Rainwater Harvesting Training

Offered Pursuant to Local Government Code §580.004, as added by

House Bill 3391

82nd Texas Legislature, 2011

Texas Water Development Board

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What is rainwater harvesting?

Rainwater harvesting is defined as the capture and storage of rainwater for subsequent use

(34 Texas Administrative Code §3.318(a)(5))

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Types of rainwater harvesting systems

While some rainwater harvesting systems can be land based, in Texas they are largely roof-based.

Roof based systems collect runoff from roof surfaces into rain barrels, cisterns, or other storage containers.

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Short history of rainwater harvesting

- Evidence of rainwater collection systems in Jordan dates back to at least 3,000 BC
- Ruins of cisterns built as early as 2000 BC are still standing in Israel
- In Texas, Mescalero Apaches used natural rainwater catchment systems near El Paso nearly 10,000 years ago to collect rainwater
- Presently, there are thousands of rainwater harvesting systems in Texas

References:

The Brethren of Cisterns by Robert Bryce

The Texas Manual on Rainwater Harvesting

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Advantages of rainwater harvesting

- Apart from costs to collect, store, treat, and convey the water into the facility, rainwater harvesting is free
- When properly managed, rainwater harvesting eliminates the need for costly treatment and distribution systems
- Rainwater is of superior quality: zero hardness, sodium-free, and nearly neutral pH (neither acidic nor basic)
- Rainwater harvesting is a water conservation practice
- Rainwater harvesting can reduce storm water runoff, thereby decreasing load on storm sewers

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Disadvantages of rainwater harvesting

- Rainwater harvesting may need to be supplemented with water from other sources, especially during extended dry periods or droughts
- Systems require regular maintenance after installation
- Storage systems can take up space around the house
- Standardized construction guidelines for systems are lacking

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Rainwater harvesting systems

can be simple

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Rainwater harvesting systems (contd.)

or elaborate and sophisticated

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Rainwater harvesting systems (contd.)

with pumps, filters, and water treatment units

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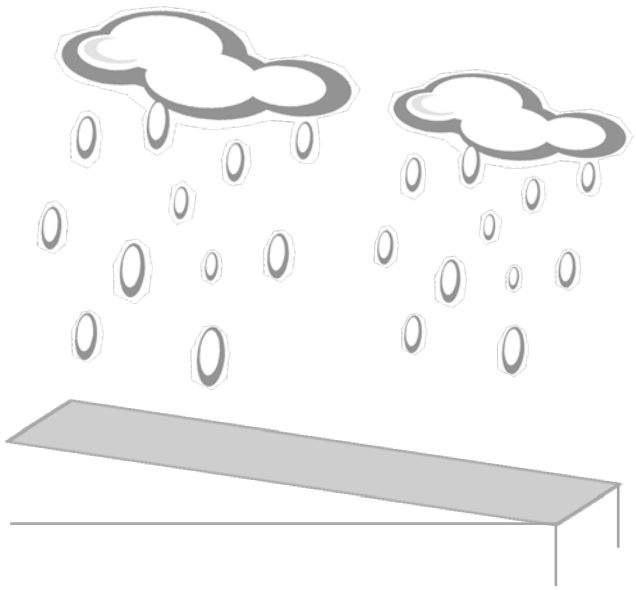
How much rainwater can be harvested?



1 inch of rain falling on a roof surface results in 0.62 gallons of water per square foot of roof

Example:

If 1 inch of rain falls on a 40 ft x 40 ft roof it would produce **992** gallons of water

[40 ft x 40 ft x 0.62 gallons/sq ft = **992** gallons of water]

However, not all of this water can usually be collected because of losses resulting from overflow or gutter splashout. To take these losses into consideration, a collection efficiency factor (generally 0.85) is applied.

Thus, in the above example, the actual amount of water that may be collected is about **843** gallons.

[992 gallons x 0.85 = 843 gallons]

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How much rainwater can be harvested?

Rule of thumb:

1 inch of rainfall on a 1,000 sq ft roof can produce approximately 525 gallons of water

For math-lovers:

Annual volume of harvested rainwater (gallons) =

roof area (sq ft) x annual rainfall (in) x collection efficiency (0.85) x 0.62 (gal/sq ft/in of rain)

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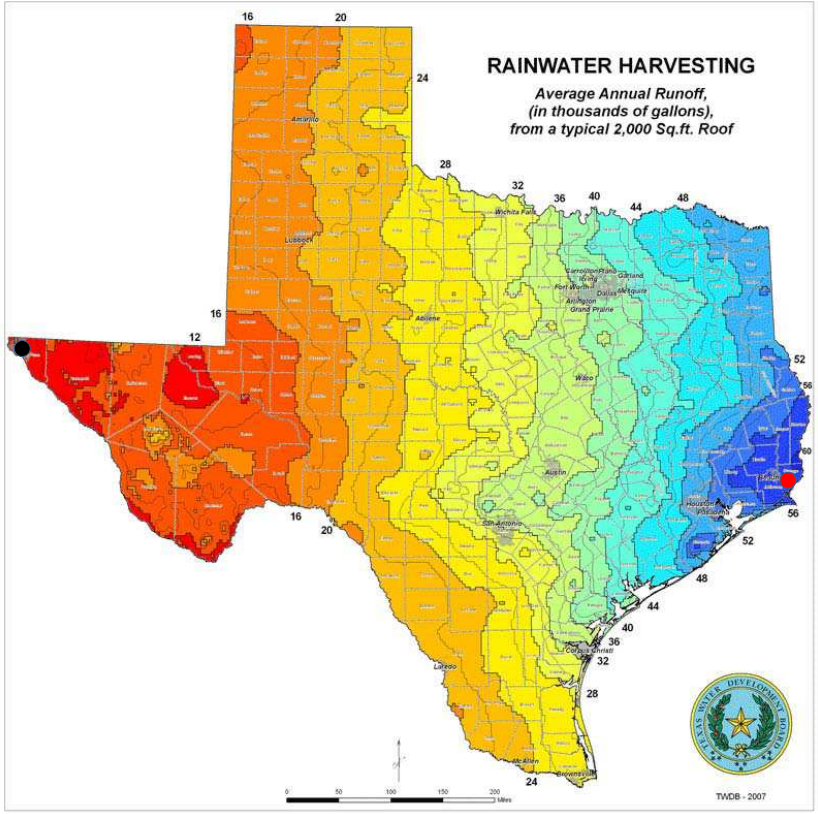
How much rainwater can be harvested?



Or, using the rainwater harvesting runoff map (left) an approximate volume can be estimated

Example:

For a 2,000 sq ft roof in:

- El Paso (•)

  About 10,000 gallons of rainwater can be collected annually

- Beaumont (•)

  About 58,000 gallons of rainwater can be collected annually

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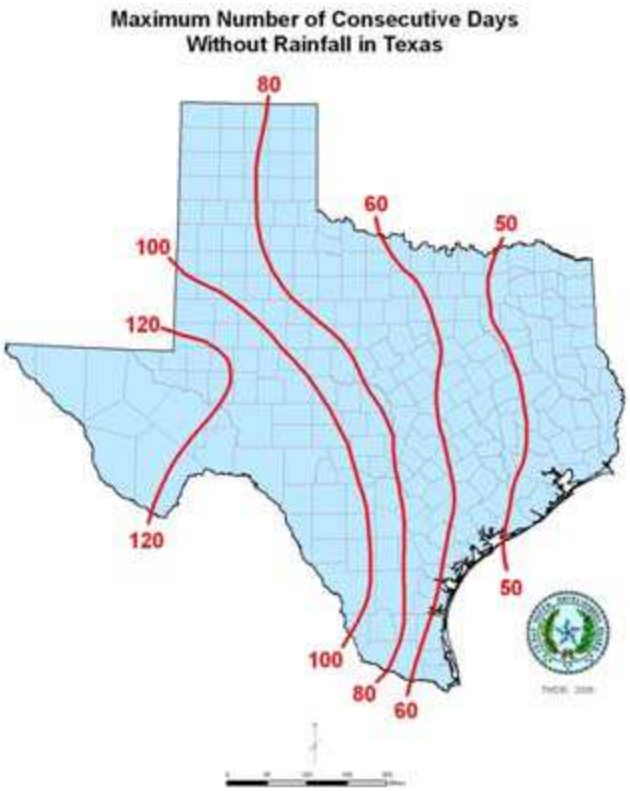
Consecutive days without rainfall



The contour lines shown on the map are useful in determining the size of an adequate storage unit for a rainwater harvesting system

Example:

In Central Texas, a storage unit that can provide water for about 80 days would be needed to meet demands through the dry months.

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Sizing a rainwater harvesting system

Basic method to size a rainwater harvesting system:

- Volume of water that can be captured and stored (supply) must equal or exceed the volume of water used (demand)
- To estimate supply: determine catchment area and use rainfall data
- To estimate demand: add indoor use + outdoor use
- The maximum number of consecutive days without rainfall should also be taken into account (map in following slide)
- Sizing a rainwater harvesting system can be facilitated by using a calculator such as the one developed by TWDB: TWDB Rainwater Harvesting Calculator

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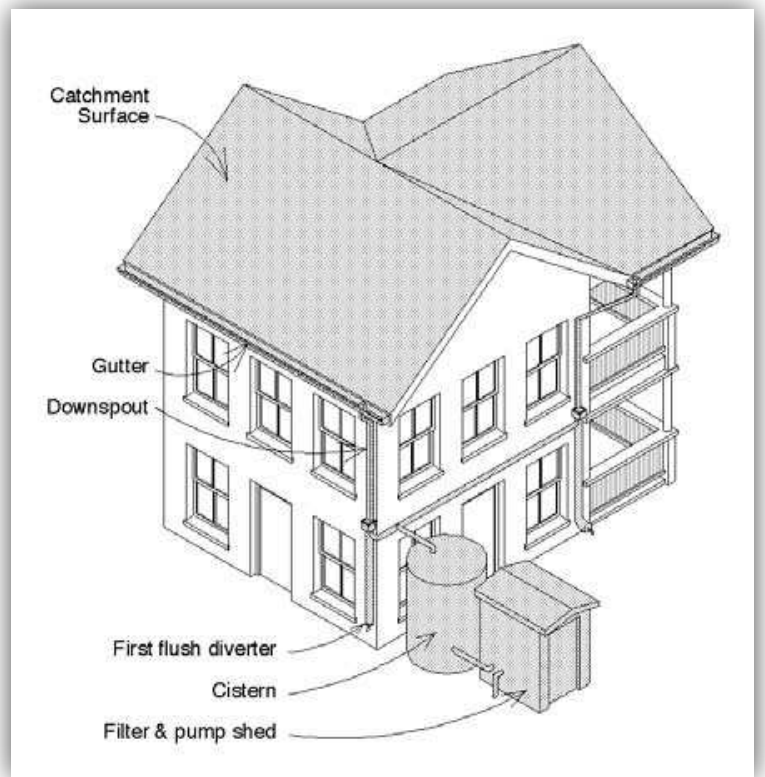
Rainwater harvesting system components

Basic unit

- Roof
- Conveyance system
- Storage system
- Distribution system

More complex unit (in addition to components in basic unit)

- Pump and pressure tank
- Filtration system
- Disinfection system



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Roofs, gutters, and downspouts

When installing roofs, gutters, and downspouts, consider:

- Materials
- Toxicity of substances
- Organic contaminants
- Designing to
  - avoid pooling of water
  - avoid sharp bends
- Maintenance that include
  - leaf screens
  - strainer baskets
- System integrity
  - Eliminate potential entry points for varmints and insects

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Examples of some common roof types

Composition shingle roof (Lady Bird Wildflower Center, Austin)

Concrete tile roof (Lady Bird Wildflower Center, Austin)

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Examples of some common roof types (contd.)

Metal roof (Lady Bird Wildflower Center, Austin)

Green roof (Lady Bird Wildflower Center, Austin)

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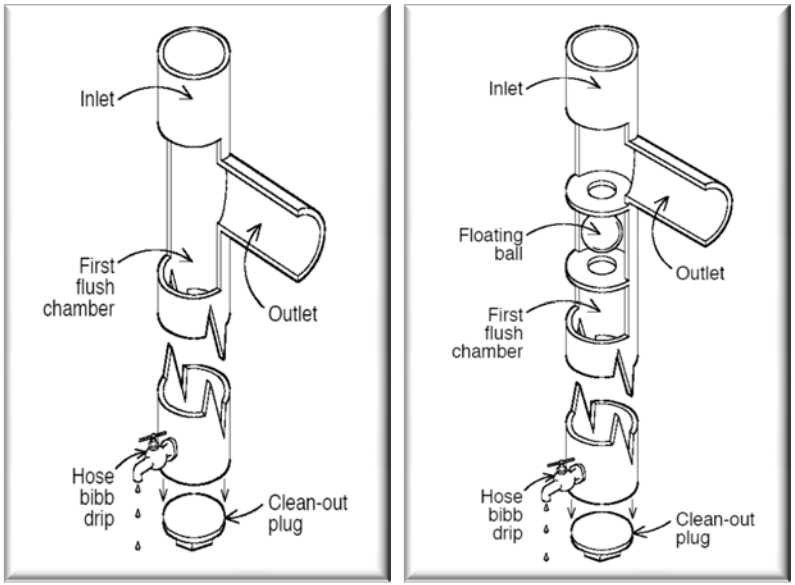
First-flush diverters

First-flush diverters serve to remove contaminants such as dust, bird droppings, leaves, and airborne residues before the water enters the storage unit



Standpipe first-flush diverter (with ball valve in right image)

As a rough approximation, divert 10 gallons per 1,000 sq ft of roof area

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Examples of first-flush diverters

Roof gutter, Y valve connector and downspout on barn, Larrison residence, Georgetown

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Examples of first-flush diverters (contd.)

First-flush washer with sock filter, Kight residence, Boerne

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Storage tanks

- Storage tanks should be:
  - opaque (if above ground to reduce algal growth)
  - of food grade quality (if water is to be used for potable purposes)
  - located:
    - close to the collection source and point of use
    - on a level and stable foundation
  - accessible for cleaning and maintenance
  - installed with overflow directed away from structures and septic systems

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Examples of common types of storage tanks

Polyethylene tanks (Kight residence, Boerne)

Concrete culverts (Medical Center, Webster)

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Examples of common types of storage tanks

Fiberglass tank, CRRC, Canyon Lake

Galvanized metal tank with food-grade liner, Salvation Army Recreation Center, Kerrville

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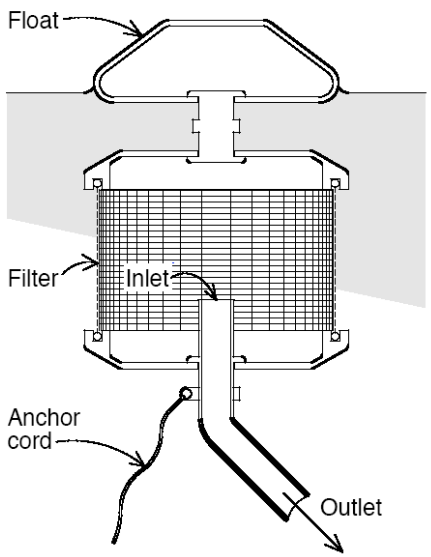
Filtration and disinfection



Cistern float filter

Sediment and sand filters, UV lamp, and pumps, Moore residence, Taft

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Cross-connection safeguards

State law requires that if a structure is connected to a public water supply system and has a rainwater harvesting system for indoor use, the structure must have appropriate cross-connection safeguards and the rainwater harvesting system may be used only for nonpotable indoor purposes.

30 Texas Administrative Code §290.44(j)

This rule is currently being amended

Backflow prevention device, McMahan residence, Dallas

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Examples of rainwater harvesting systems

Kight residence, Boerne (approximately 50,000 gallon capacity, potable and non-potable use)

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Examples of rainwater harvesting systems (contd.)

Medical Center, Webster (approximately 175,000 gallon capacity, concrete culverts under parking lot, green roof, irrigation and indoor toilet flushing use)

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Examples of rainwater harvesting systems (contd.)

PermaCulture Center, Sunset Valley (approximately 1,750 gallon capacity, rain barrels, potable and non-potable use)

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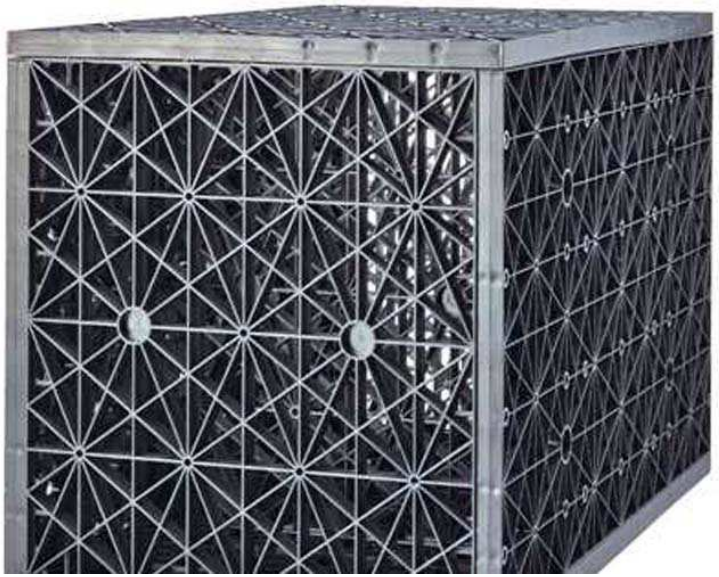
Examples of rainwater harvesting systems (contd.)



Texas A&M University, College Station (approximately 37,400 gallon capacity, cisterns consisting of plastic modular cells buried under garden, non-potable use)

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Examples of rainwater harvesting systems (contd.)

Community Resource and Recreation Center, Canyon Lake (12,500 gallon capacity, installed to control stormwater flow)

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Summary of important rainwater harvesting legislation, Texas (1993-2007)

1993: Property tax relief provided to non-residential buildings using rainwater harvesting (Proposition 2)

(Texas Constitution, Article 8, §1-l; Texas Tax Code §11.31 and §26.045)

2001: Local taxing entities given authority to exempt all or part of the assessed value of property on which water conservation modifications such as rainwater harvesting are made (Senate Bill 2)

(Texas Constitution, Article 8, §1-m; Texas Tax Code §11.32)

Equipment used for rainwater harvesting exempted from state sales tax (Senate Bill 2)

(Texas Constitution, Article 8, §1-n; Texas Tax Code §151.355)

2003: Homeowner associations prevented from implementing covenants banning rainwater harvesting (House Bill 645)

(Texas Property Code §202.007)

2005: Rainwater harvesting evaluation committee established to evaluate the potential for rainwater harvesting in the state and to make recommendations on standards (House Bill 2430)

2007: Cross-connection safeguard requirement established for a structure connected to a public water supply system that has a rainwater harvesting system for indoor non-potable use (House Bill 4)

(Texas Health and Safety Code §341.042)

Requirement that rainwater harvesting systems used for non-potable indoor purposes and landscape watering be incorporated into the design and construction of each new state building with a roof measuring at least 10,000 square feet and any other new state building where such systems are feasible (House Bill 4)

(Texas Government Code §447.004)

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Summary of House Bill 3391, 2011

- Financial institutions may consider making loans for developments that will use harvested rainwater as the sole source of water supply.

  (Texas Finance Code §59.012)

- Requirement that rainwater harvesting system technology for potable and non-potable indoor use and landscape watering be incorporated into the design and construction of each new state building with a roof measuring at least 50,000 square feet that is located in an area in which the average annual rainfall is at least 20 inches.

  (Texas Government Code §447.004)

- Rainwater harvesting systems connected to a public water supply system that is used for potable indoor purposes is required to have cross-connection safeguards to ensure that harvested rainwater does not come into contact with the public water supply system's drinking water off the property, in accordance with rules to be developed by the TCEQ.

  (Texas Health and Safety Code §341.042)

- A person intending to connect a rainwater harvesting system to a public water supply system for potable purposes must receive the consent of the municipality in which the rainwater harvesting system is located or to the owner or operator of the public water supply system before connecting the rainwater harvesting system to the public water supply system.

  (Texas Health and Safety Code §341.042)

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Summary of House Bill 3391, 2011 (contd.)

- A municipality or the owner or operator of a public water supply system may not be held liable for any adverse health effects allegedly caused by the consumption of water collected by a rainwater harvesting system that is connected to a public water supply system and is used for potable purposes if the municipality or public water system is in compliance with the sanitary standards for drinking water adapted by the TCEQ and applicable to the municipality or public water supply system.

  (Texas Health and Safety Code §341.042)
- Municipalities and counties are encouraged to promote rainwater harvesting at residential, commercial, and industrial facilities through incentives such as discounts for rain barrels or rebates for water storage facilities.

  (Texas Local Government Code §580.004)
- TWDB is required to make rainwater harvesting training available to permitting staff of certain municipalities and counties.

  (Texas Local Government Code §580.004)
- A municipality or county cannot deny a building permit solely because the facility will implement rainwater harvesting. However, it may require that the system comply with the minimum state standards established for such systems.

  (Texas Local Government Code §580.004)

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Summary of House Bill 1073 and Senate Bill 1073, 2011

- Rainwater harvesting systems connected to a public water supply system that are used for potable indoor purposes are required to have cross-connection safeguards to ensure that harvested rainwater does not come into contact with a public water supply system's drinking water off the property, in accordance with rules to be developed by TCEQ
- A person who installs and maintains rainwater harvesting systems that are connected to a public water supply system and are used for potable purposes must be licensed by the Texas State Board of Plumbing Examiners as a master plumber or journeyman plumber and hold an endorsement issued by the board as a water supply protection specialist.
- A person who intends to connect a rainwater harvesting system to a public water supply system for use for potable purposes must give written notice of that intention to the municipality in which the rainwater harvesting system is located or the owner or operator of the public water supply system before connecting the rainwater harvesting system to the public water supply system.
- A municipally owned water or wastewater utility, a municipality, or the owner or operator of a public water supply system may not be held liable for any adverse health effects allegedly caused by the consumption of water collected by a rainwater harvesting system that is connected to a public water supply system and is used for potable purposes if the municipally owned water or wastewater utility, municipality, or public water supply system is in compliance with the sanitary standards for drinking water applicable to the municipally owned water or wastewater utility, municipality, or public water supply system.

(All items in Texas Health and Safety Code §341.042)

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TCEQ rules for rainwater harvesting systems

30 Texas Administrative Code § 290.44 (current rule – amendments expected)

(h) Backflow, siphonage

(1) No water connection from any public drinking water supply system shall be allowed to any residence or establishment where an actual or potential contamination hazard exists unless the public water facilities are protected from contamination.

(A) At any residence or establishment where an actual or potential contamination hazard exists, additional protection shall be required at the meter in the form of an air gap or backflow prevention assembly. The type of backflow prevention assembly required shall be determined by the specific potential hazard identified in § 290.47(i) of this title (relating to Appendices).

(B) At any residence or establishment where an actual or potential contamination hazard exists and an adequate internal cross-connection control program is in effect, backflow protection at the water service entrance or meter is not required.

(i) An adequate internal cross-connection control program shall include an annual inspection and testing by a certified backflow prevention assembly tester on all backflow prevention assemblies used for health hazard protection.

(ii) Copies of all such inspection and test reports must be obtained and kept on file by the water purveyor.

(iii) It will be the responsibility of the water purveyor to ensure that these requirements are met.

(j) If a structure is connected to a public water supply system and has a **rainwater harvesting** system for indoor use, the structure must have appropriate cross-connection safeguards in accordance with subsection (h)(1) of this section and the **rainwater harvesting** system may be used only for nonpotable indoor purposes.

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Texas State Board of Plumbing Examiners rules for rainwater harvesting systems

22 Texas Administrative Code § 363.12. Training Programs for Journeyman Plumber and Tradesman Plumber-Limited License Applicants (current rule – amendments expected)

(e) In addition to the training required by subsections (b)(1), (b)(2), and (c) of this section, applicants for a Journeyman Plumber license must complete 18 hours of classroom training in certain chapters of the Uniform Plumbing Code, International Plumbing Code, or the International Fuel Gas Code (as appropriate); the Texas Accessibility Standards, the Americans with Disabilities Act; and water conservation, as set forth in paragraphs (1)- (12) of this subsection:

(12) 2 hours to review new technology which promotes water and energy conservation, including **rain water harvesting**, solar energy, and water smart applications.

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Texas Comptroller of Public Accounts rules for rainwater harvesting systems

34 Texas Administrative Code § 3.318. Water-Related Exemptions (Tax Code, §§ 151.314, 151.315, and 151.355)

(b) The following are exempt from sales and use tax. Equipment, services, or supplies when used solely for:

(6) **rainwater harvesting**; or

(7) water recycling and reuse.

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Costs of rainwater harvesting systems

- Depends on the size and intended use of the system
- Can range from <$500 to over $10,000
- Complete potable, home system with guttering, 6,500-gallon cistern, roof washer, pump, filters, and UV light cost approximately **$5,000** in 2007
- A more complex 175,000-gallon capacity system consisting of underground culverts and green roof used for irrigation and indoor, non-potable purposes cost approximately **$225,000** in 2007

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Financial incentives for rainwater harvesting systems

- At the state level, rainwater harvesting equipment, services, or supplies are exempt from state sales tax
- At the local level, cities and counties may have rebate programs or other financial incentives to promote rainwater harvesting. For example:
  - **City of Austin** (residential rebate program) http://www.ci.austin.tx.us/water/conservation/rainwater.htm
  - **Sunset Valley** (rainwater harvesting rebate program) http://www.sunsetvalley.org/index.asp?Type=B_BASIC&SEC=%7B7F158B19-E5F5-44C1-B648-3F7FE50EDB68%7D

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TWDB contact information for rainwater harvesting

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