# FACT SHEET

Sustainable Technologies

EVALUATION PROGRAM

## **Rainwater Cisterns**

Inspection and Maintenance of Stormwater Best Management Practices

Rainwater harvesting is the practice of collecting, storing and making use of rainwater and snowmelt (i.e., stormwater) from roofs. Relatively clean roof runoff water is collected by eavestroughs or other types of roof drains, filtered to remove coarse debris, and conveyed to a structure where it is stored and drawn upon for purposes not requiring potable water. Such purposes include landscape irrigation, outdoor washing, fire suppression and toilet flushing. Storage structures may be cisterns installed below-ground or indoors that provide a year-round water source, or aboveground tanks and rain barrels that can only be used seasonally and must be taken out of service for the winter. Rainwater cisterns can range in size from about 750 to 40,000 litres or larger and may be constructed from fiberglass, plastic, metal or concrete.

Underground cisterns are most often installed to a depth below the maximum frost penetration depth to ensure they can be used year-round. A pump is used to deliver the stored water to the hose bibs or fixtures where it is utilized. Water that is in excess of the storage capacity of the cistern overflows to an adjacent drainage system (e.g., othr BMP or municipal storm sewer) via an overflow outlet structure and pipe. Cisterns that are drawn upon for indoor water uses (e.g., toilet flushing) will also feature water level sensors and the means of adding municipal water during extended periods of dry weather or winter when stormwater does not meet the demand (i.e., make-up water supply system). They may also include in-line devices to filter stored cistern water prior to delivery at hose bibs or fixtures. Key components of rainwater cisterns for inspection and maintenance are described in Figure 1 and Table 3.

#### **DESIGN TIP**

Key design features that make inspecting and maintaining rainwater cisterns easier to do include routes for accessing roof (catchment), filters or other pretreatment devices, overflow outlets, and the cistern intself (i.e. hatch/manhole).

An important task in owning and operating a rainwater harvesting system is keeping natural debris and sediment out of the cistern or rain barrel. Add screens to eavestroughs or downspout pipes and check and clear them frequently (biannually to quarterly). Drain the cistern or rain barrel annually and rinse or vacuum out the sediment with a wet shop vacuum or hydrovac truck to keep your system trouble free.



#### **BENEFITS**

• Reduce the quantity of pollutants and runoff being discharged to municipal storm sewers and receiving waters;

• Underground and indoor cisterns can be used year-round and located below parking lots, roads, plazas, parkland, landscaped areas or within buildings themselves.

#### TIPS TO HELP PRESERVE BMP FUNCTION

• Routinely check the water delivered to hose bibs or fixtures for turbidity or discolouration which could indicate excessive sediment accumulation in the cistern or failure of pretreatment devices or filters;

• Include a filtration device to treat stored water prior to delivery to hose bibs or fixtures as part of the intake/ distribution system and clean filters at the same frequency as pretreatment devices;

• Cover overflow pipe outlets at ground level with a coarse screen to prevent entry by insects/animals;

• Provide a means of draining the cistern by gravity to make inspection and maintenance work that requires drainage of the BMP easier to perform; and

• Remove accumulated sediment from a large cistern using a pressure washer or hydro-vac truck equipped with a JetVac nozzle to scour and direct sediment to a collection point for removal by vacuuming; for small cisterns, a garden hose and wet shop vacuum may be used.

# KEY COMPONENTS AND INSPECTION AND MAINTENANCE TASKS

Figure 1. Cross-section view showing key components of a rainwaer harvesting system



### **INSPECTION TYPES**

**Routine Operation:** Regular inspections (twice annually, at a minimum) done as part of routine maintenance tasks over the operating phase of the BMP life cycle to determine if frequencies are adequate and when rehabilitation or further investigation into BMP function is warranted.

**Verification:** Periodic inspections done every 5 years (maintenance verifications) and every 15 years (performance verifications) post-construction over the operating life cycle of the BMP to ensure compliance with the maintenance agreement (e.g., Environmental Compliance Approval permit) conditions, evaluate functional performance and determine when rehabilitation or replacement is necessary.

#### INSPECTION TIME COMMITMENTS AND COSTS

"Minimum" estimates are for inspection of above ground plastic cistern. "High" estimates are for below ground concrete cistern; more details are described in the Low Impact Development (LID)Stormwater Management Practice Inspection and Maintenance Guide available at https://sustainabletechnologies.ca.

Table 1. Time commitments and costs for inspection of a rainwater cistern

Rainwater Cisterns	Routine Operation	Maintenance Verification	Performance Verification
Tasks to complete	8	8	8
Visits (per year)	1	1 every 5 years	1 every 15 years
Time (hours per m <sup>2</sup> BMP area)	0.001-0.002	0.001-0.002	0.001-0.002
Cost	\$0.07-\$0.12	\$0.07-\$0.12	\$0.06-\$0.10

Table 2. Task cost estimates for maintenance and rehabilitation of a rainwater cistern

Rainwater Cisterns	Costs per m <sup>2</sup> of BMP area		
Tasks	Min.	High	
Remove litter	\$0.01	\$0.03	
Cleaning in-line filter	\$0.11	\$0.21	
Cleaning out tank	\$1.20	\$1.20	
Replacing pump & pressure tank	\$5.92	\$5.92	
Routine - cistern pump test	\$0.05	\$0.05	
Rehabilitation	\$7.22	\$7.22	

\* NOT TO SCALE \*

Component	Description	Inspection and Maintenance Tasks	
Contributing drainage area (CDA)	Roof area(s) from which runoff directed to the BMP originates.	<ul> <li>Remove natural debris and sediment annually to biannually;</li> <li>Trim back tree boughs that hang over the roof area to reduce maintenance needs.</li> </ul>	
Pretreatment	Devices that prevent debris and sediment from entering the BMP. Includes eavestrough or downspout screens, first flush diverters or filters on pipes leading to or from the cistern. Reduce the risk of obstructing inlets, intakes or overflow outlet pipes and excessive sediment accumulation.	<ul> <li>Remove trash, debris and sediment biannually to quarterly or when the sump is half full;</li> <li>Measure sediment depth or volume during each cleaning, or annually to estimate accumulation rate and optimize frequency of maintenance.</li> </ul>	
Inlets	Pipes connected to eavestroughs or roof drains that deliver water to the BMP. May also include a pipe connected to the municipal water supply line for maintaining cistern water level during dry weather.	<ul> <li>Check for obstructions and remove any debris or sediment annually to biannually;</li> <li>For outdoor above-ground cisterns and rain barrels, inlets need to be disconnected in the late fall/early winter, prior to the onset of freezing air temperatures;</li> <li>Reconnect outdoor above-ground cisterns to the roof drainage area in the spring once air temperature remains above freezing.</li> </ul>	
Access hatch	Hatch, manhole or lid that provides access to the interior of the water storage structure.	<ul> <li>Inspect for damage, obstruction and accessibility annually.</li> </ul>	
Cistern or rain barrel	The water storage structure (e.g., concrete vault, fiberglass, plastic or metal tank, rain barrel).	<ul> <li>Inspect for damage or leaking annually;</li> <li>Drain and remove accumulated sediment as needed (annually at a minimum).</li> </ul>	
Pump	Pressurized device used to deliver stored rainwater to the hose bibs.	Inspect and test for proper function annually.	
Filter	Cisterns may include an in-line filter device on the intake pipe or prior to delivery of rainwater to hose bibs.	<ul> <li>Remove debris and sediment biannually to quarterly or as directed by the system manufacturer.</li> </ul>	
Overflow Outlet	Pipe connected to the cistern or rain barrel that conveys overflows to another drainage system (e.g., municipal storm sewer or other BMP).	<ul> <li>Check for obstructions and remove any debris or sediment annually to biannually.</li> </ul>	

Figure 2. Examples of a pretreatment device, roof inlet, indoor piping marked for rainwater use only



#### REHABILITATION

Table 4. Key components, typical problems and rehabilitation tasks.

Component	Problem	Rehabilitation Tasks	
Inlets	Pipes or fittings are damaged or displaced.	Schedule repairs	
	lce is accumulating and obstructing inflow to BMP.	Schedule installation of heat trace wire along eavestroughs, around roof drains and in above- ground pipes or disconnect during winter.	
Cistern	Cracks are visible or seals between joints in the struc- ture are leaking.	Schedule repairs with oversight by the product manufacturer or vendor.	
Overflow outlet	Overflow outlet pipe is obstructed by debris or sediment.	Schedule drain snaking service or pressure/vacuum truck to remove the obstruction.	
Make-up water supply	System is malfunctioning (e.g., tops up cistern water level when unneccesary or fails to top up when needed).	Schedule investigative work to determine the cause of system malfunction with oversight by the product manufacturer, vendor or a licensed plumber and electrician.	
Pump	Pump is not delivering water to hose bibs or not providing adequate water pressure.	Schedule investigative work to determine the cause of system malfunction with oversight by the product manufacturer, vendor or a licensed plumber and electrician.	
Cistern	Cistern has reached 40 years of age and is due for replacement.	Replace cistern with new one that meets design specifications.	

For a detailed description of construction, inspection, maintenance and rehabilitation cost assumptions see section 7.1.7 of the LID Stormwater Management Practice Inspection and Maintenance Guide. To generate BMP-specific cost estimates use the LID Life Cycle Costing Tool available at https://sustainabletechnologies.ca.

Table 5. Construction and life cycle cost estimates

Painwater Cistorne	Costs per m <sup>2</sup> of BMP area + CDA			
Rainwater Cisterns	Minimum	High		
Construction	\$22.75 - \$26.30			
LIFE CYCLE COSTS				
25 year evaluation period				
Average annual maintenance	\$0.45 - \$0.50	\$0.90 - \$0.95		
Maintenance and rehabilitation	\$10.85 - \$12.05	\$22.30 - \$23.50		
50 year evaluation period				
Average annual maintenance	\$0.45 - \$0.50	\$0.80 - \$0.85		
Maintenance and rehabilitation	\$24.25 - \$24.15	\$41.95 - \$41.85		

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For more detailed information on inspection, testing and maintenance of rainwater cisterns and a field data form (checklist) to use for collecting and recording inspection results, please refer to Appendix D of the Low Impact Development Stormwater Management Practice Inspection and Maintenance Guide, available at https://sustainabletechologies.ca.

For more information about STEP and other resources and studies related to stormwater management, visit our website or email us at **STEP@trca.on.ca**.

