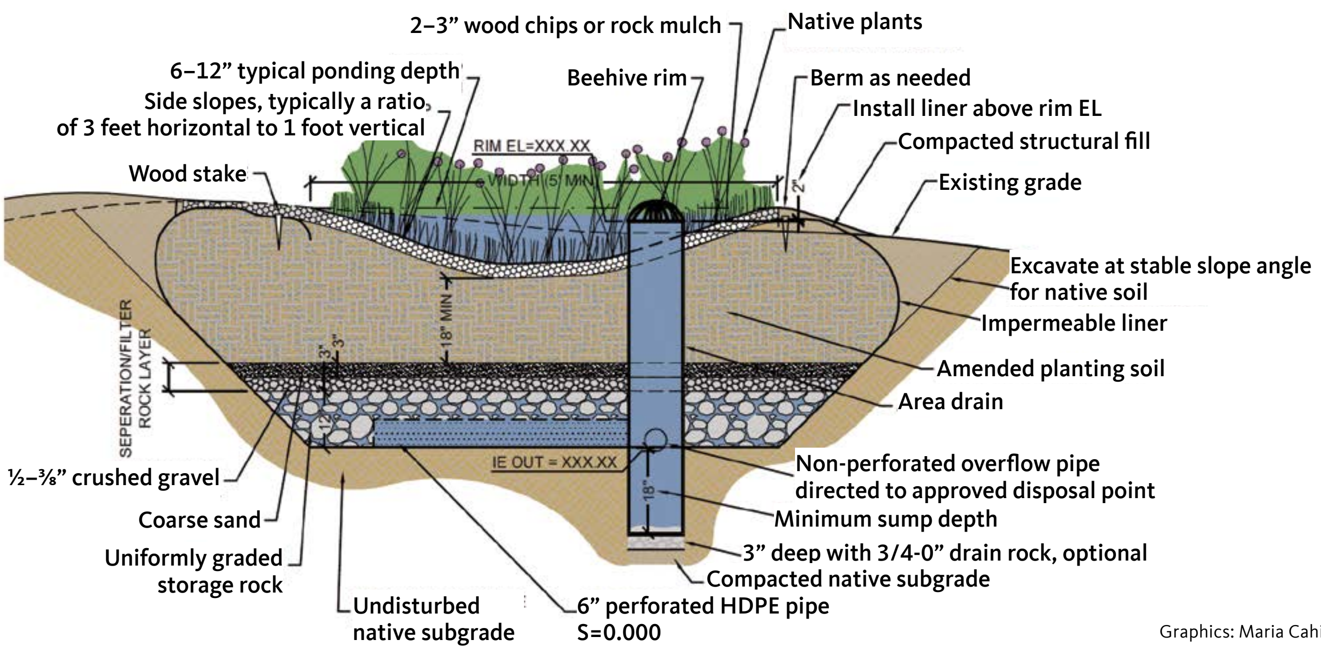
Infiltration rain garden



Filtration rain garden



Graphics: Maria Cahill

called **infiltration rain gardens.** Rain gardens that cleanse and detain stormwater runoff and then pipe the water elsewhere are called **filtration rain gardens.** Filtration rain gardens do not significantly reduce stormwater volumes.

Infiltration rain gardens allow runoff to pass through the top mulch and the middle soil layers of the rain garden. They control runoff volumes by slowly dispersing water into the native soils. In this way, runoff takes an entirely different route to waterways. Unless runoff volumes exceed the capacity of the rain garden, an extra layer of washed drain rock won’t be necessary.

Filtration rain gardens allow runoff to pass through the top mulch and the middle, amended soil layers of the rain garden before being collected in a pipe and routed to an approved disposal point. They are used in situations in which infiltration to the underlying soil layers is unsafe. Typically, a 12-inch layer of ¾-inch, washed drain rock is used in combination with a perforated, 4-inch HDPE (high density polyethylene) pipe, to allow for detention and conveyance of the water (Gresham 2007). This lined configuration should not be relied on to meet typical flow control or detention regulations. However, to slow the water a little, install this underdrain assembly as a narrow French Drain configuration rather than laying gravel across the entire bottom.

Site conditions

Rain gardens successfully manage runoff from all types of impervious surfaces, as well as more pervious surfaces such as lawns (Gresham 2007, Barr 2001). Potential sites for rain gardens include front and back yards, parking lots and streets (Barr 2001). Both infiltration and filtration facilities have been used successfully on private property, public property, and within the public right-of-way. Rain gardens may be built in both new and existing developments. They have been used in many different climates and geologic conditions, from wet western Oregon to the cold winters and hot, dry summers prevalent in eastern Oregon. Choose vegetation adapted to the climate.

SITE REQUIREMENTS FOR INFILTRATION RAIN GARDENS

- **A seasonal-high groundwater table** lower than 24 inches from the bottom of the rain garden.
- **Bedrock lower than** 18 inches from the bottom of the rain garden.
- **More than 5 feet** horizontally from underground utilities.
- **More than 5 feet** horizontally from the top of a building foundation or site wall.
- **At least 100 feet** from down-gradient slopes of 10 percent.
- **Or, at any site** approved by a qualified licensed engineer or geologist who has signed and stamped a geotechnical report or site plan clearly designating the location.

SITES WHERE FILTRATION GARDENS ARE A BETTER CHOICE

- **Where the seasonal-high groundwater table** is higher than 24 inches from the bottom of the rain garden.
- **Where the bedrock** is higher than 18 inches from the bottom of the rain garden.
- **At potential stormwater hotspots** (vehicle fueling areas or industrial loading, unloading, and material storage areas).
- **In contaminated soils** or groundwater.
- **Within 100 feet** of a well.
- **On slopes** exceeding 10 percent or in landslide areas.
- **Where adequate setbacks** and vertical separations cannot be met.
- **Over karst bedrock** (landscape underlain by eroded limestone).

Removing pollutants

Rain gardens reduce stormwater flow rates and volumes that negatively affect stream health. They also remove sediment and pollutants by filtering and settling particles through plant roots and soils, and sequestering pollutants in the soil through absorption and other processes. In addition, the plants themselves absorb some of the pollutants in a process called nutrient cycling.

Large jurisdictions commonly recommend that rain gardens remove 70 percent of total suspended solids from 80 to 90 percent of the average annual runoff to meet National Pollutant Discharge Elimination System (NPDES) permit requirements from the Oregon Department of Environmental Quality (ODEQ). The Center for Watershed Protection (CWP) estimated the phosphorus removal rate to be 25 to 50 percent; the rate of nitrogen removal was estimated at 40 to 60 percent (CWP 2008).

Photo: City of Gresham

A rain garden in Gresham, Oregon, fills with rain. Note the use of rocks at the outflow point near the top.

Cost

Rain gardens are cost-effective when compared to conventional stormwater management for flow rate, volume control, and water quality treatment, which vary with the size, site conditions, vegetation, and materials used for drainage and routing.

Maintenance costs vary with the choice of long-term erosion control, such as mulch or dense vegetation. Compost mulch is more likely to be removed with the sediment and will need to be supplemented. Rock mulch costs more to buy and maintain than compost—so much more that many stormwater managers have removed rock mulch after construction and opted for dense vegetation.

Design and sizing

INFILTRATION RAIN GARDENS

A well-designed, low-impact development project should incorporate small, numerous facilities that are distributed in the uphill and downhill areas of a given site or watershed. A general rule is that infiltration facilities that manage runoff should receive no more than 10,000 to 15,000 square feet of impervious drainage area or the equivalent in landscape area (approximately 11,750 to 17,500 square feet). Check with your local planning department for specific design requirements for your area.

An underdrain pipe is probably not needed in an infiltration rain garden, but some designers use it to ensure that the facility has drained in time to manage the next storm and that standing water does not damage plants. In this case, an underdrain pipe could convey heavy runoff volumes, but exercise care during design to avoid triggering additional state permit requirements (see Underground Injection Control (UIC) regulations, below). If using an underdrain, raise it a few inches from the bottom of the rain garden to infiltrate at least a small amount of water. Even small amounts of infiltrated water can improve water quality and support healthy water systems.

Photo: Robert Emmanuel, © Oregon State University

An outflow notch in a Portland, Oregon rain garden, Protected by rock to prevent soil erosion.

To properly size an infiltration rain garden, account for three factors: the amount of runoff routed to the garden; the depth allowed for the water to “pond,” or collect before overflowing the side slopes of the garden; and the rate at which the water is absorbed into the native soils (the infiltration rate).

The amount of runoff routed to the rain garden depends on local rainfall patterns, the area of surfaces draining to the garden, and how much of the water runs off these surfaces. Impervious surfaces will generate the most runoff, simple landscapes like lawn will generate a moderate amount of runoff, and complex garden areas with trees, shrubs, and mulch will generate the least, if any, runoff. The ponding depth of the rain garden may be up to 12 inches, and the side slopes should slope gently (a ratio of 3 feet horizontal to 1 foot vertical). Side slopes that exceed this recommendation require mechanical compaction, which would eliminate the infiltration capacity of the soil and make it difficult for plants to grow.

FILTRATION RAIN GARDENS

In situations where it’s important to keep water from infiltrating the underlying soils due to nearby structures, property lines, steep slopes, or high water tables, use an impermeable liner along the bottom of the facility to prevent infiltration to underlying soils. These liners are sometimes constructed of 60-mil PVC (Gresham 2007), but 30-mil polyethylene pond liners and bentonite clay mats can be just as effective.

The City of Portland recommends a layer of ¼- to ¾-inch washed, crushed rock between the soil medium and gravel layer, to prevent the soil from mixing with the drain rock (PSMM 2008), although any “open-graded aggregate” (that is, rock that is similar in size) will work. The University of New Hampshire has a rain garden that has been successful with a pea gravel layer on top of a layer of coarse sand. However, pea gravel (i.e. “rounded rock”) is not recommended in Oregon since it’s most often mined directly from streams, a practice that is harmful to stream health. Some jurisdictions require the use of a geotextile filter fabric instead of rocks. Clogged geotextile fabrics prevent stormwater from accumulating in the gravel layer below and inhibit proper flow, resulting in plants with constant “wet feet.” If this is not required, we recommend using layers of washed, crushed rock to limit the amount of fines (silt, fine sand) that could clog a geotextile.

	25-year event depth (inches)	Distribution	Peak flow (cfs)	Rain garden footprint needed (square feet)	Percentage of facility size compared to impervious drainage area	Peak flow exceeding rain garden storage (cfs)	Maximum ponding depth in planter (inches)
Salem	4	Type IA	0.22	940	9.4%	0	11.5
Coos Bay	5.5	Type IA	0.30	1253	12.5%	0	12.0
Redmond	1.8	Type I	0.29	535	5.4%	0	11.8
Wasco	2.3	Type I	0.38	674	6.7%	0	11.9
La Grande	2.4	Type II	0.78	955	9.6%	0	11.9
Pendleton	1.6	Type II	0.51	647	6.5%	0	11.8

Table 1. Peak flow comparison and sizing examples from modeling results to infiltrate runoff from 10,000 square feet of impervious area at a rate of 2 inches/hour during the 25-year 24-hour design storm

STORM TYPE CONSIDERATIONS

Rain gardens are designed to infiltrate and treat runoff from 80 to 99 percent of storms. Gardens are engineered to safely allow overflow from these larger storms, whether this runoff is routed off-site over land or via a storm pipe. A "design" storm is a theoretical storm a rain garden is designed to treat. The size of the storm is analyzed to occur at a given frequency; thus, we usually see design storms described as 6-month, 1-year, 2-year, 5-year, 10-year, 25-year, or 100-year storms that occur over a 6-hour or 24-hour period. The size and duration of the design storm is typically specified by local city or county regulations. For example, a jurisdiction may expect rain gardens to be designed to treat all storms up to the 10-year storm for a 24-hour period.

A rainfall distribution is a statistical representation of the intensity and duration of rainfall that occurs on average for each storm. These distributions provide a way to model the intensity and duration of rainfall for a given design storm. Oregon has three different rainfall distributions, called Type IA, Type I, and Type II. Type IA is a lower intensity, longer duration storm typical of western Oregon, while Type II storms are higher intensity, shorter duration storms. Type I storms fall in between these two. Each jurisdiction will develop its own requirements for the size of storm (design storm) and distribution type (1A, 1 and II) based on goals for water quality and quantity. Check the Soil Conservation Service Storm Type map at http://extension.oregonstate.edu/stormwater/what-storm-type-do-you-live.

Rain gardens are designed to drain within 30 hours for a Type IA storm distribution and 72 hours for Type I and Type II storm distributions. This ensures that they will drain in time to treat the next storm, provide drainage for plants, and prevent the accumulation of standing water (a draw for mosquitos and other pests). In situations where the surfaces are impervious and essentially all rainfall becomes runoff (for example, rooftops, driveways, and sidewalks and areas of fill—even if landscaped), the footprint of the rain garden typically ranges from 6 to 15 percent of the impervious surfaces draining to it (Table 1). Slower infiltration rates necessitate a larger rain garden footprint. However, most jurisdictions have no need to infiltrate the 25-year storm, so if the design storm is smaller, then facility footprints in Table 1 might be much larger than the proposed final design. Some regulations, such as the Central Oregon Stormwater Manual, require that dimensions be based on storing the volume of the entire water quality storm (a much smaller storm in depth and more frequent than the 25-year, 24-hour design storm), since the soil may be frozen and unable to infiltrate during some storms.

SOILS AND MEDIUM

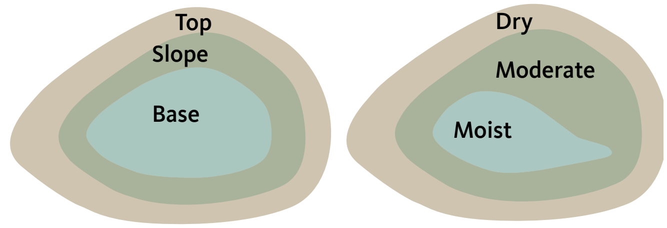
Since rain gardens are routinely inundated, soil can easily erode. Many rain garden details call for a 2-inch layer of bark mulch. However, this material can float and leave soil bare, even during small storms that simply redistribute the mulch around the garden; large storms may carry it right out through the overflow structure. This causes problems downstream because the amount of available oxygen in the water body can drop as the mulch breaks down.

For this reason, spread a 2-inch layer of coarse compost or arborist wood chips in the regularly inundated area. Above the regularly inundated area, either continue with coarse compost or switch to fine compost. It is helpful to add mycorrhizae (live mushroom soil additive, not mushroom compost) to the soil. These organisms grow into the compost and form a mat of mycelium, or mushroom roots, that hold it together and keep it from floating.

The most effective way to control erosion is to plant dense vegetation on the bottom of the rain garden, using mulch at the time of construction only. Dense plantings also shade out most weeds. Avoid rock mulch, which is expensive and difficult to maintain without causing the rocks to settle into the growing medium. Rock mulch placed at the inlet and outlet is also challenging to maintain, since high water flows bury it in sediment and may transport smaller rocks up to 2 inches in diameter around the system.

Amended planting soil or amended native soils should have infiltration rates high enough to pass the design storm through the soil, but not so high that the stormwater does not spend enough time in the soil for treatment (known as retention time). The ideal infiltration rate is between ½ inch per hour and 12 inches per hour (PSP 2009). The top 18 inches of soil is typically amended with organic compost. In some cases, existing topsoil is replaced with a soil mix, as specified by the local jurisdiction; however, agencies are beginning to move away from this requirement after observing poor plant establishment. If still required, don't use mixes that are so sandy that they do not have enough organic matter to adequately support plant life; sandy soils increase irrigation requirements and the likelihood the plants will die. Also be careful to import soil and compost that are free of weed seeds. Other key considerations for robust plant establishment and stormwater treatment include soil pH (between 5.5 and 7.5) and its ability to remove heavy metals (measured by a cation-exchange capacity of greater than 5 millequivalents/100 grams) (LIDC 2003).

Test the rate of infiltration at the proposed site to make sure the native soils at the bottom depth of the proposed rain garden are able to handle the volume of water flowing in.

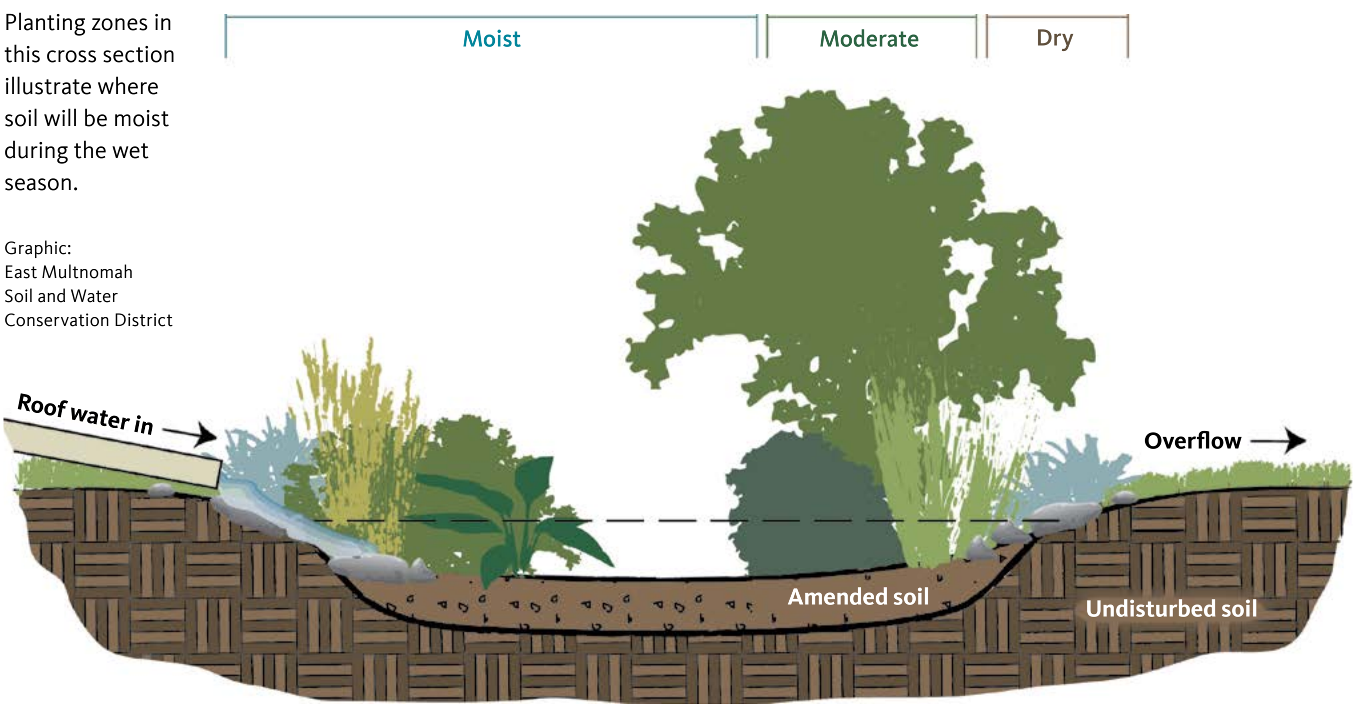


The graphic on the left illustrates the topographic zones of a rain garden. The graphic on the right illustrates zones of high and low soil moisture during the dry season. Planting zones reflect the areas where the garden will have the most and least water when flooded and during periods of drought.

The minimum infiltration rate is defined by the area available for infiltration: The larger the infiltration area, the lower the soil's infiltration rate. Most jurisdictions recommend at least ½ inch per hour when using an infiltration facility, but this measurement could be lower if space and budget allow. Since stormwater has already passed through the middle, 18-inch-deep amended soil layer and received treatment, there is no recommended maximum infiltration rate for native soils. If infiltration rates are so low that the plants will be inundated for too long, consider building an infiltration rain garden with an underdrain. Install it so it's raised a few inches above the bottom of the drain rock to allow some water to infiltrate out the bottom of the facility. Even a little infiltration helps improve water quality and reduce downstream flooding.

Planting zones in this cross section illustrate where soil will be moist during the wet season.

Graphic:
East Multnomah Soil and Water Conservation District



USDA Plants Database

Indian plum and common camas are two species native to Oregon and appropriate for rain gardens.

Photo: Chris LaBelle, © Oregon State University

This Willamette Valley rain garden is planted with Sedum 'Autumn Joy' (*Sedum telephium*), slough sedge (*Carex obnupta*), New Zealand sedge (*Carex testacea*), yellow-eyed grass (*Sisyrinchium californicum*) and mallow (*Malva* spp.).

VEGETATION

The interaction of soil, plants, and the beneficial microbes that concentrate on plant roots is what ultimately provides the treatment benefit of rain gardens. The more plants, the greater the benefit. Some rain gardens are designed with a dry creek-bed look and plants around the edges, but this approach may not provide adequate treatment for the small, frequent storms with ponding depths that never reach the plants on the side slopes.

A variety of trees, shrubs, grasses, and ground covers work in both sunny and shady rain gardens. The garden should be densely planted to control weeds and maximize water treatment value. Usual standards call for 90to 95 percent coverage in 2 to 3 years. Local jurisdictions often provide specifications for density, size, and types of vegetation. Select plants based on flood tolerance, drought tolerance and their ability to survive in local climate conditions without the use of fertilizers, herbicides, or insecticides. Select plants for separate zones depending on the amount of water reaching each zone, from wetland to upland areas. Rain gardens should also be designed to fit into the landscape.

Perennial flowers, ornamental grasses, and shrubs can add significant appeal. Rain gardens can also be designed to attract beneficial insects and wildlife. Contact your local OSU Extension Service office or planning department for a list of plants appropriate for your area. It's also important to avoid invasive plants because water can wash seeds downstream to vulnerable wetlands, affecting the habitat potential of our natural waterways. Check the Oregon Department of Agriculture's list of noxious weeds at www.oregon.gov/ODA/PLANT/WEEDS/.

Native plants provide more nutrition for native insects and birds. Native plants also support native microbes and other soil life, while non-natives have been found to negatively alter the composition of soil life. The Washington Department of Ecology provides an extensive list of plants adapted for climates east of the Cascades (WDOE, 2013).

Note that in cold climates, rain gardens may sometimes be used to store snow to treat runoff from an area that was treated with salt as a deicer. In these cases, choose salt-tolerant, non-woody plants (EPA, 2013).

Routing

Runoff at inlets can erode soil, especially when water is concentrated to enter the rain garden at a particular place. Many facilities in Oregon today have riprap placed at the entrance to dissipate energy; however, this design requires a lot of maintenance. Instead, use a catch basin inlet that overflows to the facility or some other structured box that can be cleaned out easily with a shovel or a wet vacuum.

Dense vegetation at the inlet may impede the flow of water into the facility and may be difficult to clean out. There are many ways to create a rough surface to slow flows, including the use of baffles or modified inlets. Smooth concrete channels are not recommended unless slightly tipped back towards the drainage area, because they will simply transfer erosive flows from the entrance to the end of the channel. The runoff may also be pretreated by directing it through a 4-foot-wide strip of turf grass (with less than a 10 percent slope). If runoff is being piped, it can be pretreated by specifying a catch basin with a sump. Use a check dam to spread flows and settle out solids at the inlet to greatly simplify sediment removal during maintenance. This maintains the integrity of the garden as well as the storage volume (Barr 2001, PSMM 2008).

In case the facility becomes clogged or does not

Photo: Maria Cahill

This concrete pad is tipped slightly away from the rain garden. This type of inlet is easy to clean and protects the garden from erosion.

infiltrate the entire storm event, plan to use a facility overflow as a backup. This can be accomplished with a berm, an overflow pipe, or a catch basin. Build a berm to establish a minimum 2-inch zone (that is, “freeboard”) above the ponding depth controlled by the outlet (Barr 2001, PSMM 2008). The outlet may consist of a channel lined with rocks (high maintenance) or plants (lower maintenance) if an escape route exists that maintains public safety and prevents property damage. Alternatively, set pipes at an elevation for maximum ponding depth and then convey runoff to an approved disposal point. An underdrain is used in filtration facilities to route water to an approved disposal point. This could be used by itself or in conjunction with the overflow pipe or catch basin. In all cases, it is important to think through every storm event that the rain garden will experience and make sure the design includes multiple, safe overflows, should one or more outlet routes plug or become ineffective over time.

Contact your local planning department for approved disposal methods and locations for routing overflow (for example, drainage ditches, nearby streams, and existing storm-drain systems). A disposal point that injects runoff into the ground will trigger state underground injection control (UIC) requirements. To avoid permit costs, designers should strive to route runoff from the rain garden to a public stormwater conveyance system or surface water. If this is not feasible, see the Permits, page 9, for more information on UIC requirements. Piping is typically cast-iron, ABS SCH40, or PVC SCH40, between 3 and 4 inches in diameter for gardens draining up to 3,500 square feet of impervious area. Sometimes public facilities require larger diameter pipes. Follow the current Oregon Uniform Plumbing Code. Contact your local planning department for permits and specifications.

Construction

As with all stormwater management facilities, care must be taken to properly construct a rain garden.

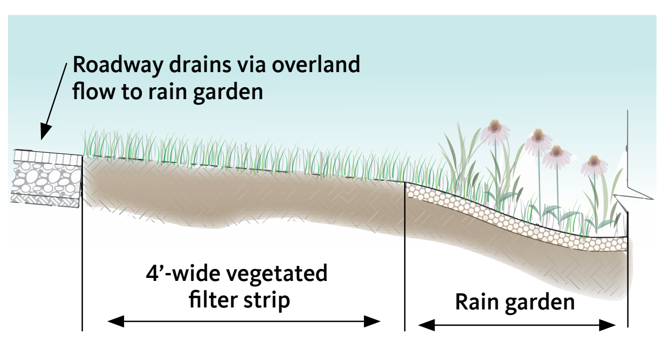
INFILTRATION RAIN GARDENS

If the facility will infiltrate, the proposed rain garden location should be fenced off to prevent auto and foot traffic that will compact soil and reduce the absorption rate of the native soil. Use track equipment or excavate from the sides of the infiltration area to protect the soils during excavation. Rain can pick up fine soil particles and move them around, which could clog the native subgrade soils. On a dry day, rake the surface to a depth of 3 inches to loosen soil before proceeding or amend the top 8–12 inches of soil with a garden spade by folding in a few inches of compost. Compost amendment will also be needed if the rain garden is located in clay soil and dug by hand, since foot traffic on the site is probably unavoidable.

FILTRATION RAIN GARDENS

If the facility is a filtration garden, it will not be necessary to protect the native soils in the area from compaction. If using a plastic liner, make sure it’s a single, solid piece of plastic big enough to be installed under the entire pond area. Overlapping plastic sheets will not adequately prevent infiltration. The underdrain pipe will be a perforated pipe that won’t require compaction. Just lay it down on top of the liner and place the rock storage layer over it.

If you choose to line the facility with a bentonite clay mat, installation is relatively simple. If you choose bentonite powder, the most challenging part will be mixing the bentonite clay with water and placing it so that it creates an impermeable seal. Follow the manufacturer’s recommendations for installation, and make sure the liner is installed high enough to protect infrastructure for all potential storm intensities and volumes.



Graphic: Maria Cahill

Pretreatment with a vegetated filter strip can extend the life of a rain garden.

Photo: Robert Emmanuel, © Oregon State University

An excavator digs from a location outside of the rain garden in order to keep the soil from becoming compacted.

Photo: Robert Emmanuel, © Oregon State University

Grading is made simpler by using four stakes, one at the inflow point and three at the opposite or lower end of the rain garden—including, most importantly, the outflow point.

ALL RAIN GARDENS

Regardless of the type of facility, local jurisdictions may call for a specific soil mix. Blend the compost, soil, and aggregate in a mechanical mixer if possible, but any method that will create a uniform mixture is acceptable. If the pH isn't quite right, reduce it by adding iron sulfate and sulfur, or increase it by adding lime or recycled, ground, gypsum board. There may be other specifications for metals and nutrients to meet; lab testing might be required to prove that the planting soil itself will not be a source of pollutants.

Place the soil in 6- to 12-inch lifts and lightly compact with water by saturating the entire area after each lift is placed. The final proposed elevations must be met after this compaction—not before—or there will be too little soil and a deeper garden than designed. After placing the soil, fence off the entire rain garden area to protect it from traffic.

Ideally, plants will be allowed to establish themselves for three months before runoff is allowed to flow into the facility. This will help hold the soil, especially if the bottom of the facility has been hydroseeded. If you hydroseed, choose a PCB or dye-free tackifier.

Maintenance

Maintenance requirements are typical of vegetated areas, but additional maintenance is required for mechanical structures, such as catch basins. A properly maintained facility can last indefinitely (Barr 2001). More maintenance is typically required during the first 3 years than in future years. Water and weed frequently to help plants survive Oregon's dry summers until plants are well established. This kind of maintenance will taper off dramatically if you choose plants that tolerate flooding and require little to no watering after establishment. Also, remember that providing the minimum amount of water will cut down on weeds. Inspect the rain garden after any major storms. Because these systems are not effective at treating soluble pollutants such as nitrogen and phosphorous, practice integrated pest management. Do not use pesticides in the facility itself.

Typical maintenance procedures include:

- **Removing sediment and debris** and replacing mulch (a frequent requirement if the facility design doesn't include a pretreatment);
- **Cleaning and repairing** inlets and outlets, embankments, and berm dams;
- **Controlling** erosion;
- **Drainage testing** to ensure it's working correctly;
- **Replacing plants** as necessary; and
- **Weeding** by hand.

Permits

Consult your local planning and building department about applicable permits, plumbing codes, and piping requirements. Find out if there are any maps, as-built drawings, or site-specific constraints. A commercial building permit may be required on nonresidential sites. A clearing, grading, and erosion control permit may also be required if ground disturbance is large enough.

Photo: Christine Johnson, © Oregon State University

Rain garden at Astor Elementary School in Portland, Oregon.

UIC REGULATIONS

ODEQ regulates systems known as Class V Underground Injection Controls (UICs), which are designed "for the subsurface placement of fluids." This program protects groundwater resources from the injection of pollutants directly underground. Depending on the pollutant potential at the site, UICs may fall under specific ODEQ rules, or may require a more formal permitting process.

The U.S. Environmental Protection Agency defines a Class V UIC well as "any bored, drilled or driven shaft; or a dug hole whose depth is greater than its largest surface dimension; or an improved sinkhole; or a subsurface fluid distribution system (an assemblage of perforated pipes or drain tiles used to distribute fluids below the surface of the ground)."

These guidelines are for designers who are considering a rain garden to treat runoff before discharging it to surface water. They will help designers avoid triggering UIC requirements in the design of a rain garden. If the rain garden is used to pretreat runoff before discharging it to a UIC, such as a drywell or soakage trench, the designer should contact ODEQ's UIC program, as the rain garden would then be considered part of the UIC system.

An infiltration rain garden designed and installed following the details on page 2 is not considered a UIC; however, changing the detail could trigger UIC permitting requirements. When sizing an infiltration rain garden, avoid designing a facility that is deeper than the widest surface dimension. Note that an infiltration rain garden that is designed without an underdrain is not considered a UIC.

A filtration rain garden is not considered a UIC because, by design, it does not infiltrate runoff. For more information, see the DEQ fact sheet, *Identifying an Underground Injection* (DEQ 2015).

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Photo: Christine Johnson, © Oregon State University

Rain garden at Seven Devil Hills Brewery in Coos Bay, Oregon.

ADDITIONAL RESOURCES

LID Infiltration Calculator (used for sizing vegetated infiltration facilities). http://extension.oregonstate.edu/stormwater/sizing-calculators

The Oregon Rain Garden Guide: A Step-by-Step Guide to Landscaping for Clean Water and Healthy Streams. 2010. Available for purchase or free download from Oregon Sea Grant: http://seagrant.oregonstate.edu/sgpubs/oregon-rain-garden-guide

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