Rainwater Collection – Calculating Water Supply and Demand to Estimate Storage Needs

University of Arizona Cochise County Cooperative Extension Water Wise Program
waterwise.arizona.edu

Balancing the water budget

When it comes to finances, balancing the budget is important. But what about balancing our water use? We turn on the tap and out comes clean, treated water that we assume will always be there. We need to realize that using water on our landscapes is a luxury, and one we may have to go without if water becomes scarce. One way to help prevent that scarcity is to balance our water budget. This means using no more water than can be collected from what falls on our property. While that may not be a reality for many of us when it comes to meeting our indoor water needs, it is possible to meet outdoor water needs using only rainwater.

How much rain water can you collect?

A 1000 square foot house, small by many standards, has the potential to provide 600 gallons of rain water for every one inch of rainfall. The runoff can be actively collected off the roof and stored for later use on landscape plants. Rain that falls directly on the ground can be passively collected and directed to plants to give them a good soaking.

How big a storage tank will you need?

How much you need to collect depends on the quantity and types of plants in your yard, and how large a collection area you have. The larger the collection area, the less you need to store because more can be collected in light rain. While it may seem that the more plants you have the more water you need , it is not always true. A landscape containing a dominant amount of plants either native or adapted to your area will need less water than the same number of plants that typically grow in areas with more rainfall or in temperate climates. Creating a balanced financial budget usually involves working with limitations and making tradeoffs. This also holds true for a balanced water budget.

How to create a budget

The key to making your raindrops work for you is to create a water budget. This budget works much the same as a financial budget. By inventorying plant material, “expenditures” can be calculated. Measuring roof areas can provide “income” information. Much like balancing a check book, water budget calculations provide monthly estimates on how much water is needed in the landscape and how much can be collected based on historical rainfall information. The budget also helps with planning a new landscape or altering an existing property to ensure water needs are meet.

For the expenditures:

- Inventory the area(s) to be watered
- Estimate the amount of water needed monthly. This will be based on plant size and type (tree, shrub or small plant). Estimators are available to help with this task. (see *Resources*)
- To plan for future plant growth and to simplify calculations, use mature plant size

For the income:

- Measure the collection area. (This is the footprint of the building being used for collection)
- Use historical rainfall data to estimate how much can be collected each month

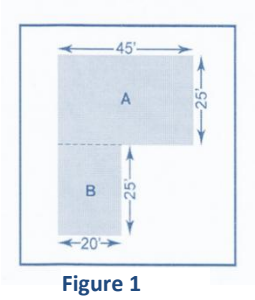

Figure 1

Estimate tank size by creating a budget:

Create a running supply and demand balance for a 24 month period by adding estimated rainfall supply and subtracting water used on plants (demand).

If during some months plant demand is greater than your supply then tap water must be used to supplement during these periods.

Formula to Calculate Water Supply

Multiply:

collection area in square feet

by

rainfall in inches

by

0.623

by

efficiency factor

(usually 0.90 for most roofs)

For example:

1000 sqft roof area x 1 inch rain x 0.623 x 0.90 =

560 gallons of water per inch of rain

Tank sizing worksheet examples are shown below.

To increase supply:

- Increase your catchment area.
- Build or retrofit roofs or shade structures
- Build a "rain barn" for tanks

To reduce demand:

- Reduce water-using landscape areas by replacing with "hardscapes" (sculptures, patios, walkways, outdoor kitchens)
- Reduce plant density
- Replace high-water-use plants with lower-water-use plants.
- For new landscapes, select types and numbers of plants that can be supported by the water harvested from your existing catchment
- Use mulch to reduce surface evaporation

How to make your rain water supply last even longer and go farther

Harvest stormwater and direct it to plants. Create speed bumps to slow the water down and make low spots to help the water soak in. Any time you can help plants get a deep soaking of rain water, less water needs to be stored and saved for later use (see Passive Water Harvesting Fact Sheet listed below).

RESOURCES:

Find local rainfall data at **www.noaa.gov** and search for "Regional Climate Centers"

UA Publications available covering related topics (http://cals.arizona.edu/pubs/):

RainScapes, AZ1539

Basic Components of a Rainwater Storage System

Passive Water Harvesting

Harvesting Rainwater for Landscape Use, AZ1344

Additional resources, including an electronic water budget calculator with plant list, can be found at **waterwise.arizona.edu**

Rules of thumb:

- *If annual demand is less than annual supply then the total annual deficit balance will dictate the tank size.*

Table 1 – Tank Sizing Worksheet (demand is less than supply)
Sample calculations below show how tank size is estimated to be 191 gallons

Month	*(in gallons)* Total Plant Demand	Supply	Balance	Cumulative Available for Storage Year 1	Year 2	Supplemental Water Needed
Jan	34	83	49	49	380	0
Feb	34	46	11	60	392	0
March	69	31	-38	23	354	0
April	69	25	-43	0	311	20
May	108	18	-90	0	221	90
June	108	27	-81	0	140	81
July	108	211	103	103	243	0
Aug	108	270	162	265	404	0
Sept	69	90	22	287	426	0
October	69	81	13	300	439	0
November	34	32	-3	297	436	0
December	34	69	34	331	471	0

Annual Demand = 843 gallons
Annual Supply = 983 gallons

- *If annual demand is greater than annual supply then the largest amount of cumulative water stored over a two year period will dictate the tank size and supplemental water will be needed. In order to balance this budget, supply will need to be increased or demand will need to be reduced.*

Table 2 – Tank Sizing Worksheet (demand exceeds supply)
Sample calculations below show how tank size is estimated to be 193 gallons

Month	*(in gallons)* Total Plant Demand	Supply	Balance	Cumulative Available for Storage Year 1	Year 2
Jan	47	83	37	37	193
Feb	47	46	-1	35	192
March	94	31	-63	0	129
April	94	25	-68	0	61
May	158	18	-140	0	0
June	158	27	-131	0	0
July	158	211	53	53	53
Aug	158	270	112	165	165
Sept	94	90	-3	162	162
October	94	81	-12	150	150
November	47	32	-15	134	134
December	47	69	22	156	156

Annual Demand = 1193 gallons
Annual Supply = 983 gallons

- *Increasing the tank storage size by 25% is recommended to accommodate varying rainfall amounts and seasonal fluctuations.*