

Rain Barrels & Cisterns



Description: Cisterns and rain barrels are structures that store rooftop runoff and reuse it for landscaping and other non-potable uses. Instead of a nuisance to get rid of, consider rooftop runoff as a resource that can be reused or infiltrated. In contrast, conventional stormwater management strategies take rooftop runoff, which is often relatively free of pollutants, and direct it into the stormwater treatment system along with runoff from paved areas.

Ability to meet specific standards

Standard	Description
2 - Peak Flow	Provides peak flow attenuation for small storms.
3 - Recharge	Provides no groundwater recharge.
4 - TSS Removal	The roof surface can be deducted from the impervious area used to calculate the Required Water Quality Volume for sizing other structural treatment BMPs, a) when rain barrel or cistern is sized to store the Required Water Quality Volume for the roof surface (0.5 inch or 1.0 inch), b) stored water is used within 72-hours or discharged to an infiltration BMP, and c) the system is designed to operate year round.
5 - Higher Pollutant Loading	Not applicable.
6 - Discharges near or to Critical Areas	Not applicable.
7 - Redevelopment	Suitable.

Advantages/Benefits:

- Can reduce water demand for irrigation or other non-potable uses.
- Property owners save money on water bills by using stored water for landscape purposes.
- Public water systems may experience lower peak demand in summer.
- When properly installed, rain barrels and cisterns reduce stormwater runoff volume for small storms.

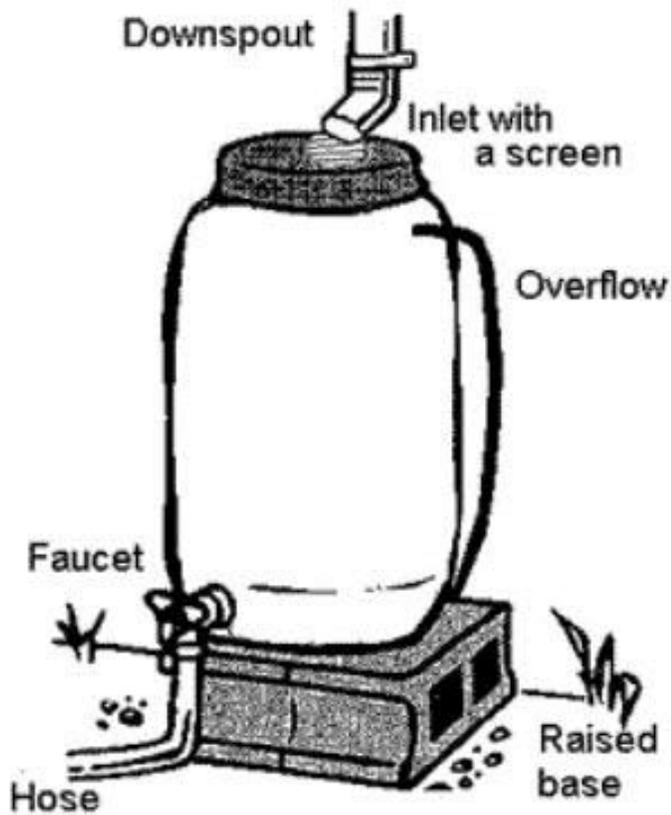
Disadvantages/Limitations:

- Provides mosquito-breeding habitat unless properly sealed.
- May need to be disconnected and drained in winter to avoid cracking of storage structure

Pollutant Removal Efficiencies

- Offers no primary pollutant removal benefits
- Rooftop Runoff presumed to be clean¹

¹Although MassDEP presumes rooftop runoff to be clean for purposes of the Stormwater Management Standards, research indicates higher PAHs in runoff from asphalt shingled roofs and zinc from metal roofs. USGS research in Texas indicates rooftop runoff contains mercury. Before using rooftop runoff for vegetable gardens, investigate the quality of the runoff, especially when using larvicides in rain barrels or cisterns for mosquito control.



Maintenance

Activity	Frequency
Maintenance requirements for cisterns and rain barrels are minimal. These requirements include the following: Inspecting the unit twice a year, larviciding for mosquito control, disconnecting and draining the system prior to winter to prevent cracking, and replacing or repairing any worn-out pieces.	

Special Features

Direct overflow from rain barrels and cisterns to a dry well, infiltration trench, rain garden, bioretention area, or other infiltration BMP sized to recharge the overflow volume.

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Applications and Design Principles

The most common approach to roof runoff storage involves directing each downspout to a 55-gallon rain barrel. A hose is attached to a faucet at the bottom of the barrel and water is distributed by gravity pressure. A more sophisticated and effective technique is to route multiple downspouts to a partially or fully buried cistern with an electric pump for distribution. Where site designs permit, cisterns may be quite large, and shared by multiple households, achieving economies of scale. Stored rainwater can be used for lawn irrigation, vegetable and flower gardens, houseplants, car washing, and cleaning windows.

The roof surface can be deducted from the impervious surfaces used to determine the Required Water Quality Volume for sizing other structural treatment practices, only when a) the cistern or barrel can store the required water quality volume for the roof surface, b) the stored water is used or discharged to an infiltration BMP within 72-hours, and c) the system is designed to operate 365 days a year.

Cisterns and rain barrels can provide benefits by reducing the required water quality volume and peak discharge rates depending on the amount of storage available at the beginning of each storm. One rain barrel may provide a useful amount of water for garden irrigation, but it will have little effect on overall runoff volumes, especially if the entire tank is not drained between storms. Improve effectiveness by having more storage volume and by designing the system with a continuous discharge to an infiltration structure, so that there is always storage available for retention. To operate the system year-round, bury or insulate the unit. State Plumbing Code requirements apply to cisterns and rain barrels located within 10 feet of a building. All applicable requirements of the Massachusetts State Plumbing or State Building Codes must be met.

Cisterns and rain barrels are applicable to most commercial and residential properties where there is a gutter and downspout system to direct roof runoff to the storage tank. They take up little room and can be used in dense urban areas. Rain barrels and cisterns are excellent retrofit techniques for almost any circumstance. Rain barrels are covered plastic tanks that can hold from 50 to 100 gallons with a hole in the top for downspout discharge, an overflow

outlet, and a valve and hose adapter at the bottom. They are used almost exclusively on residential properties. Plastic rain barrels are typically installed above ground. They must be disconnected prior to the winter, and the barrel drained completely to prevent the barrel from cracking.

Because rain barrels rely on gravity flow, place them near, and slightly higher than, the point of use (whether a garden, flower bed, or lawn). Route the overflow outlet to a dry well, bioretention area, rain garden or other infiltration BMP. It is important for property owners to use the water in rain barrels on a regular basis, otherwise the barrels can fill up and prevent additional roof runoff from being stored. Each house should have the appropriate number of rain barrels or an appropriately sized cistern. A one-inch storm produces over 620 gallons of water from a 1,000 square foot roof. Assuming a rain barrel capacity of 55 gallons, it would take 11 rain barrels to store one inch of runoff from 1,000 square feet of roof.

Cisterns are partially or fully buried tanks with a secure cover and a discharge pump; they provide considerably more storage than barrels, as well as pressurized distribution. They are less susceptible to cracking induced by expansion of freezing water when buried below grade. Cisterns can collect water from multiple downspouts or even multiple roofs, and then distribute this water wherever it needs to go via an electric pump. Property owners may use one large tank or multiple tanks in series. Either way, direct the overflow for the systems to a dry well or other infiltration mechanism so that if the cistern is full, excess roof runoff is infiltrated, and not discharged to the stormwater treatment system. Some cisterns are designed to continuously discharge water into infiltration units at very slow rates, so that the tank slowly empties after a storm, providing more storage for the next storm. The cisterns must also be designed to dewater in 72 hours or less.

Design

Because of the low pressure of the discharge, rain barrels are most effectively used with a drip irrigation system. Secure rain barrels against disturbance by children or animals. Seal any openings with mosquito netting. If present, place the cistern's continuous discharge outlet so that the tank does not empty completely. This ensures water availability at all times, and provides some storage capacity for every storm. A diverter at the cistern inlet can redirect

the “first flush” of runoff, which is more likely to have particulates, leaves, and air-deposited contaminants washed off the roof. Keep leaves and debris out of the storage tank by placing a screen at the top of the downspout. Hide rain barrels and cisterns with shrubs or other landscaped features. Direct overflow from rain barrels and cisterns to a dry well, infiltration trench, rain garden, bioretention area, or other infiltration BMP sized to recharge the overflow volume. Use pond routing methods to design cisterns or rain barrels to account for retention of early runoff in the storage tank. Include access ports for any subsurface cisterns. Confined space entry training may be needed to enter large cisterns. MassDEP does not require treatment of runoff from non-metal roofs prior to infiltration.

Maintenance

Maintenance requirements for rain barrels are minimal and consist only of inspecting the unit as a whole and any of its constituent parts and accessories twice a year. The following components should be routinely inspected and either repaired or replaced as needed:

- *Roof catchment*, to ensure that trash and particulate matter are not entering the gutter and downspout to the rain barrel.
- *Gutters*, to ensure that no leaks or obstructions are occurring.
- *Downspouts*, to assure that no leaks or obstructions are occurring.
- *Entrance at rain barrel*, to ensure that there are no obstructions and/or leaks occurring.
- *Rain barrel*, to check for potential leaks, including barrel top and seal.
- *Runoff / overflow pipe*, to check that overflow is draining in non-erosive manner.
- *Spigot*, to ensure that it is functioning correctly.
- *Any accessories*, such as rain diverter, soaker hose, linking kit, and additional guttering.
- *Apply larvicides in strict accordance with all Mass. Department of Agricultural Resources Pesticide Bureau regulations* to prevent mosquitoes from reaching adulthood.
- *Add bleach or other chemicals annually to kill bacteria present in the system*. A qualified professional should determine appropriate treatment.
- *Drain the system before winter* if it is located above ground or partially exposed, to prevent cracking.
- *Disconnect the system from roof leaders in the fall*, if water is not intended to be used during the

winter, unless the runoff is directed to a qualifying stormwater infiltration practice.

- *When the cistern or barrel is connected to a stormwater recharge system, remove particulates trapped in the cistern or rain barrel annually to limit clogging of the stormwater infiltration system.*

Adapted from:

MAPC Low Impact Development Toolkit. For more information, go to www.mapc.org/lid and www.arc-of-innovation.org.

Additional Information

<http://www.rainwaterrecovery.com/about.html>

www.crwa.org (Charles River Watershed Association)