

Rainwater Cisterns

City of Chicago Department of Environment



Richard M. Daley
Mayor



Suzanne Malec-McKenna
Commissioner

A cistern is a container used to capture and store rainwater for later use. They are larger and usually more permanent than rain barrels, with local examples ranging in size from 200 to 5,000 gallons. They can be placed above- or underground.

Cisterns are meant to capture rainwater from a roof via a downspout. The simplest cisterns are used to collect water for non-potable, outdoor uses such as landscape irrigation. While it is possible to plumb cistern water for indoor uses such as for toilets and washing machines, it is currently against code and should be approached with a professional architect/engineer and a licensed plumber if a variance will be requested.

Applicability

A cistern can be a good option for a site that has (1) a catchment area (the area of roof a downspout drains) that supplies enough stormwater, (2) a use for that water, such as landscape irrigation, and (3) consistent maintenance. Sites with a small catchment area or a need for less water should consider smaller, less expensive options such as rain barrels.

Benefits

Using rainwater in place of tap water helps to conserve Lake Michigan water, reduces energy use and carbon emissions associated with treating and pumping potable water to the tap, and can reduce water bills for metered customers. If properly sited and managed, cisterns can also help manage stormwater, thereby reducing localized flooding and basement back-ups and protecting local waterways. For even greater stormwater management benefits, cisterns can be paired with additional green infrastructure features such as permeable paving, native landscaping, bioswales, rain gardens or wetland detention basins. Furthermore, many plants respond better to rainwater than tap water, which has added chlorine to protect against bacteria harmful to humans.

Sizing

Below are the basic considerations when sizing a cistern for a given site:

- **Supply.** Assuming the site's water demand is met, one rule of thumb is to size a cistern for one inch of rain. The following calculation can help estimate the number of gallons a one-inch rain would produce for a given catchment area: $Catchment\ area\ (in\ sq.\ ft.) \times 1/12\ (1\ inch\ expressed\ as\ feet) \times 0.90\ (ex.\ runoff\ coefficient) \times 7.48\ (to\ convert\ cubic\ feet\ to\ gallons)$. For example, a 1,000 sq.ft. catchment area would produce about 560 gallons of water in a one-inch rain event.
- **Demand.** Using a common rule of thumb that a landscaped area (turf grass, ornamental shrubs, plants, trees) requires roughly 1 inch of water per week, a 300 sq. ft area of landscaping (example residential area) would require about 180 gallons of water per week. Assuming about half of that water is provided through rain, about 90 gallons of supplemental watering would be needed per week in this example. When sizing your cistern, keep in mind that every site and season is different; some landscaping will require more or less water; this example is just meant to be a starting point.
- **Overflow.** Any excess overflow not infiltrated by the landscape should be directed either to the right-of-way or back into the sewer system. The smaller the ratio of cistern to catchment area, the more overflow will have to be accommodated. Be sure that overflow does not flow onto a neighboring property or cause ponding or hazardous conditions.



Kilbourn Park Organic Greenhouse
1,500- gallon cistern

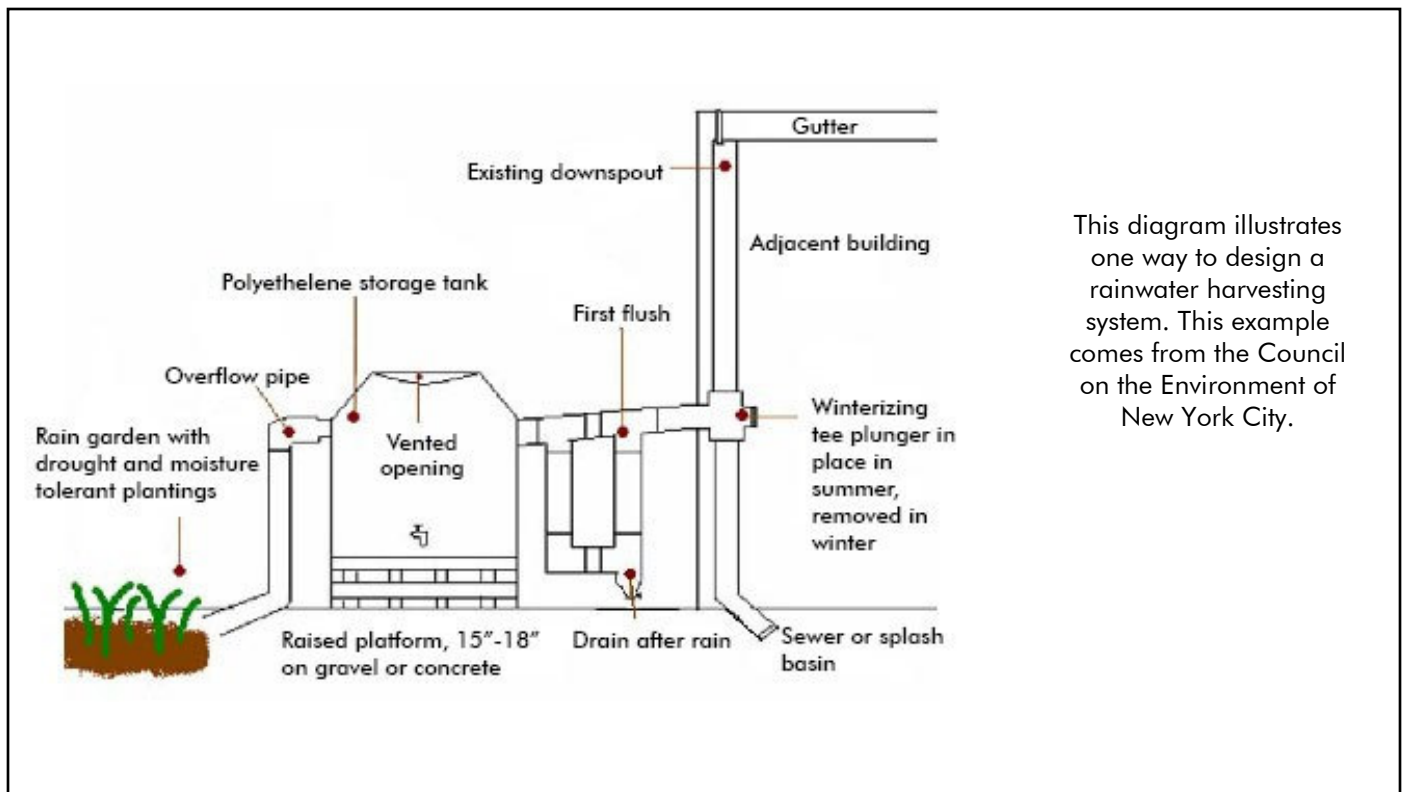
What does climate change mean for my cistern?

Climate change scientists are predicting more heavy rain storms and dry periods, the latter especially during the summer. If you have the space and funds, consider making your cistern larger to accommodate these expected changes.

Cistern System Components – the Basics

A rainwater harvesting system can be designed in a variety of ways. Here are the basic components of a typical above-ground cistern:

- **Tank.** Cisterns should be constructed of durable material, such as concrete, plastic, polyethylene, or metal, and they can take a variety of shapes. Underground cisterns may be poured concrete, prefabricated plastic tanks, or proprietary products that store water in a variety of structures. If located in direct sunlight, an opaque, dark-colored cistern will help prevent algal and bacteria growth inside the cistern.
- **Base.** To support the weight of water (about eight pounds per gallon) and the structure, cisterns should be built on a base that is approved by a structural engineer.
- **Overflow device.** The storage capacity of cisterns will likely be exceeded in large storms, depending on the catchment area and size of cistern. The overflow can occur through a hose, pipe, or other means. The discharge from the overflow can be directed to either the yard or back into the downspout or private drain, which leads to a public sewer.
- **Screen(s).** A screen placed between the downspout and the top of the cistern keeps leaves and other debris from entering the cistern and potentially clogging hoses, spigots or other irrigation equipment; a finer-grade screen can prevent mosquitoes and other bugs from entering and breeding in the cistern.
- **Pump (optional).** The simplest cistern designs drain by gravity, without a pump. However, projects should consider incorporating a pump so the cistern water can be delivered with more pressure through a hose or irrigation system, making use of cistern water much more efficient. Pump installation can be fairly straightforward, but it is recommended that a professional contractor be involved in pump installation.
- **Downspout diverter (optional).** Diverting overflow and/or winter flow into the sewer is a good option for sites in which overflow and/or over-wintering is a concern. Downspout diverters range in sophistication and reliability and are best incorporated at the beginning of a project to ensure the cistern is equipped to handle it.
- **First flush/roof cleaner device (optional).** Cistern water that will be used for outdoor, nonpotable uses does not necessarily require a “first flush” to discard the first few gallons of water that hit the roof in a rain event, although some projects may choose to incorporate one to help prevent contaminants that gather on the roof between rains from entering the cistern. If water quality is a concern, investigate putting a small amount of chlorine or hydrogen peroxide in the cistern periodically.



This diagram illustrates one way to design a rainwater harvesting system. This example comes from the Council on the Environment of New York City.

Maintenance

At a minimum, the following should be considered:

- The cistern water should be used regularly.
- The cistern should be visually inspected for leaks or damages on a seasonal basis.
- Screens, filters and hoses should be checked and cleared of debris.
- Above-ground cisterns should be drained and remain empty for the winter.
- Additional maintenance may be required for more complex systems.

Permits/Requirements

It is recommended that the project lead inquire about permits at the beginning of a project (before installation). The following permits may be required from the City of Chicago, depending on the project.

- Building permit – if a shelter or other structure is built
- Electrical permit - for installations or alterations of electrical wiring
- Sewer permit – if the project involves external underground piping or any change to stormwater runoff
- Plumbing permit – if plumbing will be altered (e.g. if cistern water is intended for indoor use)

Note: For all cisterns erected in Chicago, a notarized “Design/Construction Affidavit in Support of the Stormwater Infiltration or at Grade Discharge of Downspouts on Residential Buildings” must be sent to the Sewer Design section of the Department of Buildings, City Hall Room 104, including a short letter of explanation and drawings and requesting a Zero Fee-based Miscellaneous Special Deposit. For more information, see the Stormwater Management Requirements & Regulations (noted below) or call (312) 744-3020.



One of 4 cisterns at the Chicago Center for Green Technology (CCGT), totaling 12,000 gallons.

Local Examples

- Chicago Center for Green Technology (445 N. Sacramento Blvd.) has 4 above-ground gravity-fed cisterns, totaling 12,000 gallons, which are used to water the site’s landscaping.
- Kilbourn Park Organic Greenhouse (Chicago Park District, 3501 N. Kilbourn) uses water from a 1,500-gallon above-ground cistern to water plants on the grounds and in the greenhouse.
- Mercy Housing Lakefront Public Housing is one of the few projects in Chicago that uses treated stormwater from a cistern for use inside the facility. (The project received a variance since the building code currently prohibits non-potable water to be used indoors.)
- A community youth garden in the Austin neighborhood (in Chicago) uses a 330-gallon plastic container--called a “super-barrel” by the Center for Neighborhood Technology--made from an industrial bulk container to water apple trees.
- Garfield Park Conservatory (Chicago Park District, 300 N. Central Park Ave.), uses water from a 1,200-gallon above-ground cistern to water plants on the grounds.



330-gallon “super-barrels” used to water landscaping at housing complex in Oak Park and a community garden in the Austin neighborhood in Chicago. The right one is disguised with wood planks (credit Center for Neighborhood Technology)

Purchasing and Installation

These sources are not endorsed by the City of Chicago; this list is merely for informational purposes.

Company	Good/Service	Location	Phone	Web
Arrowhead Plastic Engineering, Inc.	tanks (polyethylene, fiberglass, steel)	Muncie, IN	(765) 286-0533	www.arrowheadtanks.com
August Winter & Sons	tanks (industrial, custom), piping/accessories	Appleton, WI	(920) 739-8881	http://www.augustwinter.com
Basco, Inc.	tanks	University Park, IL	(800) 776-3786	http://www.bascousa.com
Bornquist Inc.	tanks and piping accessories	Chicago, IL	(773) 774-2800	www.bornquist.com
The Cary Company	tanks/barrels and accessories (IBC used for "super barrels")	Addison, IL	(630) 376-2400	www.thecarycompany.com
CB Mills	tanks (industrial, custom)	Gurnee, IL	(847) 662-4000	http://www.cbmills.com/
Clack Corporation	piping/accessories	Windsor, WI	(608) 846-3010	http://www.clackcorp.com
Fato Industries, Inc	tank (industrial, fiberglass, custom)	Kankakee, IL	(815) 932-3015	http://www.fato-industries.com/
J.R. Smith Manufacturing Co.	tank and piping/accessories	Montgomery, AL	(334) 277-8520	http://jrsmith.com/green_building/index.htm
Kennedy Tank & Mfg. Co., Inc	tank (steel, custom)	Indianapolis, IN	(317) 787-1311	http://www.kennedytank.com/
Lake Street Landscape Supply	tank and piping/accessories (residential, commercial)	1810 W Lake Street, Chicago, IL	(312) 226-0760	http://www.lakestreetlandscapesupply.com/
Rainbird	piping/accessories	Dublin, OH	(800) 724-6247	www.rainbird.com
Spec-All	tanks (steel, wood), installation	Austin, TX	(800) 463-1898	http://www.specallproducts.com/
Wahaso	design (commercial and industrial)	Hinsdale, IL	(630) 235-2143	http://www.wahaso.com/
Xerxes Corp.	tank (fiberglass)	Minneapolis, MN	(952) 887-1890	www.xerxescorp.com

More information

- City of Chicago Department of Environment www.cityofchicago.org/Environment
- City of Chicago Department of Water Management www.cityofchicago.org/Water
Click "Stormwater Management Requirements & Regulations." Click "Sewer Construction & Stormwater Management Requirements" for the current year. (The affidavit(s) required for cisterns can be found as appendices to the "Regulations" document.)
- Managing Wet Weather with Green Infrastructure: Municipal Handbook (Low Impact Development Center for EPA) http://actrees.org/files/Research/epagi_harvesting.pdf
- Portland Bureau of Environmental Services <http://www.portlandonline.com/bes/index.cfm?c=43110>
- Council on the Environment of New York City <http://cenyc.org/openspace/rainwater>
- One Drop at a Time (a local residential do-it-yourself pilot) http://www.delafleur.com/168_Elm/08_Cistern_01.html
- Center for Neighborhood Technology <http://cnt.org/natural-resources>

Contact us! rainbarrel@cityofchicago.org or (312) 742-9283.