RESOLUTION NO. 1573

A RESOLUTION ADOPTING THE ROGUE VALLEY STORMWATER QUALITY DESIGN MANUAL

RECITALS:

1. The United States Environmental Protection Agency (EPA) administers the Clean Water Act (33 U.S.C.§1251 et seq. (1972)), which prohibits anyone, including municipalities, from discharging pollutants through a point source into waters of the United States without National Pollution Discharge Elimination System (NPDES) permit.
2. The State of Oregon Department of Environmental Quality (DEQ) is authorized by the Clean Water Act Section 402(b) and 40 CFR Part 123 to implement and administer the NPDES permit in Oregon.
3. The City of Central Point, Oregon has applied for a stand-alone (NPDES) Municipal Separate Storm Sewer Systems (MS4) Phase 2 General Permit from DEQ, which is scheduled to take effect sometime after March 1, 2019.
4. The General Permit in Section A.3.e, **Post-Construction Site Runoff for New Development and Redevelopment,** requires the City to reduce the discharge of pollutants and control stormwater runoff from new development and redevelopment of projects in the City.
5. The Rogue Valley Stormwater Quality Design Manual (RVSQDM) establishes stormwater quality design standards to regulate development in the Rogue Valley in accordance with the permit requirements.
6. By adopting the RVSQDM the City will satisfy a major component of the Phase 2 General Permit.

The City of Central Point resolves as follows:

Section 1. The City hereby adopts the current Rogue Valley Stormwater Quality Design Manual in the form attached hereto as Exhibit "A".

Passed by the Council and signed by me in authentication of its passage this 28th day of March, 2019.

Hank Williams

Mayor Hank Williams

ATTEST:

Deanna Casey

City Recorder

ROGUE VALLEY STORMWATER QUALITY DESIGN MANUAL

Revised July 2018

CREATED FOR:

City of Ashland
City of Central Point
City of Medford
City of Phoenix
City of Talent
Jackson County
Rogue Valley Sewer Services

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CHAPTER 1 - INTRODUCTION

1.1 PURPOSE

Managing stormwater is an essential part of maintaining livability in an urban area while trying to preserve the natural state of local rivers and streams. Typical urban development often interferes with the hydrologic process of rain filtering through the soil, recharging the groundwater, and slowly reaching the nearby streams. Most rooftops, parking lots, roadways, and other impervious surfaces collect stormwater, often increasing the temperature and amount of pollutants, and quickly discharge the flow to the closest water body. Both the quantity and quality of stormwater runoff from urban areas can have detrimental effects on the aquatic life and ecosystem of surface waters, further affecting local recreation and drinking water quality. Properly managing urban stormwater helps to prevent these detrimental effects and can lead to environmental, recreational, and economic benefits, such as reducing the cost of water treatment.

City/public planners, engineers, and developers have traditionally held to the concept of collecting and discharging stormwater as quickly as possible to avoid the potential for urban flooding. This concept is currently being modified to encourage reducing the amount of runoff from the source, providing some filtering or treatment, and slowly releasing the stormwater by infiltration into the ground or to a local water body. By designing stormwater management systems to mimic a natural hydrologic process during a rain event, urban stormwater should have minimal adverse effects on local surface waters.

The overall purpose of this design manual is to provide stormwater management principles and techniques that mimic the natural hydrologic process and meet new water quality goals. More specifically, this manual intends to do the following:

1) Establish water quality standards for stormwater discharges from public and private developments in the Rogue Valley;
2) Provide guidance to design professionals on how to meet applicable water quality standards;
3) Identify Best Management Practices (BMPs) that meet water quality standards; and
4) Establish review procedures for stormwater management plans.

1.2 APPLICABILITY

The standards set forth in Rogue Valley Stormwater Quality Design Manual (RVSQDM) apply to all development or redevelopment that creates 2,500 square feet or more of impervious surface, both public and private, within the MS4 boundaries of any jurisdiction that adopts this manual. This requirement applies to the total amount of impervious surface that will be developed or redeveloped at full build-out of the project.

Public roadway projects including 'Development and/or Redevelopment' as defined in the definitions require special attention. It is suggested that jurisdictions require staff and consultants meet with the reviewing agency to discuss stormwater management requirements and options prior to the design phase of each project.

Exemptions to Rogue Valley Stormwater Design Manual

Development or redevelopment of a single family dwelling or duplex, constructed on a single tax lot, that is not part of a larger common plan of development will be exempt from the requirements of the Design Manual.

1.3 LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT

Development or redevelopment of impervious surfaces greater than 2,500 sq. ft. on soils classified as belonging to the Type A or B hydrologic soil groups, by the Natural Resources Conservation Service, and on slopes of 5% or less, will require the use of Low Impact Development (LID) stormwater Best Management Practices (BMP). Existing facilities are only required to implement LID for added impervious surfaces of 2,500 sq ft or more. Several example LID techniques are detailed in the Design Manual.

Exemption to LID Stormwater Management

Road development and road redevelopment may use any stormwater BMP that meets the performance standards outlined in Chapter 2.

CHAPTER 2 – PERFORMANCE STANDARDS

The overall goal of the stormwater manual is to allow engineers and designers the freedom to design a stormwater management plan within a set of usable parameters without dictating specific Best Management Practices (BMPs). To accomplish this, the following performance standards have been developed for four major stormwater management issues: **Erosion and Sediment Control, Pollution Reduction, Flow Control, and Stormwater Destination**. Specific BMPs that meet these standards are included in this manual in Chapter 4 for those who wish to use a standard method/design.

When a project must meet stormwater management requirements for multiple agencies, the local jurisdiction will determine whether or not their requirements have been met (*eg.* meeting Oregon Department of Transportation or Federal-Aid Highway Program requirements does not automatically mean local requirements are met).

Please note: Chapter 3 "Analysis Methodology" provides detailed information on how individual stormwater management plans are reviewed for compliance and Chapter 6 "Submittal Requirements" provides details on the submittal requirements for these plans.

2.1 EROSION AND SEDIMENT CONTROL

Erosion rates increase significantly when ground cover is removed on a construction site. The rate of erosion may be 1000 times greater on disturbed land than land in its natural condition[1]. The typical rate of erosion on a site can vary from 100 up to 500 tons per acre annually depending on the site conditions, climate, and soil types[2]. Erosion is a stormwater management issue because of its potential to move soil off the site thereby impacting the downstream waters and/or drainage systems.

Erosion and Sediment Controls (ESC) are necessary during the construction phase of developments. All construction activities that affect more than one acre of land are currently required by the Oregon Department of Environmental Quality (DEQ) to obtain an NPDES 1200-C permit that addresses ESC measures specific to that project. Those projects that have obtained and are in compliance with an NPDES 1200-C permit are considered to be in compliance with the ESC performance standards described below. However, the standards in this manual apply to all land development projects.

Performance Standard:

The purpose of Erosion and Sediment Controls is to prevent the discharge of significant amounts of sediment to surface waters. As stated in the NPDES 1200-C Permit, the following conditions describe "significant amounts of sediment" and shall be prevented from occurring:

[1] Clean Water Services: "Erosion Prevention and Sediment Control Planning And Design Manual" December 2000, Chapter 1, Page 1-1

[2] Ibid.

- Earth slides or mud flows that leave the construction site and are likely to discharge to surface waters.
- Evidence of concentrated flows of water causing erosion when such flows are not filtered or settled to remove sediment prior to leaving the construction site and are likely to discharge to surface waters. Evidence includes the presence of rills, rivulets, or channels.
- Turbid flows of water that are not filtered or settled to remove turbidity prior to leaving the construction site and are likely to discharge to surface waters.
- Deposits of sediment at the construction site in areas that drain to unprotected storm water inlets or catch basins that discharge to surface waters. Inlets and catch basins with failing sediment controls due to lack of maintenance or inadequate design will be considered unprotected.
- Deposits of sediment from the construction site on public or private streets outside of the permitted construction activity that are likely to discharge to surface waters.
- Deposits of sediment from the construction site on any adjacent property outside of the permitted construction activity that are likely to discharge to surface waters.

Turbid flows entering the stormwater conveyance system including catch basins and ditches will be considered a violation if the turbidity is greater than 10 percent over background or receiving water.

Sediment is considered "likely to discharge to surface waters" if there is no physical barrier between the sediment source and surface waters or municipal storm drain inlets.

Design Storm:

Most ESC measures, such as silt fences, biofilter bags, etc., are not designed based on a design storm. ESC measures are designed to be used as tools to help control erosion during routine storm events and usually consist of multiple structures. ESC measures, where used, should be designed and installed in accordance with the most recent edition of the DEQ Erosion and Sediment Control Manual or Oregon Department of Transportation Hydraulics Manual, Volume 2, Erosion and Sediment Control. Unless otherwise specified in the ODOT Hydraulics Manual, ESC measures that require flow calculations will be designed based on a 10-year, 24-hour rainfall level of 3.0 inches[3].

2.2 POLLUTION REDUCTION

Urbanization typically generates new sources of pollution and provides transport mechanisms to deliver those pollutants to local water bodies. To mitigate the adverse effects of pollutants on surface waters, pollution reduction standards are essential for stormwater management. The first step in managing these pollutants is to identify which pollutants are of primary significance to the Rogue Valley area.

Bear Creek and several of its tributaries have been identified in the 303(d) list (referring to Section 303(d) of the Clean Water Act) as not meeting federal water quality standards (see Appendix J). The Bear Creek watershed is currently monitored for pollutants by the Rogue Valley Council of Governments (RVCOG). In order to improve water quality, the DEQ has developed standards by creating the Total Maximum Daily Load (TMDL) requirements for each parameter of concern in the

[3] NOAA Atlas 2, Volume X, Figure 27. *Isopluvials of 10 year 24 hour precipitation in tenths of an inch*

Bear Creek watershed. In July 2007 TMDLs for temperature, bacteria, and sedimentation were approved for the Bear Creek watershed. The water quality parameters in 1992 and 2007 TMDLs include:

Table 2.1 Bear Creek Total Maximum Daily Load Parameters

1992 TMDL Parameters	2007 TMDL Parameters
Ammonia (as Nitrogen)	Fecal Coliform
Biological Oxygen Demand (BOD)	E. Coli
Dissolved Oxygen (DO)	Temperature
Phosphorous	Sedimentation
Habitat Modification	Habitat Modification
Flow Modification	Flow Modification

Other pollutants typically caused by urbanization can be classified as follows:

- Suspended solids
- Heavy metals
- Nutrients (such as nitrogen and phosphorous)
- Bacteria
- Organics (oil, grease, hydrocarbons, etc.)
- Floatable debris
- Thermal load (temperature)

The purpose of the pollution reduction standard in this manual is to minimize, to the maximum extent practicable, the amount of all pollution that enters a water body from a particular development. However, to simplify the design process and water quality monitoring, the performance standards described below address two specific parameters that are assumed to help reduce other pollutants of concern.

Performance Standards:

Standards for pollution reduction are based both on the impact pollutants can have on a water body and the ability to measure the pollutant. The primary pollutants of concern in this manual are **Suspended Solids** and **Organics** (oil and grease). This manual assumes that by meeting standards for these two pollutants, the stormwater management system will also effectively limit the discharge of heavy metals, nutrients, bacteria, and floatable debris. Temperature loading is a concern mostly during summer months and is not addressed in this manual.

Performance standards can be set based on the percent of removal of pollutants, maximum discharge concentrations, or a combination of both. The City of Portland has developed a protocol for assessing pollution reduction that was used as a basis to create the following standards.

Suspended Solids: For influent concentrations of less than 70 mg/l the maximum effluent concentration leaving a development is 20 mg/l. For influent concentrations of 70 mg/l to 130 mg/l stormwater treatment facilities must remove 70% of suspended solids. For influent concentrations of 130 mg/l to 400 mg/l the allowable effluent concentration will increase linearly to a point corresponding to 89% removal at an influent concentration of 400 mg/l. Above 400 mg/l, the required removal will be 89% of total suspended solids. (See Chart Below).

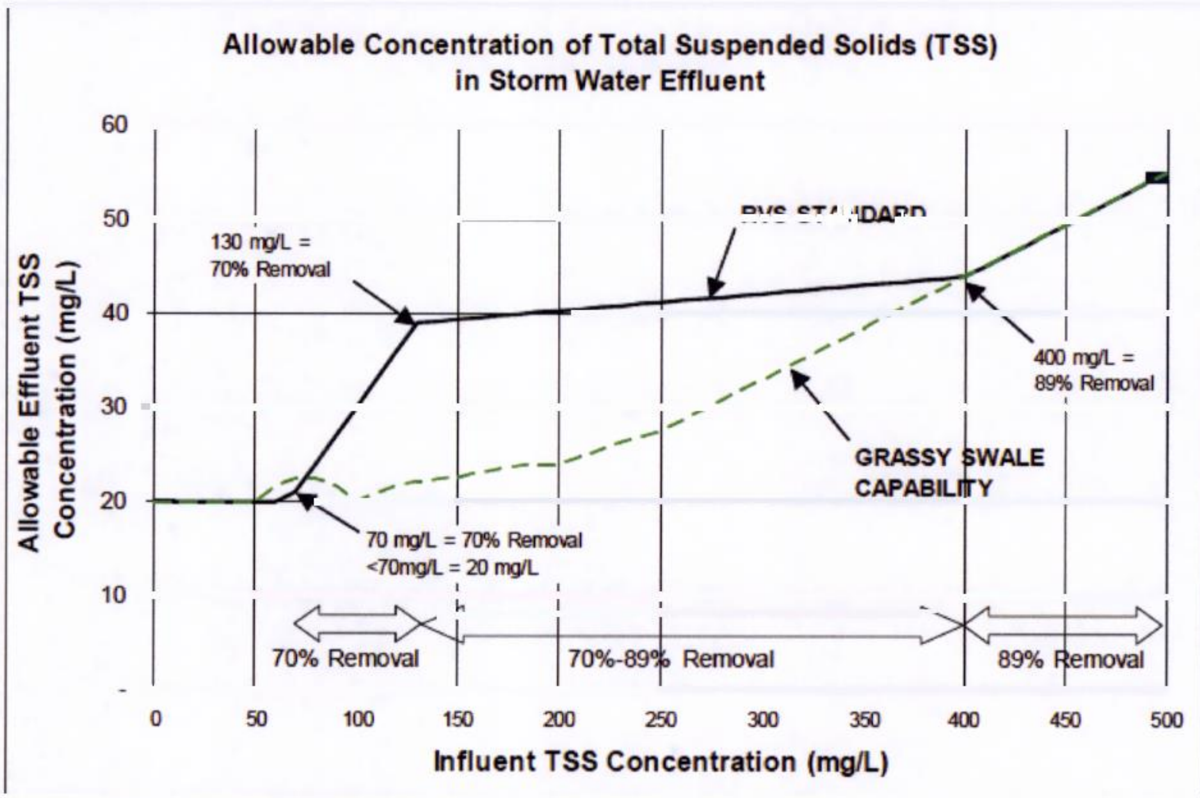

Figure 2.1 Allowable concentration of Total Suspended Solids in stormwater effluent

Oil/Grease: The maximum concentration of oil/grease discharged from a site is **10 mg/l**[4]. The lack of a visible sheen of oil/grease on stormwater effluent is not considered measurable proof of meeting this standard. As defined below, only sites expected to generate runoff containing oil and grease at a concentration equal to or greater than 10mg/l will be required to treat for oil and grease.

All of the following site conditions are expected to generate runoff containing oil and grease at a concentration equal to or greater than 10mg/l:

1. Non-employee parking areas of commercial or industrial sites with daily trip end counts greater than 100 vehicles per 1,000 square feet gross building area or greater than 300 total trip ends.
2. A commercial or industrial site storing and/or transferring petroleum, not including locations where heating fuel is routinely delivered to end users;

[4] Ibid, Page B-5

3. Fueling stations and facilities;
4. A commercial or industrial site with the capacity to use, store, or maintain a fleet of 25 or more vehicles that are over 10 tons gross weight (trucks, busses, trains, heavy equipment, etc.);
5. Maintenance and repair facilities for vehicles, aircraft, construction equipment, railroad equipment or industrial machinery and equipment;
6. Commercial on-street parking areas located on streets with an expected total Average Daily Traffic (ADT) count equal or greater than 7,500;
7. Outdoor storage yards and other sites subject to frequent use or storage of forklifts and/or other hydraulic equipment;
8. Railroad yards;
9. Any road with an expected ADT count equal to or greater than 30,000 (assumes a straight stretch of road, where intersecting ADTs are low); and,
10. Road intersections with expected ADT count equal to or greater than 25,000 on the main roadway and equal to or greater than 15,000 on any intersecting roadway.

Design Storm:

Facilities designed to remove pollutants from stormwater must be properly sized in order to be effective. Undersized facilities will not adequately detain stormwater and will not provide adequate pollutant removal; oversized facilities will be prone to stagnation and place an undue burden on development. The ideal system should treat at least 90% of the precipitation in a given year.

The Bear Creek Valley receives an average of 18.37 inches of rain per year[5]. On average, the area receives measurable rainfall 102 times per year and an excess of 1.0- inch of rain in a 24-hour period 1.8 times per year[6]. Based on this data, a design storm of **1.0-inch in 24-hours** will capture over 98% of the rainfall events and is assumed adequate to capture close to 90% of annual precipitation.

2.3 FLOW CONTROL

Flow control standards are intended to prevent an increase in the peak flow of runoff from a particular property. The purpose of maintaining the peak flow is to preserve the capacity in downstream storm drains and prevent flash flooding and erosion.

Most Cities in the Rogue Valley currently require some peak flow attenuation. In all cases, the post-development peak flow is not to exceed the pre-development peak flow as described below. Flow controls do not apply to the residential area of White City.

Note: Standards relating to total runoff volume are not included in this manual at this time.

Performance Standards:

[5] Medford WSO AP weather station, Oregon Climate Service – www.ocs.oregonstate.edu
[6] Ibid

•**Post-development peak flow ≤ pre-development peak flow**. (See definition for pre-development in Chapter 1).

Design Storm:

Peak Flow: **10-year event, 24-hour rainfall depth of 3.0 inches**[7]

Overflow: **25-year event, 24-hour rainfall depth of 3.25 inches**[8]

2.4 DESTINATION

Destination standards are designed to ensure that downstream storm drainage systems have adequate capacity to carry additional stormwater flows. Consult with the local jurisdiction to determine applicable destination requirements.

Performance Standards:

Stormwater runoff from a site must not increase the flow in any downstream storm drain system to the extent that one of the following conditions occurs during the design storm:

- Overtopping of roadways
- Flooding of buildings

In addition, pollution control and flow control facilities must be designed to safely bypass flows greater than their respective design storm without damage to private property.

Design Storm:

Design storm for the destination performance standard is a **10-year storm**. The design storm for bypass routing is a **25-year storm**.

[7] NOAA Atlas2, Volume X, Figure 27. *Isopluvials of 10-year, 24-hour precipitation in tenth of an inch*

[8] NOAA Atlas2, Volume X, Figure 28. *Isopluvials of 25-year, 24-hour precipitation in tenth of an inch*

CHAPTER 3 – ANALYSIS METHODOLOGY

3.1 INTRODUCTION

This chapter defines the methodology that will be used by staff when evaluating the performance and adequacy of stormwater controls. Engineers submitting plans are not required to use the same methodology, however the results should be comparable. Engineers may be required to submit additional data and calculations to support their results if they use alternate methodologies.

3.2 POLLUTION REDUCTION

Peak flow and total volume for water quality storms may be calculated using the Santa Barbara Urban Hydrograph Method (SBUH) with a Type 1A rainfall distribution, or any other comparable method. The key parameters in this calculation are the 24-hour rainfall, time of concentration, land area, and runoff curve number. When using the SBUH method, two hydrographs must be developed and then summed together for the calculation of peak flow and total volume from the connected and unconnected areas of the project. Refer to section 3.2.4 for definitions of connected and unconnected areas.

The Santa Barbara Urban Hydrograph method lends itself easily to spreadsheet applications. A sample printout of the spreadsheet is included in Appendix C and an Excel file of the calculations is available on the Rogue Valley Sewer Service's website under Appendix C.

3.2.1 24-Hour Rainfall

The 24-hour rainfall used to analyze pollution reduction capabilities is 1.0-inch as described in Section 2.2.

3.2.2 Time of Concentration

The time of concentration is the time it takes for a theoretical drop of water to travel from the furthest point in the drainage basin to the facility being designed. The traveled path typically includes a combination of sheet flow, shallow concentrated flow, and channel flow (as defined on page 3-3 of the NRCS TR-55 method), or any other comparable method. The time of concentration may be calculated using the NRCS method as described in TR-55 (Worksheet No. 3). A sample worksheet for this calculation is included in Appendix D.

3.2.3 Land Area

The land area used in the calculation is provided by the design engineer as part of the plan submittal.

3.2.4 Runoff Curve Number

Runoff curve numbers are used to categorize runoff potential based on soil types and land use. The curve numbers were developed by the Natural Resources Conservation Service (NRCS) and are published in TR-55, Table 2.2, which is included in Appendix D.

For **Predevelopment conditions**, the highest allowed Curve Number is 80 for any soil type, without prior approval. A curve number of 80 represents average values for brush found in Table 2-2c of TR-55.

Runoff curve numbers must be determined independently for the unconnected and connected areas of the project site as defined below. The separate hydrographs must then be summed to determine the total flow from the project site.

Unconnected Areas include *both* impervious and pervious land use areas from which stormwater runoff originates and then sheet flows over a pervious surface before reaching an outlet. For example, a tennis court surrounded by lawn or runoff from roofs that sheet flows over a lawn. Curve numbers for unconnected areas in a project can be averaged on a weighted basis and a single hydrograph can be developed for the project site.

Note: if curve number values for the unconnected areas differ by more than 20 points, then separate hydrographs must be generated for each land use area and the hydrographs shall be summed for the resultant flow.

Connected Areas include *only* impervious land use areas that are directly connected to the outlet of the project site. For example, driveways, sidewalks and streets that discharge from a project site without passing through a pervious surface are considered to be connected areas. The curve numbers for connected areas shall not be weighted with those of unconnected areas.

3.2.5 Removal Efficiency

Pollution removal efficiency will vary with the type of stormwater controls used. The sizing guidelines for stormwater controls included in Chapter 4 are presumed to meet pollution reduction standards. For stormwater approaches not described in Chapter 4, the primary method of pollution reduction is assumed to be sedimentation governed by Stokes Law. The system must be designed with sufficient detention time to allow a design particle to settle out before passing through the system.

If a soil analysis is available, the design particle will be sized smaller than 70% of the sample, by mass. If no soil analysis is available, the following is required:

- Design particle is assumed to have an effective diameter of 75 microns (0.003 inches) and a specific gravity of 2.65.
- Oil and trash must be trapped.
- Maintenance performed within four hours.
- Design for percent removal of 75 micron particle or OK 110 in accordance with chart on page 2-4. If vendor sizing table uses another design particle size then the water quality flow will be reduce in proportion to the particle size. Therefore if a vendor uses an average particle size of 125 microns and the water quality flow in the vendor table is 2 cfs, then the adjusted water quality flow in the vendor table for that model will be 2 X 75/125 = 1.2 cfs.

Approaches that use treatment processes other than sedimentation will be analyzed on an individual basis.

3.3 FLOW CONTROL

Peak flow for flow control measures may be calculated for a 10-year, 24-hour rainfall event using the SBUH or any other method acceptable to the reviewing jurisdiction. The key parameters in this calculation are the 24-hour rainfall depth, time of concentration, land area, and runoff curve number.

An expanded discussion of the SBUH is presented in Section 3.2.

3.3.1 Design Requirements

1. All stormwater discharges must be legally authorized.
2. Where practical, only "off-line" facilities, which only receive flow from the site to be managed, shall be used. In-line facilities that will receive flow from sources other than the required flow to be managed, will only be permitted in areas where site limitations won't allow an "off-line" facility. If a facility is "in-line", it shall be designed to pass the incoming flow without damage to the facility or its function, and the storage increased accordingly.
3. All weather vehicle access for maintenance shall be provided to every component of the facility.

Surface Detention Requirements: Maximum depth of water in parking lots or other areas of vehicular or pedestrian use is 6 inches, and 4 feet in ponds not subject to vehicular or pedestrian use.

Underground Detention Requirements (Pipes, Vaults, Tanks)

1. Man access is to be provided, with access at the control structure, and at the farthest upstream end of the system.
2. Provide a minimum of one foot of dead storage at or near the control structure for sediment accumulation, or an additional 10% in the entire system.
3. Maximum depth to invert shall be 15 feet.

Time of Concentration: Refer to Section 3.2.2 for time of concentration methodology.

Land Area: The land area used in the calculation is provided by the design engineer as part of the plan submittal.

Runoff Curve Number: Refer to Section 3.2.4 for runoff curve number methodology.

3.4 DESTINATION

All stormwater detention facilities must have an overflow structure capable of safely passing the 25-year storm to an approved stormwater facility. Peak flow for destination requirements may be calculated using the Rational Method with an ODOT Zone 6 IDF curve for a 10-year storm event (25-year storm event for bypass calculations), or any other comparable method. Medford's IDF curve is required for projects within the City of Medford. The flow calculations are the same as described above for flow control measures.

CHAPTER 4 – APPROVED Stormwater TREATMENT SYSTEMS

4.1 INTRODUCTION

Chapter 4 focuses on approved treatment systems for stormwater management. Design criteria have been developed by the approving jurisdictions for these treatment systems (also called Best Management Practices or "BMPs") to meet the required performance standards (described in Chapter 2). Developments that require additional or alternative BMPs should reference Chapter 5 – Alternative Treatment Systems.

The following steps should be taken to select appropriate stormwater management facilities for the site and develop submittals for review and approval:

1. Characterize the site drainage area, soil type, slopes
2. On sites characterized by the NRCS as having soils belonging to Hydrologic groups A and B, soils infiltration rate testing must be done per Appendix B.
3. Develop a conceptual plan
4. Develop a landscape plan for any vegetated stormwater facilities (described in Chapter 6)
5. Write a Stormwater Calculation Report (described in Chapter 6)
6. Complete a stormwater Operations and Maintenance Plan (described in Chapter 6)
7. Submit plans and report to the reviewing jurisdiction.

Simplified versus Performance Design Approach

Two design approaches, Simplified and Performance, are allowed by this manual, for some BMPs either design approach can be utilized and for others only the performance approach may be utilized.

Simplified Design Approach:

- There are no specific education requirements for use of this approach.
- The Falling Head Test, described in Appendix B, may be used for infiltration testing requirements.
- Only applies to projects developing or redeveloping less than 10,000 square feet.
- Must use a design sizing factor of 0.05.
- The wetted area of the SW facility shall be sized using the following equation:

SWF A = IA x SF

Where: SWF A = stormwater facility wetted area

IA = impervious area to be treated by the facility

SF = sizing factor of 0.05

Performance Approach:

- Must be performed by an engineer licensed in the state of Oregon.
- See Appendix B for infiltration testing requirements.
- Must be used for projects developing or redeveloping 10,000 square feet or more.
- Sizing factors may not be used.

BMPs for Large Sites

Depending on site characteristics including drainage area and slope, a single BMP may not be able to treat or detain runoff from the entire site. In these cases, two or more BMPs may be required to treat and detain runoff from the entire site. When using more than one BMP on a site, the total impervious surface area should be divided among the systems to achieve treatment for the effective total impervious area.

4.2 BMP SELECTION PROCESS

Green Infrastructure

As defined in Chapter 1, Low Impact Development BMPs are required to be used on sites with soils classified as belonging to Type A or B hydrologic soil groups.

Source versus Collection BMPs

The approved BMPs are listed below in order of their location in the overall system: from the source of rainfall to the collection system. Source BMPs intercept rainfall directly and infiltrate or evapotranspire it, thereby reducing effective impervious area. The area of these BMPs should not be included in the impervious area requiring treatment and detention. Collection BMPs concentrate runoff from across a site for treatment and/or flow control in a confined area.

Flow Control: Some BMPs can be designed for both treatment and flow control. Those that can be used for flow control are indicated in Table 4.1 below.

Table 4.1. Stormwater Management BMPs

BMP	Source/Collection	LID BMP?	Flow Control	Section
Vegetated Roofs	Source	LID	N	4.3.1
Trees	Source	LID	N	4.3.2
Porous Pavement	Source	LID	Y	4.3.3
Contained Planter Boxes	Source	LID	Y	4.3.4
Rain Garden, Stormwater Planter and LID Swale (Vegetated Stormwater Facilities)	Collection	LID	Y	4.4.1
Soakage Trench	Collection	LID	Y	4.4.2
Vegetated Filter Strips and Disconnected Downspouts	Collection	LID	Y	4.4.3
Water Quality Conveyance swales	Collection		Y	4.4.4
Extended Detention Basins	Collection		Y	4.4.5
Proprietary Treatment Systems	Collection		N	4.4.6
Underground Detention Systems	Collection		Y	4.4.7

4.3 SOURCE CONTROL BMPS

4.3.1 Vegetated Roof (Green Roofs) BMP

Figure 4.1. Growing medium on this small vegetated roof was stabilized with lumber to keep it from sliding down the steep slope.

Vegetated roofs are roof system assemblies that manage stormwater by holding rainfall in the pores of the growing medium, the drainage layer below if used, and by plants. While the term "green roof" is a more commonly used term, the term "vegetated roof" is more appropriate for much of Oregon which has dry summers, where some plants are dry and inactive until the rainy season begins again.

Evaporation from the growing medium and evapotranspiration from the plants releases a high volume of the moisture back into the atmosphere, even in winter, which is unique amongst all the BMPs in this guidance. Vegetated roofs usually consist of a waterproof membrane, an optional drainage layer, an engineered growing medium or soil, a layer of plants and optional mineral mulch for non-irrigated systems.

Siting

Roof Slopes. Roofs up to a slope of 20 degrees generally will not slump and need no special design to keep the growing medium in place. Those with slopes greater than 20 degrees require a system such as horizontal strapping, laths, battens, or grids that prevents the growing medium and vegetation from slumping (Figure X). These systems will also slow water flow through the assembly.

Roof Aspect. Roof aspect is the direction that a sloped roof is facing. North and east directions are considered excellent aspects for vegetated roofs, since they have reduced exposure to the sun and require less, and sometimes no, irrigation, depending on plant choices. South and west directions may require increased growing medium depths and more irrigation to support plant life. Shading from nearby vegetation and structures may reduce the need for permanent irrigation; reflection of light from nearby structures may increase it.

Design

Depending on the scale and complexity of the project, the design of vegetated roofs may involve a number of licensed professionals, including a structural engineer, landscape architect, architect, and/or a "Green Roof Professional" (Green Roofs for Healthy Cities, GRP Accreditation). Refer to local building codes for load bearing requirements.

Sizing. Vegetated roofs receive only direct precipitation and replace impervious surfaces at a 1:1 ratio.

Waterproofing Membrane. A watertight membrane must be placed at the very bottom of a vegetated roof and must not be exposed to sunlight. Refer to building codes for specifications on appropriate membrane material.

Root Barrier. A root barrier is always needed when an asphalt roof material is specified. Many other membranes such as EPDM, PVC and TPO offer sufficient root penetration protection for shallow low profile vegetated roofs. For roofs with deeper soils and larger plants and potentially trees, a root barrier may be desired. Root barriers should not be manufactured with pesticides or chemicals, which could pollute stormwater.

Drainage Layer. A drainage layer is sometimes placed above the waterproof membrane and root barrier. This layer collects water seeping from the growing medium and directs it to downspouts or gutters.

Filter Fabric. If a drainage layer is incorporated, place a filter fabric geotextile between the drainage layer and the growing medium to keep the fine soil particles of the growing medium from draining out of the system. However, almost all proprietary drainage layer products come with the fabric already attached.

Access. Provide year-round access for people and maintenance equipment, regardless of roof type, for operations and maintenance. Some common maintenance equipment and materials for vegetated roofs include rakes, buckets, ladders, irrigation supplies, plants, and hoses.

Overflow Routing. All vegetated roofs shall include an overflow drain to deliver excess runoff to an approved discharge point, in a manner that is safe and protects infrastructure. Most jurisdictions require a double drain for conventional roofs which would also apply to vegetated roofs.

Growing Medium. The growing medium is an engineered soil mix that provides nutrition to the plants and helps manage peak runoff volumes. The minimum depth for stormwater management is 4 inches, but must be deep enough to contain adequate water and nutrients to support the chosen plants. The growing medium should consist of a mix of 70% porous material such as screened pumice or sandy loam, 30% organic material such as compost or fiber compost. Other growing medium mixes may be proposed by a licensed professional willing to sign and stamp the design. Water retention rates should be 40% by weight or greater. Bulk dry densities should be 20 to 50 pounds per cubic feet.

Mulch. If mulch is used, it must be a gravel mulch or alternative mineral mulch.

Vegetation. Follow the plant densities specified in Table A-1 of Appendix A, a landscape plan in accordance with Chapter 6.3 must be submitted. Plantings should cover 95% of the vegetated roof area within 3 years of planting, excluding gravel areas for buffers, maintenance access, and other intentionally non-vegetated areas. 80% of the plants should be evergreen and active during most of the year except the coldest parts of the winter to provide runoff reduction through interception and evapotranspiration. When locating plants, consider that the growing medium is likely to drain more rapidly at peaks and remain saturated longer near gutters or drains. Selected plants should only require irrigation during periods of extreme heat.

Criteria for plant selection are as follows:

- Native species
- Adapted to the pH of the chosen growing medium.
- Sun, heat, wind, and drought tolerant.
- Successful colonizers, perennial or self-sowing.
- Easy to maintain (such as those that outcompete weeds and don't require mowing/trimming).
- Self-sustaining (no need for fertilizers or pesticides).
- Fire-resistant if not irrigated.
- Appropriate for the soil depth and composition.
- Will not require fertilizers, pesticides, or herbicides.

Irrigation. An irrigation system is required for the first three years to establish the plants. Irrigation should be no more than 1 inch every 10 days. After establishment, an irrigation system is recommended, but its use should be limited to periods of extreme heat. Piping should be covered with at last 2 inches of growing medium. Examples of irrigation systems for various roof sizes are described in the LID Guide Chapter 3.

Standard Drawings. No standard drawings are provided for Vegetated Roofs.

Construction and Cost Considerations

Guidance on construction process and cost considerations are provided in Chapter 3 of the LID Guide.

Maintenance

Designers should include the landscape plan in the operations and maintenance manual. Plants other than those specified in the landscape plan should be removed. This might include plants with deep roots such as trees that might damage the membrane, plants that might become a fire hazard, and plants on the Oregon Noxious Weed List.

Maintenance is most demanding during the 3-year plant establishment period. Ongoing inspection and maintenance activities (including during the plant establishment period), include:

- For roofs with irrigation, water plants during the dry season with no more than 1 inch of water every 10 days. During the wet season, do not irrigate at all. Wet summers or over-irrigation may encourage weed growth.
- Inspect the irrigation system annually. Look for exposed piping, broken irrigation heads, and especially leaks, which could be very detrimental to the stormwater performance of the vegetated roof and greatly increase vegetation related maintenance activities. Winterize and de-winterize the irrigation system and make repairs as needed.
- Inspect plants in early summer and early fall for overall health and coverage. If plants are struggling, correct the causes, which may include too much or too little water, pests, condensate from the HVAC system, or chemical spills from rooftop equipment maintenance.
- Replace plants as needed in the fall. Sedums can be replaced by casting cuttings over the soil in the fall.

- Install erosion control fabrics, or mineral mulch, to prevent wind erosion of growing medium when replanting.
- Perform weeding in early summer and early fall and more often as needed, removing weeds before they go to seed. In Western Oregon, checking for weeds in late May or early June may limit the necessary weeding to once a year. Irrigation encourages weed growth, so weeding may be needed more often when irrigating. Do not apply herbicides or pesticides since these pollutants will be efficiently exported downstream.
- Inspect structures such as membrane (if visible), irrigation system, drains, parapets, and access structures annually. As necessary, remove sediment and debris around drains and unclog. Repair the structural integrity of the systems. Contact the manufacturer to repair leaks or tears in the membrane.
- Inspect for and correct any erosion after large storms (*i.e.* 1 inches in 24 hours or extreme/high intensity cloud bursts) until plant coverage has been achieved.
- Remove trash as needed, frequency will depend on whether and how the roof is utilized by people.

4.3.2 Trees

General Description: Tree canopy can intercept rainfall and thereby reduce the overall amount of runoff collected on an impervious surface below a tree canopy. For the purposes of stormwater management, existing tree canopy may decrease the runoff curve number used for calculating design flows.

New trees are often planted with developments as part of overall landscaping requirements. The canopy of new trees shall not be included in the runoff curve reduction due to the time required for a tree to mature enough to infiltrate rain. However, new trees will be included in stormwater credits for a given site (Appendix F).

The following guidelines should be used to calculate the runoff curve number as it is reduced by tree canopy. The calculation for the runoff curve number is a weighted average of the runoff curve number multiplied by the associated area with specific surface characteristics. As described below, existing tree canopy can reduce the impervious surface area (C=98) for the runoff curve number calculation. *Please note that in flow calculations the impervious surface area shall not be reduced by tree cover, only the runoff curve number is reduced.*

Existing Tree Canopy

Existing tree canopy must be preserved during and after construction to qualify as a reduction in impervious surface area treatment. The minimum caliper of existing trees included in this calculation shall be 4-inches at breast height. Existing tree trunk must be within 30-feet of impervious surface. Divide total canopy area (in square-feet) by 2 for applicable decrease in impervious surface area in the runoff calculation.

Example: The spreadsheet below provides an example of calculating the runoff curve number for a 5-acre site proposing 3-acres of impervious surface, leaving 2-acres of landscaping, one acre of which is existing trees. This example assumes that half an acre of the existing trees are within 30 feet of the proposed impervious surfaces. The first example calculates the weighted C-value not including the area reduction associated with tree cover. The second example calculates the weighted C-value with a decrease in impervious surface area associated with tree canopy (note the total impervious area is reduced by half of an acre). Note the difference in the C-values. Though the reduction in the C-value is slight, this modification can result in a significant flow reduction when calculating flow.

Runoff Curve Number (CN)							
(no tree credits)							
Soil name and Hydrologic Group	Cover Description	CN			Area	Product of CN x Area	
		Table 2-2	Fig 2-3	Fig 2-4			
C	Impervious (paving, building	98			3	294	
C	Open Space, Good condition	74			1	74	
C	Existing tree cover, woods-grass combination, good condition	72			1	72	
	Totals				5	440	
	Weighted CN					88 00	

Runoff Curve Number (CN)							
(with tree credits, assume all trees within 30 feet of imp surf.)							
Soil name and Hydrologic Group	Cover Description	CN			Area	Product of CN x Area	
		Table 2-2	Fig 2-3	Fig 2-4			
C	Impervious (paving, building	98			2.5	245	Area reduced by one half of tree area.
C	Open Space, Good condition	74			1	74	
C	Existing tree cover, woods-grass combination, good condition	72			1	72	
	Totals				4.5	391	
	Weighted CN					86.89	

Figure 4.2. Example of curve number calculations

New Deciduous Trees

The minimum caliper of new deciduous trees included in stormwater credit calculations shall be 2-inches at breast height. Trees must be planted within 30-feet of impervious surface to be eligible for stormwater credits. Assume a canopy area of 100 square-feet per tree planted when determining stormwater credits.

New Evergreen Trees

The minimum height of new evergreen trees included in stormwater credit calculations shall be 6-feet. Trees must be planted within 30-feet of impervious surface to be eligible for stormwater credits. Assume a canopy area of 200 square-feet per tree planted when determining stormwater credits.

Maintenance:

Care must be given to ensure the health and viability of trees to be included in stormwater management calculations. Pruning, mulching, and treatment for disease is required for maintaining healthy trees. Dead trees must be replaced to continue stormwater credits.

4.3.3 Porous Pavement BMP

Figure 4.3. Porous pavers intercept rainfall and infiltrate it into the ground, the catch basin will only receive runoff from large storm events.

Porous pavement (also known as permeable pavement and pervious pavement) is a stormwater management facility that allows water to move through void spaces within the pavement surface and rock below and infiltrate into underlying soils.

<u>**Siting**</u>

Infiltration Testing. Perform an infiltration test per <u>Appendix B</u>.

Rainfall versus Runoff. Porous pavement should be designed to only receive direct rainfall. Porous surfaces that will receive runoff in addition to rainfall must be approved on a case by case basis.

Site Suitability for Porous Pavements Managing Runoff. Porous pavements that receive runoff from impervious areas in addition to rainfall should be located using the same criteria as soakage trenches (see 4.4.2 "Soakage Trench BMP", "Siting").

Site Suitability for Porous Pavements Managing Only Rainfall.

- Where design infiltration rates are 0.3 inches/hour or greater for roads and parking lots.
- Where design infiltration rates are 0.1 inches/hour or greater for driveways, sidewalks and trails.
- Where the seasonal high groundwater table, bedrock, or other impermeable layer is more than 18 inches from the bottom of the base rock (which is the open graded aggregate below the surface, designed to store water until it infiltrates). If in an area of known high groundwater the reviewing agency can request verification of groundwater depth or bedrock.
- Where surface slopes are <8%
- Where the pavements will be hydraulically isolated, meaning that they do not receive run-on from any other areas, unless approved by the local jurisdiction.
- Preferably, situate porous pavement on native, uncompacted soil.

- Where any fill material is structural material capable of infiltrating at the design rate.
- Should not be located at sites with high usage and disposal of oil and grease, these include but are not limited to vehicle wrecking and impound yards, fast food establishments, automotive repair shops.

Pavement Surface Types Overview

Porous Asphalt and Pervious Concrete. Porous asphalt and pervious concrete are similar to their impervious counterparts but are made with "open-graded aggregate", which includes few to no fines (*i.e.* small particles). When bound together, interconnected voids between the aggregate allow water to flow through.

Permeable Pavers. Permeable pavers are paver units of stone, concrete or other durable impervious material with gaps between or within the pavers that provide voids for water to reach sub-soils. Porous commercial pavers, like pervious concrete discussed above, are now available and need no space between them.

Porous Flexible Paving Systems. Porous flexible paving systems are prefabricated grids made of plastics or other solid materials finished with clean sand/gravel or turf. Grids with porous media provide a stable surface and sometimes resemble lawn.

Porous Gravel. Conventional gravel surfaces (*i.e.* without a permeable sub-base) are not inherently free draining. During conventional gravel pavement installation, soil is compacted to support vehicular loads, and gravel with many small particles (usually a material like "¾-inch minus drain rock", discussed above) is installed and compacted in lifts (*i.e.* smaller portions of the total depth). This results in a low void ratio with little storage for stormwater.

Gravel driveways and walkways are porous pavement alternatives that can be especially helpful in retrofit situations where drainage problems exist. To create a porous gravel pavement, specify AASHTO No. 3 or 5, as described on BMP 2.01, which is the same material used as base rock in other porous pavements and has no fine particles.

Design

Hydrologic Design Criteria. Pervious pavement replaces impervious surfaces at a 1:1 ratio. The depth of base rock for porous pavements must be designed and modeled by a licensed engineer. Model the porous surface itself as if it were impervious and draining to the base rock with 35% void ratio equal in size to the pavement surface area. If runoff onto the pervious surface has been approved, add these "real" impervious areas to the model and model these to drain to the base rock too. Alternatively, offsite runoff could be directed to a soakage trench constructed under the pervious paving, see Soakage Trench BMP for details.

Porous Shoulders. Porous shoulders will only be allowed on private roads.

Slope. The design must address ponding below the surface to promote infiltration. Chapter 3 of the LID Guide provides detailed design guidance for addressing slopes. In this case, a grading plan for the subgrade should be provided in addition to a final surface grading plan.

Grading Plans. Landscape areas must be depressed to prevent sediment and debris from migrating onto the porous pavement.

Geotextile. Install a non-woven geotextile fabric to separate the native soils from the base rock.

Hydraulic Routing. Underdrains or an auxiliary overflow must be provided for all vehicular applications.

Signage. Install signs identifying the surface as pervious and indicating that stockpiling and sealing are not allowed on the surface.

Standard Drawings. See the standard drawings, Appendix E, for the specific pervious pavement type selected.

Design, Construction Guidelines, Common Mistakes

Additional design guidelines for addressing slopes, avoiding clogging, construction processes, as well as pitfalls and common mistakes are provided in Chapter 3 of the LID Guide.

Maintenance for All Porous Pavements

- Inspect landscape areas twice a year for erosion. Implement erosion prevention and sediment control measures as needed per the Oregon DEQ Construction Stormwater Erosion and Sediment Control Manual and replant as soon as possible per the approved plan.
- Remove trash and leaves. Frequency will vary with foot traffic and the number of trees nearby. Busy commercial districts will need more frequent litter pick-ups than suburban or rural residential streets.
- Remove moss when it covers 10% of the surface or more. Mechanically remove during the dry season. Do not apply mossicides.
- Notify all landscape contractors of their responsibility to help maintain the pavement. Require them to identify an alternative place to stage and dump landscape materials.

Potholes in pervious pavement are unlikely, though settling might occur if a soft spot in the subgrade is not removed during construction. For damaged areas of less than 50 square feet, a depression could be patched by any means suitable with standard pavement, with the loss of porosity of that area being insignificant. The depression can also be filled with pervious mix. The pavement may be up to 10% patched with conventional asphalt.

- Maintain porous pavement and surrounding landscapes with integrated pest management. Fertilizers, pesticides, herbicides, or fungicides are all pollutants with the potential to leach through porous pavement.
- Remove snow and ice. Avoid frequent snow plowing on porous asphalt. If you must plow, keep the bottom of the blade about one inch above the surface. Do not use cinders as they may clog the surface. Environmentally sound, salt-free deicers may be used on any surface type. According to the National Ready Mixed Concrete Association, deicers should not be applied to pervious concrete in the first year after installation. Because porous pavements allow air to pass through them and the ground tends to be warmer than the outside air, a convective process occurs that tends to melt snow and ice much faster on porous pavements than impervious pavements.
- Inspect and maintain permanent signage, if applicable.

Test Surface Permeability. If the infiltration rate of the pavement slows over time contact the approving jurisdiction.

Maintenance Specific to Porous Asphalt and Pervious Concrete.

- Never seal coat porous asphalt.
- Remove material on surface. The cleaning interval, which might range from every 6 months to every 3 years, should be based on possible exposure to sediments. There are three proven methods:
- Vacuuming is often recommended. If the pavement is in a public ROW where agencies sweep the streets with a vacuum truck, then porous pavements will receive this recommended maintenance.

- Pressure washing can be done at an angle to the pavement and not directly into it. Employ erosion control measures when pressure washing and limit the practice to areas that can't be accessed by mechanical equipment.
- Leaf blowers during the dry season, when material can be blown, are also an option.
- Leaf/Litter vacuums have been used successfully.

Maintenance Specific to Permeable Pavers.

- Manage weeds. Permeable paver surfaces have a tendency to grow plants in the infill spaces. Use integrated pest management approaches such as hand-pulling, pouring hot water on weeds, or by using a torch. Commercial maintenance services with trucks that will burn all the weeds off at once are available in Oregon. If using a torch, adhere to all fire regulations and seasonal burning bans.
- Remove material on surface to unclog a clogged surface. Vacuum street sweeping, pressure washing, and leaf blowing may all be used on these systems; however, operations may remove or disturb the infill rock. Replenish it with clean rock meeting the AASHTO No. 8 or equivalent specification (BMP Detail 5.03).

Maintenance specific to Porous Flexible Paving Systems. Refer to the specific manufacturer's maintenance requirements. Some general guidance is as follows:

- For porous flexible paving systems with grass, maintenance is similar to turf.
- For flexible paving systems with gravel, broom or rake dislodged gravel back in place.
- Manage weeds. Use integrated pest management approaches such as hand-pulling (during the wet weather when soils are more soft and roots can be effectively removed), or by burning or pouring hot water on weeds.
- Inspect for bare soil, exposed rings, ruts, poorly growing grass from too much shade, and thatch.
- In the case of spills, ruts, or disturbance to access underground utilities, flexible paving systems may be cut with a sod cutter, set aside, and put back in place after subgrade has been reconstructed.
- Avoid aeration since this machinery will damage the pavement.
- Snow plowing may be done by using standard truck-mounted snow plowing blades with small skids on the corners to keep the bottom of the blade about 1 inch above the grass surface.

Maintenance Specific to Porous Gravel.

- Pull weeds in May and October.
- If the rock surface becomes clogged, carefully shovel the first 1 to 2 inches of rock and rinse it off. Employ appropriate erosion control techniques. Rinse rock in a disconnected landscape area, which is an area that does not drain to any sort of structured inlet such as an area drain or towards any surface like a driveway or road that drains to a structured inlet.

4.3.4 Contained Planter BMP

Figure 4.4. Contained planters are a common beautification project that benefit the watershed when placed over impervious surfaces. In a dense, "main street" application like this photo, the planter footprint shouldn't exceed the width of the furnishing zone (*i.e.* the pavement area between the curb and the walking area of the sidewalk), which is the area where signs, benches, parking meters or other similar infrastructure might be placed. This will ensure that sidewalk traffic is not impeded by a narrowed throughway.

Contained planters placed over existing impervious areas, on the ground or roof, intercept rainfall and then evaporate it back into the air, even in the winter. As an alternative to depaving, place a potted plant anywhere there is unused pavement. Acting much like vegetated roofs, contained planters can reduce annual runoff by 40% to 60% from the area on which they are placed while also improving the aesthetics of paved areas.

Siting

Contained planters should be placed over impervious areas only. Placing them over porous pavements will not reduce runoff – the porous pavement is already designed to do that – and dirt washing through the system could clog the porous pavement.

Design

Container Materials. The container must drain from the bottom. Since these will be outside year-round, consider durability.

Avoid:

- Plastic, since it is photodegradable and will break down in sunlight and can leach phthalates, a pollutant often found in groundwater.
- Treated wood. Even "environmentally friendly" treated wood will leach copper, which is a potent pollutant that affects endangered aquatic species.

Suitable materials include:

- Untreated wood. Choose cedars or other naturally rot-resistant woods for more longevity. Wine barrels cut in half are a popular aesthetic.
- Fabric "sack gardens" such as jute, hemp, flax, linen, burlap, *etc*. Ensure that the fabric is not treated with fire retardants.

- Ceramics. Long-lasting and safer than plastic. Avoid containers with metal glazes that could leach into the environment.
- Concrete or cement.

Container Size. Planters must be at least 12 inches deep for grasses and herbaceous plants and at least 18 inches deep for shrubs. Deeper containers are better suited to deeper rooting plants and take longer to dry out than shallow containers.

The larger the container's area, the more impervious surface it will cover, which makes it more effective at reducing runoff.

Plant Choices. Follow one of the planting density options shown in Tables A-1 and A-2 of Appendix A. Annual plants are suitable for use in contained planters, although native perennials that won't require as much irrigation after an establishment period of 2 – 3 years are preferred. Flowering plants and vegetables that take more fertilization than non-flowering plants should be avoided, minimized, or not fertilized.

Choose hardy species adapted to dry conditions. There are some species that will not thrive in the harsh environment of a container, which is subject to large temperature swings and can easily dry out.

Trees are not suitable for containers as they become root bound in a container without adequate soil volume, which impacts overall health and longevity.

A list of plants to be installed must be submitted including scientific and common names and quantities.

Soils.

- Imported soil shall be roughly 1/3 plant derived compost, 1/3 topsoil and 1/3 gravelly sand.
- Amended native planting soil mix shall be created by blending compost into the native soil at a rate of 1 part compost to two parts soil.
- Soil mix and compost must follow the specifications outlined in the General Notes, Appendix E.
- For any kind of soil, mycorrhizal treatments will make your plantings more resilient and reduce water demand.
- For contained planters on roofs with adequate structural integrity or shallow pots on the ground, you may want to consider purchasing engineered lightweight growing medium. See "Vegetated Roof BMP" for soil mixes, loading capacity, and other design considerations when putting plants on roofs.

Construction

See Appendix A: Plant Specifications "Planting Technique".

Maintenance

Since contained planters are above ground, they are more susceptible to freezing and may drain faster than the soil around plants that are in the ground; however, maintenance for contained planters is similar to conventional landscape maintenance practices:

- Remove weeds twice a year.
- Replenish compost to a depth of 2-3 inches annually. Avoid NPK fertilizers (nitrogen -- phosphorus -- potassium) as nitrogen is a common pollutant found in waterways and will easily dissolve in water, flow out of the container bottom onto an impervious surface, and likely into a pipe that drains to a waterway. Replenishing the 2-3" of organic compost every year should provide adequate nutrition slowly and safely.

- Repot plants with native soil and compost, or imported topsoil, on a schedule as desired or needed to keep plants healthy. Avoid potting soil, which will over nourish plants and cause nutrient pollution as described above.
- Irrigate per Establishment Period Irrigation guidance in Appendix A: Plant Specifications.
- Since contained planters will be on and presumably surrounded by impervious pavement or hot roofs, water plants once a week from July to mid-September after establishment period.

4.4 COLLECTION BMPS

4.4.1 Rain Garden, Stormwater Planter, and LID Swale (aka Vegetated Stormwater Facility) BMPs

Vegetated Stormwater Facilities collect stormwater runoff in a depression to first settle and filter out sediment and pollutants. As stormwater comes into contact with soil and plants, pollutants are reduced further through chemical and biological means. Stormwater quantity is reduced through evaporation, infiltration, and evapotranspiration. Both infiltration and lined filtration facilities have been used successfully on private property, public property, and within the public right-of-way. These BMPs may be built in new construction, re-developments, and retrofits.

Terminology. For convenience, when this manual refers to this family of BMPs that includes rain gardens, stormwater planters, or LID swales, the term "vegetated stormwater facility" or, in this section, sometimes simply "facility" is used.

Choosing Between Rain Gardens, Stormwater Planters and LID Swales. While rain gardens, stormwater planters, and LID swales are very similar in the high quality of treatment achieved through ponding (*i.e.* holding water in a pond until it can infiltrate and evaporate), the volume of water ponded differs, which affects how large they are (*i.e.* sizing). Stormwater planters have the smallest footprint, while rain gardens and LID swales have larger footprints. For more guidance on how to choose the appropriate facility for your site see *Choosing the Best Vegetated Stormwater Facility Configuration* in Chapter 3 of the LID Guide.

A rain garden:

- Has gentle side slopes and may be any shape (*e.g.* round, kidney, *etc.*).
- Should be installed on flat ground (as smooth as practical)

Figure 4.5. Neighborhood scale residential rain garden six months after installation.

An LID swale:

- Has gentle side slopes but is linear in shape.
- Is installed on sloping areas, using check dams that allow water to back up, which makes LID swales function in a similar way to rain gardens. Each cell created by the check dam ponds up before water

cascades over the check dam and into the next cell, infiltrating and evaporating along the way. At the last cell at the bottom of the LID swale, stormwater finally may overflow.

- The longitudinal slope of an LID swale cell should be 6% or less.

Figure 4.6. An LID swale with check dams to slow the flow of water and increase infiltration.

A stormwater planter:

- May be either in- or above-ground (Figures 4.7).
- Has vertical sides created by deep curbs (in ground) or walls or a container (free-standing/above ground) instead of gentle side slopes.
- Stormwater planters can be any shape. Those above-ground tend to be square or rectangular.
- A single stormwater planter cell may be installed on flat areas (as smooth as practical). On sloping ground, a stormwater planter may incorporate check dams to create a series of cells where overflow may occur in the lowest elevation cell (Figure 4.7, right).


Figure 4.7. A residential above-ground stormwater planter (left). An in-ground stormwater planter with concrete check dams in a public street before planting (right). The centerline (looking straight up the center of this photo) slopes at less than 1%. Concrete check dams were needed because the street slopes more than 1%. Grades parallel to the check dam are flat.

Design Considerations

Infiltration versus Filtration. Vegetated stormwater facilities may either be designed to infiltrate into the site's native soils (*i.e.* infiltration facility) or they may be lined or partially lined to prevent infiltration (*i.e.* filtration facility, also sometimes referred to as "flow-through facility"). Infiltration facilities are to be used whenever possible, filtration facilities should only be used when infiltration is not possible.

Siting

Unsuitable Locations for All Facilities. Vegetated stormwater facilities should NEVER be installed in the following locations:

- In other sensitive areas (*i.e.* wetlands or designated native habitat areas).
- Over septic systems.
- In seasonally wet areas.

Suitable Locations for Infiltration Facilities without Underdrains.

- Where the seasonal high groundwater table is greater than 24 inches from the bottom of a vegetated stormwater facility.
- Where the bedrock or other impermeable layer is greater than 18 inches from the bottom of a vegetated stormwater facility.
- In soils with a measured infiltration rate of at least 1.5 inches/hour.
- Where they are at least 10 feet away from an existing building foundation
- Where they are at least 10 feet from an underground tank or a retaining wall.
- In any location approved by a licensed engineer or geologist and the reviewing agency.

Locations that require Lined Filtration Facilities:

Where the seasonal high groundwater table is less than 24 inches from the bottom of a vegetated stormwater facility.

Where the bedrock or other impermeable layer is less than 18 inches from the bottom of a vegetated stormwater facility.

- In contaminated soils or groundwater.
- Within 10 feet of an existing building.
- For vehicular runoff, in wellhead protection areas.

Design

Infiltration Testing. Must be performed per Appendix B.

Sizing and Hydrologic Design. Requirements vary based on the design approach utilized.

Simplified Approach: A sizing factor of 0.05 must be used. This approach may be used for sites with the following characteristics:

- Manage runoff from less than 10,000 square feet of impervious surface
- Have design infiltration rates of 0.5 inches/hr or higher
- Must use 24 inches of imported or amended growing medium.

Performance Approach: These facilities must be designed by an engineer licensed in the state of Oregon using the methodology of Chapter 3 of this manual. The facility must have a design infiltration rate of 0.5 inches/hr or more. The performance approach must be used when any of the following conditions exist:

- The facility manages runoff from 10,000 sf or more.
- The facility will be lined or partially lined.
- The facility incorporates a rock trench (described in later sections below) beneath the vegetated stormwater facility.

Surface Geometry and Water Quality Function. Design criteria for surface geometry are as follows:

- Vegetated stormwater facilities may be any shape that meets the sizing criteria for vegetated stormwater facilities.
- Side slopes for rain gardens and LID swales, should be 33% (3 horizontal: 1 vertical) or less.
- Stormwater planters have vertical sides made of structural material like concrete, not soil.
- Bottom slopes of rain gardens and SW planters must be less than 0.5% slope in any direction
- Longitudinal slope of LID swales must be 6% or less.
- Bottom widths must adhere to the values in Table 4.2.
- Ponding depth, the depth of water allowed to accumulate in a vegetated stormwater facility, should be a maximum of 12 inches.
- Pretreatment must be provided where stormwater enters a facility in a concentrated fashion (*i.e.* piped). For design guidance on pretreatment structures refer to Chapter 3 of the LID Guide.
- Freeboard of six inches above the 10 year design storm must be provided. Less than six inches may be provided with jurisdictional approval, where potential overflow will not impact adjacent properties.

Table 4.2. Using the above guidance, minimum geometry for rain gardens, planters and LID swales are as follows below.

Treatment Ponding Depth [inches]	Minimum Base Width [ft]
<6	2
6-9	4.5
9-12	6

Energy Dissipation: Energy dissipation must be placed below each entry point to reduce velocity. At the upstream end of a facility energy dissipation can also serve to distribute flow across the treatment width. Energy dissipation must be constructed of non-biodegradable material such as concrete or rock.

Vegetation. Design criteria for vegetation is as follows:

- Must follow the landscape plan submittal requirements outlined in Chapter 6.3.
- Must follow one of the planting options outlined in Tables A-1 to A-3 of Appendix A.
- Vegetation should cover a minimum of 90% of the treatment area of the facility within three years.
- River rock is not allowed.
- Vegetation should be selected based on its tolerance to flooding and drought cycles as well as sun and shade conditions at the site.
- Trees should be used with caution in stormwater planters, refer to Chapter 3 of the LID Guide "Tree Planting BMP" "Siting".

Trees: If planting trees within the stormwater feature, assume a mature tree covers 60 square feet. The area within this 60 square feet does not need to be vegetated with herbaceous plants or shrubs.

Vegetation Establishment: The property owner is responsible for ensuring that 90% of the ground remains covered with vegetation in perpetuity. Vegetation should be selected to reduce the need for continual irrigation. Temporary irrigation is required for the first three growing seasons to ensure healthy vegetation establishment. Permanent irrigation is up to the property owner and the needs of the selected plant palette, however plants must be maintained in a vigorous, healthy condition.

Mulch. Mulch shall be either shredded wood chips or coarse compost. Mulch must be dye, pesticide and weed free. Spread in a minimum two inch layer over bare soil or in a ring around plants to increase water retention. Ensure that mulch does not touch plant stems.

Growing Medium. Directly below the mulch is soil, which may be:

- Imported soil that is roughly one third plant derived compost, one third topsoil and one third gravelly sand.
- Native soil amended to a depth of 18 inches. Amend native soil with roughly 30% compost.

- Native and free-draining (infiltration rate >0.5in/hr). If a faster draining soil is beneath a slower draining surface soil and you wish to decrease the footprint of your facility, access the faster draining soil by replacing the native soil with an imported soil mix.
- Whether native or amended, the growing medium must be in compliance with the amended planting soil mix specifications, see General Notes for Vegetated BMPS, Appendix E. A Seal of Testing Assurance certification from the US Composting Council must be provided to the approving jurisdiction for imported compost.

Inlets. Curb cuts should primarily be used to drain sheet flow directly into the facility. Example good and bad curb inlets are provided in Chapter 3 of the LID Guide.

Check Dams: Check dams shall be used where necessary to ensure that the entire facility bottom is used for infiltration. They should be keyed into the sides of the swale to prevent bypass and the toe of the upslope dam should be at the same elevation as the top of the downstream dam, similar to ODOT detail RD1005, but with a flat top. Check dams should be constructed of non-biodegradable material such as concrete or rock.

Storage Rock: If storage rock is used it must be separated from the growing medium, and any fine soil at the bottom of the facility, by a 4 inch thick layer of separation rock (see Standard Drawings).

Impermeable Liner. No additional liner is required in monolithically poured concrete stormwater planters. Impermeable liners must be a minimum 30-mil (minimum) thick, material which may be low density polyethylene (LDPE), ethylene propylene diene monomer (EPDM), or bentonite clay mat per manufacturer guidance. Liners must be installed per manufacturer specifications.

Standard Drawings. Standard drawings are provided in Appendix E for a range of facilities from those with no formal overflow structure or amended soils to complex lined facilities that require an underdrain, a large storm overflow structure, and imported, engineered soil.

Construction

Construction guidance is provided in Chapter 3 of the LID Guide.

Cost Considerations and Pitfalls and Common Mistakes

Detailed guidance on cost considerations and how to avoid common mistakes during design, construction and maintenance of these facilities is provided in Chapter 3 of the LID Guide.

Maintenance

Specific maintenance activities are needed to ensure proper long-term function. Determine who is responsible for operations and maintenance and confirm early stakeholder buy-in of maintenance practices before determining the mix of BMPs.

Inspect the facility at least 4 times a year and perform needed maintenance as follows:

- Maintain a calm flow of water entering the facility via downspout pipes or other inlets.
  - Identify erosion sources and control them when soil is exposed or erosion channels are forming. Fill erosion channels with approved soil mix and replant per the approved planting plan.
  - Identify and correct sources of sediment and debris.
- Remove sediment and debris from:
  - The pretreatment sump.
  - The facility surface with minimum damage to vegetation. Remove accumulated material if it is more than 2 inches thick or damaging vegetation.

- The facility outlet, such as overflow drain or conveyance swale.
- Curb cuts when depth exceeds ¼ inch.

- Stabilize slopes with plants and appropriate erosion control measures when soil is exposed or erosion channels are forming. Fill eroded channels with approved soil and replant. If flows can be redirected temporarily, redirect flows until plants establish. Check for erosion as a result of redirected flows on the next site visit.
- Maintain the design ponding depth by:
  - Repairing any structural elements that may leak from cracks or worn sealant
  - Maintaining the design elevation of check dams
- Soil should allow stormwater to percolate uniformly through the rain garden.
  - If the facility does not drain within 48 hours, scrape 1 inch of soil out of the facility and scarify to 3 inches.
  - If facility does not drain after scraping 1 inch, remove another 1 inch.
  - If facility does not drain after scraping 2 inches, salvage plants, till and replant the facility.
- Vegetation should be healthy and dense enough to provide filtering while protecting underlying soils from erosion with at least 90% coverage of bare soil in three years.
  - Replenish mulch until vegetation is established and shading the bottom of the facility.
  - Remove fallen leaves and debris from deciduous plant foliage.
  - Don't string trim ornamental grasses, sedges or rushes. These may be raked.
  - Don't prune shrubs into balls, natural growth will more effectively treat stormwater.
  - Low mow and no mow seed mixes should be mown a maximum of three to four times a year for aesthetics and to reduce fire risk.
  - Remove nuisance (*i.e.* plants blocking the inlet) and non-native and invasive vegetation (*i.e.* weeds such as Himalayan blackberries and English Ivy) when discovered.
  - Remove dead vegetation and woody material before it covers 10% of the rain garden surface area. Vegetation shall be replaced in compliance with the approved landscape plan and as soon as possible based on season. If unable to replace immediately prevent erosion of the area with best management practices.
  - Irrigate per guidance provided in Appendix A: Plant Specifications "Establishment Maintenance".
  - Maintain vegetation using integrated pest management per Appendix A: Plant Specifications "Integrated Pest Management".
- Exercise spill prevention measures when handling substances that can contaminate stormwater. Correct releases of pollutants as soon as identified:
  - Make sure the area is safe to enter
  - Block the outflow of the BMP
  - Block the inflow of the BMP
  - Stop the release of the hazmat
  - Clean up the flow path to the BMP
  - Clean out the BMP, replacing soil, and vegetation as necessary.

4.4.2 Soakage Trench BMP

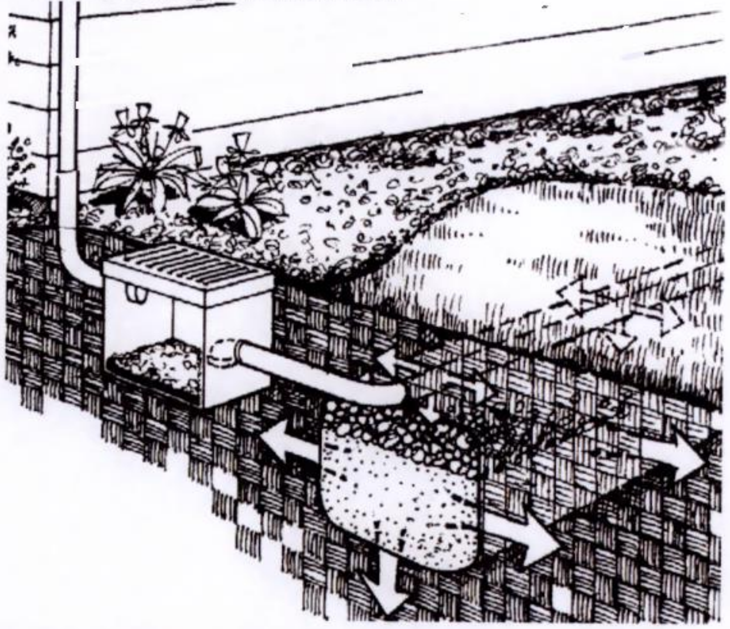

Figure 4.8. A soakage trench with a perforated pipe (right) and a sumped catch basin (left) that catches debris and sediment. A down turned pipe, as shown on the outlet side of the sumped catch basin improves sediment removal. For high sediment areas, such as roadways, two catch basins with down-turned pipe outlets may be used in series. Image adapted from City of Portland, Bureau of Environmental Services (City of Portland BES [c], 2006).

Soakage trenches (*i.e.* infiltration trenches, recharge beds) are excavated trenches filled with coarse stone (*i.e.* storage rock) and wrapped in non-woven geotextile that receive runoff via a pipe and store it in the rock voids until it is able to infiltrate into surrounding soils. The primary difference between a soakage trench and a vegetated stormwater facility is that water is injected underground via a pipe, rather than infiltrating through the soil surface.

UIC Authorization (not always required)

Soakage trenches are relatively shallow facilities and are generally only considered a UIC if injection occurs via a perforated pipe.

If perforated pipe discharges water to the subsurface, then the soakage trench IS considered a UIC and requires authorization. Contact DEQ to find out about current UIC regulations and whether authorization will be required for your project. DEQ's UIC webpage: http://www.oregon.gov/deq/wq/wqpermits/Pages/UIC.aspx.

Siting

Runoff from any surface may be directed to a soakage trench, as long as hazardous materials, toxic substances, or petroleum products are not used, stored, or handled in the area drained by the soakage trench. Consult with local jurisdiction on distance allowed from the public right-of-way.

Suitable Locations for Soakage Trenches:

- In soils with a design infiltration rate of at least 0.5 inches/hour.
- On land slopes with less than 20% grade. A setback of 100 feet is required for slopes greater than 20%.

- Where the bedrock or other impermeable layer is deeper than 24 inches from the bottom of the soakage trench.
- Where they are 10 feet from a building foundation.
- Where they are 5 feet from a property line.
- Where they are outside septic fields, contaminated soils and landslide areas.

The following restrictions apply to soakage trenches:

- Cannot be located within 100 feet of a water supply well.
- Cannot intersect the groundwater table. Soakage trenches shall have at least two feet of vertical separation from the seasonal high groundwater table.

Siting soakage trenches near newly planted trees. Soakage trenches without perforated pipes may be located within the projected mature canopy area of a newly planted tree; however, soakage trenches with perforated pipes should be located at a distance of 1.5 times the projected mature canopy spread (*i.e.* how big the canopy will be when the tree is fully grown) from the trunk to the perforated pipe to avoid root damage to the pipe.

<u>**Design**</u>

Several variations of soakage trenches are briefly described below.

Soakage Trench at the Surface. This variation incorporates rock all the way to the existing or proposed grades and usually receives runoff from an adjacent surface.

Soakage Trench beneath Landscape Areas. These facilities have a cover of soil and vegetation.

Soakage Trench beneath Porous Pavement. This variation adds additional rock underneath porous pavements and directs concentrated runoff from other areas to the bottom of the rock with perforated pipes laid out along the bottom.

Soakage Trench beneath Impervious Pavement. Soakage trenches may be installed beneath impervious pavement with an impermeable membrane to separate the soakage trench from the base rock of the impervious pavement.

Hydrologic Modeling and Sizing. Soakage trenches must be sized by a licensed engineer to meet the performance criteria outlined in Chapter 3 of the RVSQDM based on a measured infiltration rate of 1.5 inches and a minimum design infiltration rate of 0.5 inches.

Pretreatment. To prevent clogging from sediment pretreatment must be included. Options for pretreatment include a sump, lined rain garden or stormwater planter, a proprietary system with filter media, or if runoff will only be from roofs gutter screens may be used.

Dimensions. Minimum width of two feet.

Sub-surface and Ground Slopes. The facility bottom should be sloped between 0 and 0.5%. Design the bottom elevation of the trenches to match existing contours to achieve this desirable flat bottom, reduce excavation, and allow for the maximum effective storage volume as water infiltrates.

Soakage trenches running across contours that exceed 0.5% slope should be stepped down the slope by creating underground berms. This will ensure that the soakage trench infiltrates intended runoff volumes instead of just conveying it to the lowest elevation. Slopes at the ground surface may exceed 0.5% without impacting facility function; however, for soakage trenches at the surface, additional rock will be needed to backfill to surface grades.

Piping. Refer to the current Oregon Plumbing Specialty Code for specifications on piping materials and cleanout sizing and spacing requirements. For maintenance purposes, a minimum diameter of 6 inches is recommended. Non-perforated overflow pipes to an approved discharge point may be needed. If perforated pipes are placed at the bottom of the facility, control structures are required to ensure infiltration of the water quality storm.

Observation Wells/Cleanout Pipes. Install at least 1 observation well near the center of the facility or in its lowest point and every 50 feet. Observation well piping should be a 6 inch diameter non-perforated pipe. Equip the end above ground with an operable cap.

Storage rock. AASHTO No. 57 or equivalent uniformly graded aggregate is required. Alternatively, concrete or plastic vaults with open bottoms can be used. These chambers may be useful in areas with high water tables or shallow impermeable layers (typically bedrock or fragipan).

Geotextile Fabric (aka Filter fabric). Non-woven geotextile fabrics should line the trench. Segments should overlap a minimum of 12 inches. Alternatively, the bottom layer of filter fabric can be replaced with 6 inches of separation rock.

Vegetation. For the soakage trench beneath landscape areas, choose plants that will tolerate drier conditions. Follow one of the options outlined in Tables A-1 and A-2 of Appendix A. Do not plant large shrubs or trees over facilities that include pipes. See Chapter 6.3 for landscape plan submittal requirements.

Standard Drawings. See Appendix E.

Construction Guidance and Cost Considerations

Detailed construction steps and cost considerations are provided in Chapter 3 of the LID Guide.

Maintenance

Specific maintenance activities are needed to ensure proper long-term function. Determine who is responsible for operations and maintenance and confirm early stakeholder buy-in of maintenance practices before determining the mix of BMPs.

Inspect the facility a minimum of 4 times per year during each season and after major storms and perform needed maintenance as follows:

- Maintain manufactured structures like silt basins and water quality manholes per manufacturer's operations and maintenance guidelines.
- Confirm via the observation port that the facility is emptying out/infiltrating. Clogged facilities must be completely reconstructed or relocated.
- Remove debris from pipes and other conveyance.
- Repair or replace damaged pipes.
- For soakage trenches that receive runoff from adjacent surfaces, sediment and debris will tend to clog the surface of the facility. Vacuum sediment from rocks. If water can no longer drain into the facility, clogging of the top geotextile has occurred. Using sediment control techniques such as compost berms and biobags, remove and clean rock on the surface. Replace the geotextile fabric on the top, being careful not to damage the fabric on the sides. Place the cleaned rock back over the geotextile fabric. Dispose of sediment in trash destined for the landfill. Sweeping regularly will reduce the likelihood of clogging. High traffic areas will clog faster than low traffic areas.

4.4.3 Dispersion BMPs: Vegetated Filter Strips and Disconnected Downspouts

Figure 4.9. Example of sheet flow from a patio to a newly installed vegetated filter strip.

Dispersion is a BMP that spreads runoff over a landscape area specifically to reduce pollution and runoff, and is suitable for a variety of roadside applications and development densities. Vegetated filter strips typically run parallel to an impervious surface, commonly walkways and driveways, and are gently sloped away from the impervious surface. They must be completely vegetated to filter and reduce velocity as runoff flows through. Downspout disconnection redirects runoff from an underground stormwater pipe to a landscaped or mulched area for infiltration.

Siting

Dispersion BMPs shall be located according to the following guidance:

- In areas where the seasonal groundwater table is at least 2 feet below the surface.
- On slopes < 15%
- 5 feet from property lines.
- 10 feet from a building with a basement or 10 feet from where a neighboring building foundation could allowably be constructed in the future.
- 2 feet from a building without a basement (*i.e.* slab on grade, crawl space, pier, or post foundations)
- Not over or towards septic drain fields.

Design

Criteria for Vegetated Filter Strips. Vegetated filter strips must be sized using the methodology of Chapter 3 of the RVSQDM and follow the criteria outlined below. The location for the filter strip must have a design infiltration rate of at least 0.5 inches per hour.

- Maximum impervious area flow paths of 75 feet.
- The longitudinal length of the vegetated filter strip should match the length of the impervious area draining to it.
- Maximum impervious lateral slope (*i.e.* lateral equals direction perpendicular to centerline of a sidewalk or a road) of 5%.
- Maximum impervious longitudinal slope of 4%.
- Vegetated filter strip lateral slope between 1 and 15%.
- Maximum vegetated filter strip longitudinal slope of 2%.
- The filter strip width must be determined according to sizing criteria established by ODOT:

    - 2% sloped filter strip to treat 4 feet of pavement for every 1 foot of filter strip
    - 5% sloped filter strip to treat 3 feet of pavement for every 1 foot of filter strip
    - 10% sloped filter strip to treat 2 feet of pavement for every 1 foot of filter strip
    - 15% sloped filter strip to treat 1.5 feet of pavement for every 1 foot of filter strip
- Incorporate a level spreader to distribute flow across the entire filter strip (described in next section).
- See the Dispersion BMP section of Chapter 3 in the LID Guide for a figure that illustrates the above specifications.

Criteria for Downspout Disconnections.

- Maximum impervious area of 700 square feet/downspout
- Include a splash block or pad
- Include downspout extensions to protect against flooding the adjacent building (see "Siting" above). A 6-foot long downspout extension should be used for minimal excavation foundations (see Chapter 3 of the LID Guide "Minimal Excavation Foundations BMP") and 10-foot long extension should be used for buildings with full basements.
- Provide a minimum vegetated flow path of 50 feet sloping between 2% and 5% away from buildings. This may include natural areas or riparian buffers.
- Discharge from a downspout disconnection must not flow over an impervious surface.

Design Considerations. Where SW infrastructure is not required, buildings can be designed without gutters or downspouts so that runoff can sheet flow from the roof into a vegetated filter strip below. Impervious areas should slope toward the filter strip rather than toward a curb or catch basin. In parking lots and driveways, avoid the use of curbs and gutters which prevent sheet flow from reaching vegetated filter strips.

Level Spreader. Level Spreaders should be included in every vegetated filter strip to redistribute flows evenly across the facility, except on highways and roads where a gravel shoulder is proposed or already exists, or on roads with gravel parking edges.

- Length: Match length of vegetated filter strip and impervious area.
- Width = 12 inches, Depth = 9 inches (This will ensure that the level spreader is wider than it is deep, avoiding a UIC.)
- Use crushed aggregate meeting the coarse aggregate specification in BMP 2.02: Specifications or any other angular, open-graded rock with a maximum diameter of 3 inches.
- Set the elevation of the level spreader ¼ inch lower than the pavement, which meets ADA accessibility requirements.

Signage. Because vegetated filter strips look similar to a regular garden, permanent signage or demarcation, such as fencing (even as simple and attractive as a 2 foot tall post and chain fence) or road marking to prevent long-term compaction is required.

Growing Medium. Growing medium in filter strips must be one of the following:

- Imported soil that is roughly one third plant derived compost, one third topsoil and one third gravelly sand.
- Native soil amended to a depth of 18 inches. Amend native soil with roughly 30% compost.
- Native and uncompacted.

Mulch. Use mulch meeting the specifications in General Notes for Vegetated BMPs. Apply mulch during the establishment period of 3 years. After that, vegetation should have adequate structure to hold and cover soil, shading out most weeds.

Vegetation. Vegetation in the dispersion area should be well established with at least 95% cover of lawn or perennial native landscape (groundcover, grasses, shrubs, and/or trees) within 3 years. Plant numbers must be in accordance with one of the options presented in Tables A-1:A-3 in Appendix A. Place less dense vegetation at the upstream edge of the filter strip or downspout discharge. Flooding can occur when dense vegetation at the mouth of a downspout extension or the edge of a vegetated filter strip causes water to back up. See Chapter 6.3 for landscape plan submittal requirements.

Standard Drawings. See Appendix E.

Cost Consideration and Pitfalls and Common Mistakes

These are discussed in Chapter 3 of the LID Guide.

Maintenance

Specific maintenance activities are needed to ensure proper long-term function. Determine who is responsible for operations and maintenance and confirm early stakeholder buy-in of maintenance practices before determining the mix of BMPs.

- Mow and trim grasses to lengths appropriate to the type and species of grass. Longer grass is generally better.
- Identify and correct sources of sediment and debris.
- Inspect for and remove excess sediment (maximum depth of 2 inches) that may affect vegetation growth in the dispersion area or the level spreader. Dispose of sediment in trash destined for the landfill.
- Replace vegetation as needed. If a plant did not do well, choose a different plant.
- Repair eroded areas where channels have formed by filling them with soil, lightly compacting them with tamping or boot compaction, and re-establish vegetation. Do not fill eroded channels with mulch. If possible, redirect flows around the establishing vegetation for 3 months. Inspect other areas around redirecting device (*i.e.* sandbag) to ensure that this redirection is not causing additional erosion. If plants receiving redirected flows are small or not very sturdy and erosion is or may occur, biobags (a sediment control measure, which is a bag with compost or shredded wood chips) will allow water to enter the vegetated filter strip slowly and may be a better way to prevent erosion than redirecting flows.

Level Spreader Maintenance.

- Use a flat shovel, remove the rock to a depth of at least 6 inches. Install appropriate erosion control techniques (see the DEQ's "Construction Stormwater Erosion and Sediment Control Manual) such as biobags or wattles. Hose off the rock on a plastic tarp. Place the clean rock back and dispose of sediment and organic matter in trash destined for the landfill.
- Remove weeds twice a year if enough sediment accumulates to grow weeds but not enough accumulates to warrant cleaning the rock.
- Clean rock before the angular rock is completely buried in sediment. Frequency will depend on the type of pavement and if any uphill landscape areas draining across the pavement are stabilized. Roofs generally contribute the least amount of sediment, although roofs near highways will have more particulates deposited on their surface. Generally for roads, sediment will increase with the number of cars on them.

4.4.4 Water Quality Conveyance Swales

Figure 4.10. A water quality conveyance swale with dense mature vegetation that provides filtering of stormwater runoff.

Water quality conveyance swales treat stormwater by conveying it through the substrate and vegetation, rather than relying on infiltration. These facilities are not considered LID because water quality treatment is mainly achieved by filtration and settlement provided by the plant structure and growing medium rather than infiltration and evaporation. Swales must be planted with dense vegetation to filter the stormwater and should be integrated into the overall site design and used to meet landscaping requirements.

Swales should be built and planted early in the construction sequence so that vegetation can become established. Once the swale is cut to grade it should be fenced off to prevent construction traffic and staging of materials within the swale.

Water quality conveyance swales may be unlined, partially lined, or fully lined depending on where they are located.

<u>Siting</u>

Water Quality Conveyance swales should not be located in sensitive areas (*ie.* Wetlands, riparian areas, designated critical habitat, or under existing tree canopies), unless approved by the local jurisdiction, or over septic systems. Fully Lined facilities that are at grade have no setbacks.

Design and Sizing Guidelines

Sizing: Water Quality Conveyance swales must be designed to have a minimum residence time of 9 minutes. If surface runoff will enter the swale at multiple locations along its length such that residence time is less than 9 minutes, designers must incorporate check dams to increase the residence time. There is no simplified/prescriptive approach to sizing allowed, minimum requirements are listed below, unless otherwise approved by the reviewing jurisdiction.

Dimensions and side slopes:

- Minimum bottom width is one foot. If the bottom width is wider than four feet, a flow spreader is required for every 50 feet of length to uniformly redistribute the flow across the bottom width.
- Maximum depth of the water quality flow is 4 inches, flow should not be higher than 2/3 the height of the vegetation.
- Maximum side slopes of the treatment zone are 3 horizontal to 1 vertical for densely vegetated swales and 4 horizontal to 1 vertical for swales that will be mowed.
- Vertical walls may be used in tight spaces. The width of the swale bottom must be increased such that the treatment area that would have been provided in the 3:1 side slopes is provided in the swale bottom. The bottom width to wall height ratio must be at least 2:1.
- Longitudinal slope must be 0.5% or greater. Longitudinal slopes greater than 6% require installation of check dams.
- Manning's n value must be a value between 0.22 and 0.24.
- Freeboard of six inches above the 10 year design storm must be provided. Less than six inches may be provided with jurisdictional approval, where potential overflow will not impact adjacent properties.

Flow Spreaders: Use non-biodegradable materials for the flow spreader.

Energy Dissipation: Energy dissipation must be placed below each entry point to the swale to reduce velocity. At the upstream end of a swale energy dissipation can also serve to distribute flow across the treatment width. Energy dissipation must be constructed of non-biodegradable material such as concrete or rock.

Waterproofing/Liner: Swales within 10 feet of a building must be lined with minimum 30 mil EPDM, HDPE, or approved equal. Liners may be partial or full.

Check Dams: When slopes exceed 6% check dams must be installed. They should be keyed into the sides of the swale to prevent bypass and the toe of the upslope dam should be at the same elevation as the top of the downstream dam, similar to ODOT detail RD1005, but with a flat top. Check dams should be constructed of non-biodegradable material such as concrete or rock.

Growing Medium: Native soil may be amended to a depth of 18 inches or an imported soil may be used in the top 12 inches of the swale. Amend native soil with roughly 30% compost. Imported soil should be roughly one third plant derived compost, one third topsoil and one third gravelly sand. The growing medium requirements apply to the treatment area of the swale. Lined and partially lined facilities may have a growing medium depth of 12 inches if only installing herbaceous plants, but must have a growing medium depth of 24 inches for shrubs, to provide adequate substrate for plant roots to establish. Whether native or amended, the growing medium must be in compliance with the amended planting soil mix specifications, see General Notes for Vegetated BMPs, Appendix E. A Seal of Testing Assurance certification from the US Composting Council must be provided to the approving jurisdiction. To find out more about STA certified compost and for a list of entities selling STA certified compost visit the US Composting Council website.

Ground Stabilization: All ground within the swale must be stabilized with either erosion control matting or mulch. Where there is potential for rilling erosion control matting must be installed.

Erosion Control Matting: If specifying matting below the 10 year flow depth of the swale, high density, ODOT Type E, erosion control matting should be used to hold the soil in place until vegetation becomes established. Matting must be 100% biodegradable, photodegradable matting is not allowed. If seeding, place seed and then install erosion control matting. If planting, install erosion control matting and then install plants through the matting. Matting is not required on slopes 4:1 or shallower that have been hydroseeded per Table A1 in Appendix A.

Mulch: Mulch shall be either shredded wood chips or coarse compost. Mulch must be dye, pesticide and weed free. Spread in a minimum two inch layer over bare soil or in a ring around plants to increase water retention. Ensure that mulch does not touch plant stems.

Vegetation: The entire facility must be planted with vegetation, including bottom and side slopes, which should be established as soon as possible after the swale is constructed. Native plants are preferred. A minimum of 90% of the ground within the treatment zone must be vegetated at maturity. Dense vegetation can be achieved either through installation of herbaceous plants and shrubs or through use of a native, no-mow seed mix, as specified in Appendix A. Tables A-1:A-3. The amount of standing water that plants can tolerate, as well as the amount of irrigation that will be required to maintain plants should be considered during plant selection. Vegetation in swales with liners should be carefully chosen to avoid impacting the liner, trees should not be planted in lined facilities. Plant layout should comply with the Water Quality Conveyance Swale Planting Detail 8.03.

Landscape Plan: A planting plan must be submitted that indicates the species and location, by hydrologic zone (see BMP 8.03), of all plants within the stormwater feature. A table listing the scientific and common name of each species, quantity, installation size and spacing should also be included. See Chapter 6.3 for submittal requirements.

Vegetation Establishment: The property owner is responsible for ensuring that 80% of the original plants survive and that 90% of the ground remains covered with vegetation in perpetuity. Vegetation should be selected to reduce the need for continual irrigation. Temporary irrigation is required for the first three growing seasons to ensure healthy vegetation establishment. Permanent irrigation is up to the property owner and the needs of the selected plant palette, however plants must be maintained in a vigorous, healthy condition.

Inlets/Outlets/Underdrains: Underdrains must be included in fully lined swales. Unlined and partially lined swales should not include underdrains.

Standard Drawings. See Appendix E.

Cost Consideration and Pitfalls and Common Mistakes

These are discussed in Chapter 3 of the LID Guide.

Maintenance

Specific maintenance activities are needed to ensure proper long-term function. Determine who is responsible for operations and maintenance and confirm early stakeholder buy-in of maintenance practices before determining the mix of BMPs.

Inspect the facility at least 4 times a year and perform needed maintenance as follows:

- Maintain a calm flow of water entering the facility via downspout pipes or other inlets.

  - Identify erosion sources and control them when soil is exposed or erosion channels are forming. Fill erosion channels with approved soil mix and replant per the approved planting plan.
  - Identify and correct sources of sediment and debris.
- Remove sediment and debris from:
  - The pretreatment sump.
  - The facility surface with minimum damage to vegetation. Remove accumulated material if it is more than 2 inches thick or damaging vegetation.
  - The facility outlet, such as overflow drain or conveyance swale.
  - Curb cuts when depth exceeds ¼ inch.
- Stabilize slopes with plants and appropriate erosion control measures when soil is exposed or erosion channels are forming. Fill eroded channels with approved soil and replant. If flows can be redirected temporarily, redirect flows until plants establish. Check for erosion as a result of redirected flows on the next site visit.
- Maintain the design ponding depth by:
  - Repairing any structural elements that may leak from cracks or worn sealant
  - Maintaining the design elevation of check dams
- Soil should allow stormwater to percolate uniformly through the rain garden.
  - If the facility does not drain within 48 hours, scrape 1 inch of soil out of the facility and scarify to 3 inches.
  - If facility does not drain after scraping 1 inch, remove another 1 inch.
  - If facility does not drain after scraping 2 inches, salvage plants, till and replant the facility.
- Vegetation should be healthy and dense enough to provide filtering while protecting underlying soils from erosion with at least 90% coverage of bare soil in three years.
  - Replenish mulch until vegetation is established and shading the bottom of the facility.
  - Remove fallen leaves and debris from deciduous plant foliage.
  - Don't string trim ornamental grasses, sedges or rushes. These may be raked.
  - Don't prune shrubs into balls, natural growth will more effectively treat stormwater.
  - Low mow and no mow seed mixes should be mown a maximum of three to four times a year for aesthetics and to reduce fire risk.
  - Remove nuisance (*i.e.* plants blocking the inlet) and non-native and invasive vegetation (*i.e.* weeds such as Himalayan blackberries and English Ivy) when discovered.
  - Remove dead vegetation and woody material before it covers 10% of the rain garden surface area. Vegetation shall be replaced in compliance with the approved landscape plan and as soon as possible based on season. If unable to replace immediately prevent erosion of the area with best management practices.
  - Irrigate per guidance provided in <u>Appendix A</u>: Plant Specifications "Establishment Maintenance".
  - Maintain vegetation using integrated pest management per <u>Appendix A</u>: Plant Specifications "Integrated Pest Management".
- Exercise spill prevention measures when handling substances that can contaminate stormwater. Correct releases of pollutants as soon as identified:
  - Make sure the area is safe to enter
  - Block the outflow of the BMP
  - Block the inflow of the BMP
  - Stop the release of the hazmat
  - Clean up the flow path to the BMP

- Clean out the BMP, replacing soil, and vegetation as necessary.

4.4.5 Extended Detention Basin

An extended detention basin receives stormwater and releases it slowly over time, to provide peak flow control. The basin completely drains between storm events. The primary treatment process of an extended detention basin is sedimentation.

Design Considerations: Slopes and depth should be kept as mild as possible to avoid safety risks. The pond must have an overflow capable of spilling storms larger than the design event.

The discharge rate for pollution control is significantly smaller than the discharge rate for flow control. The basin should be designed with at least two discharge controls, one at a low level for water quality discharge rate and one at a higher level for the flow control discharge rate.

Design Requirements:

- Maximum Hydraulic Loading Rate is 2.0 ft^3/ft^2/day (This is equal to the settling velocity of the design particle, 75 microns diameter = 0.003 inch, specific gravity =
- 2.65).
- Maximum outflow rate for pollution control = 2/3 of design daily inflow rate.
- Maximum outflow rate for flow control = pre-development discharge rate.
- Maximum slope = 3 horizontal to 1 vertical.
- Minimum orifice size = 1-inch. The orifice structure shall be designed to prevent clogging and provide access for maintenance.
- The distance between all inlets and the outlet shall be maximized to facilitate sedimentation.
- The minimum length-to-width ratio is 3:1, at the maximum water surface elevation. If this ratio cannot be maintained the basin must be equipped with baffles or islands to increase to flow distance between inlet and outlet.
- The maximum depth of the pond at overflow level shall be 4 feet.
- Minimum freeboard at design depth is 1 foot.

Location: Extended detention basins must be located within the public right-of-way or on a dedicated public open space tract. The outlet control structure must be accessible to maintenance vehicles via an all-weather road.

Materials: Extended Detention basins are appropriate for all soil types. Native or imported topsoil should be used in the top 12-inches of the basin. Soil should be 75 – 80% compacted.

Sizing: Extended detention basins are sized based on Hydraulic Loading Rate for pollution control and based on the total volume for peak flow control.

Pollution Control: Sizing for pollution control is based on the Hydraulic Loading Rate, which is the daily inflow divided by the surface area of the basin under the design storm. The maximum hydraulic loading rate is 2.0 ft^3/ft^2/day. The minimum required volume for pollution control is equal to 1/3 of the daily inflow rate.

Peak Flow: Sizing for peak flow is based on the volume which must be detained to meet the pre-development discharge rates. The flow control device for peak flow control should be located above the maximum elevation reached during a water quality storm event.

Overflow: The emergency overflow spillway should be set at a level higher than the maximum elevation of the peak flow design storm.

Landscaping: Soil must be amended with compost meeting the specifications provided in General Notes for Vegetated BMPs. Vegetation within and around extended detention basins must be capable of withstanding drought conditions during the summer months and temporary submergence during winter months. Turf grass is acceptable in areas where irrigation and mowing is provided by a private party. Landscaping must be in accordance with one of the options outlined in Tables A-1 and A-2 of Appendix A. See Chapter 6.3 for landscape plan submittal requirements.

Operations and Maintenance: The primary maintenance concern with extended detention basins is the potential for the outlet control structure to become clogged by debris. These structures should be cleared of debris and trash annually in the fall and inspected at least quarterly, under both wet and dry conditions, to ensure that they are operating properly.

Excessive vegetation is generally not a problem unless it blocks the outlet controls, becomes a fire hazard, or becomes an eyesore. Under these conditions the vegetation should be pruned or mowed.

4.4.6 Proprietary Treatment Devices

Figure 4.11. Stormtech Chambers are one example of a stormwater treatment technology that has been pre-approved by the Rogue Valley Stormwater Advisory Team.

Proprietary treatment devices may be used when Low Impact Development and Green Infrastructure are determined to be infeasible and where the soil is not Hydrologic Soil Group A or B. The proposed treatment device must either be on the list of *Pre-Approved Proprietary Stormwater Treatment Technologies for use under the Rogue Valley Stormwater Design Manual,* located in Appendix G, or on the Washington Department of Ecology's Technology Assessment Protocol – Ecology (TAPE) Approved Stormwater Technologies List, https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies. Depending on the device chosen, a treatment train approach may be needed. Devices from the TAPE approve list must meet the following criteria:

- Devices must have a General Use Level Designation (GULD) or a Conditional Use Level Designation (CULD).
- The Design Manual's performance standards for suspended solids will be considered met by devices designated by TAPE for either Pre-Treatment or Basic Treatment.
- The Design Manual's performance standards for oil/grease will be considered met for devices designated by TAPE for Oil Treatment.

4.4.7 Underground Detention

Underground detention consists of underground vaults or oversized pipes used to detain stormwater. Underground detention systems should be designed to meet the peak flow requirements stated in Chapter 2. These systems do not meet the water quality design standards and should be coupled with other BMPs for this purpose.

CHAPTER 5 – ALTERNATIVE TREATMENT SYSTEMS

5.1 INTRODUCTION

The Best Management Practices (BMPs) identified in Chapter 4 represent the pre- approved systems that designers can use without submitting justification and performance calculations. One of the goals of this manual is to foster innovative stormwater design practices. This chapter specifies the additional information that must be provided to gain approval for alternative stormwater quality treatment systems.

5.2 TREATMENT PROCESSES

The designer must identify the type or types of processes that will provide stormwater treatment.

5.2.1 Gravity Separation

In gravity separation, stormwater is allowed to stand for a specified period of time under quiescent conditions while suspended solids settle out. An analysis of gravity separation systems is included in Section 3.2.

A subset of gravity separation is the vortex-type separators. These are typically pre- engineered proprietary systems that are designed to achieve higher solids removal rates in small areas.

5.2.2 Coagulation and Precipitation

Coagulation and precipitation both involve adding chemical additives to stormwater to induce suspended solids and colloids to coagulate into larger particles. The larger particles are then more readily removed through gravity separation or filtration.

Coagulation and precipitation are highly sophisticated processes and are typically only used to remove phosphorous and metals from stormwater. These are not pollutants addressed by this manual at this time. The use of coagulation or precipitation is discouraged due to high maintenance and operation costs and must be justified in every case. Design submittals must include a thorough description of the chemical process along with maintenance schedules and estimates of chemical consumption.

5.2.3 Inert Media Filtration

Inert media filtration involves the removal of suspended solids and attached pollutants by passing the water through a bed of material such as sand or fabric. The removal efficiency of the filter will depend on the loading rate and the porosity of the filter media. This process does not remove dissolved pollutants.

5.2.4 Sorptive Media Filtration

Sorptive media filtration differs from inert media in that dissolved pollutants can be chemically bonded to the media. This is particularly useful for removing heavy metals, nutrients such as phosphorous, or organics such as oil and grease. The type of media will vary depending on the target pollutants. Sorptive media filtration is generally used when there is a known pollutant that must be removed.

5.3 PERFORMANCE CRITERIA

5.3.1 Design Storm

Stormwater treatment systems must be designed to meet water quality standards under the Water Quality Design Storm, as defined in Chapter 2. The systems must also have the ability to by-pass flows from a peak flow storm as defined in Chapter 2.

5.3.2 Performance Criteria

Stormwater treatment systems must meet the pollution removal criteria as defined in Chapter 2.

5.4 TECHNOLOGY ASSESSMENT PROTOCOL

Proprietary Treatment Systems that are not on the Washington Department of Ecology's TAPE approved list may be evaluated by the approving jurisdiction for use. Data must be collected and submitted to the jurisdiction in accordance with the Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies (TAPE).

CHAPTER 6- SUBMITTAL REQUIREMENTS

6.1 INTRODUCTION

This chapter defines requirements for design calculations, construction plans, landscape plans, and operation and maintenance plans that must be submitted to ensure compliance with stormwater treatment and flow control requirements. Stormwater treatment facilities (SWF) designed to treat less than 10,000sf of impervious surface may utilize prescriptive sizing criteria outlined in this manual and do not need to be prepared by a licensed engineer. Stormwater facilities designed to treat 10,000sf or more of impervious surface, provide flow control, or use alternate sizing criteria, cannot use prescriptive sizing criteria and must be prepared by an engineer licensed in the state of Oregon.

6.2 DRAFTING STANDARDS

Stormwater construction plans must be submitted for review in electronic format, except public improvement plans for which three sets of 24 x 36 plans must be submitted. Plans must be drawn to a standard scale of 1 inch = 10, 20, 30, 40, 50, or 60-feet, with English units. Plans must include the following information:

1. North Arrow and Scale
2. Site street address
3. Plan Set: project location map, utility, grading, site plan, erosion prevention and sediment control plans, relevant standard details.
4. Plans should show all ROW, easements, property lines and setbacks
5. Plan view of any SWFs; with all elevations and dimensions necessary to complete calculations in the SWF report and build the SWF.
6. Profile view of SWF(s) with related elevations and dimensions to complete calculations in the SWF report and build the SWF.
7. Detail(s) for the SWF outlet structure with related elevations and dimensions to complete calculations in the SWF report and build the SWF.
8. Proposed stormwater discharge location
9. General Notes and specifications for the SWF

6.3 LANDSCAPE SUBMITTAL REQUIREMENTS

Landscape specifications and plans are required for all vegetated stormwater facilities. At this time, there is no required species list for vegetated stormwater facilities, however species should be carefully selected for the site conditions, see Appendix A, Criteria for Choosing Plants for guidance. In general, shade loving species of the Willamette Valley will not survive in Rogue Valley SWF that do not have deep shade at project completion. Landscape specifications and plans must address all factors needed to ensure plant survival and must include:

1. Delineation of all vegetation to be preserved on-site
2. Statement on whether imported or amended soil will be used and reference to the soil specifications from the required General Notes. The required General Notes must be included in the construction plan set.
3. A planting plan that indicates the size, species and location, by hydrologic zone, of all plants within the facility. See Appendix A, Figure A.1 for guidance on hydrologic zones, as well as the standard drawings for the BMP chosen.
4. Plant table that contains scientific and common names, plant size, number and spacing
5. If applicable, seed mix type and volume
6. Irrigation plans for establishment and long term (if different)
7. Location of any proposed or existing trees to be used for SW credits

6.4 STORMWATER CALCULATION REPORT

Design calculations per Chapters 2 and 3 of this manual must demonstrate that treatment and flow control is provided for all runoff generated from developed or re-developed impervious surfaces on the subject property. A Stormwater Calculation Report must be submitted that includes the following:

1. Cover sheet which includes: project name, property owner's name, site street address, map and tax lot, submission/revision date
2. Page numbers on each page of the document, can be hand numbered.
3. Engineer of record's contact information, Engineer's Stamp (only required for facilities treating 10,000sf or more of impervious surface and/or providing flow control)
4. A short narrative to explain the project and how the SWF design meets the requirements of the Rogue Valley Stormwater Quality Design Manual (RVSQDM).
5. Drainage map showing redevelopment conditions, contours and sources of all on and offsite stormwater flows for each stormwater facility
6. Site conditions including soil types, offsite drainage, existing contours
7. Infiltration testing results as applicable
8. Takeoffs showing impervious area acreage to be developed/redeveloped, and pervious area acreage
9. Takeoffs showing total site disturbance area acreage.
10. Design assumptions used to size SWF including variables and their sources, design storms and software used
11. Design calculations, as required for each facility

12. Pre and post development time of concentration calculations (only required for sizing facilities treating 10,000sf or more of impervious surface and/or provide flow control)
13. For each facility treating 10,000sf or more of impervious surface and/or that provides flow control, hydrographs and peak flow calculations for the following storm events:
    a. 1 inch, 24hr treatment storm (post-developed)
    b. 10yr, 24hr (pre & post developed)
    c. 25yr, 24hr (post-developed, for facility bypass/overflow calculations)
14. Design layout and specifications from the manufacturer for any proprietary SWF
15. Bypass calculations (only for facilities treating 10,000sf or more of impervious surface and/or provide flow control)

6.5 PROPRIETARY SYSTEMS

Proprietary systems used for stormwater treatment must be on Washington Department of Ecology's Technology Assessment Protocol – Ecology (TAPE) list of approved Stormwater Technologies List. Devices must have a General Use Level Designation (GULD) or a Conditional Use Level Designation (CULD). The Design Manual's performance standards for total suspended solids will be considered met by devices designated by TAPE for either Pre-Treatment or Basic Treatment. The Design Manual's performance standards for oil/grease will be considered met for devices designated by TAPE for Oil Treatment. Depending on the device chosen, a treatment train approach may be needed.

The Stormwater Advisory Team (SWAT) consisting of Rogue Valley stormwater permit holders has approved some proprietary devices not approved by TAPE. A list of these devices is located in Appendix G. Designers wishing to use proprietary stormwater systems that have not been approved by TAPE or the SWAT, refer to section 5.4.

6.6 OPERATIONS AND MAINTENANCE PLAN

Stormwater facilities for private developments that do not serve the public will be required to have a Stormwater Facilities Operation and Maintenance Plan that requires the owner of the property to maintain the facility to ensure peak performance. The Operation and Maintenance Plan must include the following sections:

1. Contact Information
2. Declaration of Covenants, signed and recorded on the deed of the property
3. Subdivision Operations and Maintenance Agreement (If Required)
4. Stormwater Facility Access Diagram/Route
5. Civil Plans for Stormwater Facility Construction
6. Inspection and Maintenance Action Checklists
7. Proprietary Stormwater Components Operation and Maintenance Information (If Used)

8. DEQ Hazardous Spill Response Fact Sheet

6.7 STORMWATER FACILITY EASEMENT

Stormwater facilities that serve the public will require the owner to provide a Stormwater Facility Easement, Appendix I. The easement will allow the jurisdiction access to the property for the purpose of constructing, installing, maintaining, and/or inspecting the SWF.

DEFINITIONS

Applicant: Any person, company, or agency required by Rogue Valley Sewer Services (RVS) or any of the jurisdictions adopting this manual required to comply with the standards set forth in this Stormwater Manual (see applicability above).

Average Daily Traffic (ADT): The total traffic volume during a given time period, ranging from 2 to 364 consecutive days, divided by the number of days in that time period, and expressed in vpd (vehicles per day).

Best Management Practices (BMPs): Methods of managing stormwater that meet or attempt to meet water quality standards as determined by the DEQ and local governing agencies.

Structural BMPs: The design and construction of physical structures that provide stormwater management. Structural BMPs are included in the technical aspects of this Manual, i.e. Detention Ponds, Catch Basins, Porous Pavement, etc.

Non-Structural BMPs: Intangible methods of stormwater management including pollution removal standards, ordinances governing stormwater management, public education of stormwater quality, etc.

Capacity: The capacity of a stormwater drainage system is the flow volume or rate that a facility (e.g., pipe, pond, vault, swale, ditch, drywell, etc.) is designed to safely contain, receive, convey, reduce pollutants from or infiltrate stormwater that meets a specific performance standard. There are different performance standards for pollution reduction, detention, conveyance, and disposal, depending on location.

Catch Basin: A structural facility located just below the ground surface, used to collect stormwater runoff for conveyance purposes. Generally located in streets and parking lots, catch basins have grated lids, allowing stormwater from the surface to pass through for collection.

Combination Facilities: Systems that are designed to meet two or more of the multiple objectives of stormwater management.

Common plan of development: The overall plan for development of land, including any pre-existing development, and approved plans for future development.

Constructed Treatment Wetlands: Wetlands (see definition) designed and constructed for the specific purpose of providing stormwater management. (See attached brochure from the Oregon Department of State Lands.)

Contained Planter Box: A structural facility filled with topsoil and planted with vegetation. When placed over impervious surfaces such as sidewalks or rooftops, contained planter boxes intercept rainfall that would otherwise contribute to stormwater runoff.

Control Structure: A device used to hold back or direct a calculated amount of stormwater to or from a stormwater management facility. Typical control structures include vaults or manholes fitted with baffles, weirs, or orifices.

Conveyance: The transport of stormwater from one point to another.

Detention Facility: A facility designed to receive and hold stormwater and release it at a slower rate, usually over a number of hours. The full volume of stormwater that enters the facility is eventually released.

Detention Tank, Vault, or Oversized Pipe: A structural subsurface facility used to provide flow control for a particular drainage basin.

Development: Any human-induced conversion of previously undeveloped or pervious land to impervious surfaces whether public or private, including but not limited to construction, installation, or expansion of a building or other structure, land division, street construction, drilling, and site alteration such as dredging, grading, paving, parking or storage facilities, excavation, filling, or clearing.

Development Footprint: The new or redeveloped area covered by buildings or other roof structures and other impervious surface areas, such as roads, parking lots, and sidewalks.

Destination: The ultimate discharge point for the stormwater from a particular site. Destination points can include drywells and sumps, soakage trenches, ditches, drainageways, rivers and streams, off-site storm pipes, and beneficial uses or re-uses (see the definition for Stormwater Re-use).

Drainage Basin: A specific area that contributes stormwater runoff to a particular point of interest, such as a stormwater management facility, stream, wetland, or pipe.

Dry Detention Pond: A surface vegetated basin used to provide flow control for a particular drainage basin. Stormwater temporarily fills the dry detention pond during large storm events and is slowly released over a number of hours, reducing peak flow rates.

Drywell: A structural subsurface facility with perforated sides or bottom, used to infiltrate stormwater into the ground.

Eco-Roof: A lightweight low-maintenance vegetated roof system used in place of a conventional roof. Eco-roofs provide stormwater management by capturing, filtering, and evaporating rainfall.

Erosion: A mechanical process soil movement by water or wind.

Erosion Control Matting: A product made of various materials including straw, coconut fiber, and jute that is attached to the soil purpose to reduce exposure of the soil to wind and precipitation, which cause erosion.

Extended Wet Detention Pond: A surface vegetated basin with a permanent pool of water and additional storage volume, used to provide pollution reduction and flow control for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out. During large storm events, stormwater temporarily fills the additional storage volume and is slowly released over a number of hours, reducing peak flow rates.

Flow Control: The practice of limiting the peak flow rates and volumes. Flow control is intended to protect downstream properties, infrastructure, and resources from the increased stormwater runoff peak flow rates and volumes resulting from development.

Flow-Through Planter Box: A structural facility filled with topsoil and gravel and planted with vegetation. The planter is completely sealed, and a perforated collection drain is placed in its bottom and directed to an acceptable disposal point. The stormwater planter receives runoff from impervious surfaces, where it is filtered and retained for a period of time.

Green Infrastructure: Green infrastructure (GI) is a term that has evolved, originally referring to a strategic landscape approach to using open space for environmental, social, and economic benefits. GI now more often refers specifically to an approach for managing stormwater runoff that relies on using natural processes in the soil and vegetation to infiltrate, evapotranspirate and/or harvest stormwater runoff. Rain gardens, bioswales, and pervious paving are all examples of green infrastructure.

Impervious surface/ area: Types of impervious surface include rooftops, traditional asphalt and concrete parking lots, driveways, roads, sidewalks, and pedestrian plazas. Note: Slatted decks are considered pervious. Gravel surfaces used for vehicular traffic are considered impervious.

Infiltration: The percolation of water into the ground.

Infiltration Planter Box: A structural facility filled with topsoil and gravel and planted with vegetation. The planter has an open bottom, allowing water to infiltrate into the ground. Stormwater runoff from impervious surfaces is directed into the planter box, where it is filtered and infiltrated into the surrounding soil.

Infiltration Rate, Design: The infiltration rate measured on site and divided by three.

Infiltration Rate, Measured: The infiltration rate that is measured on site using one of the methods described in Appendix B.

Inlet: The point at which stormwater from impervious surfaces or conveyance piping enters a stormwater management facility. The term "inlet" can also be used in reference to a catch basin (see definition).

Low Impact Development (LID): LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and retain runoff close to its source. Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing / treating stormwater in large end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small landscape features located at the lot level.

Low Impact Development Guidance Manual: As of September 2018, this manual was still in development. Once complete, this manual will provide additional guidance on how to create project teams, lay out sites and design stormwater management for effective low impact development. In addition, this guidance manual will include references to research on which low impact development principles are based.

Manufactured Stormwater Treatment Technology: A proprietary structural facility used to remove pollutants from stormwater.

Maximum Extent Practicable (MEP): See definition of Practicable.

Mycorrhizal fungi: A beneficial fungi that grows in association with plant roots. The mychorhizae helps the plant absorb water and minerals from the soil.

Off-site stormwater facility: Any stormwater management facility located outside the property boundaries of a specific development, but designed to reduce pollutants from and/or control stormwater flows from that development.

Oil-Water Separator: A facility designed to remove oil and grease from stormwater.

On-site stormwater facility: Any stormwater management facility necessary to control stormwater within an individual development project and located within the project property boundaries.

Operations and Maintenance (O&M): The continuing activities required to keep stormwater management facilities and their components functioning in accordance with design objectives.

Outfall: The point at which stormwater is discharged from a contained conveyance system, such as a pipe, to a surface drainage system.

Pollutant: An elemental or physical product that can be mobilized by water or air and creates a negative impact on the environment. Pollutants include suspended solids (sediment), heavy metals (such as lead, copper, zinc, and cadmium), nutrients (such as nitrogen and phosphorus), bacteria and viruses, organics (such as oil, grease, hydrocarbons, pesticides, and fertilizers), floatable debris, and increased temperature.

Pollutants of concern: Watershed-specific parameters identified by the Oregon Department of Environmental Quality (DEQ) as having a negative impact on the receiving water body. Pollutants of concern can include suspended solids, heavy metals, nutrients, bacteria and viruses, organics, floatable debris, and increased temperature.

Porous Pavement: The numerous types of pavement systems that are designed to allow stormwater to percolate through them and into subsurface drainage systems or the ground.

Post-Developed Condition: As related to new or redevelopment: A site's ground cover after development.

Practicable: Available and capable of being done as determined by the agency with stormwater quality jurisdiction, after taking into consideration cost, existing technology, and logistics in light of overall project purpose.

Pre-Developed Condition: As related to new development: A site's ground cover prior to development. Pre-developed condition, as related to redevelopment, is a site's natural ground cover prior to any development taking place.

Public facility: A street, right-of-way, sewer, drainage, or other stormwater management facility that is either currently owned by a public agency or RVS or will be conveyed to a public agency or RVS for maintenance responsibility after construction. A stormwater management facility that receives direct stormwater runoff from a public right-of-way shall become a public facility provided that adequate maintenance easements are in place.

Public works project: Any development or utility improvement conducted or financed by a local, state, or federal governmental body.

Redevelopment: Any development that requires demolition or complete removal of existing structures or impervious surfaces at a site and replacement with new impervious surfaces. Maintenance activities such as top-layer grinding and re-paving are not considered to be redevelopment. Interior remodeling projects and tenant improvements are also not considered to be redevelopment. Utility trenches in streets are not considered redevelopment unless more than 50% of the street width is removed and re-paved.

Retention Facility: A facility designed to receive and hold stormwater runoff. Rather than storing and releasing the entire runoff volume, retention facilities permanently retain water on-site, where it infiltrates, evaporates, or is absorbed by surrounding vegetation. In this way, retention facilities reduce the total volume of excess water released to downstream conveyance facilities.

Roof Garden: A heavyweight roof system of waterproofing material with a thick soil and vegetation cover. Roof gardens provide stormwater management by capturing, filtering, and evaporating rainfall.

Runoff: Stormwater flows across the ground surface during and after a rainfall event.

Runoff Curve Number: Defined in Section 3.2.4 (see Appendix D for list).

Sand Filter: A structural facility with a layer of sand, used to filter pollutants from stormwater.

Santa Barbara Urban Hydrograph (SBUH): A hydrologic method used to calculate runoff hydrographs.

Seal of Testing Assurance (STA): The US Composting Council's Seal of Testing Assurance Program ('STA') is a compost testing, labeling and information disclosure program designed to give you the information you need to get the maximum benefit from the use of compost.

Sedimentation: The process of depositing soil particles that were suspended in water or air.

Soakage Trench: A long linear excavation backfilled with sand and gravel, used to filter pollutants from and infiltrate stormwater into the ground.

Storm Event: As used in this manual: Any precipitation that falls within a defined time period and geographic area.

Stormwater: As used in this manual: Water runoff that originates as precipitation on a particular site, basin, or watershed.

Stormwater Management: As used in this manual: The overall culmination of techniques used to reduce pollutants from, detain and/or retain, and dispose of stormwater to best preserve or mimic the natural hydrologic cycle, or to incorporate sustainable building practices by reusing stormwater, on a development site. Public health and safety, aesthetics, maintainability, capacity of existing infrastructure and sustainability are important characteristics of a site's stormwater management plan.

Stormwater Management Facility: A single technique used to treat, detain, and/or retain stormwater to best preserve or mimic the natural hydrologic cycle, or to fit within the capacity of existing infrastructure, on a development site.

Stormwater Re-use: The practice of collecting and using stormwater for purposes such as irrigation and toilet flushing.

Sump: As used in this manual: A large public drywell (see definition) used to infiltrate stormwater from public streets. The term "sump" can also be used to reference to any volume of a facility below the point of outlet, in which water can accumulate.

Surface Waters: See Water Body.

Tenant Improvements: Upgrades made to the interior or exterior of buildings.

Time of Concentration (T of C): The time it takes stormwater runoff to travel from the most distant point on a particular site or drainage basin to a particular point of interest.

Total Suspended Solids (TSS): All matter organic and inorganic material suspended in water.

Underground Injection Control (UIC): A federal program under the Safe Drinking Water Act, delegated to the Oregon Department of Environmental Quality (DEQ), which regulates the injection of water below ground. The intent of the program is to protect groundwater aquifers, primarily those used as a source of drinking water, from contamination. For information on UICs see Oregon Department of Environmental Quality's UIC page.

US Composting Council: A non-profit trade and professional organization promoting the recycling of organic materials through composting.

Vegetated Filter Strip: A gently sloping, densely vegetated area used to filter, slow, and infiltrate stormwater.

Vegetated Infiltration Basin: A vegetated surface facility that temporarily holds and infiltrates stormwater into the ground.

Water Body: Water bodies include rivers, streams, sloughs, drainages including intermittent streams and springs, ponds, lakes, aquifers, wetlands, and coastal waters.

Water Quality Conveyance Swale: A long, narrow, trapezoidal or circular channel, densely planted with a variety of trees, shrubs, and grasses, or seeded with a native mix. Stormwater runoff from impervious surfaces is directed through the swale, where it filters through the vegetation and soil, allowing pollutants to settle out.

Water Quality/ Pollution Reduction Facility: Any structure or drainage device that is designed, constructed, and maintained to collect and filter, retain, or detain surface water runoff during and after a storm event for the purpose of maintaining or improving surface and/or groundwater quality.

Water Quantity/ Flow Control Facility: Any structure or drainage device that is designed, constructed, and maintained to collect, retain, infiltrate, or detain surface water runoff during and after a storm event for the purpose of controlling post- development quantity leaving the development site.

Watercourse: A channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity. Watercourses may be either natural or artificial.

Wet Pond: A surface vegetated basin with a permanent pool of water, used to provide pollution reduction for a particular drainage basin. The permanent pool of water provides a storage volume for pollutants to settle out.

Wetland: An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas except those constructed as water quality or quantity control facilities. Specific wetland designations shall be made by the Corps of Engineers and the Division of State Lands.