Stormwater Credit Manual

Stormwater Service Charge

City of Portland, Maine

CLEAN WATER equals CLEAN GROWTH

Version 1.1
Last Updated: August 2015

Table of Contents

1. Introduction

1.1 Stormwater Mandate

The City of Portland's Department of Public Services (DPS) is responsible for the operation and management of the publicly owned stormwater drainage system and the regulation of stormwater runoff from all developed properties in Portland. Its goals include both the protection of the quality of the surface and tidal waters in the Portland area and reduction of the risk of flood damage to citizens or property.

As such, it has construction and maintenance oversight of miles of storm drain pipes, drainage ditches, the combined sewer system (pipes that carry both sanitary sewage and stormwater runoff) and thousands of structures such as culverts, catch basins, stormwater management controls and water quality treatment facilities. The City is also responsible for the regulation of new development and redevelopment of properties within the City and for meeting State and Federal requirements regarding the quality of its streams and tidal waters within the City's jurisdiction.

Rain Gardens - Bayside Trail

1.2 Stormwater Service Charge

In 2009, the City began reviewing the requirements and costs of its stormwater program, based on the condition of its stormwater system, combined sewer system, and the quality of its streams and tidal waters. A group of citizen stakeholders provided insight and guidance throughout the process. It was determined that the City is facing stormwater management issues and costs that are significant, growing, and are currently not fully addressed, largely due to the lack of a dedicated funding source. This process identified the need for an enhanced stormwater management program and a stormwater service charge as the most appropriate funding method. These efforts provided the basis for the City to modify Chapter 24 of its local Code of Ordinances to establish a stormwater service charge:

> *The City Council is responsible for the protection and preservation of the public health, safety, and welfare of the community, and the environment and finds that it is in the best interest of the health, safety, and welfare of the citizens of the City and the community at large and the environment to provide stormwater services accounted for in the City budget as a separate enterprise fund dedicated solely to the provision of stormwater services and to institute funding methods associated therewith.*

Chapter 24, Article V of the Code of Ordinances, revised and approved by the City Council on January 21, 2015, provides for a stormwater service charge to be levied upon all developed land for the cost of providing stormwater services. As of January 1, 2016, property owners will be charged a monthly rate per one thousand two hundred (1,200) square feet of impervious area, rounded to the nearest increment of 1,200 square feet. The basis for the charge is the amount of impervious area as measured by the City. This measured area may be updated at the discretion of the Department of Public Services upon evidence of changes to the amount of impervious area or the availability of updated or more accurate information.

1.3 What is a stormwater credit?

A stormwater credit is a conditional reduction in the amount of a stormwater service charge to developed land based on the provision and continuing presence of an approved and effectively maintained on-site stormwater facility (structural control) that reduces the impact of the parcel's impervious area and thus the cost of providing service. The credit is applied only to the portion of a site's treated impervious area.

The structural control limits the impacts to the stormwater drainage system by reducing peak rates of runoff, total runoff volume, temperature, and/or removing pollutants. These measures can include on-site practices such as detention areas for flood control and other structural controls such as wet ponds, rain gardens, and other approved designs that manage stormwater quality.

1.4 How can I earn a credit?

The credit structure is focused on structural controls that reduce the impact of the development on the stormwater drainage system. Two broad categories of controls are recognized: water quality controls and water quantity (flooding) controls. Credits are available for residential properties and non-residential properties, as discussed in the following sections.

1.5 Definitions

Best Management Practice (BMP): a means to mitigate the effect of urban development on the quantity and quality of stormwater runoff. BMPs can be structural, such as detention ponds and soil filters, or non-structural, such as practices that reduce pollution, like parking lot sweeping and spill prevention planning.

Chapter 500: the chapter of the Maine Department of Environmental Protection's (DEP) Stormwater Management Law that defines the stormwater management standards and regulations that pertain to activities licensed under the Stormwater Management Law.

Design Storm: a theoretical precipitation event used to design a hydrologic system. Design storms are typically referred to by their return period (2-year, 24-hour storm; 10-year, 24-hour storm; 25-year, 24-hour storm; and so on). The return period reflect the frequency with which the design storm is expected to occur. For example, a 2-year, 24-hour storm is a precipitation event with a 50% probability of being equaled or exceeded in any 24-hour period during a given year.

Developed Land: "disturbed area" excluding area that within one calendar year of being disturbed is re-vegetated and returned to a condition with the same drainage pattern that existed prior to the disturbance, provided the area is not mowed more than once per year.

Disturbed Area: all land areas that are stripped, graded, grubbed, filled or excavated at any time during the site preparation or vegetation removal for construction of a project. Disturbed area does not include routine maintenance, but does include re-development and new impervious areas. In this case, "routine maintenance" is maintenance performed to maintain the original line and grade, hydraulic capacity and original purpose of the facility.

Impervious Area: as defined in Chapter 24 of the Code of Ordinances, impervious surfaces are areas that prevent or impede the infiltration of stormwater into the soil as it had entered in natural conditions prior to the development. Impervious surfaces include, but are not limited to, rooftops, sidewalks, walkways, patio areas, driveways, parking lots, storage areas, compacted gravel surfaces, awnings and other fabric or plastic coverings, and other surfaces that prevent or impede the natural infiltration of stomwater runoff which existed prior to development.

Undeveloped Land: land in its unaltered natural state or which has been modified to such a minimal degree as to have a hydrologic response comparable to land in an unaltered natural state. Undeveloped land shall have less than or equal to 400 square feet of impervious surfaces as defined in this chapter consisting of limited pavement, asphalt or compacted dirt or gravel surfaces or structures which create an impervious surface that would prevent infiltration of stormwater or cause stormwater to collect, concentrate or flow in a manner materially different than that which would occur naturally.

Landscaped Area: land that has been disturbed and re-planted or covered with one or more of the following: lawn or other herbaceous plants, shrubs, trees or mulch. Landscaped area does not include area that has reverted to a natural, vegetated condition. A field or meadow is considered landscaped if it is mowed more than twice per twelve month period.

Section 5: the fifth section of the City of Portland's Technical Manual, entitled *Portland Stormwater Management Standards and Maine DEP Chapter 500 Stormwater Management.* Section 5 describes the stormwater management standards with which development projects in the City of Portland must comply. These standards are based on the Maine DEP's Chapter 500 stormwater management standards and are designed to protect and improve water quality in Portland's inland and coastal waters as required by the Clean Water Act as set forth in state and federal regulations. The City of Portland has modified the Applicability of these standards to apply to a broader range of development projects in the City; refer to the Technical Manual, Section 5. II. Applicability in Portland[1], and City of Portland Code of Ordinances Sec. 14-526. Site plan standards. (b).3.b[2].

Stormwater: the part of precipitation, including runoff from rain or melting ice and snow that flows across the surface as sheet flow, shallow concentrated flow or in drainage ways.

Stormwater Billing Unit (SBU): 1,200 (one thousand two hundred) square feet of impervious area.

[1] http://www.portlandmaine.gov/DocumentCenter/Home/View/2345
[2] http://www.portlandmaine.gov/DocumentCenter/Home/View/1080

2. Residential Stormwater Credits

Properties with a total of four or fewer dwelling units – including detached dwelling units, duplexes, triplexes, and quadraplexes, or combinations thereof – are eligible for residential stormwater credits. All other properties are considered non-residential for the purposes of administering stormwater credits.

Residential properties can earn a credit of 0.5 SBU for every whole increment of 600 square feet of impervious area treated, up to a maximum of 0.5 SBU for properties with less than 1800 square feet of impervious area, and 1.0 SBU for properties with 1800 or more square feet of impervious area. The credits available for given amounts of impervious surface area are outlined in **Table 1.**

Credits are available to residential properties that treat impervious area with the following structural controls:

- ***Cisterns***;
- ***Dry Wells***;
- ***Modified French Drains***;
- ***Permeable Pavers***; and
- ***Rain Gardens***.

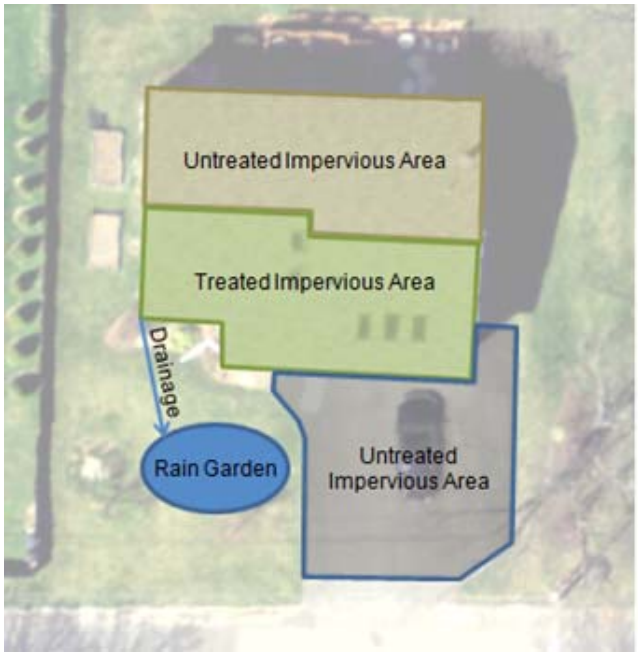
These structural controls can be combined or used alone to earn up to the maximum obtainable credit. See the **Section 6** for more information.

An application must be filed with the City to receive credit (refer to **Section 4** for more information on how to apply); even if a property is eligible to receive a credit, it will not be awarded automatically. Residential properties have the option of applying for the non-residential stormwater credit program to obtain a larger credit, but must meet all associated requirements.

Table 1. Summary of Residential Credits

Monthly Billed IA (SBU)	Maximum Available Credit	Minimum IA Treated
1 SBU (400 - 1,799 ft^2)*	0.5 SBU	600 ft^2
2 SBU (1,800 - 2,999 ft^2)*	1.0 SBU	1,200 ft^2
≥3 SBU (greater than 2,999 ft^2)*	1.0 SBU	1,200 ft^2

***Assessed amount of impervious area on property in question.**



Total Impervious Area = 2,600 ft^2

2,600 ft^2 / 1,200 ft^2 = 2.17

2.17 rounds to **2 Stormwater Billing Units**

Treated Impervious Area = 900 ft^2

Credit = 0.5 SBU

Residential Credit Example

3. Non-Residential Stormwater Credits

Several credit options are available to non-residential properties: Basic Credits, Extra Credits, Minimum Standard Credits, and Independent Stormwater Fee Credits. The maximum credit that a property may receive is 100% of the stormwater service charge. An application must be filed with the City to receive credit (refer to the next section for more information on how to apply); even if a property is eligible to receive a credit, it will not be awarded automatically.

Tree Well Filter – University of Southern Maine

3.1 Basic Credits

A total Basic Credit of up to 60% of the stormwater service charge is available to non-residential properties that implement measures that meet the applicable sections of the Maine Department of Environmental Protection's (DEP) Chapter 500 stormwater management regulations and whose designs comply with the current technical standards of Section 5 of the City of Portland's Technical Manual or equivalent. The Basic Credit is broken into a water quality component and a water quantity component, as described below.

Basic Water Quality Management Credit: A Basic Credit of 50% is available for impervious area treated with water quality controls that meet the **General Standard** of Chapter 500.

- Wet ponds, filters, infiltration, and/or vegetated buffers must be used in accordance with Chapter 500 to control a runoff volume equal to 1.0 inch of rainfall on all impervious area that is to be considered treated. Alternate treatment measures may be considered on a case-by-case basis.
- The portion of the 50% credit granted to a given property will be equal to the proportion of the property's impervious area that is treated to the standards of this credit. For example, if only 50% of the property's impervious area is treated, only a 25% credit will be granted.
- Although credit is granted only for treated impervious area, the structural controls must be designed such that they are capable of treating stormwater runoff from their entire catchment area in order to meet design standards within Volume III of the DEP Stormwater BMP Manual. In addition to a runoff volume equal to 1.0 inch of rainfall on all impervious area, they must treat 0.4 inches of rainfall on the drainage area that is landscaped.

Basic Water Quantity Management Credit: A Basic Credit of 10% is available for impervious area treated with flood reduction controls that meet the **Flooding Standard** of Chapter 500.

- The site's stormwater management systems must detain, retain, or infiltrate stormwater from the 2-year, 10-year and 25-year, 24-hour storm event such that peak flows of stormwater from the project site in its post-development condition do not exceed the peak flows from the site in its pre-development condition.
- For the purpose of administering stormwater credits on a site where a stormwater retrofit will manage runoff from an existing, developed condition, the standard pre-development condition shall be evaluated as turf grass over the underlying Hydrologic Soil Group (HSG) for the site.
- For the purpose of determining pre and post-development flows, the project site is defined to be the drainage area of the structural controls.
- Credit is granted in proportion to the amount of the property's impervious area that is treated to the standards of this credit.

Basic Water Quantity Waiver Credit: If a property meets the General Standard, receives or obtains a waiver of the Flooding Standard, as defined in the Department of Environmental Protection Chapter 500 – Stormwater Management Law, and discharges directly into a tidal water without flowing through an off-site, publicly-owned man-made conveyance or natural stream system, it will qualify for the Basic Water Quantity Management Credit of 10% of the stormwater service charge without the need to construct a flood control structure.

3.2 Extra Credits

An additional credit of up to 40% of the stormwater service charge is available for impervious area treated with controls that *exceed* the standards of Chapter 500 and Section 5 of the current Technical Manual, making it possible to obtain a full credit of 100%. Extra credit is again broken into a water quality component and a water quantity component, as described below.

Extra Water Quality Management Credit: An additional 25% credit of the stormwater service charge is available for impervious area that is treated by structural controls that are sized for 1.6 inches of rainfall instead of 1 inch; all other conditions of the Basic Water Quality Management Credit described above apply.

Extra Water Quantity Management Credit: An additional 15% credit of the stormwater service charge is available for impervious area treated with flood reduction controls that detain, retain, or infiltrate stormwater through the 100-year, 24-hour storm; all other conditions of the Basic Water Quantity Management Credit described above apply.

3.3 Minimum Standard Credits

Credits are available for developments that have existing structural controls that met applicable standards when constructed, but do not meet the standards in Section 5 of the *current* Technical Manual. These credits will be evaluated on a case by case basis. Minimum Standard credits are broken into a water quality component and a water quantity component, as described below.

Minimum Water Quality Management Credit: A 25% credit of the stormwater service charge is available for impervious area that is treated with structural controls that achieve 50% removal of total suspended solids (TSS)

- Credit is granted for impervious area within the drainage area of a structural control that achieves an area-weighted average TSS removal of at least 50%.
- The portion of the 25% credit granted will be equal to the proportion of the property's total impervious area that is included in the area-weighted average calculation.

Minimum Water Quantity Management Credit: A 5% credit of the stormwater service charge is available for impervious area treated with flood reduction controls that detain, retain, or infiltrate stormwater for the 2-year and 10-year, 24-hour storm events; all other conditions of the Basic Water Quantity Management Credit described above apply.

3.4 Independent Stormwater Fee Credit

Property owners that pay a stormwater fee to a qualifying entity will be credited on a dollar-for-dollar basis the sum of that fee, up to 100% of the City of Portland's stormwater service charge. Currently, the only property owners eligible to receive this credit are those who pay a fee to the Long Creek Watershed Management District (LCWMD), known as Participating Landowners[3].

[3] Participating Landowners have a Participating Landowner Agreement (PLA) and Memorandum of Agreement (MOA) with the Long Creek Watershed Management District to comply with the "General Permit – Post Construction Discharge of Stormwater in the Long Creek Watershed", issued by the Maine Department of Environmental Protection on November 6, 2009. See http://www.restorelongcreek.org/index.htm for more information.

4. Application Processes

Applicants who are proposing to construct new systems to receive a credit for the stormwater service charge must follow all current local, state and federal design standards, regulatory review and permitting requirements.

Upon initial receipt of an application, DPS will conduct an administrative review for completeness and will notify the applicant within 30 days if additional information is required. Upon receipt of a complete application, DPS will notify the applicant within 60 days whether their application for credit has been approved or denied. Denied requests may be appealed. The forms required for submission and processes for specific types of credit are described in the following subsections.

4.1 Residential Stormwater Credit Applications

Existing Structural Controls

Applicants who have existing structural stormwater controls on their property for which they wish to obtain credit must submit to DPS **Form 1A** (**Appendix**). The submitted information must reflect existing conditions on the applicant's property.

Proposed Structural Controls

Applicants who have not yet installed structural controls on their property must submit to DPS **Form 1A** (**Appendix A**). The submitted information must reflect what the applicant intends to install on his or her property. DPS will review the application and will either request additional information, request changes to the proposed plan, or will issue a *conditional approval*. Conditional approval indicates that the plan, as proposed, is worthy of credit; if the applicant installs a structural control as conditionally approved, he or she will receive the corresponding credit. After receiving conditional approval and installing the associated structural control(s), the applicant must submit **Form 1B** (**Appendix**). The applicant must include photos demonstrating that the structural controls are installed and operational.

4.2 Non-Residential Stormwater Credit Applications

New Development and Re-Development (Site Plan Review Required)

Applicants who are developing or re-developing a site and are undergoing a site plan review with the Department of Planning and Urban Development may simultaneously apply for credits by submitting to DPS **Form 2** (**Appendix**). DPS will review the stormwater management plan submitted with the site plan application to determine the applicant's eligibility for credits. Note that properties that attain site plan approval with exemptions or waivers from Chapter 500 regulations may not necessarily be eligible for credits.

Existing Structural Controls

Applicants whose property has existing structural controls for which they wish to obtain credit must submit to DPS **Form 3** (**Appendix**). This applies to both property owners who have previously developed their site in compliance with Chapter 500 and are eligible for Basic or Extra credits, and to property owners with older controls that are eligible for Minimum credits.

Applicants must demonstrate the efficacy of their stormwater management system with the appropriate computations, prepared by a professional engineer. The applicant may use the documentation that was submitted to attain site plan approval when the site was developed, as long as the documentation reflects current conditions. Furthermore, the applicant must demonstrate that the stormwater structural controls and associated features have been maintained and are in full operating condition. This requirement is satisfied if the applicant has complied with annual inspection requirements pertaining to Chapter 500; if not, the applicant must have the structural controls inspected, returned to operating condition if necessary, and submit **Form 4** (**Appendix**), prepared by a qualified third party post-construction stormwater inspector.

Retrofits of Existing Development or Stormwater System Upgrades

Applicants who wish to obtain credits by retrofitting an existing development or by upgrading and existing stormwater system must submit to DPS **Form 3** (**Appendix**). DPS will review the application, in conjunction with the Department of Planning and Urban Development, as necessary, to determine the credit-worthiness of the proposed retrofit and whether it complies with Portland's Code of Ordinances and Design and Technical Manuals. Note that some stormwater retrofit projects, depending on the scope of work, might necessitate a site plan review. Applicants are encouraged to participate in a pre-application with DPS to help determine what requirements will pertain to their project. Once the plan for the proposed retrofit has been approved, the applicant may proceed with construction. The applicant will have to demonstrate that the retrofit was constructed as designed and approved before credit is granted. This will require certification from the design engineer, or by a qualified 3rd party post construction stormwater inspector.

Treatmemt of Off-Site City Owned Area

Properties that have attained City of Portland site plan approval which allows for the water quality treatment of City-owned off-site-impervious area (including City right-of way) in lieu of treatment of on-site impervious area ***may*** be eligible to receive stormwater credits for the treated off-site impervious area. Applicants must have an agreement in place with the City to provide all inspection, operations, maintenance, and reporting associated with the continuous functionality of the stormwater BMP's installed on City of Portland-property. Strictly meeting this criteria does not guarantee that DPS will grant stormwater credits to the Applicant. DPS reserves the right to make decisions on a case by case basis.

5. Maintenance and Inspection

5.1 Required Maintenance and Reporting

Structural controls are only effective if they are maintained. A property owner will receive credit for a given structural control as long as it is maintained and functioning as intended and approved. The following stipulations apply to residential and non-residential stormwater credits.

Residential Stormwater Credits: Structural controls installed for Residential Stormwater Credits are assumed to be maintained and functioning until deemed otherwise. No annual reporting is required, but the City reserves the right to perform inspections, as noted below. See **Section 6** for recommended maintenance activities that will ensure your structural control is functional for years to come.

Although the residential credit is specific to a property, the residential credit is also specific to an owner. In the event that a property is transferred to another owner, the new owner will need to reapply of the residential credit to receive credit.

Stormwater Non-Residential Stormwater Credits: In order to continue receiving these credits, a property owner must submit an annual inspection report by June 30 of each year, in accordance with Chapter 32, Article III and Chapter 24, Article V of the City of Portland's Code of Ordinances. A qualified 3rd party post-construction stormwater inspector must conduct an inspection of the stormwater control system, including all BMPs and associated features, and complete **Form 4 (Appendix)**. If the credit holder does not submit a completed annual inspection report by June 30, or submits a failing inspection report, credits will be suspended. Credits will be reinstated on the first bill issued 30 days after submission of a passing inspection report. If the credit holder submitted a failing inspection report by June 30 and submits a passing inspection report before August 31, credits will be applied retro-actively for the months of July and August.

5.2 Right to Inspect

The City may request an inspection of the structural control on a property at any time, as granted by the applicant at the time of application for credit. The City reserves the right to suspend an existing credit upon inspection of a structural control that is found to be non-functioning, until such time that the property owner performs remedial actions and submits a renewal application for credit.

6. Design Guidance for Residential Credits

Design guidance is provided for the following structural controls that may be used to meet the criteria of the residential stormwater credit: cisterns, dry wells, rain gardens, modified French drains, and permeable pavers.

Consult a professional for the installation of any stormwater control structure. Be sure to follow local, state, and federal design standards, and adhere to any regulatory review and permitting requirements.

6.1 Sizing of Structural Controls

To qualify for the Residential Stormwater Credit, the combination of residential structural controls used must be designed to hold or treat 1 inch of runoff from either 600 or 1,200 square feet of impervious area (rooftop, driveway, etc.). The areas and volumes of runoff to be treated for different amounts of impervious area and credits are summarized in Table 2.

Table 2. Capacity Requirements for Residential Structural Controls

Stormwater Billing Units (SBU)	IA Treated	Volume of Runoff to Treat	Maximum Available Credit
1 SBU = 400 - 1,799 sf	600 sf	50 cubic feet	0.5 SBU
2 SBU = 1,800 - 2,999 sf	1,200 sf	100 cubic feet	1.0 SBU
≥3 SBU = greater than 2,999 sf	1,200 sf	100 cubic feet	1.0 SBU

It should be noted that the actual sizing of structural controls may need to be modified from the designs provided in this guide if they are intended to capture more than the first inch of runoff, and if the IA treated varies from the values listed in the table.

6.2 Cisterns

Cisterns are low impact development practices that store rainwater for later use. Rain is collected from a downspout system, screened to remove trash and leaves and conveyed to a storage container for subsequent use. Unless an advanced filtration system is used, water stored in the cistern is for non-potable water use only. If properly sized, they can provide significant reductions in the volume and pollutant loads of stormwater runoff from residential sites.

1,500 Gallon Cistern
Source: LID Urban Design Tools

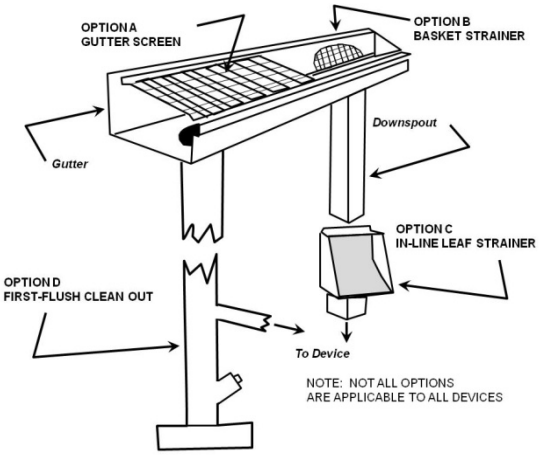
Location

- To determine the size of the storage tank that is necessary, consider the size of the contributing drainage areas and projected water needs. Cisterns should drain only impervious areas – preferably rooftops.
- When picking a location keeping in mind: (1) ease in connecting roof drains, (2) overflow to downslope areas, (3) grade (level areas are preferred), (4) location relative to intended water uses, (5) utility conflicts, (6) electrical connections if applicable, (7) residential emergency ingress/egress, (8) leaf screen option, (9) location of hoses or other water distribution components, and (10) aesthetic considerations.

Design

- Cistern capacity must be designed for a 1 inch storm. A good rule of thumb is that when sizing a cistern for the one inch rain standard, each square foot of rooftop will contribute 0.6 gallons of runoff. A one-hundred square foot roof surface will fill a 55 gallon barrel.
- If the cistern cannot hold the full inch one alternative is to divert overflow to another low impact development structure such as a rain garden.
- Measure the width of contributing roof area from the drip line of the overhang to the roof peak, ignoring the slope. The width times the length in feet is the drainage area in square feet. Multiply that by 0.6 gallons and that is the size of the cistern you will need to fully meet the one-inch rainfall standard.
- All holding tanks should be opaque to prevent algae growth.

- Pretreatment of water entering the cistern will remove debris, dust, leaves and other material. Pretreatment options are illustrated on the specification sheet. One or more options should be chosen.
- The cistern should have an overflow pipe so that when the tank reaches capacity, the rainwater will be directed away from adjacent buildings. More than one cistern can be linked to increase storage capacity.
- Drainage system components leading to the cistern should have a minimum slope of 2% for gravity drainage to the cistern.

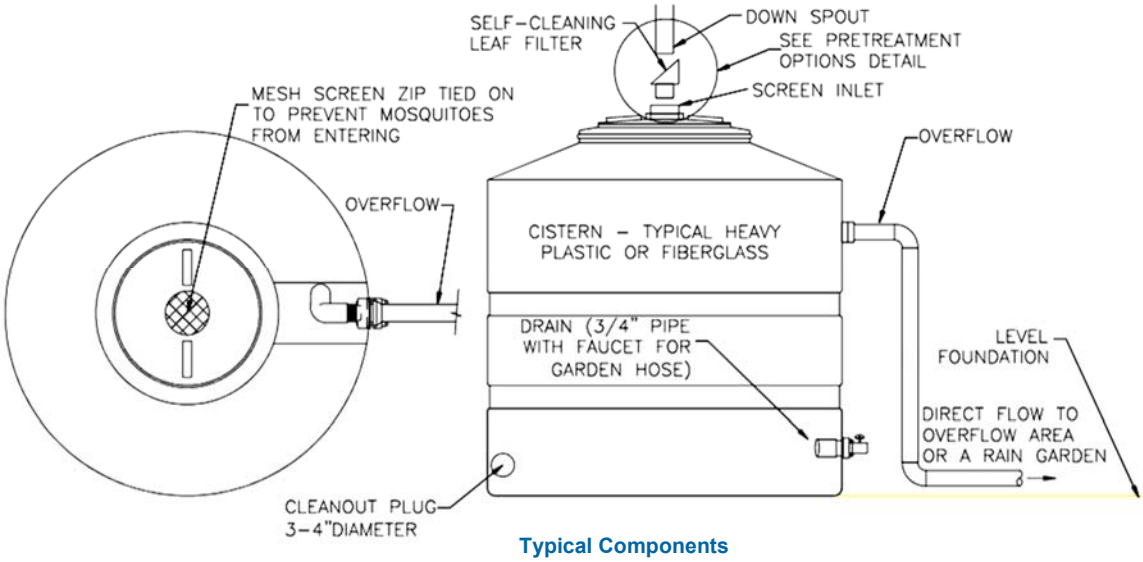


PRETREATMENT OPTIONS DETAIL

- Gravity feed drip irrigation kits are available from several suppliers as well as complete instructions on how to design an irrigation system for the low pressure of a cistern system without a pump.

Maintenance

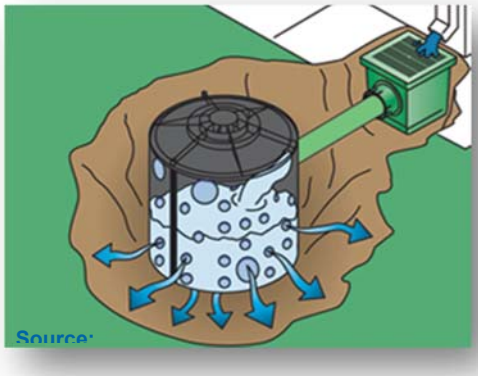
- To maintain the storage capacity of the cistern, a draw down plan should be initiated and the collected rain water should be used regularly.
- Routine checks of the intake and leaf screening components should be done once in the spring and periodically during the fall if leaves fall on the contributing roof area.
- Ensure mosquito screen is tight.
- Inspect and if necessary clean out tank annually by scrubbing and letting water drain through low flow plug.
- Check connections for leaks and inspect overflow for erosion.



Typical Components

6.3 Drywells

Drywells are comprised of seepage tanks set in the ground and surrounded with stone and are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. Alternately, the pit can be filled with stone with a perforated standpipe in place of the tank.



Dry wells are particularly well suited to receive rooftop runoff entering the tank via an inlet grate (shown right) or direct downspout connection (below right). When properly designed, dry wells can provide significant reductions in stormwater runoff and pollutant loads.

Note that dry wells are considered Class V wells under the federal Underground Injection Control Program. Their installation is authorized by rule, but they must be registered with the Maine Department of Environmental Protection[4].

Design

- Dry wells should be located at least 10 feet from building foundations and not within 10 feet of a property line.
- Drainage of driveways or other areas where vehicle fluids could be transported to the subsurface environment is not recommended.
- To reduce the chance of clogging, dry wells should drain only impervious areas, and runoff should be pretreated with at least one of the leaf removal options to remove debris and larger particles.
- The height of the tank should not exceed 45 inches unless infiltration testing has been done to ensure a drain time of 72 hours or less.
- Dry wells should <u>not</u> be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or (4) above a septic field. Always call Dig Safe to locate utility lines before you dig. (Dial 811).

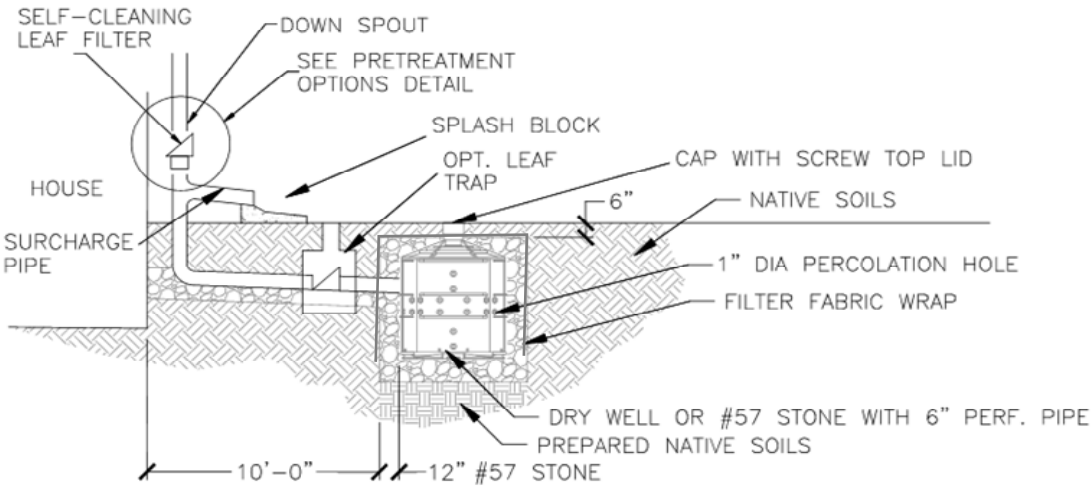
Construction

- Consider the drainage area size and the soil infiltration rate when determining the size of the dry well, (see table below).

[4] https://www1.maine.gov/dep/water/wd/uic/classVregis.htm

- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used to line the sides and top of the dry well.
- The dry well hole should be excavated one foot deeper and two feet larger in diameter than the well to allow for a 12 inch stone fill jacket.
- The native soils along the bottom of the dry well should be scarified or tilled to a depth of 3 to 4 inches.
- Fill below and around dry well with approximately 12 inches of clean, washed #57 stone. #57 stone averages ½ inch to 1-1/2 inches in diameter.
- Fill the final 6 inches of the excavation with native soil. Optionally pea gravel or #8 stone can be carried to the surface.
- For rooftop runoff, install a leaf screen in the gutter or down spout prior to entering the dry well to prevent leaves and other large debris from clogging the dry well. For non-rooftop runoff, precede dry well with an in ground sump grate inlet leaf trap.

- An overflow, such as a vegetated filter strip or grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely bypassing the dry well.
- The optional design involves placement of a vertical standpipe connected to the inlet pipe. See figure below.



Typical Components

The table below can be used to size a dry well system. For a tank system, the maximum contributing drainage area is based on the diameter and height of the tank, as well as the depth of gravel surrounding the tank. For a standpipe system, the contributing drainage area is based on the diameter and depth of the gravel filled hole. For example, a tank with a height of 30” and a diameter of 48” can treat 755 square feet of impervious area.

If you elect to measure the infiltration rate and find it is higher than 0.5 in/hr, the size of the dry well can be reduced. For every 0.5 in/hr increase in measured infiltration rate above 0.5 in/hr subtract ten percent of the required dry well size as measured in square feet captured. It should be noted that infiltration rates in Portland are often low due to the soil conditions.

Gravel Bed Depth (inches)	Tank Height (inches)	Tank Inside Diameter (inches)				
		24	30	36	42	48
		Contributing Area Captured (square feet)				
6	30	258	345	447	563	692
12	30	285	380	490	615	755
6	60	461	622	809	1022	1263
12	60	489	657	852	1075	1325
	Hole Depth (inches)	6" Perforated Standpipe Gravel Filled Hole Diameter (inches)				
		24	30	36	42	48
		Contributing Area Captured (square feet)				
	24	30	46	65	88	114
	30	38	58	82	110	142
	36	46	69	98	132	171
	42	53	81	114	154	199
	48	61	92	130	176	228
	60	76	115	163	219	285

Maintenance

Annual maintenance is important for dry wells, particularly in terms of ensuring that they continue to provide measurable stormwater management benefits over time.

- Inspect gutters and downspouts, removing accumulated leaves and debris.
- Inspect dry well following rainfall events.
- If applicable, inspect pretreatment devices for sediment accumulation. Remove accumulated trash and debris.
- Inspect top layer of filter fabric for sediment accumulation. Remove and replace sediment accumulation if clogged.

6.4 Rain Gardens

Rain gardens are small, landscaped depressions that are filled with a mix of native soil and compost, and are planted with trees, shrubs and other garden-like vegetation. They are designed to temporarily store stormwater runoff from rooftops, driveways, patios and other areas around your home while reducing runoff rates and pollutant loads in your local watershed. A rain garden can be a beautiful and functional addition to your landscape.

Location

- Rain gardens should be located to receive the maximum amount of stormwater runoff from impervious surfaces, and where downspouts or driveway runoff can enter garden flowing away from the home.
- Swales, berms, or downspout extensions may be helpful to route runoff to the rain garden.
- Locate at least 10 feet from foundations, not within the public right of way, away from utility lines, not over septic fields, and not near a steep bluff edge. Call Dig Safe before you dig to locate the utility lines on your property. (811)
- Rain gardens should be located at least 10 feet from the property line when possible. If locating the rain garden 10 feet from the property line is not possible, DPS will require a signed agreement between the applicant and the neighbor of the abutting property.
- Rain gardens on steep slopes (>10%) may require an alternative design with terracing.
- Rain gardens should be located in an area where rainwater can infiltrate through the garden and discharge into the ground. To determine if an area is suitable for a rain garden a simple percolation test shall be performed. Dig a hole that is at least 12” deep, fill the hole with water and allow it to drain into the soil so it becomes saturated. Refill the hole with 6” of water and let sit for 24 hours. If the hole does not drain more than 3.5” inches in this time period, the location is not suitable for a rain garden. Rain gardens that are built in areas that cannot infiltrate water efficiently can create wet areas that last long enough to create mosquito problems for landowners.

Design

- Rain gardens must be sized appropriately to treat the stormwater runoff generated from the first 1” of rainfall over *the entire impervious drainage area that is directed towards the rain garden*. The size of the rain garden will vary depending on the impervious surface draining to it and the soils observed on site. In general silty loam soils can infiltrate 6

inches of storm water over the course of 24 hours. Soils with high clay content can infiltrate 3.5 inches of stormwater over 24 hours. Soils that drain water more quickly require less rain garden surface area to treat and control stormwater. The surface area of the rain garden is determined as follows:

$$Rain\ Garden\ Surface\ Area\ (square\ feet) = \frac{Impervious\ Area\ Treatment\ Volume\ (cf)}{Design\ Ponding\ Depth\ (ft)}$$, where

$$Treatment\ Volume\ (cf) = Impervious\ Drainage\ Area\ (sf)\ x\ 1\ inch\ of\ rain\ (0.083\ ft)\ .$$

For silty/sandy soils: $maximum\ ponding\ water\ depth\ =\ 6\ inches.$

For clay soils: $maximum\ ponding\ water\ depth\ =\ 3.5\ inches.$

Example:

Impervious Drainage Area of Rain Garden: = 1,200 square feet (sf)

Soil Type: Silt

Ponding Depth = 6 inches (0.5 feet)

Treatment Volume = 1,200 sf x 0.083 feet = 100 cubic feet (cf)

Required Rain Garden Surface Area = 100 cf / 0.5 ft = 200 sf

- A simple soil test can be performed to determine the soil classification for your property. Methods to identify soil type can be found at the link below:
  http://www.ext.colostate.edu/mg/gardennotes/214.pdf
- A maximum ponding depth of 6 inches is allowed within rain gardens. Rain Garden overflows should be set 6" above the mulch layer. Rain Gardens should be constructed to allow 6" of freeboard above the overflow elevation. On average, rain gardens drain within a day which should not create a mosquito problem.
- Design the rain garden entrance to immediately intercept inflow and reduce its velocity with stones, dense hardy vegetation or by other means such as a forebay.
- If sides are to be mowed rain gardens should be designed with side slopes of 3:1 (H:V) or flatter.
- Rain Gardens built on slopes (10% max.) require the construction of a berm on the down slope side of the garden. The top of berm height should be equal to the elevation on the up slope edge of the garden.
- If the location has sandy soils, only organic amendments may be needed, but clay soils may need to be replaced with a (50-60% sand, 20-30% topsoil, 20-30% organic amendments) to provide adequate infiltration of runoff. High Quality compost is an optimum soil amendment but decomposed wood chips or leaves are also effective. If

the parent soils are sandy and do not need to be replaced, the organic soils amendments should be well mixed with the parent topsoil to a depth of 12”.

- A mulch layer consisting of 2-3 inches of non-floatable organic mulch (fine shredded hardwood mulch, pine straw, or leaf compost) should be included on the surface of the rain garden. Pine bark and wood chips should not be used.

- Often rain gardens have a better appearance and can be more easily maintained if they have defined edges similar to a normal garden.

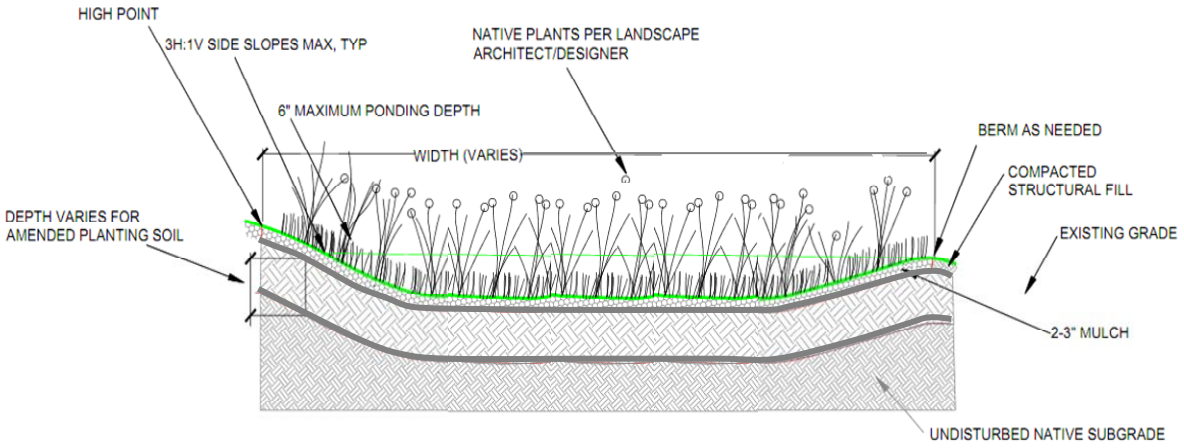
- The overflow from the rain garden should be set no higher than 6” from the top of the garden’s mulch layer. The overflow shall be non-eroding and can consist of a small berm or even an inlet grate set at the proper elevation in the garden. The grate should be set at a slant or be domed to allow clogging debris to fall off. Overflows should be oriented to direct flow away from neighboring properties and towards natural drainage pathways located on the property.

Vegetation

- Vegetation commonly planted in rain gardens include native trees, shrubs and other herbaceous vegetation. When developing a landscaping plan, you should choose vegetation that will be able to stabilize soils and tolerate the stormwater runoff rates and volumes that will pass through the rain garden.

- Vegetation used in rain gardens should also be able to tolerate both wet and dry conditions.

- As with any garden in the first season the vegetation may require irrigation to become well established. It may be appropriate to plant more densely than a normal garden to



obtain the benefit of plant soil stabilization and evapotranspiration as soon as possible.

- The amount of plantings required is dependent on the area of the rain garden. For a 100 sf rain garden approximately 7 shrub plantings and 24 herbaceous plantings shall be installed to provide an adequate level of water treatment.

Maintenance

Routine garden maintenance should include weeding, deadheading, replacing dead plants, and replenishing mulch when depleted. Catching areas of erosion is also important as is correcting standing water problems. If standing water persists it may be necessary to place a perforated underdrain in the garden daylighting downstream.

6.5 Modified French Drains

Modified French Drains (MFD) are shallow trench excavations filled with stone that are designed to intercept and temporarily store stormwater runoff until it infiltrates into the soil. MFDs can provide significant reductions in stormwater runoff and pollutant loads. They are particularly well suited to receive rooftop runoff, but can also be used to receive stormwater runoff from other small impervious areas. The perforated pipe is daylighted at its end allowing for overflow of larger storms and a failsafe mechanism should infiltration not be as anticipated.

Design

- MFD trenches should be located at least 5 feet from building foundations, 10 feet from buildings with basements, and 10 feet from property lines. The top end of the MFD can be adjacent to the building to connect downspouts but should be directed away from the structure.
- MFDs should slope away from structures. The slope of the MFD pipe should be between 0.5% and 6%. It can be serpentine or multi-pronged in construction if sufficient slope is available.
- To reduce the chance of clogging, MFDs should drain only impervious areas and runoff should be pretreated with at least one of the leaf removal options to remove debris and larger particles.
- MFD gravel depths should be at least 18 inches and no more than 36 inches.
- MFDs should be located in a lawn or other pervious (unpaved) area and should be designed so that the

top of the MFD is located as close to the surface as possible to reduce digging.

- MFDs should not be located: (1) beneath an impervious (paved) surface; (2) above an area with a water table or bedrock less than two feet below the trench bottom; (3) over other utility lines; or, (4) above a septic field. Always call Dig Safe to locate utility lines before you dig.
- The downstream end of the pipe must daylight overflows more than ten feet from the property line.

Construction

- As a rule of thumb, there should be about 23 cubic feet of stone for every 100 square feet of rooftop. The table provides MFD length requirements for different depths.
- The assumed width in the trench sizing table is 24 inches. The width can be from 18 to 32 inches. Required lengths should be adjusted proportionately if other widths are used.
- The sides of the excavation should be trimmed of all large roots that will hamper the installation of the permeable drainage fabric used part way down the sides and above the gravel layer on top of the MFD.
- The native soils along the bottom of the MFD should be scarified or tilled to a depth of 3 to 4 inches.
- Fill the MFD with clean, washed #57 stone. The pipe should be embedded towards the top of the stone layer such that the stone just covers the top of the pipe. #57 stone averages ½ inch to 1-1/2 inches in diameter.
- The pipe should have 3/8 inch perforations, spaced 6 inches on center, and have a minimum slope of 0.5% and a maximum slope of 6%.

Rooftop Area (square feet)	Depth of Gravel From Top of Pipe (inches)			
	18	24	30	36
	Required Linear Feet of MFD			
100	6	5	4	3
500	30	25	20	15
1000	60	45	40	35
2000	120	95	75	65
3000	185	140	115	100
4000	245	190	155	130
5000	305	235	195	165

- The perforated pipe must daylight at the downstream end of the trench.
- An overflow, such as a grass channel, should be designed to convey the stormwater runoff generated by larger storm events safely out of the downstream end of the MFD.
- Place permeable landscape fabric over gravel to keep soil or pea gravel from migrating into the gravel and filling the pore spaces. Leave four to six inches above the pipe to the ground surface.
- Cover with top soil and sod or with pea gravel.
- For rooftop runoff, install one or more leaf screen options prior to entering the MFD to prevent leaves and other large debris from clogging the MFD. For driveway or parking runoff, a screened inlet grate over a sump or pea gravel pit can be used to settle out material prior to entering the pipe.

Vegetation

- A MFD is normally covered with topsoil and managed turf or other herbaceous vegetation.
- As an alternative, the area above the surface of a MFD may be covered with pea gravel (or larger depending on the inflow rates) to allow for incidental lateral inflow along the edge of ground level impervious surfaces.
- The downstream end of the pipe must be stabilized and can be landscaped for aesthetics.

Maintenance

- Inspect gutters/downspouts removing accumulated leaves and debris, cleaning leaf removal system(s).
- Inspect any pretreatment devices for sediment accumulation. Remove accumulated trash and debris.
- Inspect MFD following a large rainfall event to insure overflow is operating and flow is not causing problems.

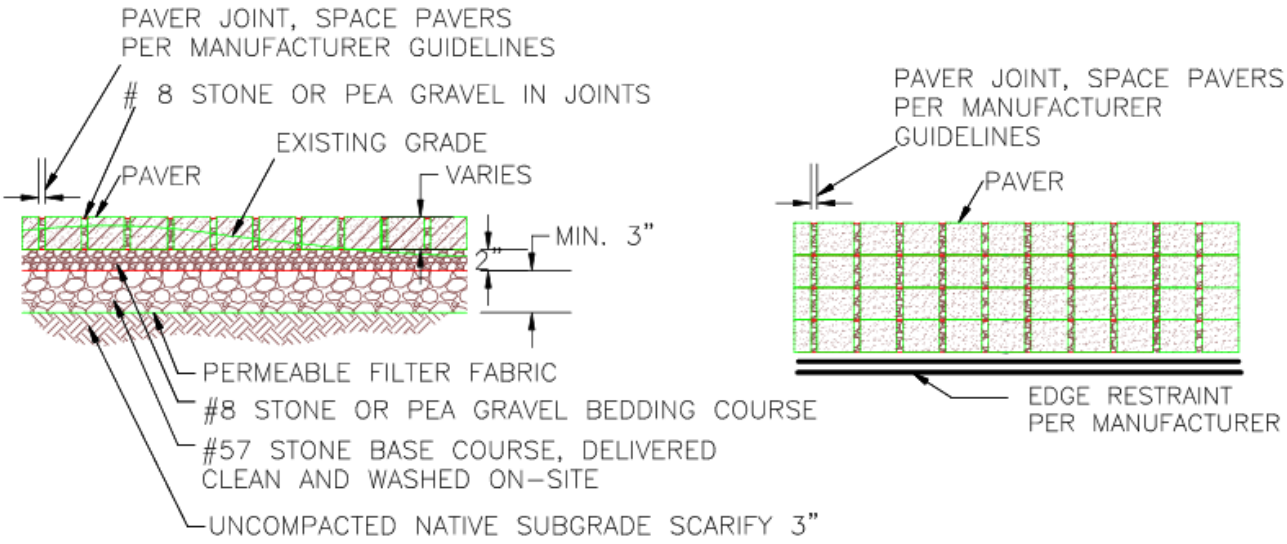
6.6 Permeable Pavers

Permeable pavers are an alternative to traditional paving surfaces that can decrease stormwater runoff around your home. They are well suited for use when constructing sidewalks, parking areas, patios, and driveways. Permeable pavers consist of permeable interlocking or grid concrete pavers underlain by a drainage layer. A permeable paver system allows stormwater runoff to pass in between the paver surface and into an underlying stone reservoir, where it is temporarily stored and allowed to infiltrate into the underlying soils. Permeable pavers can provide significant reductions in stormwater runoff and pollutant loads in your watershed.

Design

- Maximum ratio of contributing drainage area to surface area is 4:1.
- Permeable paver systems should be located at least 5 feet from building foundations and 10 feet from buildings with basements.
- Permeable pavers should not be located: (1) above an area with a water table or bedrock less than two feet below the gravel bottom; (2) over other utility lines; or, (3) above a septic field. Always call Dig Safe to locate utility lines before you dig.
- Permeable pavers should drain only impervious areas. Drainage from other areas onto the pavers will eventually clog the permeable paver system.
- The desirable soil infiltration rate suitable for a paver system is 0.50 inches per hour (in/hr) or greater. If there is concern due to tight soils when digging an infiltration test should be done. If the rate is less than 0.5 in/hr, an underdrain leading to daylight should be provided. Professional assistance should be obtained in this case.

- Permeable paver systems should be installed on slopes less than 6% to help ensure even distribution of runoff over the infiltration surface, and should slope away from structures.



Typical Components

Construction

The table at the right provides Permeable Paver area size requirements for different depths of the #57 stone layer. This stone averages in size from ½ inch to 1-1/2 inches in diameter.

Example: A roof top is 1000 square feet. For a stone depth of 8 inches the required area of permeable pavers 280 sq ft.

Contributing Drainage Area (square feet)	Depth of Lower Stone Storage Layer (inches)				
	3	4	5	6	8
	Area of Pavers (square feet)				
100	54	45	39	34	27
500	280	230	200	170	140
1000	550	460	390	340	280
2000	1090	910	780	680	550
3000	1630	1360	1170	1020	820
4000	2180	1810	1560	1360	1090
5000	2720	2270	1940	1700	1360

- Permeable paver systems require multiple layers. Manufacturer's instructions, if they exist, should be followed in lieu of these guidelines.
- The top course consists of the pavers and a crushed aggregate material swept between the paver joints, such as #8 stone or 1/8" to 3/8" pea gravel. The thickness of this layer varies depending upon the depth of the paver.
- The bedding course consists of 2 to 3 inches of #8 stone or 1/8" to 3/8" pea gravel. The bedding course provides a level bed for setting the pavers evenly.
- The aggregate base course consists of #57 stone, a minimum of 3 inches deep. The aggregate base course acts as a reservoir to provide stormwater storage capacity and must be compacted.

- As an option, a permeable drainage fabric can be used to separate the aggregate base course and the subgrade.
- The subgrade layer is the layer of native soils below the gravel and the permeable drainage fabric (if used). The subgrade soil layer should be prepared by scarifying or tilling to a depth of at least 6 inches.

Maintenance

Maintenance is very important for permeable paver systems, particularly in terms of ensuring that they continue to provide measurable stormwater management benefits over time.

- Remove accumulated sediment and debris from joint space monthly.
- Observe the permeable paver system for excessive ponding during storm events and repair as needed.
- Vacuum, sweep or blow permeable paver surface quarterly to keep the surface free of sediment. New #8 stone may need to be swept into the space between stones as needed.
- Inspect permeable paver surface for deterioration annually. Repair or replace any damaged areas as needed.