Rainwater Harvesting

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Rainwater Collection Issues

- How much rainfall can I expect?
  - Annual total
  - Seasonal distribution
- How much rainwater can I collect?
  - Collection area
  - Storage
- How much water do I need?
  - Household use
  - Irrigation
  - Livestock
Oklahoma Annual Precipitation
(30-year Average: 1971-2000)
Oklahoma Annual Precipitation
(30-year Average: 1961-1990)

Normal precipitation (1961 – 1990)

- ≤16"
- 16 – 18"
- 18 – 20"
- 20 – 22"
- 22 – 24"
- 24 – 26"
- 26 – 28"
- 28 – 30"
- 30 – 32"
- 32 – 34"
- 34 – 36"
- 36 – 38"
- 38 – 40"
- 40 – 42"
- ≥52"
Oklahoma Precipitation
What is Normal?

1990 annual percent of normal precipitation.

OCS 1990 Annual Summary
Oklahoma Rainfall
What is Normal?

1998 Annual Percentage of Normal Precipitation

OCS 1998 Annual Summary
## OK Monthly Rainfall Distribution

<table>
<thead>
<tr>
<th>Month</th>
<th>Percentage of Annual Rainfall</th>
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<tbody>
<tr>
<td>January</td>
<td>4%</td>
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<tr>
<td>February</td>
<td>5%</td>
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<tr>
<td>March</td>
<td>8%</td>
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<td>April</td>
<td>9%</td>
</tr>
<tr>
<td>May</td>
<td>14%</td>
</tr>
<tr>
<td>June</td>
<td>12%</td>
</tr>
<tr>
<td>July</td>
<td>8%</td>
</tr>
<tr>
<td>August</td>
<td>8%</td>
</tr>
<tr>
<td>September</td>
<td>11%</td>
</tr>
<tr>
<td>October</td>
<td>9%</td>
</tr>
<tr>
<td>November</td>
<td>7%</td>
</tr>
<tr>
<td>December</td>
<td>5%</td>
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</table>
Rainwater Volume Collected

Volume of water collected = \( L \times W \times D \)

- \( D \): rainfall depth
- \( W \): catchment width
- \( L \): catchment length
Roof Catchment Area

Use the vertical projection of the eave line, not the sloped roof area.

Square footage based on these measurements.
Annual Rainwater Yield
(70% Harvest Efficiency)

Annual Rainfall

<table>
<thead>
<tr>
<th>Annual Rainfall (in/yr)</th>
<th>Storage Volume (gal.)</th>
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<tr>
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<td>0</td>
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<tr>
<td>20</td>
<td>1000</td>
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<tr>
<td>30</td>
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<tr>
<td>40</td>
<td>3000</td>
</tr>
<tr>
<td>50</td>
<td>4000</td>
</tr>
<tr>
<td>60</td>
<td>5000</td>
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</table>

Catchment Area (sq. ft.)

0 500 1000 1500 2000 2500 3000 3500 4000
Roof Catchments- Potable Water

• Preferred Materials
  – Steel (galvanized, painted)
  – Tile (clay, cement)
  – Wood (untreated)
  – Fiberglass
  – Composition

• Undesirable Materials
  – Tar
  – Asbestos
Rainwater Conveyance Structures
(from Sustainable Building Sourcebook)

- Slope gutters 0.5% (1 in/16 ft)
- Place gutter hangers 3 ft on center
- Use expansion joints in gutters 60 ft or longer
- 1 downspout per 50 ft of gutter length
- 1 in² of downspout area per 100 ft² of roof area
- Slope horizontal conveyance pipes 2% (1 in/4 ft)
- Horizontal conveyance pipes should have cleanouts every 100 ft
- Limit horizontal conveyance pipe bends to 45°
Gutter Guard to Remove Roof Debris

Slide This Side Under Shingles

Clip This Side to Gutter

¼ to ½-inch wire mesh
Homemade Roof Washer

- Downspout from Roof
- ¼" Hardware Cloth
- 4" Hole

6" to 12" Wide Trough

Tank or Barrel, hole in top

2½" to 3" Pipe to Cistern

Trickle Drain
Diverting Rainwater to Storage Tanks

Manually operated diverter allows initial rainfall to be wasted while roof is being washed free of sediment.

Overflow hose 2-4 ft above downspout end with small weep hole allows initial runoff and sediment to collect in bottom of downspout. After initial washing period, cleaner water overflows into collection tank.
Rainwater Storage
(from Sustainable Building Sourcebook)

- Cisterns may be above or below ground
- Preferred materials: concrete, steel, fiberglass
- Smooth interior surfaces preferred
- Use water-tight, non-toxic joint sealant
- Cover to prevent mosquito and algae growth
- Manholes should be ≥24 inches wide
- Buried cistern manholes should be 8 inches or more above original ground surface
## Circular Tank Capacity
*(Tank Dimensions: feet – Capacity: gallons)*

<table>
<thead>
<tr>
<th>Height Diameter</th>
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### Square Tank Capacity
(Tank Dimensions: feet – Capacity: gallons)

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<td>36000</td>
<td>42000</td>
<td>48000</td>
<td>54000</td>
<td>60000</td>
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Large Capacity Above-Ground Cisterns

Nonpotable System
"Collecting rainwater from a house"

Hill Country Rain Systems
Large Capacity Below-Ground Tank

Product #: 350-025

1,700 Gallon Poly Underground Water Cistern

Customer: ___________________________ Order #: __________
Approval: ___________________________ Date: __________
Small Capacity Above-Ground Tanks

- New polypropylene rain storage barrels
- Recycled barrels
- Food-grade polyethylene
- Oak
Household Water Requirements

Typical Usage: 50-100 gallons/person-day

- Toilets: 0.6-1.6 gallons/flush
- Washing Machine: 30-50 gallons/load
- Dishwasher: 7-15 gallons/load
- Bathtub: 30-50 gallons/use
- Shower: 2.5-3.0 gallons/minute
- Kitchen/Bath Sinks: 1.0-1.5 gallons/minute
Peak Irrigation Water Requirements  
(Adequate for grass & small vegetables)

- **Eastern OK:** 0.20-0.25 inch/day  
  (18 gallons/100 sq. ft.-day)  
  (8150 gallons/acre-day)

- **Western OK:** 0.25-0.30 inch/day  
  (23 gallons/100 sq. ft.-day)  
  (9950 gallons/acre-day)

- The storage volume required makes rainwater irrigation makes impractical for large, water-intense landscapes
<table>
<thead>
<tr>
<th>Location</th>
<th>Warm Season Turf (inches/season)</th>
<th>Small Vegetables (inches/season)</th>
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<tr>
<td>Altus</td>
<td>18.4</td>
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<tr>
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<td>Woodward</td>
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Livestock Water Requirements

- Beef Cattle: 8-12 gallons/head-day
- Beef Calves: 1-1.5 gallons/100 lb-day
- Horses: 12 gallons/head-day
- Sheep & Goats: 2 gallons/head-day
- Chickens: 9 gallons/100 head-day
Rainwater Collection
(Drinking Water)

- Waste initial runoff to wash off sediment
- Screen organic matter (leaves) to prevent fermentation and disinfection by-products
- Filtration by coarse sand recommended
- Disinfection by chlorination, ozonation, or ultraviolet light is necessary
Rainwater Collection
(Irrigation)

- Waste initial runoff to wash off sediment
- Screen organic matter (leaves) to prevent fermentation
Units Conversions

• 1 acre-inch = 27,154 gallons
• 1 cubic foot = 7.48 gallons
• 1 cubic foot of water = 62.4 pounds
• 1 gallon of water = 8.34 pounds
Rainwater Harvesting Information

Green Building Program: Sustainable Building Sourcebook
www.greenbuilder.com/sourcebook/Rainwater.html

Texas Natural Resource Conservation Commission
www.tnrcc.state.tx.us/exec/sbea/rainwater/rainwater.html