GENERAL DESCRIPTION

Rainwater harvesting is the process of intercepting, conveying and storing rainfall for future use. The rain that falls upon a catchment surface, such as a roof, is collected and conveyed into a storage tank. Storage tanks range in size from rain barrels for residential land uses (typically 190 to 400 litres in size), to large cisterns for industrial, commercial and institutional land uses. A typical pre-fabricated cistern can range from 750 to 40,000 litres in size.

With minimal pretreatment (e.g., gravity filtration or first-flush diversion), the captured rainwater can be used for outdoor non-potable water uses such as irrigation and pressure washing, or in the building to flush toilets or urinals. It is estimated that these applications alone can reduce household municipal water consumption by up to 55%. The capture and use of rainwater can, in turn, significantly reduce stormwater runoff volume and pollutant load. By providing a reliable and renewable source of water to end users, rainwater harvesting systems can also help reduce demand on municipal treated water supplies. This helps to delay expansion of treatment and distribution systems, conserve energy used for pumping and treating water and lower consumer water bills.

DESIGN GUIDANCE

CATCHMENT AREA

The catchment area is simply the surface from which rainfall is collected. Generally, roofs are the catchment area, although rainwater from low traffic parking lots and walkways, may be suitable for some non-potable uses (e.g., outdoor washing). The quality of the harvested water will vary according to the type of catchment area and material from which it is constructed. Water harvested from parking lots, walkways and certain types of roofs, such as asphalt shingle, tar and gravel, and wood shingle roofs, should only be used for irrigation or toilet flushing due to potential for contamination with toxic compounds.

COLLECTION AND CONVEYANCE SYSTEM

The collection and conveyance system consists of the eavestroughs, downspouts and pipes that channel runoff into the storage tank. Eavestroughs and downspouts should be designed with screens to prevent large debris from entering the storage tank. For dual use cisterns (used year-round for both outdoor and indoor uses), the conveyance pipe leading to the cistern should be buried at a depth no less than the local maximum frost penetration depth and have a minimum 1% slope. If this is not possible, conveyance pipes should either be located in a heated indoor environment (e.g., garage, basement) or be insulated or equipped with heat tracing to prevent freezing. All connections between downspouts, conveyance pipes and the storage tank must prevent entry of small animals or insects into the storage tank.

PRE-TREATMENT

Pretreatment is needed to remove debris, dust, leaves, and other debris that accumulates on roofs and prevents clogging within the rainwater harvesting system. For dual use cisterns that supply water for irrigation and toilet flushing only, filtration or first-flush diversion pretreatment is recommended. To prevent ice accumulation and damage during winter, first-flush diverters or in-ground filters should be in a temperature controlled environment, buried below the local frost penetration depth, insulated or equipped with heat tracing.

STORAGE TANKS

The storage tank is the most important and typically the most expensive component of a rainwater harvesting system. The required size of storage tank is dictated by several variables: rainfall and snowfall frequencies and totals, the intended use of the harvested water, the catchment surface area, aesthetics, and budget. In the Greater Toronto Area, an initial target for sizing the storage tank could be the predicted rainwater usage over a 10 to 12 day period.

DISTRIBUTION SYSTEM

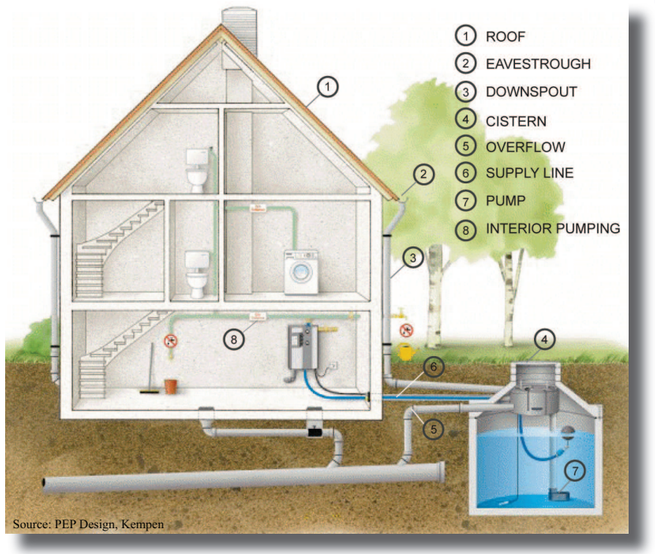
Most distribution systems are gravity fed or operated using pumps to convey harvested rainwater from the storage tank to its final destination. Typical outdoor systems use gravity to feed hoses via a tap and spigot. For underground cisterns, a water pump is needed. Indoor systems usually require a pump, pressure tank, back-up water supply line and backflow preventer. The typical pump and pressure tank arrangement consists of a multistage centrifugal pump, which draws water out of the storage tank into the pressure tank, where it is stored for distribution.

OVERFLOW SYSTEM

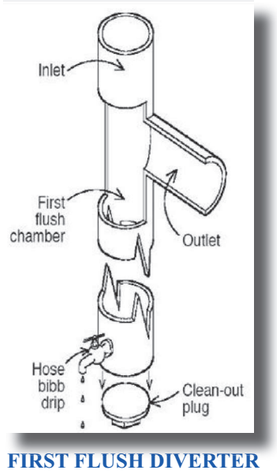
An overflow system must be included in the design. Overflow pipes should have a capacity equal to or greater than the inflow pipe(s). The overflow system may consist of a conveyance pipe from the top of the cistern to a pervious area down gradient of the storage tank, where suitable grading exists. The overflow discharge location should be designed as simple downspout disconnection to a pervious area, vegetated filter strip, or grass swale. The overflow conveyance pipe should be screened to prevent small animals and insects from entering. Where site grading does not permit overflow discharge to a pervious area, the conveyance pipe may either be indirectly connected to a storm sewer (discharge to an impervious area connected to a storm sewer inlet) or directly connected to a storm sewer with incorporation of a backflow preventer.

ACCESS AND MAINTENANCE

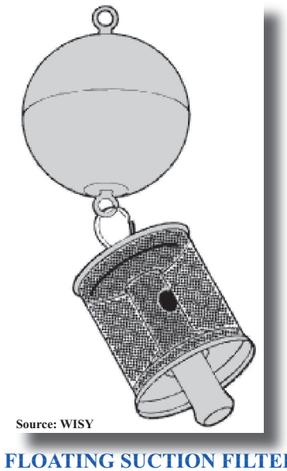
For underground cisterns, a standard size manhole opening should be provided for maintenance purposes. This access point should be secured with a lock to prevent unwanted access.



OVERVIEW



FIRST FLUSH DIVERTER



FLOATING SUCTION FILTER

ABILITY TO MEET SWM OBJECTIVES

BMP	Water Balance Benefit	Water Quality Improvement	Stream Channel Erosion Control Benefit
Rainwater Harvesting	Yes - magnitude depends on water usage	Yes - size for the water quality storage requirement	Partial - can be used in series with other practices

GENERAL SPECIFICATIONS

Component	Specification	Quantity
Eavestroughs and Downspouts	Materials commonly used for eavestroughs and downspouts include polyvinylchloride (PVC) pipe, vinyl, aluminum and galvanized steel. Lead should not be used as solder as rainwater can dissolve the lead and contaminate the water supply.	Length of eavestroughs and downspouts is determined by the size and layout of the catchment and the location of the storage tanks.
Pretreatment	At least one of the following: • leaf and mosquito screens (1 mm mesh size); • first-flush diverter; • in-ground filter; • in-tank filter. Large tanks (10 m3 or larger) should have a settling compartment for removal of sediments.	1 per inlet to the collection system
Storage Tanks	• Materials used to construct storage tanks should be structurally sound. • Tanks should be installed in locations where native soils or building structures can support the load associated with the volume of stored water. • Storage tanks should be water tight and sealed using a water safe, non-toxic substance. • Tanks should be opaque to prevent the growth of algae • Previously used containers to be converted to rainwater storage tanks should be fit for potable water or food-grade products. • Cisterns above- or below ground must have a lockable opening of at least 450 mm diameter.	The size of the cistern(s) is determined during the design calculations.

Note: This table does not address indoor systems or pumps.

OPERATION AND MAINTENANCE

Maintenance requirements for rainwater harvesting systems vary according to use. Systems that are used to provide supplemental irrigation water have relatively low maintenance requirements, while systems designed for indoor uses have much higher maintenance requirements. All rainwater harvesting system components should undergo regular inspections every six months during the spring and fall seasons to keep leaf screens, eavestroughs and downspouts free of leaves and other debris; check screens and patch holes or gaps; clean and maintain first flush diverters and filters, especially those on drip irrigation systems; inspect and clean storage tank lids, paying special attention to vents and screens on inflow and outflow spigots; and replace damaged system components as needed.

MOSQUITO CONTROL

If screening is not sufficient to deter mosquitoes, vegetable oil can be used to smother larvae. Alternatively mosquito dunks or pellets containing larvicide can be used.

WINTER OPERATION

Rainwater harvesting systems have a number of components that can be affected by freezing winter temperatures. For above-ground systems, winter-time operation may not be possible. Prior to the onset of freezing temperatures, above-ground systems should be disconnected and drained. For below-ground and indoor systems, downspouts and overflow components should be checked for ice blockages during snowmelt events.

SITE CONSIDERATIONS

Available Space
Storage tanks can be placed underground, indoors, on roofs, or adjacent to buildings depending on intended uses of the rainwater.

Site Topography
Influences the placement of the storage tank and design of the distribution and overflow systems.

Soil
Underground cisterns should be placed on or in native, rather than fill soil.

Head
Rain barrels or above ground cisterns with gravity distribution systems should be sited up-gradient from landscaping areas to which rainwater is to be applied.

Pollution Hot Spot Runoff
Can be an effective BMP for roof runoff from sites where land uses or activities at ground level have the potential to generate highly contaminated runoff.

Winter Operation
Can be used throughout the winter if tanks are located below the local frost penetration depth or indoors.

Underground Utilities
Presence of underground utilities may constrain the location of underground storage tanks.

Plumbing Code
Code allows the use of harvested rainwater for toilet and urinal flushing, but systems require installation of backflow prevention devices.

Standing Water and Mosquitoes
If improperly managed, tanks can create habitat suitable for mosquito breeding, so screens should be placed on inlets and outlets to prevent entry.

Child Safety
Above and below ground cisterns with openings large enough for children to enter must have lockable covers.

Setback
Tanks should be water tight to avoid ponding or saturation of soils within 4 metres of building foundations.

Vehicle Loading
Underground tanks should be sited in areas without vehicular traffic.

Drawdown Between Storms
A suggested target for sizing the storage tank to ensure drawdown between storms is the predicted rainwater demand over a 10 to 12 day period.

CVC/TRCA LOW IMPACT DEVELOPMENT
PLANNING AND DESIGN GUIDE - FACT SHEET

RAINWATER HARVESTING

TORONTO AND REGION Conservation for The Living City

CVC CREDIT VALLEY CONSERVATION

FOR FURTHER DETAILS SEE SECTION 4.1 OF THE CVC/TRCA LID SWM GUIDE