

Considerations for design

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Great guide from Greenbuilder

Capacity Needs

- A conserving household may use 25- 40 gallons of water per person per day. Multiply the number of persons in the household by the average use (40 gallons per person is a generous amount, 25 gallons is quite conservative. See the Water Budget section if more precise amounts are needed.) The longest drought in 50 years lasted 75 days in our area. Multiply the total of the number of persons times daily use times 100. This gives a safety factor of 25 days over the worst-case scenario of the last 50 years. The total is the amount of storage capacity required.

Pasted from <<http://www.greenbuilder.com/sourcebook/RainwaterGuide1.html>>

If our house is sized for 5 people at 30 g each = 150 gpd

3.0 Subsystem Components

A rainwater harvesting system consists of the following subsystems: catchment area (roof), conveyance system (guttering, downspouts, and piping), filtration, storage (cistern), and distribution.

- 3.1 Catchment Subsystem
 - Rainwater harvesting can be done with any roofing material if it is for non-drinking use only. For potable use of rainwater, the best roof materials are metal, clay, and cementitious although all roof material types have been used (except asbestos). Asbestos roof materials used in older homes should not be part of a system to provide drinking water. Asphalt shingles can contribute grit to the system and need a pre-filter for the water before it enters the cistern. Lead materials in any form should not be used in the system (i.e. lead flashing).
- 3.2 Conveyance Subsystem
 - Gutters are used to convey water from the roof to pipes to the cistern.
 - If a straight run of gutter exceeds 60 feet, use an expansion joint.
 - Keep the front of the gutter one half inch lower than the back.
 - Provide a gutter slope of 1/16 inch per foot minimum.
 - Provide gutter hangers at 3 feet O.C. (on center).
 - Gutter should be a minimum of 26 gauge galvanized steel or 0.025 inch aluminum.
 - Downspouts should provide 1 square inch of downspout opening for every 100 square feet of roof area.
 - The maximum run of gutter for one downspout is 50 feet.
 - The conveyance piping from the gutter system to the cistern or filter should be Schedule 40 PVC or comparable in a 4 inch diameter. Do not exceed 45 degree angle bends in horizontal pipe runs and provide 1/4 inch slope per foot minimum. Use one or two-way cleanouts in any horizontal pipe run exceeding 100 feet.
- 3.3 Storage Subsystem
 - The storage tank (cistern) must be sized properly to ensure that the rainwater potential is optimized. See the previous section regarding capacity for sizing information.
 - Cisterns can be located above or below ground.
 - The best materials for cisterns include concrete, steel, ferro-cement, and fiberglass.
 - When ordering a cistern, specify whether the cistern will be placed above or below ground and if the cistern will be used to store potable water. (Fiberglass cisterns are constructed differently to meet the various criteria.)
 - If using a manufactured tank designed to hold drinking water, the tank should conform to the published specifications of the American Waterworks Association. (See Resources.)
 - Cistern characteristics
 - A cistern should be durable and watertight.
 - A smooth clean interior surface is needed.
 - Joints must be sealed with non-toxic waterproof material.
 - Manholes or risers should have a minimum opening of 24 inches and should extend at least 8 inches above grade with buried cisterns.
 - Fittings and couplings that extend through the cistern wall should be cast-in-place.
 - Dissipate the pressure from the incoming water to minimize the stirring of any settled solids in the bottom of the cistern. This can be accomplished in a concrete cistern by placing concrete blocks (cavities facing upward) surrounding the base of the inlet pipe. The blocks can be 8" x 8" x 16" blocks with the pipe exiting one inch above the bottom of the cistern. Baffles to accomplish the same result can be made as part of fiberglass cisterns. This is not a concern for cisterns that always have a large reserve.
 - The use of two or more cisterns permits servicing one of the units without losing the operation of the system.
 - Have a fill pipe on the cistern for adding purchased water as a backup.
 - Have a cover to prevent mosquito breeding and algae growth from contact with sunlight.

Diameter of Round Type

DEPTH	6	8	10	12	14	16	18
6	1266	2256	3522	5076	6906	9018	11412
8	1688	3008	4696	6768	9208	12024	15216
10	2110	3760	5870	8460	11510	15030	19020
12	2532	4512	7044	8532	13812	18036	22824
14	2954	5264	8218	11844	16114	21042	26628

Length of Sides of Square Type

DEPTH	6	8	10	12	14	16	18
6	1614	2874	4488	6462	8796	11490	14534
8	2152	3832	5984	8616	11728	15320	19378
10	2690	4790	7480	10770	14660	19150	24222
12	3228	5748	8976	12924	17592	22980	29068
14	3766	6706	10472	15078	20524	26810	33912

- 3.4 Filtering Subsystem
 - The rainwater may become contaminated by dirt, debris, and other materials from the roof surface. The best strategy is to filter and screen out the contaminants before they enter the cistern.
 - A leaf screen over the gutter and at the top of the downspout is helpful.

Guidelines

- 1) Capacity
- 2) Rainwater for Irrigation
Example of Irrigation Requirement Estimation
- 3) Subsystem Components
Catchment
Conveyance
Storage
Filtering
Distribution

Pasted from <<http://www.greenbuilder.com/sourcebook/Rainwater.html>>

Downspouts are located about every 20 ft. along the gutter, instead of the more common 40 feet. This ensures that heavy rains will not likely overflow the gutter and instead will flow to catchments

Pasted from
<<http://ag.arizona.edu/AZWAT/ER/arroyo/071rain.html>>

- A screened 1.25 inch foot valve inside the tank connected to an 1.25 inch outlet from the cistern approximately one foot above the bottom (to avoid any settled particles) will help maintain the prime on the pump. A float switch should be used to turn off the pump if the water level is too low.
 - Another alternative is the use of a floating filter inside the cistern connected to a flexible water line. This approach withdraws the water from approximately one foot below the surface which is considered to be the most clear water in any body of water.
 - The water that will be used for potable purposes can pass through an inline purification system or point of use water purification system. Other uses for the water do not need additional purification. (Water purification options are not discussed in the Sourcebook.)
- 3.5 Distribution
 - Removing the water from the cistern can be achieved through gravity, if the cistern is sufficiently high enough, or by pumping.
 - Most cases will require pumping the water into a pressure vessel similar to the method used to withdraw and pressurize water from a well (except a smaller pump can be used to pump from a cistern).
 - A screened 1.25 inch foot valve inside the tank connected to an 1.25 inch outlet from the cistern approximately one foot above the bottom (to avoid any settled particles) will help maintain the prime on the pump. A float switch should be used to turn off the pump if the water level is too low.
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Pasted from <<http://www.greenbuilder.com/sourcebook/RainwaterGuide3.html>>

Rainwater Quality

The image of falling rain may be pure and refreshing but harvested rain is not without water quality concerns. Rain in certain urban areas may contain various impurities absorbed from the atmosphere, including arsenic and lead. Certain desert conditions also can cause rainwater quality concerns. Desert rain is infrequent and, therefore, bird droppings, dust and other impurities accumulate between rain events. They then occur in high concentrations in runoff when it does rain. As a result, the quality of harvested rainfall needs frequent monitoring if it is used for potable uses.

Pasted from <<http://ag.arizona.edu/AZWATER/arroyo/071rain.html>>

Regular maintenance should include:

- Keeping roof catchments clean and clear of moss, lichen, debris and leaves;
- Cutting back trees and branches that overhang roofs;
- Regular inspections and, if necessary, cleaning of gutters;
- Cleaning gutter and tank inlets and screens every 3–4 months;
- Disinfecting the supply, if tank contamination is apparent;
- Inspecting tanks annually and cleaning them out if necessary; and
- Testing the water periodically.

Good design features should include:

- A clean, impervious roof made from non-toxic material;
- The absence of lead flashings or lead-based paints;
- A course filter and first flush device to intercept water entering tank and gutter guards / screens;
- Wire mesh (screens) to cover all tank inlets;
- A covered and light-proof tank;
- Tank taps or draw-off pipes that are at least 100 mm above the tank floor (Alternatively, a floating arm draw-off valve);
- A tank floor which slopes towards the sump and washout pipe; and
- A well-covered manhole for easy access and inspection.

Pasted from <http://www.rainharvesting.com.au/rainwater_research.asp>