# A Guide:

# Rain Barrel Water Harvesting

*Water harvesting system in Nogales, Arizona*


**By**

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# Introduction

The southwestern United States and northwestern Mexico have generally dry climates and rapidly growing populations. Both Nogales, Arizona, and Nogales, Sonora, have limited water resources and must rely on the drought-prone Santa Cruz River for 50 percent or more of their water supply.

Rainwater is one way to increase the quantity of available water for the two cities. Approximately 40 percent of all urban water use is for irrigation, and rainwater captured in water barrels is a simple way to meet the needs of outdoor plants.

Household rainwater use is beneficial for several reasons:

1. It reduces the amount of water consumed by a household – homeowners can save money on their water bill.
2. It gives homeowners the satisfaction of knowing that they are conserving our limited water resources.
3. It provides additional water for landscaping needs.
4. It reduces flooding of streets during rainstorms by capturing the water for use in yards.

### *A lesson from India*

A thirsty crow peered into an earthen pitcher. There was water at the bottom.

"Dregs," it cawed, alarmed.

But it was thirsty. It began to drop pebbles into the pitcher. Drop by drop, the water rose to the top. The crow drank and flew away sated. It could have used a drill to smash through to the water. It didn't.

This water harvester of a crow could teach us a thing or two.

We stare at the dregs of our ingenuity, at a resource traditionally underutilized. We caw our alarm. But we only keep cawing, raucously at that.

## Health concerns of rainwater

When rainwater comes in contact with a roof or collection surface, it can wash many types of bacteria, molds, algae, protozoa and other contaminants into the storage tank. If you plan to use the rainwater *inside* the house for drinking or cooking, you would need to use filtration and disinfection practices. However, if the rainwater is only used *outside* for plant watering, the presence of contaminants would not be of major concern.

The location of the water harvesting system can have an effect on the quality of the rainwater. A location exposed to air pollution caused by industries such as cement kilns, gravel quarries and crop dusting, or concentrated automobile emissions could adversely affect the rainwater quality. Securely cover all tanks and put fine-mesh screens on all inlet and outlet pipes to keep mosquitoes from entering tanks.

***We need to recognize that the source of all water on earth is not the river, is not the underground aquifer, is not the lake, well or stream. Rain is the source of all water.***

# Building your system

## A. Gutters and Downspouts

Gutters and downspouts will catch the rain from the roof and transport it to the barrels or storage tanks. These must be properly sized, sloped and installed to maximize efficiency and minimize water loss.

The most common materials for gutters are seamless five-inch-wide aluminum or galvanized steel. To keep leaves and other debris from entering the system, the gutters can have a continuous leaf screen made of quarter-inch wire mesh in a metal frame installed along the length of the gutter and a screen or wire basket at the head of the downspout. Or, just clean out gutters regularly.

Slope the gutters one-sixteenth inch per one foot of gutter to assure proper downward flow. Place the gutter hangers about every three feet. The outside face of the gutter should be lower than the inside face to assure drainage away from the building wall. Gutters should be placed one-quarter inch below the slope line of the roof so that debris can clear without knocking down the gutter.

## B. Barrels and Storage Tanks

We recommend using 55-60-gallon plastic barrels as the most low-cost, easy-to-install option. The plastic barrels can be transported to a house and hand carried to the proper location.

Barrels and storage tanks should be located on firm, level ground or on a level pad or blocks. The higher the barrels are raised, the more gravity-fed pressure will push water through a garden hose or into a watering can.

Ideally, the vegetation to be watered will be downgrade from the barrels and will be watered by merely opening the water valve attached to the barrels. The water will flow downhill from the barrels to the vegetation.

Larger tanks should be located 6-10 feet from the foundation of the house to avoid foundation damage.

Barrels are connected together by one-half-inch PVC pipe. An overflow PVC pipe on the barrels will prevent damage to the barrels during heavy rains.

## C. Material Costs and Suppliers

Cost of materials for the demonstration house included:

| | **Quantity** | **Cost** |
|---|---|---|
| 55-gallon plastic rain barrels | 6 | $90 |
| Cement blocks (to raise height of barrels) | 18 | $20 |
| PVC pipe and connections | | ≈ $25 |
| Gutters, downspouts, hangers, straps, sealant | | ≈ $160 |
| Drain fittings and hose bibs (faucets) | | ≈ $80 |
| TOTAL | | ≈ $375 |

**Southern Arizona Suppliers:**

Rain barrels:
Freeway Tanks & Pumps, Inc.
1415 S. Farmington Rd.
Tucson, AZ 85213-1415
520-623-2573

Other materials:
Home Depot
Various locations

**Step-by-step guide:**

# Installing a rooftop rainwater harvesting system

**Step One: Install Gutters**

**Step Two : Attach Downspouts**

**Step Three:**
**Drill Holes in Barrels**

**Step Four: Attach Bib Hose Connector and Valve**

**Step Five:**
**Attach PVC to Barrels**

## Completed Projects

## Appendix 1:  Supply & Demand Calculations

For those who just want a simple system to capture one or two barrels of rainwater to water gardens and trees, calculations of supply and demand will probably not be necessary.  However, for those who want a more complex system that has the capability to capture more rainwater, these calculations would be useful.

Average Precipitation Nogales, Arizona, 1952-2000 (inches)
Annual = 17.9

| Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | .9 | .9 | .4 | .2 | .5 | 4.5 | 4.2 | 1.6 | 1.4 | .7 | 1.5 |
| | | | | | | | | | | | |

(Western Regional Climate Center)

Supply in Gallons = Roof Area (in square feet) x rainfall (in ft)

**Example**:  a 20 x 30 ft. roof area is 600 sq. ft.
The roof area is multiplied by the amount of rainfall (in feet) to get the supply in cubic feet.
In this case, a 600 sq. ft. roof in the month of February would receive .9 in., or .08 ft. (inches are converted to feet) of rain, for a total of 600 sq. ft. x .08 in = 48 cubic feet of rainwater.

To convert cubic feet to gallons, multiple by 7.48.
So, 48 cubic ft. x 7.48 = 359 gallons of rainwater.

Question: How many 55-gallon drums would be needed to capture all of the rainwater in February?
Answer:  6.5 barrels (divide 359 by 55)

## Calculating Landscape Demand

Again, these calculations are not necessary for smaller rainwater harvesting projects.
The demand formula (from the booklet, "Harvesting Rainwater For Landscape Use") is:

Demand = (ET x Plant Factor) x area x 7.48

Evapotransporation (ET) for Tucson (Nogales is not listed as an Arizona Meteorological Network Station)

| **Month** | **Feet** | | | | |
|---|---|---|---|---|---|
| Jan | .2 | June | .9 | Nov | .3 |
| Feb | .3 | July | .8 | Dec | .2 |
| Mar | .5 | Aug | .7 | | |
| Apr | .7 | Sept | .6 | TOTAL | 6.5 |
| May | .8 | Oct | .5 | | |

The Plant Factor represents the percent of ET that is needed by the plant. This is determined by the type of plant – high, medium, or low water use. These plant factors are approximations that tell us what is needed to maintain plant health and appearance.

**Plant Water Use Table**

| **Plant Type** | **Percentage Range** | |
|---|---|---|
| | High | Low |
| Low water use | .26 | .13 |
| Medium water use | .45 | .26 |
| High water use | .64 | .45 |

Area:  The irrigated area refers to how much area is planted and is expressed in square feet.
Conversion Factor:  The conversion factor of 7.48 converts cubic feet into gallons.

## Appendix 1, continued

**An Example Calculation**

Calculate landscape water demand for January.
We have a 100 square foot (10 ft x 10 ft) area that we would like to water.
The area is comprised of medium water use plants and we use .45 for the plant factor.
Under this scenario the equation would look like:

Demand = (.2 ft. ET x .46 Plant Factor) x 100 sq. ft. area x 7.48
= (.092 ft.) x 100 sq. ft. x 7.48
= 68.8 gallons

This tells us that we would need 68.8 gallons of water to irrigate the 100 sq. ft. area of medium water-use plants in January.

## Appendix 2: Water harvesting resources

City of Tucson Water Harvesting Guidance Manual. http://www.ci.tucson.az.us/water/harvesting.htm

Harvesting Rainwater for Landscape Use. Available from the Arizona Department of Water Resources, Tucson Active Management Area, Water Conservation Specialist, 400 W. Congress Suite 518, Tucson AZ 85701, or call 520-770-3800. Also available at http://ag.arizona.edu/pubs/water/az1344.pdf

An Introductory Guide to Water Harvesting in Ambos Nogales. Published by the Bureau of Applied Research in Anthropology, University of Arizona. Available at http://nogales.bara.arizona.edu/WH.Guide.final05.31.02.PDF

Texas Guide to Rainwater Harvesting, at http://www.twdb.state.tx.us/publications/reports/RainHarv.pdf

Sustainability of semi-Arid Hydrology and Riparian Habitat, Residential Water Conservation page, http://www.sahra.arizona.edu/programs/water_cons/

Harvest H20. The Online Rainwater Harvesting Community. http://www.harvesth2o.com/

**For questions contact Terry Sprouse at tsprouse@cals.arizona.edu.**
**For an electronic version of this booklet, visit the**
**WRRC webpage at: http://www.ag.arizona.edu/AZWATER/**
**or the Sonoran Institute Webpage at: www.sonoran.org**