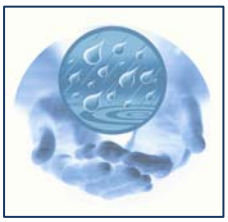
RAINWATER HARVESTING
DEMAND AND NEEDS ASSESSMENT



The design and sizing of a rainwater harvesting system has several key elements.

1. **Projected demands**
2. **Anticipated annual rainfall**
3. **Available surface collection area**
4. **Available cistern storage volumes**

Homes using rainwater should maximize low flow equipment such as faucets, shower heads, toilets, washing machines and dishwashers. **Homes totally on rainwater systems should design for about 35 gallons per capita per day for indoor use.** For the past 13 years we have averages less than 25 gallons per capita per day for indoor use on an annual basis.

Outdoor water use is highly variable and depends on the size of area to be maintained and type of landscaping. **Typically, outdoor water use can make up 50% or more of the total water used.** Our experience over the past 5 years is that outdoor water use is 24% to 46% of the total water use on an annualized basis.

The following is a summary of total water use at our house:

Year	Total Annual Use Gal.	Daily Average Gallons	Average Indoor Gal./Day	Average Outdoor Gal./Day	Rainfall inches/ year
2010	31,688	87	41 (47%)	46(53%)	40.02
2011	27,508	75	42 (56%)	33 (44%)	14.67
2012	30,186	83	43 (52%)	40 (48%)	31.08
2013	26,100	71	47 (66%)	24 (24%)	33.64
2014	29.614	81	51 (63%)	30 (37%)	26.26
2015	26,237	72	46 (64%)	26 (36%)	53.94

The above summary is an annualized average that doesn't reflect minimum or maximum usage months.

Example:

Month	Total Use Gallons	Daily Average Gallons	Average Indoor Gal./Day	Average Outdoor Gal./Day
June 2005	10,074	336	46 (14%)	290 (86%)
February 2006	1,444	48	42 (88%)	6 (12%)

(Above examples are selected from our records of usage.)

ANNUAL AVERAGE RAINFALL:

In designing a rainwater harvesting system one must consider the expected annual average precipitation amounts as well as the maximum number of anticipated days without rain.

For the Boerne, Texas area the average rainfall for the past 123 years is 34 inches annually. However, at our home, for the past 10 years the average is 29.52 inches/year and for the last 5 years, the average is 29.13 inches per year.

MAXIMUM NUMBER OF DRY DAYS:

Also, in determining the necessary storage capacity of the system one needs to know the maximum number of dry days. Based on our research it appears that the Boerne area would experience about 90 dry days. To be conservative I would use 120 days or 4 months without rainfall.

Knowing the long-term average rainfall and number of anticipated dry days, one can determine the required storage capacity and collection surface area once the demand is calculated.

DEMAND ESTIMATE

Indoor Daily Demand Estimate Based on 3 Persons Per Household

Faucets – 5 minutes per person per day @ 1.5 gallons per minute, 5 x 1.5 x 3 = 22.5 gallons per day = 675 gallons/month

Showers – 5 minutes per person per day @ 2 gallons per minute, 5 x 2 x 3= 30 gallons per day =900 gallons/ month

Toilets – 6 flushes per person per day @ 2 gallons per flush, 6 x 2 x 3 =36 gallons per day – 1,080 gallons/month

Washing Machine – 3 loads per week @ 16 gallons per load, 3 x 16 x 4 = 192 gallons/month

Dishwasher – 4 loads per week @ 8 gallons per load, 4 x 8 x 4 = 128 gallons /month

Total indoor use = 2,975 gallons per month = 99 gallons per day = 33 gallons/person /day

Add outdoor use:

Add 45 gallons per day for outdoor use, 99 + 45 = 144 gallons / day

Total Usage = 4,320 gallons/month

EFFECTIVE RAINFALL

Indoor water use is estimated at 33 gallons per person per day and an allowance for outdoor water is included which results in a demand of 144 gallons per day. This projected use for 120 days yields 17,280 gallons which I would round up to 20,000 gallons of required storage capacity.

It is known that 1 inch of rain over a 1,000 square foot surface yields 623 gallons. It is also known that only about 80% of the rainfall is actually captured.

Therefore, the effective rainfall for the Boerne area is 26.4 inches (80% of 33 inches) annually. A 1,000 square foot area would capture 16,447 gallons annually.

Using 144 gallons per day results in an annual demand of 52,560 gallons per year. Based on long term historical rainfall averages and a consummation rate of 144 gallons per day, we can conclude that a minimum of a 3,200 square foot collection surface is required.

SUMMARY

If one had 20,000 gallons storage capacity one could weather a 120-day dry spell and still use 144 gallons per day of stored water. This would be equivalent to a drought of record condition.

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