

HOW TO USE THIS MANUAL

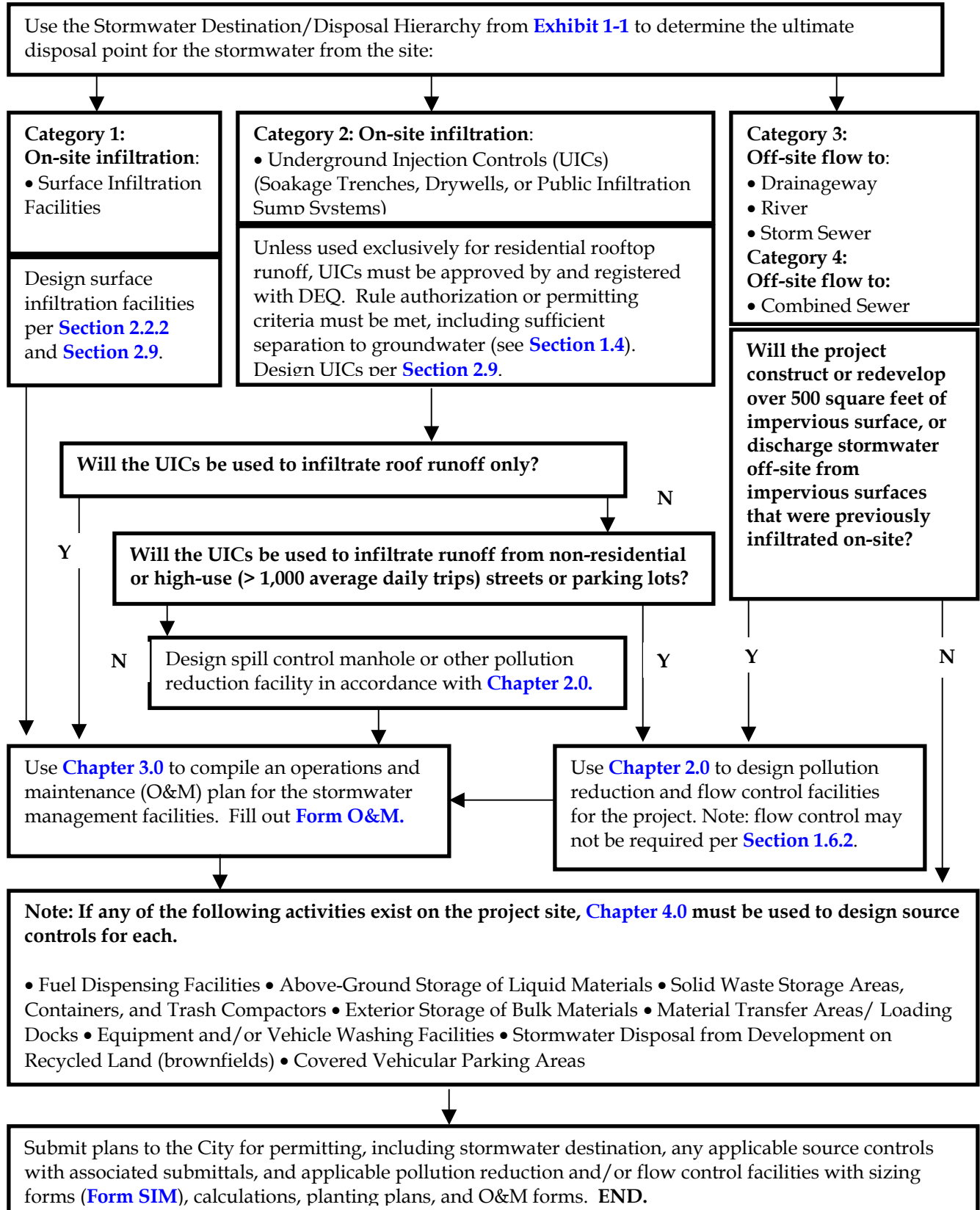
This section includes:

- **“How To Use This Manual” Flowchart**
- Case examples for:
 - **#1 Single-family house (Southeast Portland)**
 - **#2 Single-family house (Northwest Portland)**
 - **#3 Rowhouse with private driveway (Northeast Portland)**
 - **#4 Rowhouse with private driveway (Southwest Portland)**
 - **#5 Commercial site development with parking lot (North Portland)**
 - **#6 Commercial site development with parking lot (Southwest Portland)**
 - **#7 Subdivision with public street improvements (Southeast Portland)**
 - **#8 Subdivision with public street improvements (Northwest Portland)**

The purpose of this section is to help the user navigate the *Stormwater Management Manual* and apply it to projects of varying size, type, and complexity. The goal is a higher number of successful permit applications, resulting in fewer check-sheet revisions.

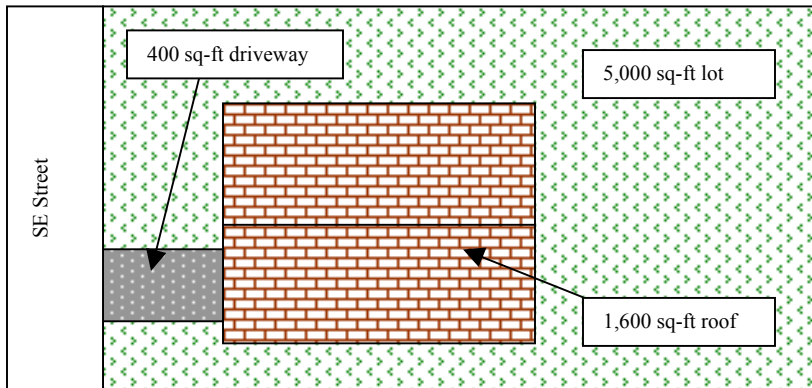


“HOW TO USE THIS MANUAL” FLOWCHART



CASE EXAMPLE #1: Single-Family House (Southeast Portland)

A single-family house with a footprint of 1,600 square feet and a driveway with a footprint of 400 square feet will be constructed on a 5,000 square-foot lot in Southeast Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group B (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and depth to groundwater is approximately 100 feet. The lot has slopes less than 2 percent.



Step 1: Determine the stormwater disposal point for the site. Use [Exhibit 1-1: Stormwater Destination/Disposal Hierarchy](#) (in Chapter 1.0)

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Using Exhibit 1-1: For approval of a stormwater destination method in the City of Portland, the highest (1 = high, 4 = low) technically feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an approvable destination for stormwater.

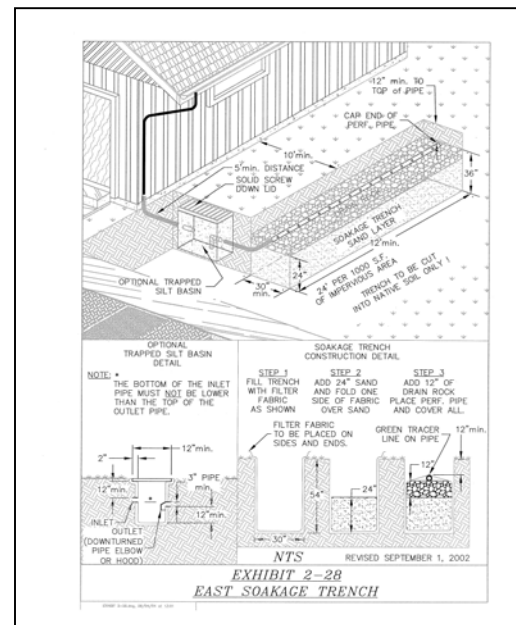
City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sited in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exceptions:</p> <ol style="list-style-type: none"> 1) Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. 2) Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. 3) Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right of way, this is generally determined by comparing the amount of available previous surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right of way width may be dedicated by the applicant if needed, as approved by PDOT (for public streets) or EDS (for private streets). For surface infiltration facilities located outside of the street right of way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on site. 4) Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted. 5) Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or EDS (for private facilities). 6) Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2-35), where on-site infiltration is not accepted as a stormwater destination. 7) Existing basements do not have adequate surfacings (see Surface Infiltration Facility design methodology in Section 2.2.2). A minimum setback of 10 feet is required on private property, as approved by EDS. 8) For half-street improvements, existing utilities or street trees make it impractical to construct a surface infiltration facility within the street right of way.

City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UICs (underground injection control structures) and must be rule-authorized or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Rooftop runoff does not require pollution reduction, runoff from residential low-use streets or parking lots (< 1,000 average daily trips) requires the use of sedimentation/ spill control measures, and high-use streets and parking lots (> 1,000 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> 1) Project does not meet DEQ UIC rule authorization or permitting criteria (see Section 1.4.4 for list of criteria, or go to http://www.deq.state.or.us/wq/groundwa/RA/Stormwater/Requirements.pdf). 2) Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by BES (for public streets) or EDS (for private streets). 3) Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or EDS (for private facilities). 4) Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2-35), where on-site infiltration with UICs is not allowed. <p>Category 3: Off-site flow to drainage way, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> 1) System does not exist or does not have available capacity, as determined by BES. 2) Sensitivity of the water resource justifies connection to an alternative destination method, as determined by BES. <p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> 1) System does not exist or does not have available capacity, as determined by BES.

Under category #1, the Stormwater Destination/Disposal Hierarchy states that where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. In this case, with B-type soils and mild slopes, on-site infiltration is most likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. In addition to drywells and soakage trenches, other options include surface infiltration facilities such as vegetated or grassy swales, infiltration planters, or vegetated infiltration basins. In addition to the options listed above, the driveway may use pervious pavement or be graded to sheet flow into adjacent lawn areas.

Step 2: Design drywells, soakage trenches, or surface infiltration facilities in accordance with **Chapter 2.0: Stormwater Management Facility Design.**

Soakage Trenches: If soakage trenches are used to infiltrate stormwater from the rooftop areas, **Exhibit 2-28: East Soakage Trench** is used. In accordance with this exhibit, 24 feet of soakage trench is required per 1,000 square feet of rooftop area. In this example, the length of soakage trench needed to dispose of stormwater from the roof area will be: $1,600 \times (24/1,000) = 38.4$ feet in length. If used for the roof *and* the driveway, the soakage trench will need to be: $2,000 \times (24/1,000) = 48$ feet. The design criteria presented in the soakage trench section of Chapter 2.0 must be used to design the trench, and to locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.

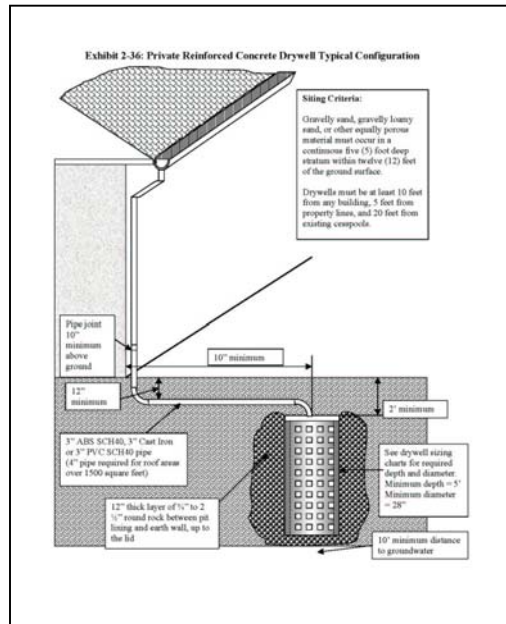


Drywells: If drywells are used to infiltrate stormwater from the rooftop areas, **Exhibit 2-34: Drywell Sizing** is used. In accordance with this exhibit, a 10-foot deep, 28-inch diameter drywell or a 5-foot deep, 48-inch diameter drywell is required to infiltrate stormwater from impervious areas between 1,000 and 2,000 square feet in size. The design criteria presented in the private drywell section of Chapter 2.0 must be used to design the drywell, and to locate the facility on-site. Setbacks from building structure must be considered (see **Exhibit 2-36**). The detailed design and location must be shown on the permit drawings.

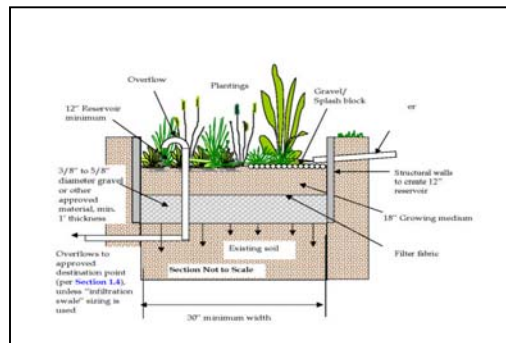
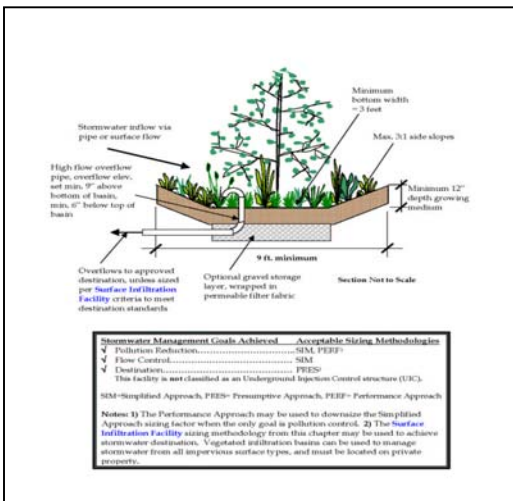
Exhibit 2-34: Drywell Sizing

Once approval has been given by RCS for an site infiltration of stormwater, the following chart shall be used to select the number and size of drywells.

Impervious Area (sq. ft.)	12" Diameter			18" Diameter			24" Diameter		
	Drywell Depth	5'	10'	Drywell Depth	5'	10'	Drywell Depth	5'	10'
1000									
2000									
3000									
4000									
5000									
6000									
7000									
8000									
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Surface Infiltration Facilities: If surface infiltration facilities are used to infiltrate stormwater from the rooftop areas, [Section 2.2.2](#) is used. In accordance with the surface infiltration design approach from this section, enough storage volume must be provided in the facility to contain the runoff from a 10-year, 24-hour storm. For the rooftop, this volume is: 0.28 feet x 1,600 square feet = 448 cubic feet. For the rooftop and the driveway, this volume is approximated by the following equation: 0.28 feet x 2,000 square feet = 560 cubic feet. The design criteria presented in each applicable section of Chapter 2.0 must be used to design the facility, and to locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.



Step 3: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the drywells, soakage trenches, or other stormwater management facilities used on the site. **Form O&M** must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example)
 REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38
 For official county use only

Project Building Application No. _____

Owner's Name: John Doe
 Phone No.: (503) 555-1234
 Mailing Address: 1234 SE XX Street, Portland, OR 97203
 XXXXX-XXXX-XXXX
 Site Address: XXXXX-XXXX-XXXX
 Site Legal Description: Section XX, Township XX, Range XX, T14S R12E S12

BY SIGNING BELOW, I/we accept and agree to the terms and conditions contained in this operations & maintenance plan and to any document referred to by and covered with it.

File: _____
 Signature: _____
 Date: _____

NOTARIZATION: (SEEK notary seal and affidavit and file with the City of Portland)

O&M PLAN REQUIRED INFORMATION:

1. Site Plan, including a site plan showing the facility location (in relation to building footprint or other permanent construction on the site), nature of runoff entering the facility, and where maintenance will be distributed to after leaving the facility.

The stormwater management facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is responsible to operate and maintain the facility in accordance with the O&M plan on this site. The City of Portland, Bureau of Environmental Services, The Department of Water Resources, and the Bureau of Environmental Services, shall not be held responsible for the maintenance of the facility. The O&M plan may be modified with the consent of the owner with written approval by the City of Portland, Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 1100 SW 4th Avenue, Room 1000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 823-7318 for assistance.

2. Description of the identified method used to cover, fence, operate, and maintain. Check box:
 Stormwater Infiltration Property Storm Drainage Other (describe): _____

3. Party (ies) responsible for maintenance only if other than owner. Owner Responsibility.
 Contact Name: Mr. John Doe, (503) 555-1234
 Maintenance Contact Address: 1234 SE XX Street, Portland, OR 97203

4. Maintenance practices and schedule for the stormwater facility included in the facility specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operation and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual.
 Preparation Date: XX/XX/20XX Revision Date: _____ Estimated Date of Installation (optional): XX/XX/XX

Prepared by: John Doe

Soakage Trenches
 Operations & Maintenance Plan

Soakage Trenches consist of drain rock and sand, and receive stormwater from roof downspouts and/or area drains. There are various components within the system: piping, silt basin and the trench itself. The Conveyance Piping consists of an inlet pipe (downspout or area drain), an outlet pipe located between the silt basin and the soakage trench, and a perforated pipe located on top of the aggregate and of the soakage trench. The Silt Basin is a structure receiving runoff from an inlet pipe and conveying it to the soakage trench. The silt basin serves as the pre-treatment system for the soakage trench, removing sediments and other debris that can impact its proper functioning. All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, then two times per year afterwards, or within 48 hours after each major storm. The facility owner must keep a log recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Soakage trench infiltration. If water is noticed on top of the trench within 48 hours of a major storm, the soakage trench may be clogged.

- Check for debris/debris accumulation, rate and remove and evaluate upland causes (erosion, surface or roof debris, etc.)
- Assess the condition of the aggregate and the filter fabric in the trench. If there is sediment in the aggregate, excavate and replace.
- If there is a tear in the filter fabric, repair or replace.

Conveyance Piping. If water ponds over the trench for more than 48 hours after a major storm and no other cause is identified, it may be necessary to remove the filter fabric to determine if the perforated pipe is clogged with sediment or debris.

- Any debris or algae growth located on top of the soakage trench should be removed and disposed of properly.
- If the piping is less settled more than 1 inch, add fill material. If there are cracks or releases, replace or repair the pipe. If there are signs of erosion around the pipe, this may be an indication of water seeping due to a crack or break.

Silt Basin. If water remains in the soakage trench for 30-48 hours after storm, check for sediment accumulation in the silt basin.

- If less than 50% capacity remains in the basin or 4" of sediment has accumulated, remove and dispose the sediment.

Spill Prevention. Virtually all sites, including residential and commercial, present dangers from spills. All homes contain a wide variety of toxic materials including gasoline for lawn mowers, antifreeze for cars, oil, paint, solvents, pesticides, and cleaning agents that can adversely affect groundwater if spilled. It is important to exercise caution when handling substances that can contaminate stormwater.

- Activities that pose the chance of hazardous material spills shall not take place near soakage trenches.

Shut-Off Valve or Flow-Blocking Mechanism may have been required with the construction of the soakage trench to temporarily prevent stormwater from flowing into it in the event of an accidental toxic material spill. This may also involve mats kept on-site that can be used to cover inlet drains in parking lots. The shut-off valve shall remain in good working order, if mats or other flow-blocking mechanisms are used, they shall be kept in stock on-site.

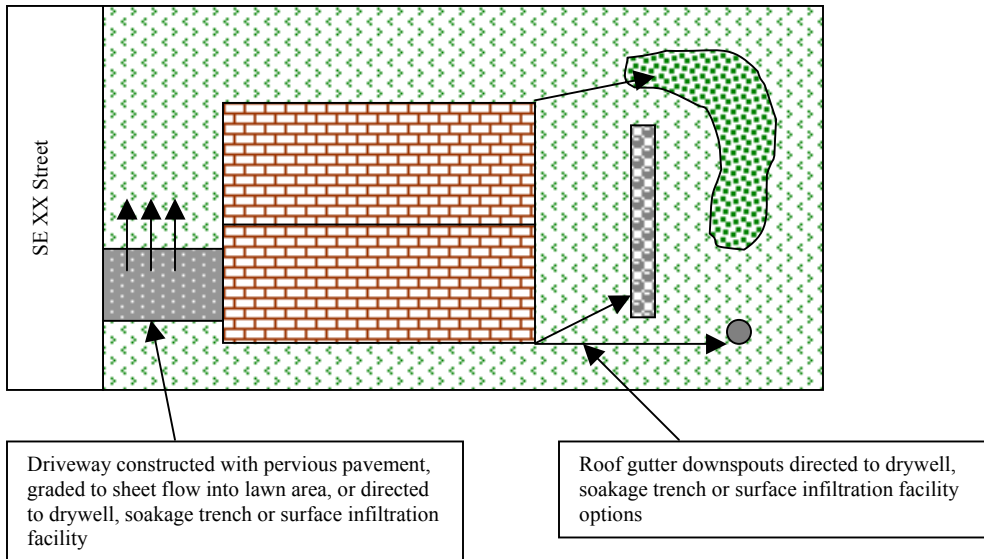
Training and/or written guidance information for operating and maintaining soakage trenches shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.

Access to the soakage trench is required for efficient maintenance. Egress and ingress routes will be maintained to design standards of inspections.

Insects & Rodents shall not be harbored in the soakage trench. Pest control measures shall be taken when insecticides are found to be present.

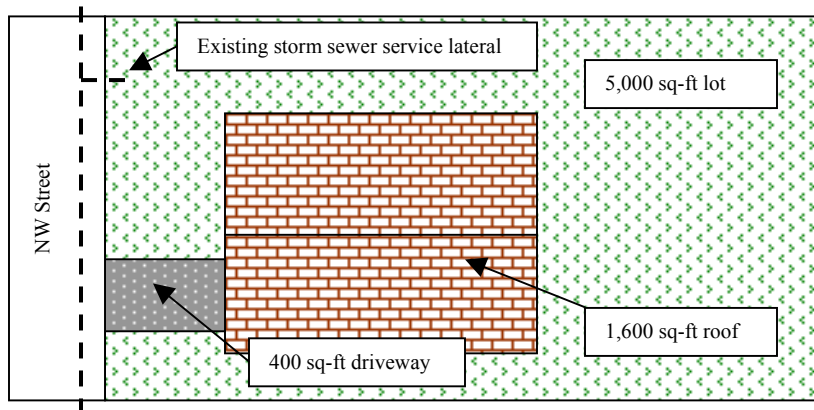
- If sprays are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
- Moats in the ground located in and around the soakage trench shall be filled.

Step 4: Submit the house plans to the city for permitting. The drywell, soakage trench, or other stormwater management facilities must be shown on the drawings, along with applicable details, and the recorded O&M plan must be attached. **END.**



CASE EXAMPLE #2: Single-Family House (Northwest Portland)

A single-family house with a footprint of 1,600 square feet and a driveway with a footprint of 400 square feet will be constructed on a 5,000 square-foot lot in Northwest Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group C (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the lot has slopes that range from 10 to 20 percent. There is an existing public storm sewer pipe in the frontage street with an existing service lateral to the property.



Step 1: Determine the stormwater disposal point for the site. Use [Exhibit 1-1: Stormwater Destination/Disposal Hierarchy](#) (in Chapter 1.0)

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Using Exhibit 1-1: For approval of a stormwater destination method in the City of Portland, the highest (1= high, 4= low) technically feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an approvable destination for stormwater.

City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sited in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by PDOT (for public streets) or BDS (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on-site. Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wellhead Protection Area (see Exhibit 2.35), where on-site infiltration is not accepted as a stormwater destination. Resident basements do not have adequate setbacks (see Surface Infiltration Facility design methodology in Section 2.2.2). A minimum setback of 10 feet is required on private property, as approved by BDS. For haul street improvements, existing utilities or street trees make it impractical to construct a surface infiltration facility within the street right-of-way.

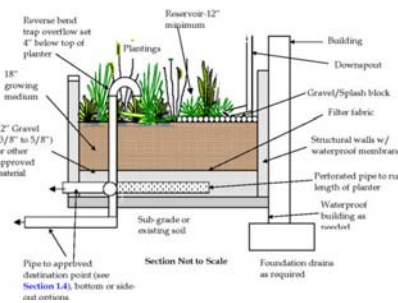
City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UICs (underground injection control structures) and must be rule-submitted or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Rooftop runoff does not require pollution reduction, runoff from residential low-use streets or parking lots (< 1,000 average daily trips) requires the use of sedimentation/soil control measures, and high-use streets and parking lots (> 1,000 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Project does not meet DEQ UIC rule authorization or permitting criteria (see Section 1.4.4 for list of criteria, or go to: http://www.deq.state.or.us/wq/groundwa/RA/RArules/ra/RARequirements.pdf). Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by BES (for public streets) or BDS (for private streets). Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wellhead Protection Area (see Exhibit 2.35), where on-site infiltration with UICs is not allowed. <p>Category 3: Off-site flow to drainageway, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BES. Sensitivity of the water resource justifies connection to an alternative destination method, as determined by BES. <p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BES.

Category #1 (surface infiltration facilities) and category #2 (on-site infiltration with drywell or soakage trench) depend on project site soils that infiltrate relatively well (2 inches per hour minimum). In this example, with C-type soils and moderate slopes, on-site infiltration is not likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. Category #3 (off-site flow to drainageway, river, or storm-only pipe system) depends on the availability of such resources. Portlandmaps.com or other city maps available at the Development Services Center (1900 SW 4th Avenue) can be used to identify off-site stormwater conveyance systems. In this case, there is an existing storm sewer service lateral that the property will use. Pollution reduction and flow control are required prior to discharge into the storm sewer.

Step 2: Choose pollution reduction and flow control facilities from **Chapter 2.0: Stormwater Management Facility Design**. There are many facility types to choose from that will achieve both pollution reduction and flow control. **Exhibit 2-1** can be used to help choose a facility type that can use the simplified approach for sizing. In this example, flow-through planters will be used to manage stormwater from the rooftop, and the overflow and underdrain pipes from the planters will be connected to the storm sewer service lateral. The driveway may use pervious pavement; may be graded to sheet flow into adjacent lawn areas if sufficiently sized in accordance with vegetated filter design criteria (at least 1 square foot of lawn area per 5 square feet of driveway area, lawn area must be at least 10 feet by 10 feet); or may be directed to the flow-through planters.

Exhibit 2-1: Stormwater Management Facility Application Table

Stormwater Management Facility Type	Credits Given with Associated Design Approach		
	Pollution Reduction	Flow Control	Destination
Roofscapes & roof gardens	Simplified	Simplified	NA
Pervious pavement	Simplified	Simplified	Performance
Container planter	Simplified	Simplified	NA
Tree credit	Simplified	Simplified	NA
Infiltration planter	Simplified	Simplified	Presumptive ^a
Flow-through planter	Simplified	Simplified	NA
Vegetated swale	Simplified	Simplified	Presumptive ^a
Grassy swale < 15,000 sq ft impervious area	Simplified	Simplified	Presumptive ^a
Grassy swale > 15,000 sq ft impervious area	Presumptive	NA	Presumptive ^a
Street swales	Simplified	Simplified	Presumptive ^a
Vegetated filter strip	Simplified	Simplified	Presumptive ^a
Vegetated infiltration basin	Simplified	Simplified	Presumptive ^a
Sand filter	Simplified	Simplified	Presumptive ^a
Wet pond	Presumptive	NA	NA
Extended sand det. pond	Presumptive	Presumptive	NA
Day detention pond	Presumptive ^a	Presumptive	NA
Treatment wetland	Presumptive	Presumptive	NA
Manufactured treatment technology	Performance	NA	NA
Structural det. facility	NA	Presumptive	NA
Oil/grate separator	Presumptive	NA	NA
Rainwater harvesting	Performance	Performance	NA
Private soakage trench	NA	Presumptive	Presumptive
Public infiltration	NA	Presumptive	Presumptive
Private drywell	NA	Presumptive	Presumptive



Step 3: Design pollution reduction and flow control facilities from Chapter 2.0: Stormwater Management Facility Design.

Form SIM will be used to size the flow-through planters to meet pollution reduction and flow control requirements. From this form, the sizing factor for flow-through planters is 0.06. The required square-footage of planters is the square footage of the roof multiplied by the sizing factor: 1,600 square feet x 0.06 = 96 square feet. The planters can be split up and located at each roof downspout, or the downspouts can be plumbed to one large planter, as long as 96 square feet of flow-through planter is provided and all the planters are connected to the storm sewer service lateral.

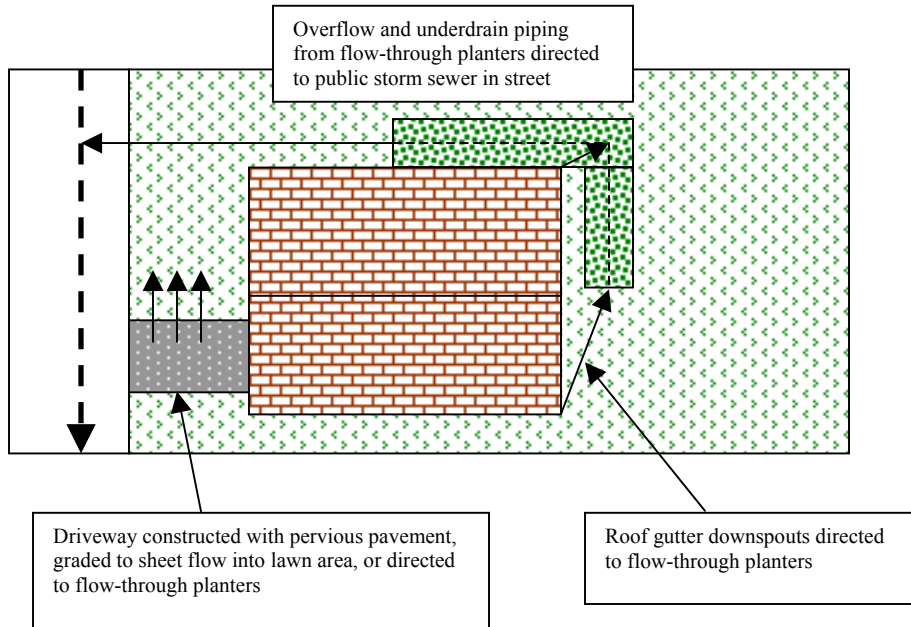
Form SIM: Simplified Approach for Stormwater Management			
INSTRUCTIONS			
1. Enter project details of new or redeveloped impervious site area (do not include roof areas that will be infiltrated on-site with dyes or soakage trenches).	Box 1	Column 1	Column 2
2. Select impervious area reduction techniques from rows 1-3 to reduce the site's impervious area. Management requirement. This value will be calculated using the tree credit reduction (in the next page).	Impervious Area Reduction Technique	Area Managed	Facility Surface Area
3. Total Column 1 (Rows 1-3) and enter the result in Box 2. Filter the number against 1. Stormwater quality and quantity requirements must be met. (See the form with the application for permit.)	1) Eco-Roof / Roof Garden 2) Covered Planter 3) Tree Credit (See Next Page)		
4. Select stormwater management facilities from rows 4-7 to accept runoff and temporarily store the water in a reservoir on top of the soil. The flow-through planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 3-4 hours after a storm event. All facility components and vegetation shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:	Stormwater Management Facility	Impervious Area Managed	Storage Factor
5. Total Column 2 (Rows 4-7) and enter the result in Box 3. Filter the number against 1. Stormwater quality and quantity requirements must be met. (See the form with the application for permit.)	4) Infiltration Planter 5) Flow-Through Planter 6) Vegetated Soak 7) Grassy Soak 8) Vegetated Filter Strip 9) Vegetated Infiltration Basin 10) Sand Filter		
6. If Box 2 is greater than 1,000 square feet, the stormwater management facility must be designed to meet the requirements of the Stormwater Management Manual for Oregon, Chapter 2.0 of the Stormwater Management Manual for Oregon, and the design requirements for infiltration and flow-through planters.			
	Total Impervious Area Managed	Box 2	Box 3

Step 4: Use Chapter 3.0: Operations & Maintenance to compile an operations and maintenance plan for the flow-through planters used on the site. Form O&M must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example)	
REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38	
Project Building Application No. _____	File official county use only
Owner's Name: John Doe Phone No. (area code required) (503) 1-555-5555 Mailing Address (BEYOND ADDRESS FOR RECORDING) XXX SW XXX Street, Portland, OR XXXXX Site Address XXX SW XXX Street, Portland, OR XXXXX Site Legal Description Section XX, Township XX, Range XX, T4S, R12E, W1E	
BY SIGNING BELOW, the owner agrees to the terms and conditions contained in this operations & maintenance plan and in any document executed by the owner and recorded with the city.	
File: <i>John Doe</i>	
NOTIFICATION: (OPTIONAL) submit hand and official seal.	
City Public is in effect for the State of Oregon.	
My Agreement Expires on: _____	
O&M Plan Requirements:	Site Plan (Insert here or include separate sheets)
1. This Plan, including a site plan showing the facility location (in relation to building structures or other permanent monuments on the site), sources of runoff entering the facility, and where stormwater will be discharged to after leaving the facility.	
2. Description of the financial method used to cover future operations and maintenance. Check One: <input type="checkbox"/> Homeowner Association <input type="checkbox"/> Property Owner Account <input type="checkbox"/> Other (describe): _____ 3. Party (ies) responsible for maintenance only if other than owner's. Owner's Responsibility. Operation Phone No. (area code required) (503) 555-5555 Emergency After Hours Contact Phone No. (503) 555-5555 Maintenance Contact & Address: Garden Coop Landscaping, XXX NE XX Street, Portland, OR 972XX 4. Maintenance practices and schedule for the stormwater facility is included in the facility-specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operations and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual. Preparation Date: XX/XX/20XX Revision Date: ____/____/____ Estimated Date of Installation (insert year): XX/XXXX Prepared by: John Doe	

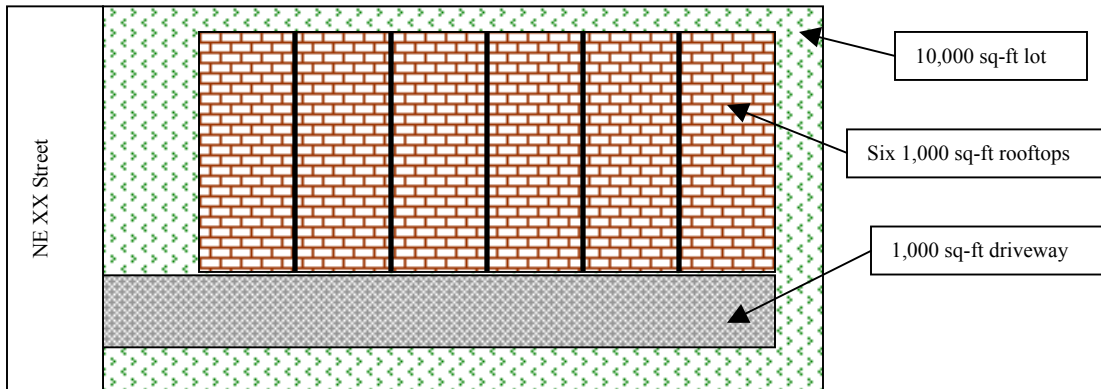
Infiltration and Flow-Through Planters
Operations & Maintenance Plan
Planters are designed to allow runoff to filter through layers of topsoil (thus capturing pollutants) and then either infiltrate into the native soils (infiltration planter) or be collected in a pipe to be discharged off-site (flow-through planter). The planter is sized to accept runoff and temporarily store the water in a reservoir on top of the soil. The flow-through planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 3-4 hours after a storm event. All facility components and vegetation shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:
Downspout from rooftop or sheet flow from paving allow unimpeded stormwater flow to the planter.
• Debris shall be removed routinely (e.g., no less than every 6 months) and upon discovery.
• Damaged pipe shall be repaired upon discovery.
Splash Blocks prevent splashing against adjacent structures and convey water without disrupting media.
• Any deficiencies in structure such as cracking, rotting, and failure shall be repaired.
Planter Reservoir receives and detains storm water prior to infiltration. Water should drain from reservoir within 3-4 hours of storm event.
• Sources of clogging shall be identified and corrected.
• Topsoil may need to be amended with sand or replaced all together.
Filter Media consisting of sand, gravel, and topsoil shall allow stormwater to percolate uniformly through the planter. The planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates.
• Holes that are not consistent with the design and allow water to flow directly through the planter to the ground shall be plugged.
• Sediment accumulation shall be hand removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation.
• Litter and debris shall be removed routinely (e.g., no less than quarterly), and upon discovery.
Planter shall contain filter media and vegetation.
• Structural deficiencies in the planter including rot, cracks, and failure shall be repaired.
Overflow Pipe safety conveys flow exceeding reservoir capacity to an approved stormwater receiving system.
• Overflow pipe shall be cleared of sediment and debris when 50% of the conveyance capacity is plugged.
• Damaged pipe shall be repaired or replaced upon discovery.
Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion.
• Mulch shall be replenished at least annually.
• Vegetation, large shrubs or trees that limit access or interfere with planter operation shall be pruned or removed.
• Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
• Nuisance or prohibited vegetation from the Portland Plant List shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
• Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired.
• Vegetation shall be replaced within a specific timeframe, e.g., 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.
Spill Prevention measures shall be exercised when handling substances that contaminate stormwater.
• Releases of pollutants shall be corrected as soon as identified.
Training and/or written guidance information for operating and maintaining stormwater planters shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
Access to the stormwater planter shall be safe and efficient. Litter and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.
• Obstacles preventing maintenance personnel and/or equipment access to the stormwater planter shall be removed.
• Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
Insects & Rodents shall not be harbored in the stormwater planter.
Pest control measures shall be taken when insects/rodents are found to be present.
• If grays are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abateid formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
Holes in the ground located in and around the stormwater planter shall be filled and compacted.

Step 5: Submit the house plans to the city for permitting. The stormwater destination (pipe connection to the storm sewer service lateral) must be clearly identified on the drawings, along with flow-through planter locations and applicable details, and the completed Form SIM and recorded O&M plan must be attached. **END.**



CASE EXAMPLE #3: Rowhouse Development w/ Private Driveway (Northeast Portland)

A rowhouse development with six 1,000 square-foot rooftops and a driveway with a footprint of 1,000 square feet will be constructed on a 10,000 square-foot lot in Northeast Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group B (from the USDA/ NRCS Soil Survey of Multnomah County, Oregon), and the depth to groundwater is approximately 130 feet. The lot has slopes less than 2 percent.



Step 1: Determine the stormwater disposal point for the site. Use [Exhibit 1-1: Stormwater Destination/Disposal Hierarchy](#).

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Use Exhibit 1-1: For approval of a stormwater destination method in the City of Portland, the highest (1 = high, 4 = low) technically feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an approvable destination for stormwater.

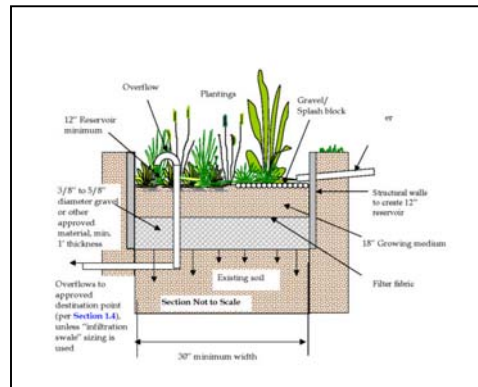
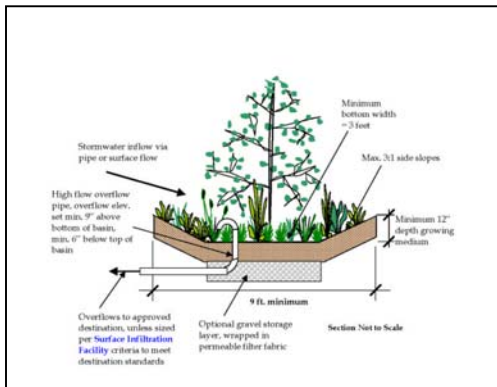
City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sized in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right of way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right of way width may be dedicated by the applicant if needed, as approved by PDOT (for public facilities) or BDS (for private facilities). For surface infiltration facilities located outside of the street right of way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on-site. Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing UIC assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BDS (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration is not accepted as a stormwater destination. Existing basements do not have adequate setbacks (see Surface Infiltration Facility design methodology in Section 2.2.3). A minimum setback of 10 feet is required on private property, as approved by BDS. For half-street improvements, existing utilities or street trees make it impractical to construct a surface infiltration facility within the street right of way.

City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UICs (underground injection control structures) and must be rule-authorized or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Rooftop runoff does not require pollution reduction, runoff from residential low-use streets or parking lots (< 1,000 average daily trips) requires the use of sedimentation/spill control machines, and high-use streets and parking lots (> 1,000 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Project does not meet DEQ UIC rule authorization or permitting criteria (see Section 1.4.4 for list of criteria, or go to: http://www.deq.state.or.us/wq/groundwa/RAStormwaterRequirements.pdf). Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by BDS (for public facilities) or BDS (for private facilities). Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BDS (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration with UICs is not allowed.
<p>Category 3: Off-site flow to drainage way, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.6.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BDS. Sensitivity of the water resource justifies connection to an alternative destination method, as determined by BDS.
<p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BDS.

Under category #1, the Stormwater Destination Hierarchy states that where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. In this case, with B-type soils and mild slopes, on-site infiltration is most likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. In addition to drywells and soakage trenches, other options generally include surface infiltration facilities such as vegetated or grassy swales, infiltration planters, or vegetated infiltration basins.

In accordance with the surface infiltration design approach from [Section 2.2.2](#), enough storage volume must be provided in the surface infiltration facility to contain the runoff from a 10-year, 24-hour storm. For the rooftop areas, this volume is: 0.28 feet x 6,000 square feet = 1,680 cubic feet. In this example, there is not adequate space on-site to construct surface infiltration facilities for the rooftop areas.

Under category #1, the 1,000-square-foot driveway must be evaluated for surface infiltration. In accordance with the surface infiltration design approach in [Section 2.2.2](#), enough storage volume must be provided in the surface infiltration facility to contain the runoff from a 10-year, 24-hour storm. For the driveway, this volume is: 0.28 feet x 1,000 square feet = 280 cubic feet. The design criteria presented in each applicable section of Chapter 2.0 must be used to design the surface infiltration facility itself, and locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.

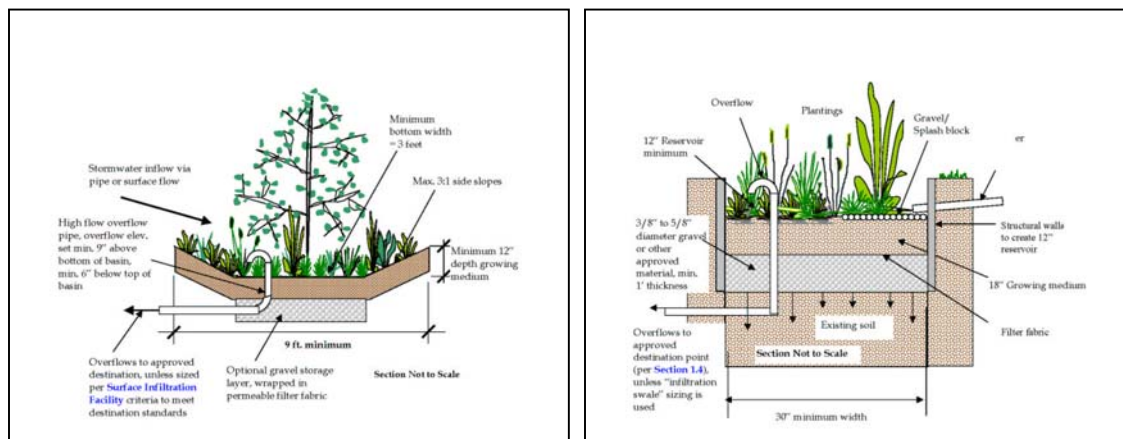


If there is not adequate space on-site to use a surface infiltration facility to infiltrate stormwater from the driveway, under category #2 the runoff from the driveway may be infiltrated on-site with a private drywell or soakage trench. In

that case, a spill control manhole or other pollution reduction facility is also required. Drywells or soakage trenches must be registered with DEQ per [Section 1.4.4](#).

Step 2: Design the drywells, soakage trenches, surface infiltration facilities, and/or pollution reduction facilities in accordance with [Chapter 2.0: Stormwater Management Facility Design](#).

If surface infiltration facilities such as swales, infiltration planters, or vegetated infiltration basins are used to infiltrate stormwater from the driveway area, [Section 2.2.2](#) is used. As discussed under step 1, 280 cubic feet of storage volume must be provided. The design criteria presented in each applicable section of Chapter 2.0 must be used to design the facility, and to locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.



If there is not sufficient space to locate a surface infiltration facility on-site for the driveway runoff, a drywell or soakage trench may be used. In that case, a pollution reduction facility sized in accordance with the simplified approach from Chapter 2.0 must be used to meet pollution reduction requirements.

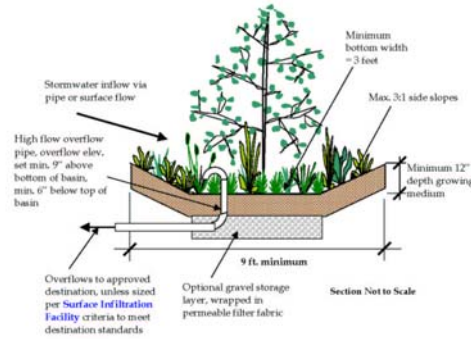
[Exhibit 2-1](#) can be used to help select a facility type that can use the simplified approach for sizing. If the driveway will generate fewer than 1,000 average daily trips, a spill control manhole from Chapter 2.0 may be used instead of a pollution reduction facility to meet the pollution reduction requirements.

The following discussion assumes there is sufficient space for an on-site surface infiltration facility to manage stormwater from the driveway. A vegetated swale will be used, and the overflow from the swale will be connected to an on-site drywell or soakage trench. Drywells and soakage trenches must be registered

with the Oregon Department of Environmental Quality (DEQ), in accordance with [Section 1.4.4](#).

Exhibit 2-1: Stormwater Management Facility Application Table

Stormwater Management Facility Type	Credits Given with Associated Design Approach		
	Pollution Reduction	Flow Control	Destination
Lawns & most gardens	Simplified	Simplified	NA
Pervious pavement	Simplified	Simplified	Performance
Container planters	Simplified	Simplified	NA
Tree credit	Simplified	Simplified	NA
Infiltration planter	Simplified	Simplified	Presumptive ^a
Flow-through planter	Simplified	Simplified	NA
Vegetated swale	Simplified	Simplified	Presumptive ^a
Grassy swale < 10,000 sq ft impervious area	Presumptive	NA	Presumptive ^a
sq ft impervious area	Simplified	Simplified	Presumptive ^a
Vegetated filter strip	Simplified	Simplified	Presumptive ^a
Vegetated infil. basin	Simplified	Simplified	Presumptive ^a
Sand filter	Simplified	Simplified	Presumptive ^a
Wet pond	Presumptive	NA	NA
Extended wet det. pond	Presumptive	Presumptive	NA
Dry detention pond	Presumptive	Presumptive	NA
Treatment wetland	Presumptive	Presumptive	NA
Manual activated treatment technology	Performance	NA	NA
Structural det. facility	NA	Presumptive	NA
Oil/water separator	Presumptive	NA	NA
Retention basins/wet	Performance	NA	NA
Private soakage trench	NA	Presumptive	Presumptive
Public infil. trench	NA	Presumptive	Presumptive
Private drywell	NA	Presumptive	Presumptive



Form SIM will be used to size the vegetated swale to meet pollution reduction requirements. From this form, the sizing factor for vegetated swales is 0.09. The required square-footage of swale is: 1,000 square feet x 0.09 = 90 square feet. The swale will be 5 feet wide by 18 feet long, and will include an overflow catch basin plumbed to the site's drywell or soakage trench.

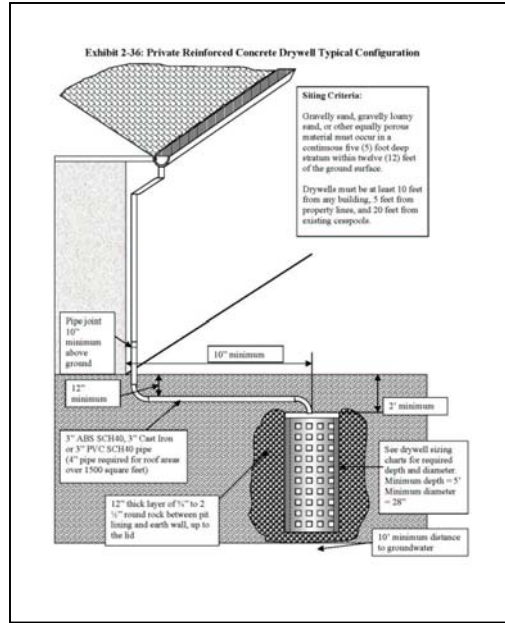
Form SIM: Simplified Approach for Stormwater Management				
New or Redeveloped Impervious Site Area [] Box 1 (do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)				
		Column 1	Column 2	Column 3
INSTRUCTIONS	Impervious Area	[]	[]	[]
	Stormwater Management Facility	[]	[]	[]
	Soakage Trench	[]	[]	[]
1) Roof/Floor / Roof Garden	[]	[]	[]	[]
2) Container Planter	[]	[]	[]	[]
3) Tree Credit (See Hand Pages)	[]	[]	[]	[]
Note: Previous Plans/Drawings do not need to be included in Box 1.				
Box 2: Stormwater Management Facility	Impervious Area	Stormwater Management Facility	Sizing Factor	Facility Surface Area
4) Infiltration Planter	[]	[]	[]	[]
5) Flow Through Planter	[]	[]	[]	[]
6) Vegetated Swale	[]	[]	[]	[]
7) Grassy Swale	[]	[]	[]	[]
8) Vegetated Filter Strip	[]	[]	[]	[]
9) Vegetated Infil. Basin	[]	[]	[]	[]
10) Sand Filter	[]	[]	[]	[]
See Chapter 2.0: Drywell and soakage trench sizing and design requirements.				
Box 3: Drywell and soakage trench sizing and design requirements.				
Total Impervious Area Managed		[]	[]	[]
Box 1 - Box 2		[]	[]	[]
Box 1 - Box 2		[]	[]	[]

If a drywell is used to infiltrate stormwater from the rooftop or driveway areas, [Exhibit 2-34: Drywell Sizing](#) is used. In accordance with that exhibit, a 10-foot deep, 48-inch diameter drywell is required to infiltrate stormwater from the 6,000 square-foot impervious rooftop area. If the drywell will be used to infiltrate stormwater from both the rooftop and driveway areas (7,000 square-feet of impervious area), a 15-foot deep, 48-inch diameter drywell is required. The design criteria presented in the private drywell section of Chapter 2.0 must be used to design the drywell, and to locate the facility on-site. Setbacks from building structure must be considered (see [Exhibit 2-36](#)). The detailed design and location must be shown on the permit drawings.

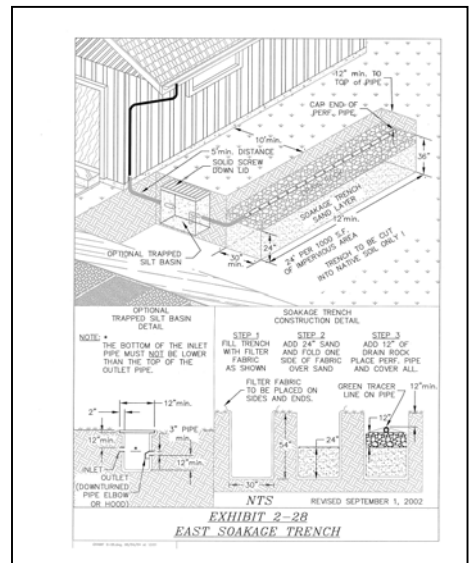
Exhibit 2-34: Drywell Sizing

Once approval has been given by BCG for on-site infiltration of stormwater, the following chart shall be used to select the number and type of drywells.

Impervious Area (sq. ft.)	36" Diameter Drywell Depth				48" Diameter Drywell Depth				60" Diameter Drywell Depth			
	5'	10'	15'	20'	5'	10'	15'	20'	5'	10'	15'	20'
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If a soakage trench is used to infiltrate stormwater from the rooftop or driveway areas, **Exhibit 2-28: East Soakage Trench** is used. In accordance with this exhibit, 24 feet of soakage trench is required per 1,000 square feet of rooftop area. In this example, the length of soakage trench to handle the roof runoff will be: $6,000 * (24/1,000) = 144$ feet in length. If used for the roof *and* the driveway, the soakage trench will be: $7,000 * (24/1,000) = 168$ feet. The design criteria presented in the soakage trench section of Chapter 2.0 must be used to design the trench, and to locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.



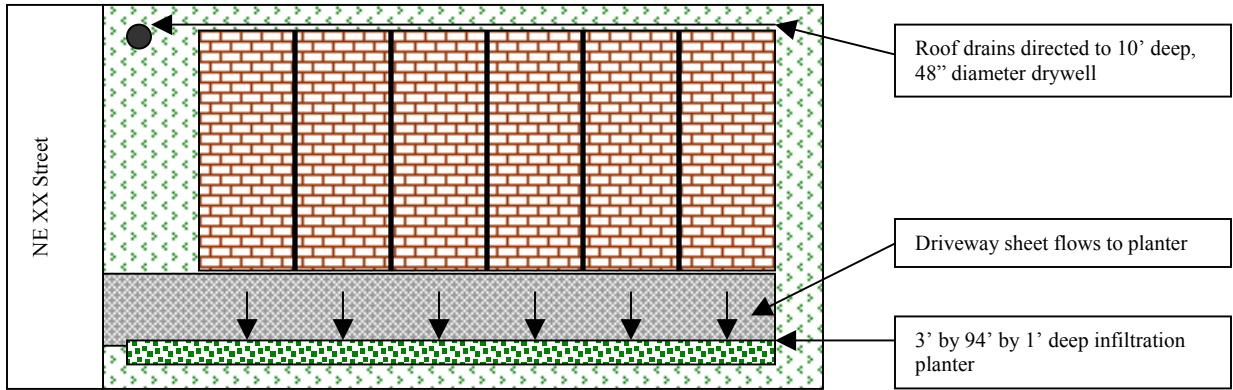
Step 3: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the drywell, soakage trench, or other stormwater management facilities used on the site. **Form O&M** must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example) REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38	
Project Building Application No. _____ For official county use only	
Owner's Name: John Doe	Phone No.: (503) 555-1234
Mailing Address: 1234 Main Street, Portland, OR 97201	City: Portland, OR
Site Address: 5678 SW 10th Ave, Portland, OR 97205	City: Portland, OR
Site Legal Description: Section 12, Township 33N, Range 12E, T12S	
BY SIGNING BELOW, I/We accept and agree to the terms and conditions contained in this operations & maintenance plan and to any document referred to by this and covered with it.	
File: _____	Signature: _____
Notarize/Attest: (SEE back and official seal)	Notary Public in and for the State of Oregon
O&M PLAN REQUIRED INFORMATION	
1. Site Plan, including a site plan showing the facility location (in relation to building footprint or other permanent structures on the site), extent of runoff serving the facility, and where stormwater will be discharged to after leaving the facility.	Site Plan (sheet here or include separate sheet)
The stormwater management facility located on this site plan is a required condition of building permits approved for the identified property. The owner of the identified property is responsible to operate and maintain the facility in accordance with the O&M plan on this site. The City of Portland, Bureau of Environmental Services, the Department of Water and Sewerage, and the Bureau of Environmental Services, the O&M plan may be modified under certain circumstances with written approval of the City of Portland, Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 1111 SW 4th Avenue, Room 1000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 823-7318 for assistance.	
2. Description of the identified method used to cover stormwater operation and maintenance. Check One: <input type="checkbox"/> Stormwater Infiltration <input type="checkbox"/> Property Stormwater <input type="checkbox"/> Other (describe): _____ 3. Party (ies) responsible for maintenance only if other than owner. Owner Responsibility. Erosion Control No. _____ Stormwater Infiltration No. _____ Maintenance Contact & Address: Garden City Landscaping XXXX SW 10th Street, Portland, OR 97205	
4. Maintenance practices and schedule for the stormwater facility included in the facility specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operation and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual. Preparation Date: XX/XX/XXXX Revision Date: _____ Estimated Date of Installation (optional): XX/XXXX Prepared by: John Doe	

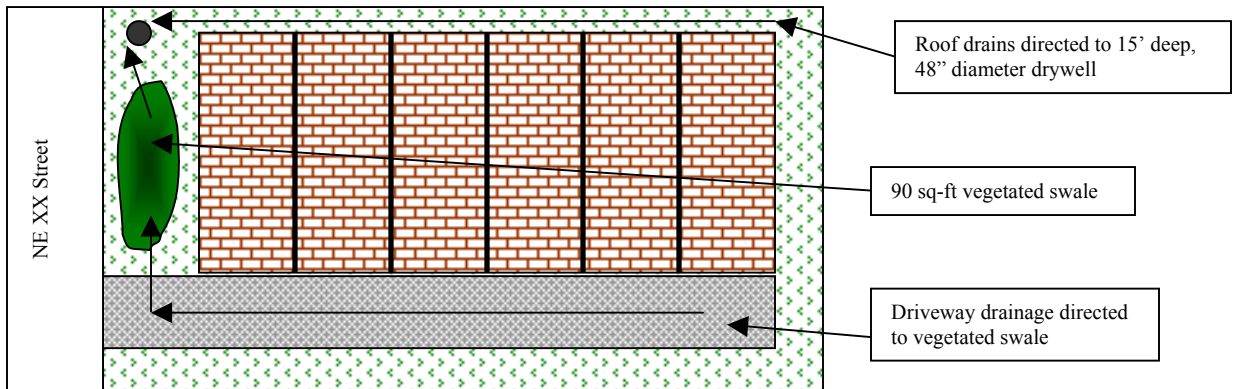
Soakage Trenches Operations & Maintenance Plan
<p>Soakage Trenches consist of drain rock and sand, and receive stormwater from roof downspouts and/or area drains. There are various components within the system: piping, silt basin and the trench itself. The Conveyance Piping consists of an inlet pipe (downspout or area drain), an outlet pipe located between the silt basin and the soakage trench, and a perforated pipe located on top of the aggregate bed of the soakage trench. The Silt Basin is a structure receiving runoff from an inlet pipe and conveying it to the soakage trench. The silt basin serves as the pre-treatment system for the soakage trench, removing sediments and other debris that can impact its proper functioning. All facility components, vegetation, and source controls should be inspected for proper operation and structural stability. These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, then two times per year afterwards, or within 48 hours after each major storm. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:</p> <p>Soakage trench infiltration. If water is noticed on top of the trench within 48 hours of a major storm, the soakage trench may be clogged.</p> <ul style="list-style-type: none"> Check for debris/accumulation, raze and remove and evaluate splash causes (inflow, surface or roof debris, etc). Assess the condition of the aggregate and the filter fabric in the trench. If there is sediment in the aggregate, excavate and replace. If there is a tear in the filter fabric, repair or replace. <p>Conveyance Piping. If water ponds over the trench for more than 48 hours after a major storm and no other cause is identified, it may be necessary to remove the filter fabric to determine if the perforated pipe is clogged with sediment or debris.</p> <ul style="list-style-type: none"> Any debris or algae growth located on top of the soakage trench should be removed and disposed of properly. If the piping has settled more than 1 inch, add fill material. If there are cracks or leakage, replace or repair the pipe, if there are signs of erosion around the pipe, this may be an indication of water seeping due to a crack or break. <p>Silt Basin. If water remains in the soakage trench for 36-48 hours after storm, check for sediment accumulation in the silt basin.</p> <ul style="list-style-type: none"> If less than 50% capacity remains in the basin or if sediment has accumulated, remove and dispose the sediment. <p>Spill Prevention. Virtually all sites, including residential and commercial, present dangers from spills. All homes contain a wide variety of toxic materials including gasoline for lawn mowers, antiseptics for cars, nail polish remover, pesticides, and cleaning agents that can adversely affect groundwater if spilled. It is important to exercise caution when handling substances that can contaminate stormwater.</p> <ul style="list-style-type: none"> Activities that pose the chance of hazardous material spills shall not take place near soakage trenches. <p>Shut-Off Valve or Flow-Blocking Mechanism may have been required with the construction of the soakage trench to temporarily prevent stormwater from flowing into it in the event of an accidental toxic material spill. This may also involve mats kept on-site that can be used to cover inlet drains in parking lots. The shut-off valve shall remain in good working order, if mats or other flow-blocking mechanisms are used, they shall be kept in stock on-site.</p> <p>Training and/or written guidance information for operating and maintaining soakage trenches shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.</p> <p>Access to the soakage trench is required for efficient maintenance. Egress and ingress routes will be maintained to design standards of inspections.</p> <p>Insects & Rodents shall not be harbored in the soakage trench. Pest control measures shall be taken when mosquitoes are found to be present.</p> <ul style="list-style-type: none"> If sprays are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor. Moats in the ground located in and around the soakage trench shall be filled.

Step 4: Submit the plans to the city for permitting. The drywell, soakage trenches, or other stormwater management facilities must be shown on the drawings, along with applicable details, and the recorded O&M plan must be attached. **END.**

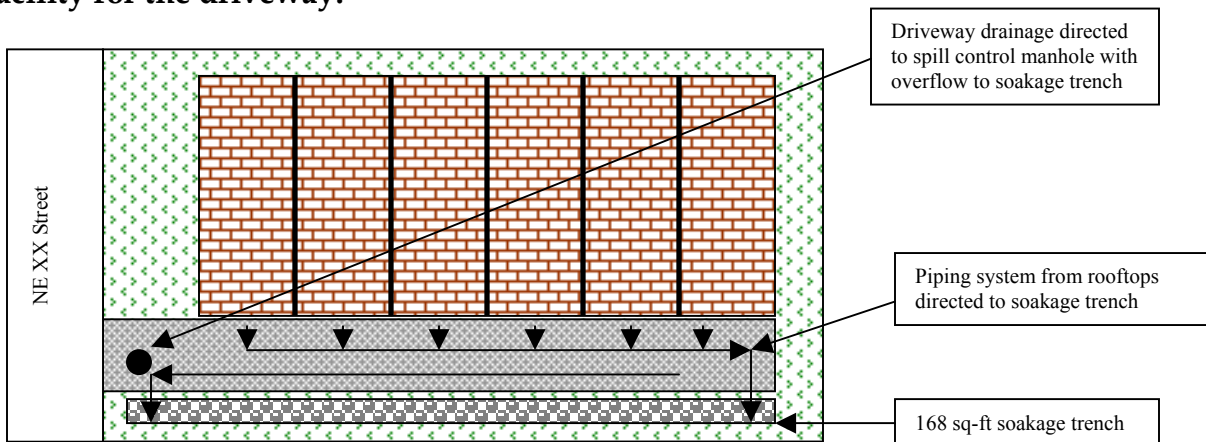
Drywell used for rooftops, surface infiltration used for driveway:



Drywell used for rooftops and driveway, with pollution reduction facility for driveway:

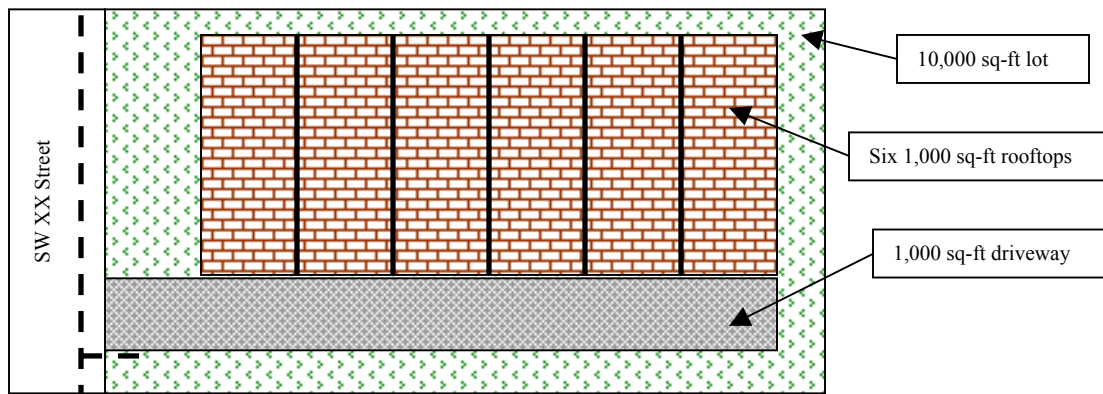


Soakage trenches used for rooftops and driveway, with a pollution reduction facility for the driveway:



CASE EXAMPLE #4: Rowhouse Development w/ Private Driveway (Southwest Portland)

A rowhouse development with six 1,000 square-foot rooftops and a driveway with a footprint of 1,000 square feet will be constructed on a 10,000 square-foot lot in Southwest Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group C (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the lot has slopes that range from 5 to 15 percent. There is an existing public storm sewer pipe in the frontage street with an existing service lateral to the property.



Step 1: Determine the stormwater disposal point for the site. Use **Exhibit 1-1: Stormwater Destination/Disposal Hierarchy**.

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Use Exhibit 1-1 for approval of a stormwater destination method in the City of Portland, the highest (1 = high, 4 = low) technically feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an approvable destination for stormwater.

City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sized in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by PDST (for public streets) or BDS (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on site. Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration is not accepted as a stormwater destination. Existing basements do not have adequate surface (see Surface Infiltration Facility design methodology in Section 2.2.2). A minimum setback of 10 feet is required on private property, as approved by BDS. For full street improvements, existing utility or street trees make it impractical to construct a surface infiltration facility within the street right-of-way.

City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UICs (underground injection control structures) and must be risk-substantiated or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Rooftop runoff does not require pollution reduction, runoff from residential low-use streets or parking lots (< 1,000 average daily trips) requires the use of administrative spill control measures, and high-use streets and parking lots (> 1,000 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Project does not meet DEQ UIC rule authorization or permitting criteria (see Section 1.4.4 for list of criteria), or go to: http://www.deq.state.or.us/wq/groundwa/BAS/StormwaterRequirements.pdf. Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by BES (for public streets) or BDS (for private streets). Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration with UICs is not allowed. <p>Category 3: Off-site flow to drainageway, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BES. Sensitivity of the water resource justifies connection to an alternative destination method, as determined by BES. <p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BES.

Category #1 (surface infiltration facilities) and category #2 (on-site infiltration with drywell or soakage trench) depend on project site soils that infiltrate relatively well (2 inches per hour minimum). In this example, with C-type soils

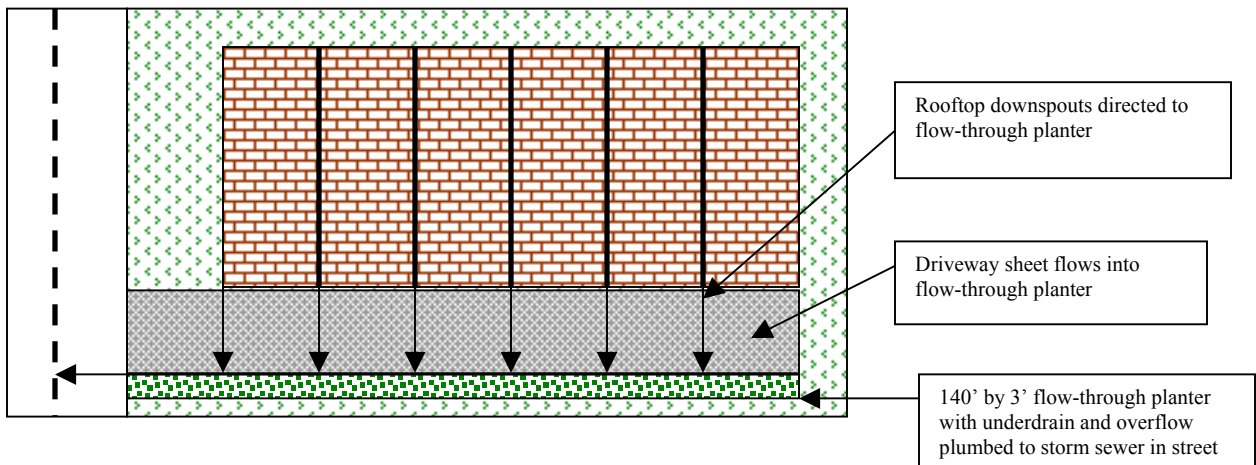
located at each roof downspout, or the downspouts can be plumbed to one large planter, as long as 360 square feet of flow-through planter is provided and all the planters are connected to the storm sewer service lateral.

Step 4: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the flow-through planter used on the site. Form O&M must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example) REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.28	
<i>For official county use only</i>	
Project Building Identification No. _____	
Owner's Name: John Doe	Phone No. (555) 555-1234
Building Address: 1234 Main Street, Portland, OR 97201	City: Portland, OR 97201
Site Address: 1234 Main Street, Portland, OR 97201	Site Legal Description: Section XX, Township XX, Range XX, Lot XX
BY SIGNING BELOW, I/We accept and agree to the terms and conditions contained in this operations & maintenance plan and to any document executed by me and recorded with it.	
Signature: <i>John Doe</i>	
DATE: _____	
City: _____	
City Approval Expires on: _____	
O&M PLAN REQUIRED INFORMATION:	
1. Site Plan. Includes a site plan showing the facility location in relation to building operations or other permanent construction on the site, contours of runoff entering the facility, and where construction will be directed to after leaving the facility.	Site Plan (insert here or include separate sheet)
The stormwater management facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is required to operate and maintain the facility in accordance with the O&M plan on file with the City of Portland, Bureau of Environmental Services. This requirement to operate and maintain the facility in accordance with the on file O&M plan is binding on all current and future owners of the property. The O&M plan may be modified and/or revised without consent of any owner with written approval by and a filing with the Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 1120 SW 4 th Avenue, Room 3000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 833-7811 for assistance.	
2. Description of the finished method used to store stormwater operations and maintenance. Check One:	
<input type="checkbox"/> Stormwater Reservoir <input type="checkbox"/> Property Stormwater <input type="checkbox"/> Other (describe): _____	
3. Party (ies) responsible for maintenance only (other than owner). Owner Responsible	
Designation: _____	Emergency After Hours Contact Phone No. (503) xxx-xxxx
Maintenance Contact: 1120 SW 4 th Avenue, Room 3000, Portland, OR 97201	
4. Maintenance practices and schedule for the stormwater facility is included in the facility specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operation and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual.	
Preparation Date: XX/XX/20XX	Revision Date: _____ Estimated Date of Installation: XX/XX/XX
Prepared By: John Doe	

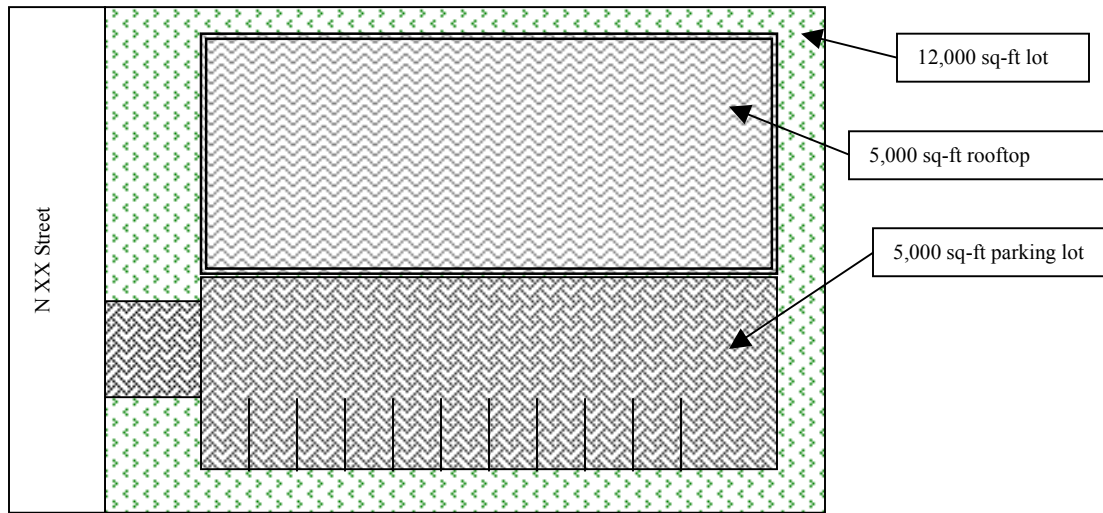
Infiltration and Flow-Through Planters Operations & Maintenance Plan
Planters are designed to allow runoff to filter through layers of gravel (then capturing pollutants) and then either infiltrate into the native soils (infiltration planters) or be collected in a pipe to be discharged off-site (flow-through planters). The planter is sized to accept runoff and temporarily store the water in a reservoir on top of the soil. The flow-through planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 3-4 hours after a storm event. All loose components and vegetation shall be inspected for proper operation and structural stability. These inspections shall occur at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated.
Downspout from rooftop or sheet flow from paving above unimpeded stormwater flow to the planter. <ul style="list-style-type: none"> • Debris shall be removed routinely (e.g., no less than every 6 months) and upon discovery. • Damaged pipe shall be repaired upon discovery.
Splice Blocks prevent splitting against adjacent structures and convey water without disrupting media. <ul style="list-style-type: none"> • Any deficiencies in structure such as cracking, settling, and failure shall be repaired.
Planter Reservoir receives and detains storm water prior to infiltration. Water should drain from reservoir within 3-4 hours of storm event. <ul style="list-style-type: none"> • Sources of slugging shall be identified and corrected. • Topsoil may need to be amended with sand or replaced all together.
Filter Media consisting of sand, gravel, and riprap that allow stormwater to percolate uniformly through the planter. The planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates. <ul style="list-style-type: none"> • Holes that are not consistent with the design and allow water to flow directly through the planter in the ground shall be plugged. • Sediment accumulation shall be hand removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation. • Litter and debris shall be removed routinely (e.g., no less than quarterly) and upon discovery.
Planter shall contain filter media and vegetation. <ul style="list-style-type: none"> • Structural deficiencies on the planter including rot, cracks, and failure shall be repaired.
Overflow Pipe which conveys flow exceeding reservoir capacity to an approved stormwater receiving system. <ul style="list-style-type: none"> • Overflow pipe shall be cleared of sediment and debris when 50% of the conveyance capacity is plugged. • Damaged pipe shall be repaired or replaced upon discovery.
Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. <ul style="list-style-type: none"> • Mow shall be performed at least annually. • Vegetation, large shrubs or trees that limit access or interfere with planter operation shall be pruned or removed. • Fallen leaves and debris from deciduous plant foliage shall be raked and removed. • Invasive or prohibited vegetation from the Portland Plant List shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced. • Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired. Vegetation shall be replaced within a specific timeframe, e.g., 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.
Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.
Training and/or written guidance information for operating and maintaining stormwater planters shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
Access to the stormwater planter shall be safe and efficient. Egress and ingress shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable. <ul style="list-style-type: none"> • Obstacles preventing maintenance personnel and/or equipment access to the stormwater planter shall be removed. • Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
Insects & Rodents shall not be harbored in the stormwater planter. <ul style="list-style-type: none"> • Pest control measures shall be taken when insects/rodents are found to be present. • If sprays are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor. • Holes in the ground located in and around the stormwater planter shall be filled and compacted.

Step 5: Submit the plans to the city for permitting. The stormwater destination (pipe connection to the storm sewer service lateral) must be clearly identified on the drawings, along with flow-through planter locations and applicable details, and the completed Form SIM and recorded O&M plan must be attached. **END.**



CASE EXAMPLE #5: Commercial Development w/ Parking Lot (North Portland)

A commercial building development with a 5,000 square-foot building footprint and a 5,000 square-foot parking lot will be constructed on a 12,000 square-foot lot in North Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group B (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the depth to groundwater is approximately 70 feet. The lot has slopes less than 2 percent.



Step 1: Determine the stormwater disposal point for the site. Use [Exhibit 1-1: Stormwater Destination/Disposal Hierarchy](#).

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Using Exhibit 1.1: For approval of a stormwater destination method in the City of Portland, the highest (1-4) technically feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an appropriate destination for stormwater.

City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sited in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by PDOT (for public streets) or EDS (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning codes, after the infiltration facility has been located on site. Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by EES (for public facilities) or EDS (for private facilities). Site is located within the Columbia South Shore Willford Protection Area (see Exhibit 2.35), where on-site infiltration is not accepted as a stormwater destination. Resident basements do not have adequate setbacks (see Surface Infiltration Facility design methodology in Section 2.2.2). A minimum setback of 10 feet is required on private property, as approved by EDS. For half street improvements, existing utilities or street trees make it impractical to construct a surface infiltration facility within the street right-of-way.

City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UICs (underground injection control structures) and must be retrofitted or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Rooftop runoff does not require pollution reduction, runoff from residential low-use streets or parking lots (< 1,000 average daily trips) requires the use of sedimentation and control measures, and high-use streets and parking lots (> 1,000 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Project does not meet DEQ UIC rule authorization or permitting criteria (see Section 1.4.4 for list of criteria, or go to: http://www.deq.state.or.us/wq/groundwater/RA/Nonwater/Requirements.pdf). Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by EES (for public streets) or EDS (for private streets). Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by EES (for public facilities) or EDS (for private facilities). Site is located within the Columbia South Shore Willford Protection Area (see Exhibit 2.35), where on-site infiltration with UICs is not allowed. <p>Category 3: Off-site flow to drainageway, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by EES. Sensitivity of the water resource justifies connection to an alternative destination method, as determined by EES. <p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by EES.

Under category #1, the Stormwater Destination/Disposal Hierarchy states that where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. In this case, with B-type soils and mild slopes, on-site infiltration is most likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. In addition to drywells and soakage trenches, other options generally include surface infiltration facilities such as vegetated or grassy swales, infiltration planters, or vegetated infiltration basins. In accordance with the surface infiltration design approach from [Section 2.2.2](#), enough storage volume must be provided in the surface infiltration facility to contain the runoff from a 10-year, 24-hour storm. For the rooftop areas, this volume can be approximated by: 0.28 feet x 5,000 square feet = 1,400 cubic feet. In this example, there is not adequate space on-site to construct surface infiltration facilities for the rooftop areas.

Under category #1, the 5,000 square-foot parking lot must be evaluated for surface infiltration. In accordance with the surface infiltration design approach in [Section 2.2.2](#), enough storage volume must be provided in the surface infiltration facility to contain the runoff from a 10-year, 24-hour storm. For the parking lot, this volume is: 0.28 feet x 5,000 square feet = 1,400 cubic feet. In this example, there is not adequate space on-site to construct surface infiltration facilities to completely dispose of stormwater from the parking lot areas.

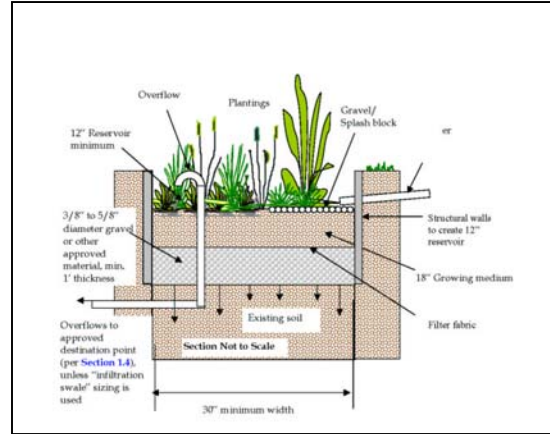
Because there is not enough space on-site for complete surface infiltration, under category #2 the runoff from the parking lot may be infiltrated on-site with a private drywell or soakage trench. A pollution reduction facility or a spill control manhole must also be used to meet pollution reduction requirements.

Step 2: Design the drywells, soakage trenches, surface infiltration facilities, and/or pollution reduction facilities in accordance with [Chapter 2.0: Stormwater Management Facility Design](#). [Exhibit 2-1](#) can be used to help select a facility type that can utilize the simplified approach for sizing.

In this example, an infiltration planter will be used to manage stormwater from the parking lot, and the overflow from the planter will be connected to the site's drywell. Drywells and soakage trenches must be registered with DEQ in accordance with [Section 1.4.4](#).

Exhibit 2-1: Stormwater Management Facility Application Table

Stormwater Management Facility Type	Credits Given with Assumed Design Approach		
	Pollution Reduction	Flow Control	Destination
Tree-roof & roof garden	Simplified	Simplified	NA
Pervious pavement	Simplified	Simplified	Performance
Container planter	Simplified	Simplified	NA
Tree credit	Simplified	Simplified	NA
Infiltration planter	Simplified	Simplified	Presumptive ^a
Flow-through planter	Simplified	Simplified	NA
Vegetated swale	Simplified	Simplified	Presumptive ^a
Grassy swale < 15,000 sq ft impervious area	Simplified	Simplified	Presumptive ^a
Grassy swale > 15,000 sq ft impervious area	Presumptive	NA	Presumptive ^a
Street swales	Simplified	Simplified	Presumptive ^a
Vegetated filter strip	Simplified	Simplified	Presumptive ^a
Vegetated infiltration basin	Simplified	Simplified	Presumptive ^a
Sand filter	Simplified	Simplified	Presumptive ^a
Wet pond	Presumptive	NA	NA
Extended wet det. pond	Presumptive	Presumptive	NA
Dry detention pond	Presumptive	Presumptive	NA
Treatment wetland	Presumptive	Presumptive	NA
Managed stormwater treatment technology	NA	Presumptive	NA
Structural det. facility	NA	NA	NA
Oil/water separator	Presumptive	NA	NA
Rainwater harvesting	Performance	Performance	NA
Private sewage trench	NA	Presumptive	Presumptive
Public infil. sump	NA	Presumptive	Presumptive
Private drywell	NA	Presumptive	Presumptive



Form SIM will be used to size the infiltration planter to meet pollution reduction requirements. From this form, the sizing factor is 0.06. The required square-footage of planter is: 5,000 square feet (parking lot area) \times 0.06 = 300 square feet. The planter will be 3 feet wide by 100 feet long, and will include an overflow catch basin plumbed to an on-site drywell or soakage trench.

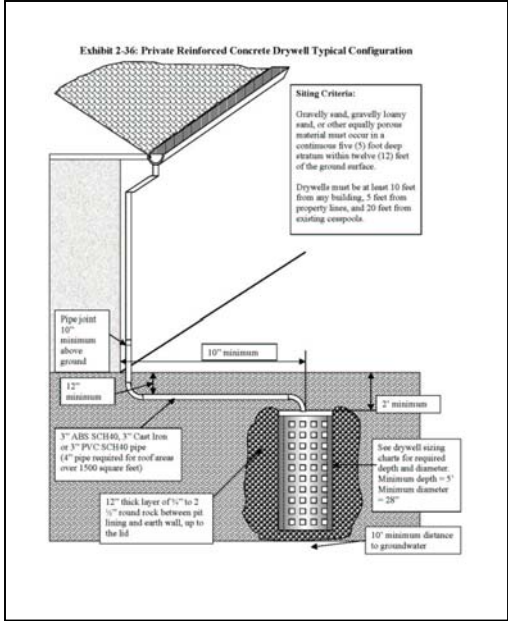
Form SIM: Simplified Approach for Stormwater Management			
New or Redeveloped Impervious Site Area <input type="text" value="Box 1"/>			
(do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)			
INSTRUCTIONS		Impervious Area Managed ^a	Facility Surface Area ^b
1. Enter square footage of total impervious area (see Note 1) for full top of structure.		Column 1	Column 3
2. Select impervious area from Category 1, enter the square footage of impervious area that will be managed.		Column 2	Column 3
3. Select impervious area from Category 2, and enter the square footage of impervious area that will be managed. This is the surface area available to manage runoff from the impervious area.			
4. Select impervious area from Category 3, and enter the square footage of impervious area that will be managed. This is the surface area available to manage runoff from the impervious area.			
5. Enter column 1 (Box 1) and enter the resulting "Impervious Area Managed" in Box 2.			
6. Enter column 2 (Box 2) and enter the resulting "Facility Surface Area" in Box 3.			
7. See Chapter 2.8, drywell and soakage trench sizing and design requirements.			
8. See Note 1 for details on how to calculate the square footage of impervious area for full top of structure, or for details on how to calculate the square footage of impervious area that will be managed from the impervious surface.			
Total Impervious Area Managed <input type="text" value="Box 2"/>			
Box 1 - Box 2 <input type="text" value="Box 3"/>			

If a drywell is used to infiltrate stormwater from the rooftop, driveway, or parking lot, **Exhibit 2-34: Drywell Sizing** is used. In accordance with this exhibit, a 10-foot-deep, 48-inch-diameter drywell is required to infiltrate stormwater from the 5,000 square-foot impervious rooftop area. If the drywell will be used to infiltrate stormwater from the rooftop and parking lot (10,000 square-feet of impervious area), a 20-foot-deep, 48-inch-diameter drywell is required. The design criteria presented in the private drywell section of Chapter 2.0 must be used to design the drywell, and to locate the facility on-site. Setbacks from building structure must be considered (see **Exhibit 2-36**). The detailed design and location must be shown on the permit drawings.

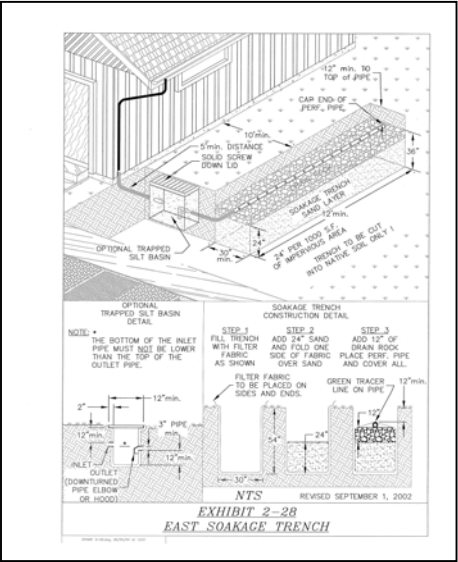
Exhibit 2-34: Drywell Sizing

Once approval has been given by BDC for on-site infiltration of stormwater, the following chart shall be used to select the number and type of drywells.

Impervious Area (sq.ft)	18" Diameter Drywell Depth				24" Diameter Drywell Depth				36" Diameter Drywell Depth			
	5'	10'	15'	20'	5'	10'	15'	20'	5'	10'	15'	20'
1000												
2000												
3000												
4000												
5000												
6000												
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17000												
18000												
19000												
20000												



If a soakage trench is used to infiltrate stormwater from the rooftop or parking lot, **Exhibit 2-28: East Soakage Trench** is used. In accordance with this exhibit, 24 feet of soakage trench is required per 1,000 square feet of rooftop area. In this example, the length of soakage trench to handle the roof runoff will be: $5,000 * (24/1,000) = 120 \text{ feet}$ in length. If used for the roof *and* the parking lot, the soakage trench will be: $10,000 * (24/1,000) = 240 \text{ feet}$. The design criteria presented in the soakage trench section of Chapter 2.0 must be used to design the trench, and to locate the facility on-site. Setbacks from building structure must be considered. The detailed design and location must be shown on the permit drawings.

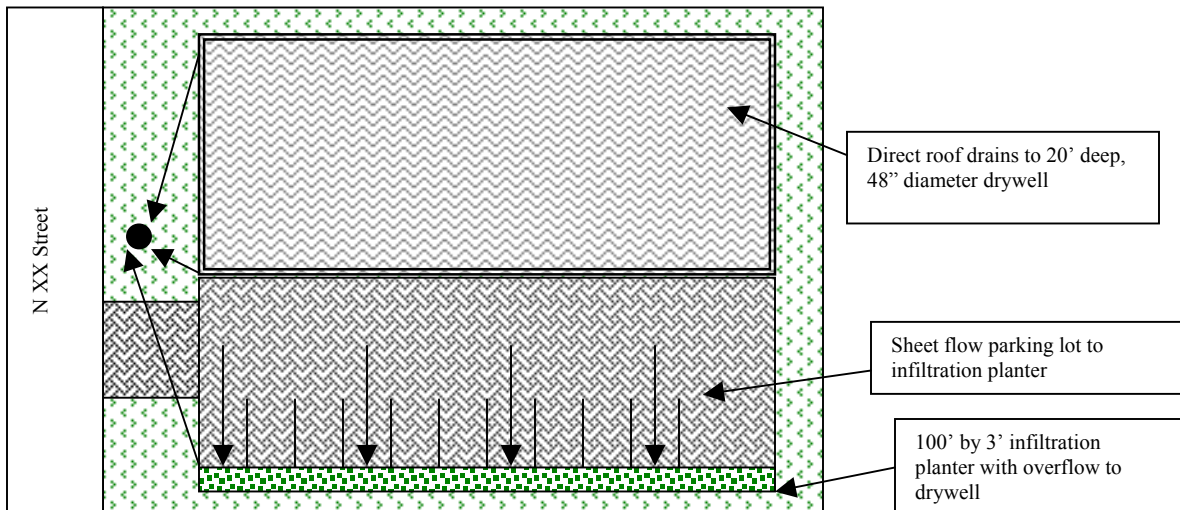


Step 3: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the drywell, soakage trench, or other stormwater management facilities used on the site. **Form O&M** must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example)	
REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38	
For official county use only	
Project Building Application No. _____	
Owner's Name: John Doe	Phone No.: (503) 555-1234
Mailing Address: 1234 N. Street, Portland, OR 97201	Site Address: XXXXX N. Street, Portland, OR 97201
Site Legal Description: Section 12, Township 33 N., Range 12 E., T43N E23E	
BY SIGNING BELOW, I/We accept and agree to the terms and conditions contained in this operations & maintenance plan and to any document referred to by this and covered with it.	
File: _____	
NOTARIZATION: (SEEK NOTARIZATION OFFICE AND OFFICIAL AND SIGNATURE) _____	
Notary Public in and for the State of Oregon	
My Appointment Expires on: _____	
O&M PLAN REQUIREMENTS:	
1. Site Plan, including a site plan showing the facility location (in relation to building footprint or other permanent structures on the site) or a map of the site showing the facility, and where measures will be distributed to other building facilities.	Site Plan (Insert here or include separate sheet)
The stormwater management facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is responsible to operate and maintain the facility in accordance with the O&M plan and the City of Portland, Bureau of Environmental Services. The responsible operator and maintains this facility in accordance with the O&M plan by holding an O&M permit and by the Bureau of Environmental Services. The O&M plan may be modified under certain circumstances with the written approval of the City of Portland, Bureau of Environmental Services. The O&M plan for this facility is valid for the Bureau of Environmental Services, located at 1100 NE Oregon Street, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 823-7318 for assistance.	
2. Description of the facility method used to cover future operation and maintenance. Check One: <input type="checkbox"/> Stormwater Infiltration <input type="checkbox"/> Property Street Infiltration <input type="checkbox"/> Other (describe): _____	
3. Party (ies) responsible for maintenance (if other than owner). Owner Responsibility	
4. Contact Name: Mr. John Doe, (503) 555-1234 <input type="checkbox"/> Stormwater Infiltration Contact Phone No.: (503) 555-1234	
Maintenance Contact Address: 1234 N. Street, Portland, OR 97201	
5. Maintenance practices and schedule for the stormwater facility included in the facility-specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operation and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual.	
Preparation Date: XX/XX/XXXX <input type="checkbox"/> Revision Date: _____ <input type="checkbox"/> Estimated Date of Installation: XX/XX/XXXX	
Prepared by: John Doe	

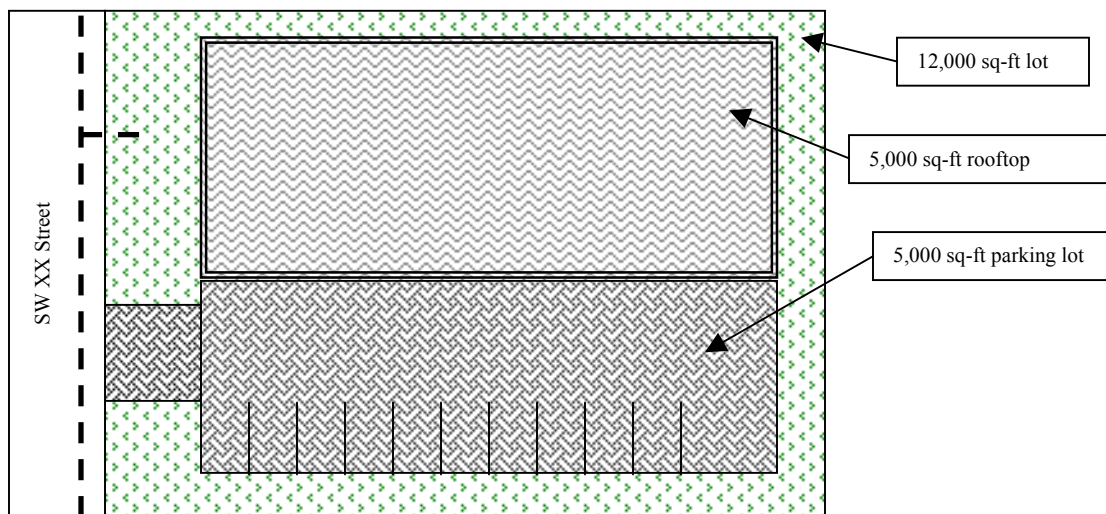
Soakage Trenches
Operations & Maintenance Plan
Soakage Trenches consist of drain rock and sand, and receive stormwater from roof downspouts and/or area drains. There are various components within the system: piping, silt basin and the trench itself. The Conveyance Piping consists of an inlet pipe (downspout or area drain), an outlet pipe located between the silt basin and the soakage trench, and a perforated pipe located on top of the aggregate and over the soakage trench. The Silt Basin is a structure receiving runoff from an inlet pipe and conveying it to the soakage trench. The silt basin serves as the pre-treatment system for the soakage trench, removing sediments and other debris that can impact its proper functioning. All facility components, vegetation, and source controls shall be inspected for proper operation and structural stability. These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, then two times per year afterwards, or within 48 hours after each major storm. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:
Soakage Trench Infiltration: If water is noticed on top of the trench within 48 hours of a major storm, the soakage trench may be clogged. <ul style="list-style-type: none"> Check for debris/debris accumulation, rake and remove and evaluate upland causes (erosion, surface or roof debris, etc.) Assess the condition of the aggregate and the filter fabric in the trench. If there is sediment in the aggregate, excavate and replace. If there is a tear in the filter fabric, repair or replace.
Conveyance Piping: If water ponds over the trench for more than 48 hours after a major storm and no other cause is identified, it may be necessary to remove the filter fabric to determine if the perforated pipe is clogged with sediment or debris. <ul style="list-style-type: none"> Any debris or algae growth located on top of the soakage trench should be removed and disposed of properly. If the piping has settled more than 1 inch, add fill material. If there are cracks or releases, repair or replace the pipe. If there are signs of erosion around the pipe, this may be an indication of water seeping due to a crack or break.
Silt Basin: If water remains in the soakage trench for 36-48 hours after storm, check for sediment accumulation in the silt basin. <ul style="list-style-type: none"> If less than 50% capacity remains in the basin or if sediment has accumulated, remove and dispose the sediment.
Spill Prevention: Virtually all sites, including residential and commercial, present dangers from spills. All homes contain a wide variety of toxic materials including gasoline for lawn mowers, antifreeze for cars, oil, paint, remover, pesticides, and cleaning agents that can adversely affect groundwater if spilled. It is important to exercise caution when handling substances that can contaminate stormwater. <ul style="list-style-type: none"> Activities that pose the chance of hazardous material spills shall not take place near soakage trenches.
A Shut-Off Valve or Flow-Blocking Mechanism may have been required with the construction of the soakage trench to temporarily prevent stormwater from flowing into it in the event of an accidental toxic material spill. This may also involve mats kept on-site that can be used to cover inlet drains in parking lots. The shut-off valve shall remain in good working order or other flow-blocking mechanisms are used, they shall be kept on-site.
Training and/or written guidance information for operating and maintaining soakage trenches shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants. Access to the soakage trench is required for efficient maintenance. Egress and ingress routes will be maintained to design standards of inspections.
Insects & Rodents shall not be harbored in the soakage trench. Pest control measures shall be taken when insects/rodents are found to be present. <ul style="list-style-type: none"> If spiders are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor. Inlets in the ground located in and around the soakage trench shall be fitted.

Step 4: Submit the plans to the city for permitting. The drywell, soakage trenches, along with applicable details, Form SIM, and the recorded O&M plan must be attached. **END.**



CASE EXAMPLE #6: Commercial Development w/ Parking Lot (Southwest Portland)

A commercial building development with a 5,000 square-foot building footprint and a 5,000 square-foot parking lot will be constructed on a 12,000 square-foot lot in Southwest Portland. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group C (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the lot has slopes that range from 2 to 5 percent. There is an existing public combined sewer pipe in the frontage street with an existing service lateral to the property.



Step 1: Determine the stormwater disposal point for the site. Use **Exhibit 1-1: Stormwater Destination/Disposal Hierarchy**.

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Use Exhibit 1-1 for approval of a stormwater destination method in the City of Portland, the highest "fit" and lowest technical hierarchy category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an appropriate destination for stormwater.

City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grass swale, street swale, vegetated infiltration basin, or infiltration planter sized in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2.2 shall be used.</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by FDOT (for public streets) or BES (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on site. Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BES (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2-35), where on-site infiltration is not accepted as a stormwater destination. Adjacent basements do not have adequate setbacks (see Surface Infiltration Facility design methodology in Section 2.2.2.2). A minimum setback of 10 feet is required on private property, as approved by BES. For full street improvements, existing utilities or street trees make it impractical to construct a surface infiltration facility within the street right-of-way.

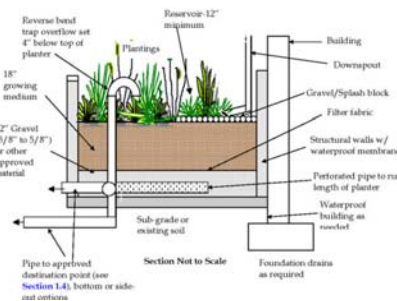
City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration sump system, private drywell or soakage trench.</p> <p>These facility types are classified as TCS (underground injection control structure) and must be sub-authorized or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the extent of the stormwater runoff. Runoff itself does not require pollution reduction, runoff from residential low-use streets or parking lots (1,000 average daily trips) requires the use of sedimentation and control structures, and higher street and parking lots (1,700 average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.4.2.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Project does not meet DEQ/USC rule authorization or permitting criteria (see Section 1.4.4 for list of facilities, as per http://www.oregon.gov/dep/water/RS/Non-stormwater/Regulations.pdf). Soils do not infiltrate well enough for on-site infiltration, as approved by BES (for public streets) or BES (for private streets). There is no available infiltration area on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or BES (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2-35), where on-site infiltration with TCS is not allowed. <p>Category 3: Off-site flow to drainageway, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Stream does not exist or does not have available capacity, as determined by BES. Nearby water resources justify connection to an alternative destination method, as determined by BES. <p>Category 4: Off-site flow to a combined sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).</p> <p>Exclusions:</p> <ol style="list-style-type: none"> Stream does not exist or does not have available capacity, as determined by BES.

Category #1 (surface infiltration facilities) and category #2 (on-site infiltration with drywell or soakage trench) depend on project site soils that infiltrate relatively well (2 inches per hour minimum). In this example, with C-type soils and moderate slopes, on-site infiltration is not likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. Category #3 (off-site flow to drainageway, river, or storm-only pipe system) depends on the availability of such resources. Portlandmaps.com or other City maps available at the Development Services Center (1900 SW 4th Avenue) can be used to identify off-site storm systems. In this example, there are no existing storm-only conveyance systems available to serve the site. Where on-site infiltration is not possible, and there is not an available storm-only system to serve the site, category #4 (off-site flow to a combined sewer) may be evaluated for use.

Step 2: Choose pollution reduction and flow control facilities from **Chapter 2.0: Stormwater Management Facility Design**. There are many facility types to choose from that will achieve both pollution reduction and flow control. Options that retain water on-site are required to the maximum extent practicable. Exhibit 2-1 can be used to help choose a facility type that can use the simplified approach for sizing. In this example, flow-through planters will be used to manage stormwater from the rooftop and parking lot, and the overflow and underdrain pipes from the planters will be connected to the public combined sewer in the street. The driveway may use pervious pavement with underdrains connected to the combined sewer, or the runoff may be directed to the flow-through planter.

Exhibit 2-1: Stormwater Management Facility Application Table

Stormwater Management Facility Type	Credits Given with Associated Design Approach		
	Pollution Reduction	Flow Control	Destination
Lawns & roof gardens	Simplified	Simplified	NA
Permeable pavement	Simplified	Simplified	Performance
Container planters	Simplified	Simplified	NA
Tree credits	Simplified	Simplified	NA
Infiltration planters	Simplified	Simplified	Presumptive ^o
Flow-through planters	Simplified	Simplified	NA
Vegetated swale	Simplified	Simplified	Presumptive ^o
Grassy swale < 15,000 sq ft impervious area	Simplified	Simplified	Presumptive ^o
Grassy swale > 15,000 sq ft impervious area	Presumptive	NA	Presumptive ^o
10 ft impervious area	Simplified	Simplified	Presumptive ^o
Street swales	Simplified	Simplified	Presumptive ^o
Vegetated filter strip	Simplified	Simplified	Presumptive ^o
Vegetated infiltration basin	Simplified	Simplified	Presumptive ^o
Sand filter	Simplified	Simplified	Presumptive ^o
Wet pond	Presumptive	NA	NA
Detention and det. pond	Presumptive	Presumptive	NA
Day detention pond	Presumptive	Presumptive	NA
Treatment wetland	Presumptive	Presumptive	NA
Manufactured treatment technology	Performance	NA	NA
Structural det. facility	NA	Presumptive	NA
Oil/water separator	Presumptive	NA	NA
Rainwater harvesting	Performance	Performance	NA
Private soakage trench	NA	Presumptive	Presumptive
Public infiltration	NA	Presumptive	Presumptive
Private drywell	NA	Presumptive	Presumptive



Step 3: Design pollution reduction and flow control facilities from **Chapter 2.0: Stormwater Management Facility Design.** Form SIM will be used to size the flow-through planters to meet pollution reduction and flow control requirements. From this form, the sizing factor for flow-through planters is 0.06. The required square-footage of planters is: 10,000 square feet \times 0.06 = 600 square feet for the roof drainage and the parking lot. The planter can be split up and located at each roof downspout, or the downspouts can be plumbed to one large planter, as long as 300 square feet of flow-through planter is provided for the roof, 300 square feet of planter is provided for the parking lot, and all the planters are connected to the public combined sewer in the street.

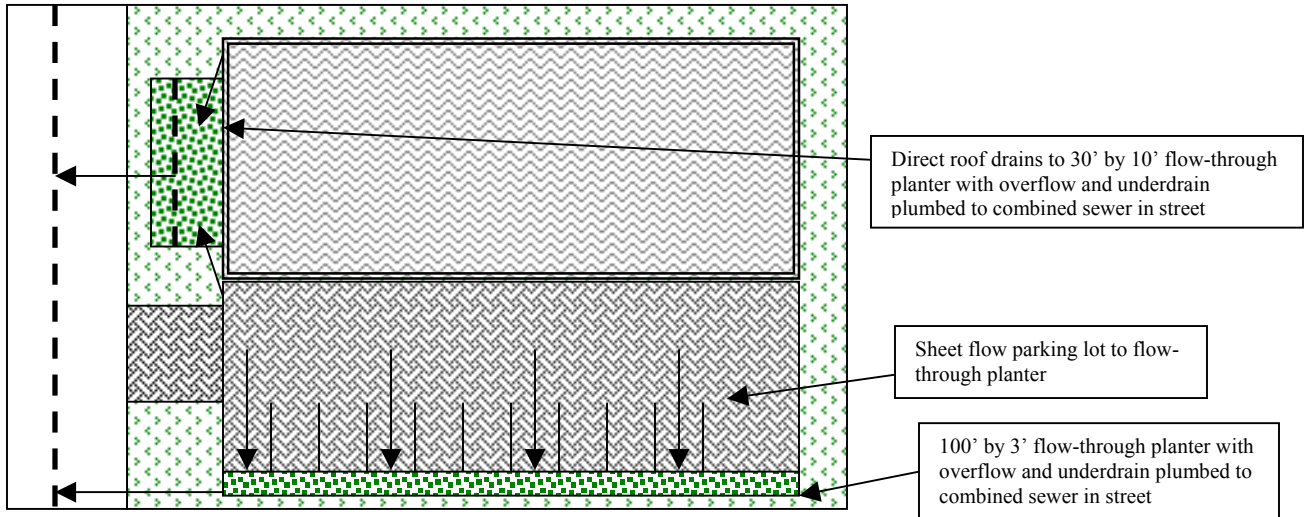
Form SIM: Simplified Approach for Stormwater Management			
New or Redeveloped Impervious Site Area <input type="text"/> Box 1 (do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)			
INSTRUCTIONS	Impervious		
	Impervious Area Reduction Technique	Area Managed x Facility Surface Area	Impervious Area
1. Enter square footage of total impervious area in Box 1. Enter the square footage of impervious area that will be infiltrated on-site with drywells or soakage trenches in Box 2.	1) Eco-Floor / Roof Garden	<input type="text"/>	<input type="text"/>
2. Select impervious area reduction techniques from rows 1-3 to reduce square footage of impervious area. This credit can be calculated using the tree credit calculated on the next page.	2) Contained Planter	<input type="text"/>	<input type="text"/>
	3) Tree Credit (See Next Page)	<input type="text"/>	<input type="text"/>
3. Select square footage of stormwater management facilities from rows 4-12. Column 1: enter the square footage of impervious area that each facility will manage.	4) Infiltration Planter	<input type="text"/>	<input type="text"/>
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 total square footage of impervious area that is managed by the stormwater management facilities.	5) Flow-Through Planter	<input type="text"/>	<input type="text"/>
	6) Vegetated Swale	<input type="text"/>	<input type="text"/>
	7) Grassy Swale	<input type="text"/>	<input type="text"/>
	8) Vegetated Filter Strip	<input type="text"/>	<input type="text"/>
	9) Vegetated Infiltration Basin	<input type="text"/>	<input type="text"/>
	10) Sand Filter	<input type="text"/>	<input type="text"/>
5. If Box 1 is greater than 1 square foot, and square footage of facilities in Column 1 are not available, or additional facilities from Chapter 2.0 of the Stormwater Management Manual to manage stormwater from these remaining surfaces.	Total Impervious Area Managed <input type="text"/> Box 2		
	Box 1 - Box 2 <input type="text"/> Box 3		

Step 4: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the flow-through planters used on the site. Form O&M must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example) REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.28	
Project Building Application No. _____ Owner's Name: John Doe Phone No. (area code required) 503.1.555.5555 Mailing Address (if not the same as project address) Site Address Site Legal Description	For official county use only
BY SIGNING BELOW, the signatory agrees to the terms and conditions contained in this operations & maintenance plan and in any document executed by him and recorded with it.	
Signature: <i>John Doe</i>	
Title: _____	
My Appointment Expires on: _____	
O&M Plan REQUIRED INFORMATION:	
1. Site Plan, include a site plan showing the facility location (in relation to building envelope or other permanent monuments on the site), contours of runoff causing the facility, and where stormwater will be discharged to after leaving the facility.	Site Plan (insert here or include separate sheets)
The stormwater management facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is required to operate and maintain this facility in accordance with the O&M plan on file with the City of Portland, Bureau of Environmental Services. This requirement to operate and maintain this facility in accordance with the O&M plan is binding on all current and future owners of the property. The O&M plan may be modified under certain circumstances with written approval by and in filing with the Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 1100 SW 7 th Avenue, Room 1000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m. Monday through Friday. Call (503) 823-7344 for assistance.	
2. Description of the structural method used to cover future operations and maintenance. Check One: <input type="checkbox"/> Homeowner Association <input type="checkbox"/> Property Owner Association <input type="checkbox"/> Other (describe): 3. Party (ies) responsible for maintenance (only if other than owner's). Owner: Responsible District Phone No. (area code required) (503) xxx-xxxx Emergency After Hours Contact Phone No. (503) xxx-xxxx Maintenance Contact & Address: Garden Coop Landscaping, 3333 SE XX Street, Portland, OR 972XX	
4. Maintenance practices and schedule for the stormwater facility is included in the facility specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operations and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual. Preparation Date: XX/XX/200X Revision Date: ____/____/____ Estimated Date of Installation (insert year): XX/XXXX Prepared By: John Doe	

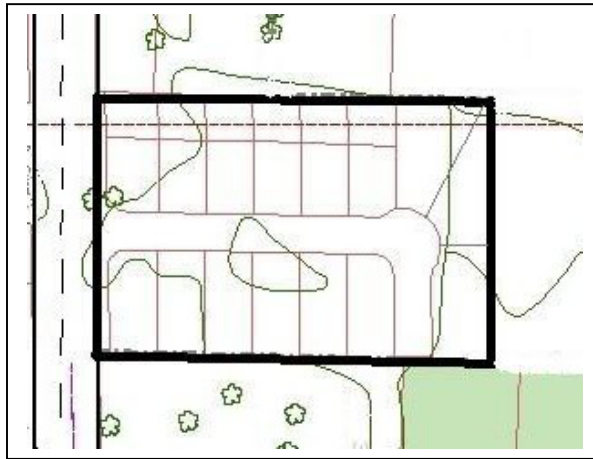
Infiltration and Flow-Through Planters Operations & Maintenance Plan
Planters are designed to allow runoff to filter through layers of topsoil (thus capturing pollutants) and then either infiltrate into the native soils (infiltration planter) or be collected in a pipe to be discharged off-site (flow-through planter). The planter is sized to accept runoff and temporarily store the water in a reservoir on top of the soil. The flow-through planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 3-4 hours after a storm event. All facility components and vegetation shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated.
Downspout from rooftop or sheet flow from paving allows unimpeded stormwater flow to the planter. <ul style="list-style-type: none"> Debris shall be removed routinely (e.g., no less than every 6 months) and upon discovery. Damaged pipe shall be repaired upon discovery.
Splash Blocks prevent splashing against adjacent structures and convey water without disrupting media. <ul style="list-style-type: none"> Any deficiencies in structure such as cracking, rotting, and failure shall be repaired.
Planter Reservoir receives and detains storm water prior to infiltration. Water should drain from reservoir within 3-4 hours of storm event. <ul style="list-style-type: none"> Sources of clogging shall be identified and corrected. Topsoil may need to be amended with sand or replaced all together.
Filter Media consisting of sand, gravel, and topsoil shall allow stormwater to percolate uniformly through the planter. The planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates. <ul style="list-style-type: none"> Holes that are not consistent with the design and allow water to flow directly through the planter to the ground shall be plugged. Sediment accumulation shall be hand removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation. Litter and debris shall be removed routinely (e.g., no less than quarterly) and upon discovery.
Planter shall contain filter media and vegetation. <ul style="list-style-type: none"> Structural deficiencies in the planter including rot, cracks, and failure shall be repaired.
Overflow Pipe safely conveys flow exceeding reservoir capacity to an approved stormwater receiving system. <ul style="list-style-type: none"> Overflow pipe shall be cleared of sediment and debris when 50% of the conveyance capacity is plugged.
Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. <ul style="list-style-type: none"> Mulch shall be replenished at least annually. Vegetation, large shrubs or trees that limit access or interfere with planter operation shall be pruned or removed. Fallen leaves and debris from deciduous plant foliage shall be raked and removed. Nuisance or prohibited vegetation from the Portland Plant List shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced. Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired. Vegetation shall be replaced within a specific timeframe, e.g., 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.
Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. <ul style="list-style-type: none"> Structural deficiencies in the planter including rot, cracks, and failure shall be repaired.
Training and/or written guidance information for operating and maintaining stormwater planters shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants. <ul style="list-style-type: none"> Access to the stormwater planter shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable. Obstacles preventing maintenance personnel and/or equipment access to the stormwater planter shall be removed. If any are considered, then a mosaic landscape, such as <i>Basilica thurensensis</i> or <i>Abies</i> formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
Insects & Rodents shall not be harbored in the stormwater planter. <ul style="list-style-type: none"> Pest control measures shall be taken when insects/rodents are found to be present. If any are considered, then a mosaic landscape, such as <i>Basilica thurensensis</i> or <i>Abies</i> formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
Holes in the ground located in and around the stormwater planter shall be filled and compacted.

Step 5: Submit the plans to the city for permitting. The stormwater destination (pipe connection to the combined sewer service lateral) must be clearly identified on the drawings, along with flow-through planter locations and applicable details, and the completed Form SIM and recorded O&M plan must be attached.
END.



CASE EXAMPLE #7: Subdivision w/ Public Street Improvement (Southeast Portland)

A residential subdivision will be developed in Southeast Portland with 14 single-family house lots and public street improvements. Each lot is approximately 5,000 square-feet in size, and the public street improvement will consist of 500 feet of 26-foot-wide street with 6-foot-wide sidewalks on each side. Total street and sidewalk impervious area is 19,000 square-feet. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group B (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the depth to groundwater is approximately 20 feet. The property has slopes less than 2 percent.



Step 1: Determine the stormwater disposal point for the site. Use **Exhibit 1-1: Stormwater Destination/Disposal Hierarchy**.

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Exhibit 1-1: For approval of a stormwater destination method in the City of Portland, the highest (1) high, 4) low (hydrologic) feasible category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an approvable destination for stormwater.

City of Portland Stormwater Destination Hierarchy
<p>Category 1: On-site infiltration with a surface infiltration facility.</p> <p>To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sized in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater. Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by PDOT (for public streets) or BDS (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning code, after the infiltration facility has been located on-site. Contaminated soils are present on site such that DQI will not permit stormwater infiltration. Documentation showing DQI assessment must be submitted. Slope instability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% in the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BDS (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration is not accepted as a stormwater destination. Adjacent basements do not have adequate setbacks (see Surface Infiltration Facility design methodology in Section 2.2.2). A minimum setback of 10 feet is required on private property, as approved by BDS. For full street improvements, existing utility or street trees make it infeasible to construct a surface infiltration facility within the street right-of-way.

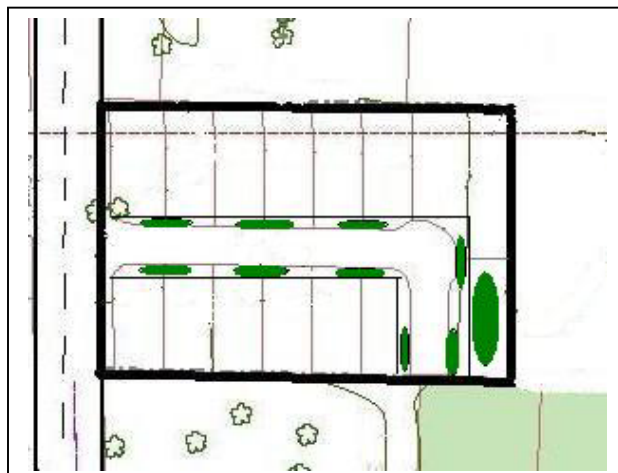
City of Portland Stormwater Destination Hierarchy (Continued)
<p>Category 2: On-site infiltration with a public infiltration using sump system, private drywell or soakage trench.</p> <p>These facility types are classified as UIC (underground injection control structures) and must be submittal and permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the source of the stormwater runoff. Roofing runoff does not require pollution reduction, runoff from residential law-care streets or parking lots (1,000 average daily trips) requires the use of submittal/DEQ control standards, and high-use streets and parking lots (1,000+ average daily trips) require full pollution reduction. A surface retention facility is required to the MEP to meet applicable pollution reduction requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> Project does not meet DEQ UIC submittal or permitting criteria (see Section 1.4.4 for list of criteria, or go to: Sub-surface soils do not infiltrate well enough for on-site infiltration, as approved by BDS (for public streets) or BDS (for private streets). Slope instability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BDS (for public facilities) or BDS (for private facilities). Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.35), where on-site infiltration with UIC is not allowed. <p>Category 3: Off-site flow to drainageway, river, or storm-only pipe system.</p> <p>Pollution reduction is required. Flow control is required in most cases (see Section 1.6.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BDS. Sensitivity of the water resource justifies connection to an alternative destination method, as determined by BDS. <p>Category 4: Off-site flow to a established sewer.</p> <p>Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.6.2 for MEP criteria).</p> <p>Exceptions:</p> <ol style="list-style-type: none"> System does not exist or does not have available capacity, as determined by BDS.

Private Home Sites: Under category #1, the Stormwater Destination/Disposal Hierarchy states that where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground injection control facilities, such as soakage trenches and drywells. In this case, with B-type soils and mild slopes, on-site infiltration is most likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. Drywells and soakage trenches must have at least 10 feet of separation to the seasonally high groundwater table. In addition to drywells and soakage trenches, other options include surface infiltration facilities such as vegetated or grassy swales, infiltration planters, or vegetated infiltration basins. In addition to the options listed above, the driveways may use pervious pavement or be graded to sheet flow into adjacent lawn areas.

Public Streets: Under category #1, surface infiltration facilities must be evaluated for the public street and sidewalk impervious surfaces. To do this, Section 2.2.2 must be used to determine the square-footage of surface infiltration facility that would be needed, as follows:

1) Determine the preliminary facility size by using [Section 2.2.2](#) to calculate the runoff volume generated by the 10-year, 24-hour storm. Runoff volume (cubic feet) = 0.28 feet x impervious area (square-feet) = 0.28 feet x 19,000 square-feet = **5,320 cubic feet**. The facility will need to be capable of containing this volume of runoff through a combination of above-ground storage and below-ground storage within voids in subsurface base rock. Check the subdivision for available surface infiltration areas, which can be located within the public rights-of-way between the curb and sidewalk, or on private property in a separate stormwater tract.

Potential surface infiltration areas:



2) If there are sufficient areas on-site to use surface infiltration facilities to meet stormwater destination requirements, infiltration tests must be done to verify that the minimum rate of 2 inches per hour is met, and that the maximum drawdown time for all surface infiltration facilities will not exceed 30 hours.

If there are not sufficient areas on-site to use surface infiltration facilities, or the minimum infiltration rate or maximum drawdown requirements are not met, go to destination hierarchy category #2: on-site infiltration with a public infiltration sump system, private drywell, or soakage trench. For the management of public street stormwater, public infiltration sump systems may be used if Oregon Department of Environmental Quality (DEQ) rule authorization criteria (presented in [Section 1.4.4](#)) can be met, including sufficient separation distance to groundwater and drinking water wells. In this case, adequate separation distance to groundwater (10 feet) does not exist; another option must therefore be pursued. Lots may need to be rearranged or sacrificed to provide more room for surface infiltration facilities.

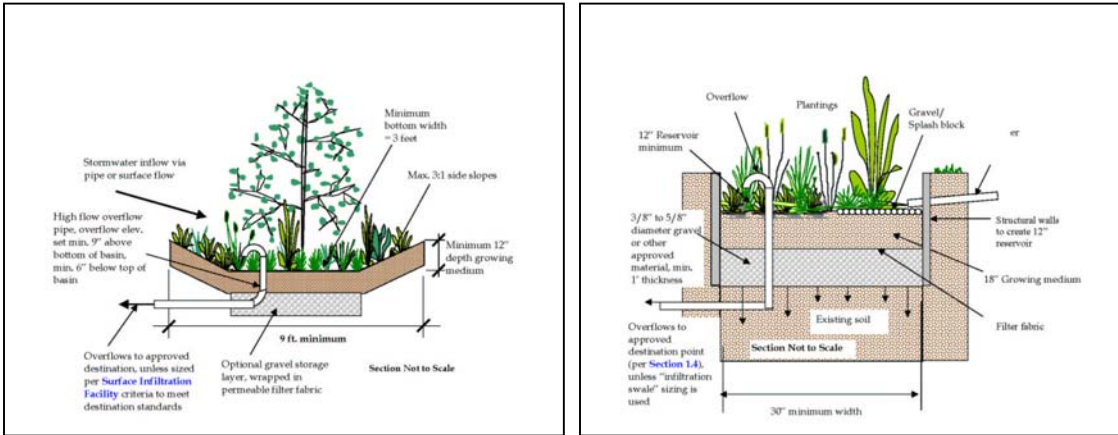
Half-Street Improvements along Existing Public Streets: Half-street improvements along existing public streets that lack curbs, sidewalks, or both are often required at the time of development, and can pose particular stormwater management challenges. Where adequate stormwater destinations exist (existing sump systems, ditches, storm or combined sewer systems), tree mitigation may be used in some cases to meet pollution reduction and flow control obligations. Where this is not possible, the design and construction of a pollution reduction and flow control facility will be required, or in cases where a facility is not practicable and special circumstances are present (see [Section 1.11](#)), the off-site management fee may be paid.

Step 2: Design the surface infiltration facilities and drywells or soakage trenches in accordance with [Chapter 2.0: Stormwater Management Facility Design](#).

See [Case Example #1](#) for the design of drywells, soakage trenches, and surface infiltration facilities for single-family homes.

If surface infiltration facilities are used to infiltrate stormwater from the street and sidewalk areas, they must have a storage volume of 5,320 cubic feet, as discussed under Step 1. If the facilities are to be located within the public right-of-way, the design criteria presented in the street swale section of Chapter 2.0 must be used. For a 7-foot-wide swale with 3-foot by 3-foot rock trench underneath (void ratio = 30 percent), there is approximately 5.5 cubic feet of storage per linear foot. Approximately 970 linear feet of swale would be needed to provide 5,320 cubic feet of storage. Because the new public street is only 500

feet long, and 15 driveways will cross the planting strip between the curb and sidewalk (interrupting the area to be used for swales) there is not enough area within the public right-of-way. A combination of swales within the right-of-way and a surface infiltration facility located in a separate stormwater tract, or a single facility in a separate stormwater tract providing 5,320 cubic feet of storage could be used. The detailed design and location must be shown on the permit drawings.



Step 3: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the surface infiltration facilities, drywells, soakage trenches, or other stormwater management facilities used on the site. **Form O&M** must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

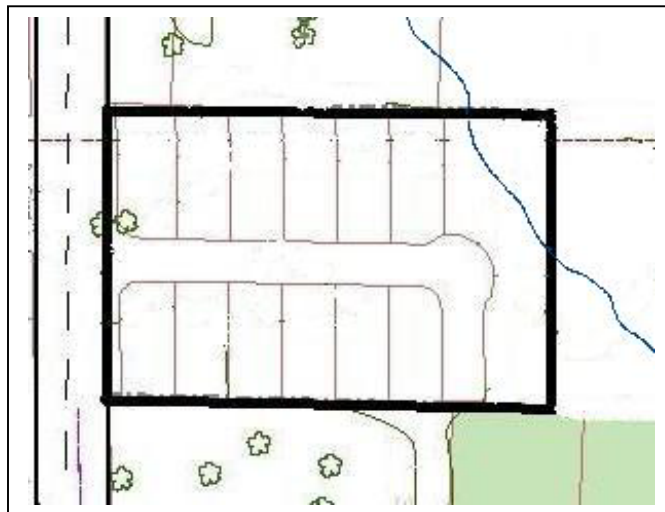
FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example)	
REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38	
Project Building Application No. _____ (For official county use only)	
Owner's Name: John Doe	City of Portland, Oregon
Phone No. (503) 555-1234	City of Portland, Oregon
Mailing Address: 12345 NE Oregon Street, Portland, OR 97232	City of Portland, Oregon
City, State, Zip: Portland, OR 97232	City of Portland, Oregon
Site Address: _____	City of Portland, Oregon
Site No.: _____	City of Portland, Oregon
Site Legal Description: _____	City of Portland, Oregon
BY SIGNING THIS FORM, the applicant agrees to the terms and conditions contained in this operations & maintenance plan and to any Amendment issued by the city and recorded with it.	
File: _____	City of Portland, Oregon
NOTARIZATION: (2007) valid and used and official and not _____ of _____	City of Portland, Oregon
Notary Public in and for the State of Oregon My Commission Expires: _____	City of Portland, Oregon
<p>O&M PLAN: OPERATIONS & MAINTENANCE PLAN</p> <p>1. The plan, including a site plan showing the facility location (in relation to building footprint or other permanent structures on the site), extent of runoff serving the facility, and where maintenance will be developed for after leaving the facility.</p> <p>The structural occupation facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is required to operate and maintain the facility in accordance with the O&M plan as filed with the City of Portland, Bureau of Environmental Services. The equipment to operate and maintain the facility in accordance with the O&M plan is building on all relevant and relevant areas of the property. The O&M plan may be modified under the provisions of the O&M plan with written approval and filing with the Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 1101 NE Oregon Street, Room 1000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 823-7744 for assistance.</p>	
2. Description of the facility and use and its owner, operator, and maintenance. Check One:	
3. Maintenance responsibility. Check One:	
4. Parts and equipment to be maintained on-site by other services. Check Applicable:	
5. Decision flow for parts and equipment (O&M) use. Check One:	
6. Maintenance contact information. Check One:	
7. Maintenance procedure and schedule for the structure facility located in this facility. Check One:	
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Soakage Trenches	
Operations & Maintenance Plan	
<p>Soakage Trenches consist of drain rock and sand, and receive stormwater from roof downspouts and/or area drains. There are various components within the system - piping, sill basin and the trench itself. The Conveyance Piping consists of an inlet pipe (downspout or area drain), an outlet pipe located between the sill basin and the soakage trench, and a perforated pipe located on top of the aggregate bed of the soakage trench. The Sill Basin is a structure receiving runoff from an inlet pipe and conveying it to the soakage trench. The sill basin serves as the pre-treatment system for the soakage trench, removing sediments and other debris that can impact its proper functioning. All facility components, vegetation, and source controls shall be inspected for proper operation and structural stability. These inspections shall occur: at a minimum, quarterly for the first two years from the date of installation, then two times per year afterwards, or within 48 hours after each major storm. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:</p>	
<p>Soakage trench infiltration. If water is noticed on top of the trench within 48 hours of a major storm, the soakage trench may be clogged.</p> <ul style="list-style-type: none"> • Check for debris/obstruction accumulation, raise and remove and evaluate upland causes (erosion, surface or roof debris, etc.) • Assess the condition of the aggregate and the filter fabric in the trench. If there is sediment in the aggregate, excavate and replace. • If there is a tear in the filter fabric, repair or replace. 	
<p>Conveyance Piping. If water persists over the trench for more than 48 hours after a major storm and no other cause is identified, it may be necessary to remove the filter fabric to determine if the perforated pipe is clogged with sediment or debris.</p> <ul style="list-style-type: none"> • Any debris or algae growth located on top of the soakage trench should be removed and disposed of properly. • If the piping has settled more than 1 inch, add fill material. If there are cracks or repairs, replace or repair the pipe. If there are signs of erosion around the pipe, this may be an indication of water seeping due to a crack or break. 	
<p>Sill Basin. If water remains in the soakage trench for 36-48 hours after storm, check for sediment accumulation in the sill basin.</p> <ul style="list-style-type: none"> • If less than 50% capacity remains in the basin or if sediment has accumulated, remove and dispose the sediment. 	
<p>Spill Prevention. Virtually all sites, including residential and commercial, present dangers from spills. All homes contain a wide variety of toxic materials including gasoline for lawn mowers, antifreeze for cars, nail polish remover, pesticides, and cleaning aids that can adversely affect groundwater if spilled. It is important to exercise caution when handling substances that can contaminate stormwater.</p> <ul style="list-style-type: none"> • Activities that pose the chance of hazardous material spills shall not take place near soakage trenches. 	
<p>A Shut-Off Valve or Flow-Blocking Mechanism may have been required with the construction of the soakage trench to temporarily prevent stormwater from flowing into it. In the event of an accidental toxic material spill. This may also involve using mats or dikes that can be used to cover most drains in parking lots. The shut-off valve shall remain in good working order, or floats or other flow-blocking mechanisms are used, they shall be kept in stock on-site.</p> <p>Training under written guidance is recommended for operating and maintaining soakage trenches. This shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.</p> <p>Access to the soakage trench is required for efficient maintenance. Egress and ingress routes will be maintained to design standards of inspections.</p>	
<p>Insects & Rodents shall not be harbored in the soakage trench. Pest control measures shall be taken when insects/rodents are found to be present.</p> <ul style="list-style-type: none"> • If species are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor. • Holes in the ground located in and around the soakage trench shall be filled. 	

Step 4: Submit the construction plans to the city for permitting. The stormwater management facilities must be shown on the drawings, along with applicable details. The recorded O&M plans for the private facilities must also be included in the submittal. **END.**

CASE EXAMPLE #8: Subdivision w/ Public Street Improvement (Northwest Portland)

A residential subdivision will be developed in Northwest Portland with 12 single-family house lots and public street improvements. Each lot is approximately 5,000 square-feet in size, and the public street improvement will consist of 500 feet of 26-foot-wide street with 6-foot-wide sidewalks on each side. Total street and sidewalk impervious surface is 19,000 square-feet. Preliminary geotechnical research indicates that the soil in the area belongs to hydrologic soil group C (from the USDA/NRCS Soil Survey of Multnomah County, Oregon), and the property has slopes that range from 2 to 10 percent. There is an existing natural drainage way through the eastern portion of the site.



Step 1: Determine the stormwater disposal point for the site. Use **Exhibit 1-1: Stormwater Destination/Disposal Hierarchy**.

EXHIBIT 1-1: STORMWATER DESTINATION HIERARCHY

Table Exhibit 1-1: For approval of a stormwater destination method in the City of Portland, the highest (1) - (6) flow destination hierarchy category for the project must be used. All appropriate technical design criteria must be met to receive approval. Information provided in this chart does not guarantee that there will be an appropriate destination for stormwater.

City of Portland Stormwater Destination Hierarchy	
Category 1: On-site infiltration with a surface infiltration facility.	
To utilize this category, a vegetated swale, grassy swale, street swale, vegetated infiltration basin, or infiltration planter sized in accordance with the Surface Infiltration Facility design procedure in Section 2.2.2 shall be used.	
Exclusions:	
1) Where subsurface soils infiltrate adequately, runoff from rooftops may be directed to underground inspection/cleanout facilities, such as sump pumps and dry wells.	
2) Soils do not infiltrate well enough for surface infiltration facility design. This exception includes projects on the west side of the Willamette River. Soils must achieve a minimum infiltration rate of 2 inches per hour to consider using a surface infiltration facility as the only destination for stormwater.	
3) Adequate space is not available for infiltration facility design (see Surface Infiltration Facility design methodology in Section 2.2.2). For facilities serving public street drainage and located within the street right-of-way, this is generally determined by comparing the amount of available pervious surface area (usually located between the curb and sidewalk) with the size of the required infiltration facility. Additional right-of-way width may be dedicated by the applicant if needed, as approved by PDOT (for public streets) or ESD (for private streets). For surface infiltration facilities located outside of the street right-of-way, adequate space is determined by the applicant's ability to meet minimum density requirements, as determined by City of Portland zoning codes, after the infiltration facility has been located on site.	
4) Contaminated soils are present on site such that DEQ will not permit stormwater infiltration. Documentation showing DEQ assessment must be submitted.	
5) Slope stability conditions exist on site, which stormwater infiltration may exacerbate. Slopes must not exceed 10% on the facility area. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or ESD (for private facilities).	
6) Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.2B), where on-site infiltration is not accepted as a stormwater destination.	
7) Flooded basements do not have adequate setback for Surface Infiltration Facility design methodology in Section 2.2.2 . A minimum setback of 10 feet is required on private property, as approved by ESD.	
8) For full street improvements, existing utility or street trees make it impractical to construct a surface infiltration facility within the street right-of-way.	

City of Portland Stormwater Destination Hierarchy (continued)	
Category 2: On-site infiltration with a public infiltration ramp system, private drywell or sump pump.	
These facility types are classified as L1/C1 (underground inspection/cleanout structures) and must be fully authorized or permitted by DEQ (see Section 1.4.4). The degree of pollution reduction required depends on the slope of the stormwater runoff. Stormwater runoff does not require pollution reduction, except from residential low-traffic streets or parking lots (1.0% average daily slope requires the use of sedimentation sump control structures and high-traffic streets and parking lots > 1.0% average daily slope requires full pollution reduction). A surface retention facility is required to the MEP or meet applicable pollution reduction requirements (see Section 1.4.2 for MEP criteria).	
Exclusions:	
1) Project does not meet DEQ (C1) site infiltration or permitting criteria (see Section 1.4.4 for list of criteria, as applicable).	
2) Subsurface soils do not infiltrate well enough for on-site infiltration, as approved by BES (for public facilities) or ESD (for private streets).	
3) Slope stability conditions exist on site, which stormwater infiltration may exacerbate. If this exception is claimed, a geotechnical investigation must be conducted and submitted, as approved by BES (for public facilities) or ESD (for private facilities).	
4) Site is located within the Columbia South Shore Wetland Protection Area (see Exhibit 2.2B), where on-site infiltration with L1/C1 is not allowed.	
Category 3: Off-site flow to drainage way, river, or stream-only pipe system.	
Pollution reduction is required. Flow control is required in most cases (see Section 1.4.2). A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).	
Exclusions:	
1) System does not exist or does not have available capacity, as determined by BES.	
2) Severity of the water resource pollution constraints to be alternative destination method, as determined by BES.	
Category 4: Off-site flow to a combined sewer.	
Pollution reduction and flow control is required. A surface retention facility is required to the MEP to meet pollution reduction and flow control requirements (see Section 1.4.2 for MEP criteria).	
Exclusions:	
1) System does not exist or does not have available capacity, as determined by BES.	

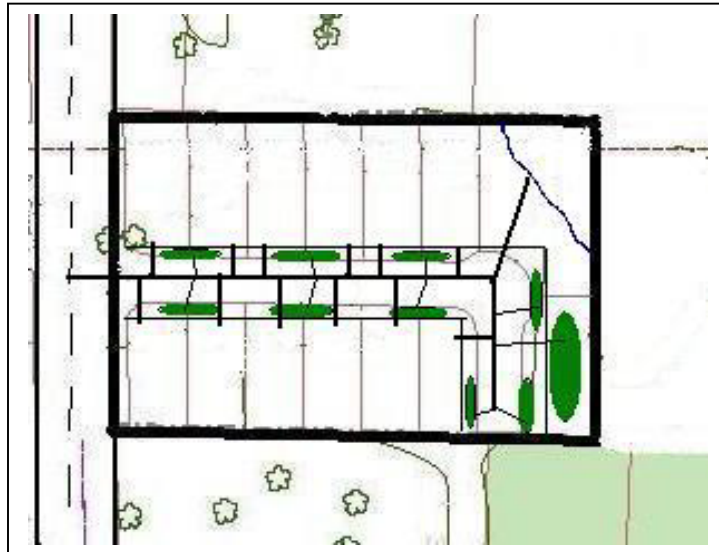
Category #1 (surface infiltration facilities) and category #2 (on-site infiltration with drywell or soakage trench) depend on project site soils that infiltrate relatively well (2 inches per hour minimum). In this example, with C-type soils and moderate slopes, on-site infiltration is not likely feasible. The Environmental Soils section of the Bureau of Development Services (BDS) may be contacted to confirm the viability of infiltration on private property at 503-823-7790. Category #3 (off-site flow to drainageway, river, or storm-only pipe system) depends on the availability of such resources. Portlandmaps.com or other City maps available at the Development Services Center (1900 SW 4th Avenue) can be used to identify off-site storm systems. In this example, there is an existing natural drainageway that will be used, in combination with a public storm sewer extension down the length of the new public street with service laterals to each lot. A Public Works Permit will be required for the construction of the new public storm sewer. When stormwater is being discharged off-site, pollution reduction and flow control are required.

Step 2: Choose pollution reduction and flow control facilities from [Chapter 2.0: Stormwater Management Facility Design](#). For the single-family home sites, there are many facility types to choose from that will achieve both pollution reduction and flow control. Exhibit 2-1 can be used to help choose a facility type that can use the simplified approach for sizing, such as flow-through planters or vegetated swales.

Facilities will be needed on each lot, with overflows piped to the new public storm sewer in the street. Driveways may use pervious pavement; may be graded to sheet flow into adjacent lawn areas if sufficiently sized in accordance with vegetated filter design criteria (at least 1 square foot of lawn area per 5 square feet of driveway area, lawn area must be at least 10 feet by 10 feet); or may be directed to the flow-through planters or vegetated swales.

For the public street and sidewalk areas, vegetated swales within the public right-of-way will be used to meet pollution reduction and flow control requirements.

Potential vegetated street swale locations, with new public storm sewer extension:



Step 3: Design pollution reduction and flow control facilities from **Chapter 2.0: Stormwater Management Facility Design**. Form SIM will be used to size the vegetated street swales to meet pollution reduction and flow control requirements. From this form, the sizing factor for vegetated swales is 0.09. The required square-footage of swales is: 19,000 square feet x 0.09 = 1,710 square feet. If the width of the swales is 7 feet, the required total length of swales is 244 feet.

Form SIM: Simplified Approach for Stormwater Management			
New or Redeveloped Impervious Site Area <input type="text" value=""/> Box 1 (do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)			
	Column 1	Column 2	Column 3
INSTRUCTIONS	<p>1. Enter square footage of area of redeveloped impervious site area in Box 1 at the top of this form.</p> <p>2. Select impervious area reduction techniques from rows 1-3 to reduce the site's resulting stormwater management requirement. Total credit can be calculated using the tree credit worksheet on the next page.</p> <p>3. Select desired stormwater management facilities from rows 4-10 in Column 1, enter the square footage of impervious areas that each facility will manage.</p> <p>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.</p> <p>5. Total Column 3 rows 1-10, and enter the resulting "Impervious Area Managed" in Box 2.</p> <p>6. Subtract Box 2 from Box 1 and enter the result in Box 3. When this number reaches 0, stormwater quality and quantity requirements have been met. Submit this form with the application for permit.</p> <p>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 this Stormwater Management Manual to manage stormwater from these remaining surfaces.</p>		
	Impervious Area Reduction Technique	Area Managed = Facility Surface Area	Impervious Area Managed
	1) Eco-Roof / Roof Garden	_____ sf	_____ sf
	2) Contained Planter	_____ sf	_____ sf
	3) Tree Credit (See Next Page)	_____ sf	_____ sf
	<i>Note: Pervious Pavement areas do not need to be included in Box 1.</i>		
	Stormwater Management Facility	Impervious Area Managed	Sizing Factor
	4) Infiltration Planter	_____ sf	0.06 = _____ sf
	5) Flow-Through Planter	_____ sf	0.06 = _____ sf
	6) Vegetated Swale	_____ sf	0.09 = _____ sf
	7) Grassy Swale	_____ sf	0.12 = _____ sf
	8) Vegetated Filter Strip	_____ sf	0.2 = _____ sf
	9) Vegetated Infiltration Basin	_____ sf	0.09 = _____ sf
	10) Sand Filter	_____ sf	0.07 = _____ sf
	<i>See Chapter 2.0: drywell and soakage trench sizing and design requirements.</i>		
	Total Impervious Area Managed	<input type="text" value=""/> Box 2	
	Box 1 - Box 2	<input type="text" value=""/> Box 3	

Step 4: Use **Chapter 3.0: Operations & Maintenance** to compile an operations and maintenance plan for the private stormwater management facilities used on the site. Form O&M must be filled out and recorded with the applicable county prior to submission to the city with the permit drawings.

FORM O&M: OPERATIONS & MAINTENANCE PLAN (Example) REQUIRED IN ACCORDANCE WITH CITY CODE CHAPTER 17.38	
Project Building Application No. _____	
Owner's Name: John Doe	
Phone No. (area code) (988) 1-555-5555	
Mailing Address (if different from location): XXX NW XXX Street, Portland, OR XXXXX	
Site Address: XXX SW XXX Street, Portland, OR XXXXX	
Site Legal Description: Section XX, Township XX, Range XX, T4E Lot XX	
BY SIGNING BELOW, the owner agrees to the terms and conditions contained in this operations & maintenance plan and in any document executed by the owner and recorded with the _____.	
Signature: <i>John Doe</i>	
NOTARIZATION: (Only when on hand and official and for _____ day of _____)	
Notary Public in and for the State of Oregon	
My Appointment Expires on: _____	
O&M PLAN REQUIRED INFORMATION:	
1. Site Plan. Include a site plan showing the facility location (in relation to building structure or other permanent structures on the site), sources of runoff entering the facility, and where stormwater will be discharged to after leaving the facility.	Site Plan (insert here or include separate sheets)
The stormwater management facility located on this site plan is a required condition of building permit approval for the identified property. The owner of the identified property is required to operate and maintain this facility in accordance with the O&M plan on file with the City of Portland, Bureau of Environmental Services. The requirement to operate and maintain this facility in accordance with the on file O&M plan is binding on all current and future owners of the property. The O&M plan may be modified and/or revised, in whole or in part, with written approval by and in filing with the Bureau of Environmental Services. The O&M plan for this facility is available at the Bureau of Environmental Services, located at 110 SW 7 th Avenue, Room 1000, Portland, Oregon, between the hours of 9 a.m. and 5 p.m., Monday through Friday. Call (503) 823-7361 for assistance.	
2. Description of the financial method used to cover future operations and maintenance. Check One: <input type="checkbox"/> Homeowner Association <input type="checkbox"/> Property Owner Account <input type="checkbox"/> Other (describe): _____	
3. Party (ies) responsible for maintenance (only if other than owner). Owner: Responsible. District Phone No. (area code required) (988) xxx-xxxx Emergency After Hours Contact Phone No. (988) xxx-xxxx Maintenance Contact Address: Garden Gap Landscaping, XXX SE XX Street, Portland, OR 972XX	
4. Maintenance practices and schedule for the stormwater facility is included in the facility specific O&M plan filed with the Bureau of Environmental Services, City of Portland. The operations and maintenance practices are based on the publication date of the City of Portland's Stormwater Management Manual. Preparation Date: XX/XX/200X Revision Date: ____/____/____ Estimated Date of Installation (insert year): XX/XX/XX Prepared by: John Doe	

Infiltration and Flow-Through Planters
Operations & Maintenance Plan
Planters are designed to allow runoff to filter through layers of topsoil (thus capturing pollutants) and then either infiltrate into the native soil (infiltration planter) or be collected in a pipe to be discharged off-site (flow-through planter). The planter is sized to accept runoff and temporarily store the water in a reservoir on top of the soil. The flow-through planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 3-4 hours after a storm event. All facility components and vegetation shall be inspected for proper operations and structural stability. These inspections shall occur, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 48 hours after each major storm event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:
Downspout from rooftop or sheet flow from paving allows unimpeded stormwater flow to the planter.
<ul style="list-style-type: none"> • Debris shall be removed routinely (e.g., no less than every 6 months) and upon discovery. • Damaged pipe shall be repaired upon discovery.
Splash Blocks prevent splashing against adjacent structures and convey water without disrupting media.
<ul style="list-style-type: none"> • Any deficiencies in structure such as cracking, rotting, and failure shall be repaired.
Planter Reservoir receives and detains storm water prior to infiltration. Water should drain from reservoir within 3-4 hours of storm event.
<ul style="list-style-type: none"> • Sources of clogging shall be identified and corrected. • Topsoil may need to be amended with sand or replaced all together.
Filter Media consisting of sand, gravel, and topsoil allow stormwater to percolate uniformly through the planter.
The planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates.
<ul style="list-style-type: none"> • Holes that are not consistent with the design and allow water to flow directly through the planter to the ground shall be plugged. • Sediment accumulation shall be hand removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation. • Litter and debris shall be removed routinely (e.g., no less than quarterly) and upon discovery.
Planter shall contain filter media and vegetation.
<ul style="list-style-type: none"> • Structural deficiencies in the planter including rot, cracks, and failure shall be repaired.
Overflow Pipe safely conveys flow exceeding reservoir capacity to an approved stormwater receiving system.
<ul style="list-style-type: none"> • Overflow pipe shall be cleared of sediment and debris when 50% of the conveyance capacity is plugged.
Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion.
<ul style="list-style-type: none"> • Mulch shall be replenished at least annually. • Vegetation, large shrubs or trees that limit access or interfere with planter operation shall be pruned or removed. • Fallen leaves and debris from deciduous plant foliage shall be raked and removed. • Nuisance or prohibited vegetation from the Portland Plant List shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced. • Dead vegetation shall be removed to maintain less than 10% of area coverage or when planter function is impaired. Vegetation shall be replaced within a specific timeframe, e.g., 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.
Spill Prevention measures shall be exercised when handling substances that contaminate stormwater.
Release of pollutants shall be completed as soon as identified.
Training and/or written guidance information for operating and maintaining stormwater planters shall be provided to all property owners and tenants. A copy of the O&M Plan shall be provided to all property owners and tenants.
Access to the stormwater planter shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.
<ul style="list-style-type: none"> • Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.
Insects & Rodents shall not be harbored in the stormwater planter.
Pest control measures shall be taken when insects/rodents are found to be present.
If sprays are considered, then a mosquito larvicide, such as Bacillus thuringiensis or Abate formulations can be applied only if absolutely necessary, and only by a licensed individual or contractor.
Holes in the ground located in and around the stormwater planter shall be filled and compacted.

Step 5: Submit the plans to the city for permitting. The stormwater management facilities must be clearly identified on the drawings, along with applicable details, and the completed Form SIM and recorded O&M plan must be attached. **END.**

