Rainwater Harvesting Training

Offered Pursuant to Local Government Code §580.004

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 Section 3.318(a)(5))

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 (TWDB, 2005)

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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 stormwater runoff, thereby decreasing load on storm sewers

Challenges to rainwater harvesting

- Capital costs can be higher than connecting to a conventional water supply system
- Systems require regular maintenance after installation
- Storage systems can take up space around the house
- Rainwater harvesting may need to be supplemented with water from other sources, especially during extended dry periods or droughts

Rainwater harvesting systems

can be simple

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Rainwater harvesting systems (contd.)

or elaborate and sophisticated

Rainwater harvesting systems (contd.)

with pumps, filters, and water treatment units

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]

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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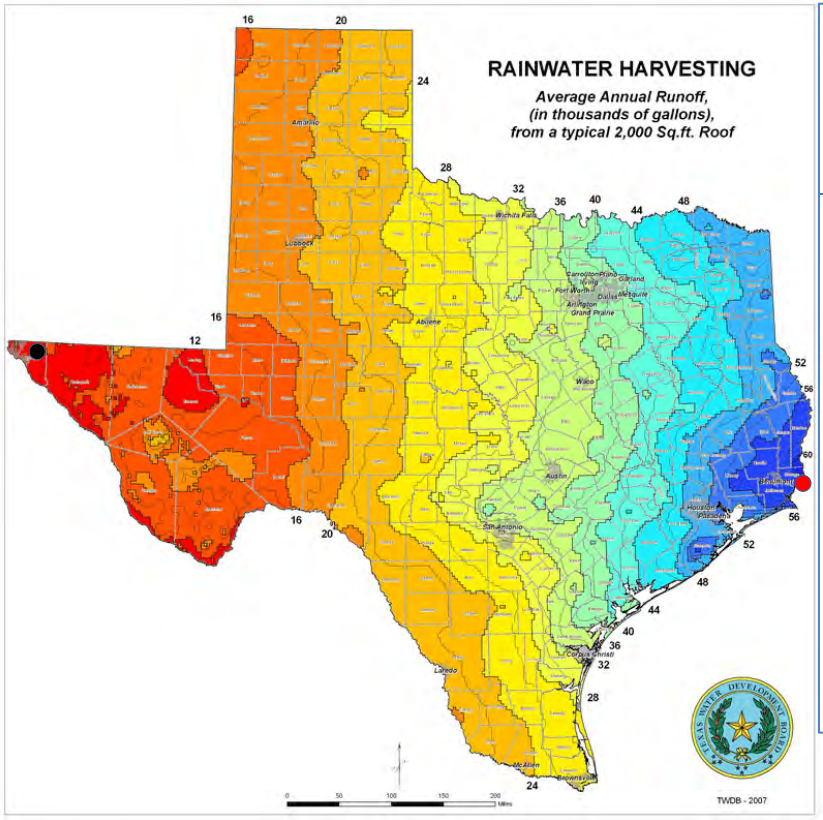
How much rainwater can be harvested?



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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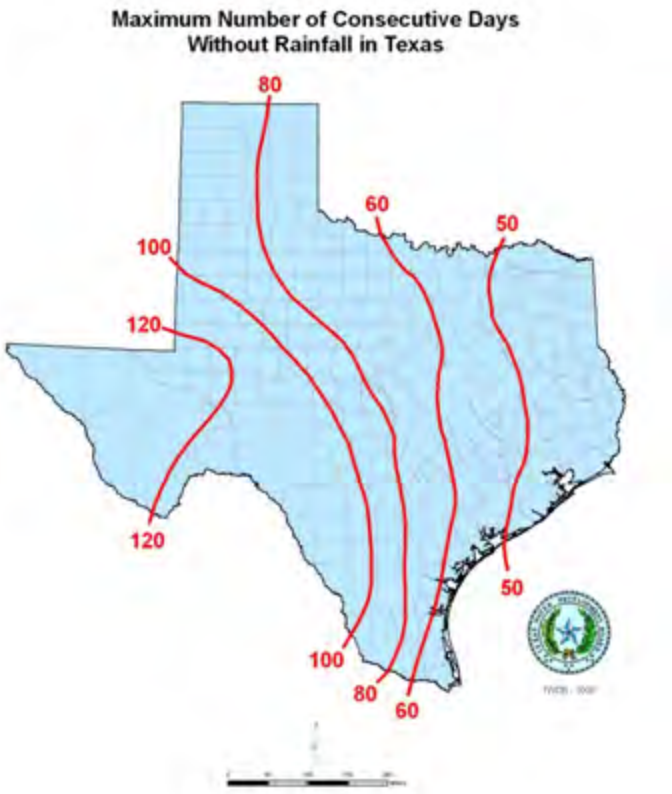
Consecutive days without rainfall



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 preceding 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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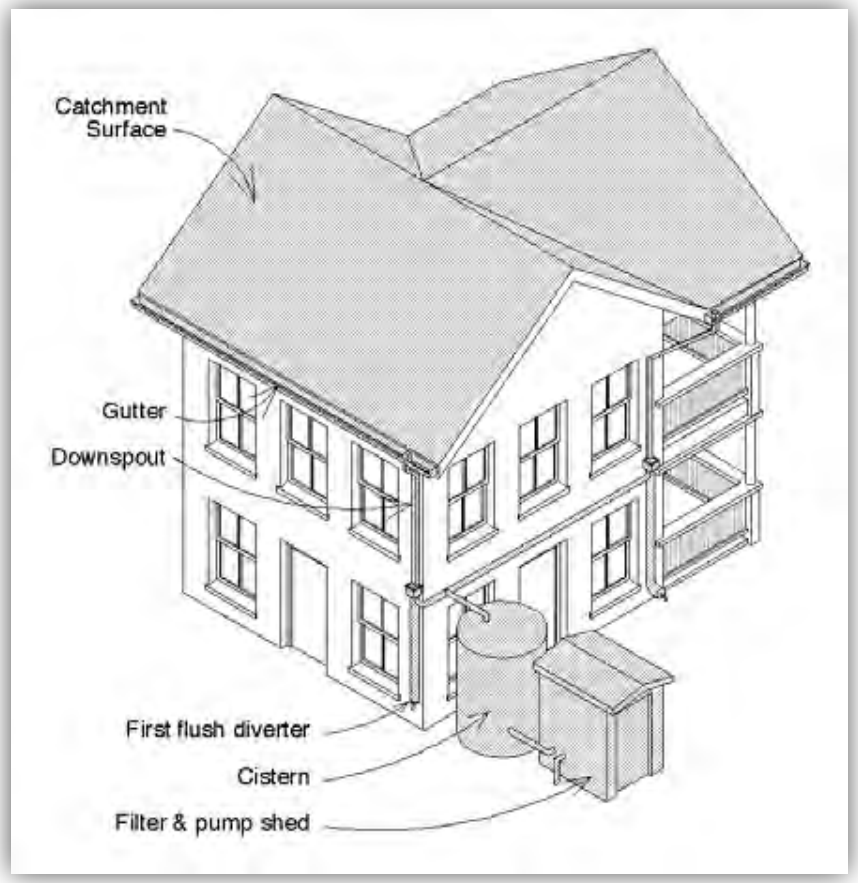
Rainwater harvesting system components

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

Examples of some common roof types

Composition shingle roof (Lady Bird Wildflower Center, Austin)

Concrete tile roof (Lady Bird Wildflower Center, Austin)

Examples of some common roof types (contd.)

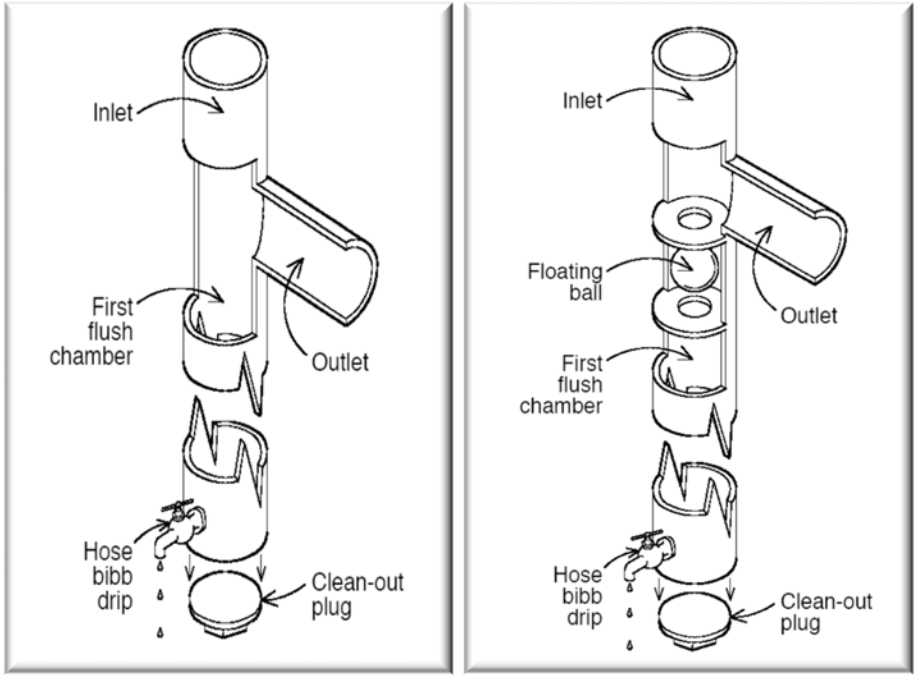
Metal roof (Lady Bird Wildflower Center, Austin)

Green roof (Lady Bird Wildflower Center, Austin)

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

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



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

Examples of first-flush diverters

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

Examples of first-flush diverters (contd.)

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

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

Examples of common types of storage tanks

Polyethylene tanks (Kight residence, Boerne, Texas)

Concrete culverts (Medical Center, Webster, Texas)

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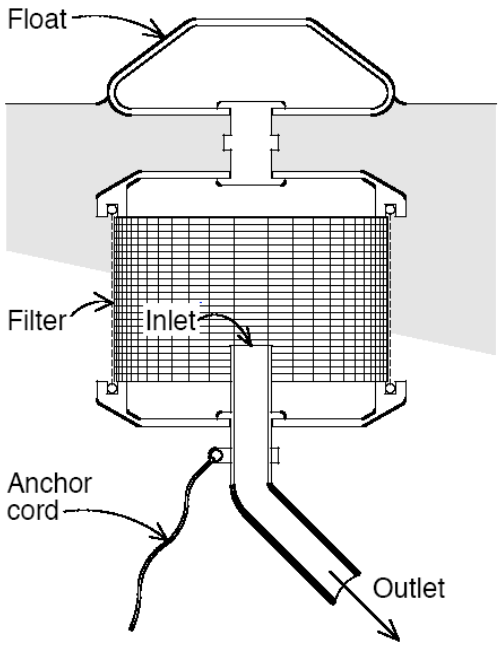
Examples of common types of storage tanks

Fiberglass tank, Community Resource and Recreation Center, Canyon Lake, Texas

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

Filtration and disinfection



Cistern float filter

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

Cross-connection safeguards

State law requires that if a structure has a rainwater harvesting system and uses a public water supply for an auxiliary water source, the structure must have appropriate cross-connection safeguards.

Health and Safety Code Section 341.042(b)

Backflow prevention device, McMahan residence, Dallas, Texas

Examples of rainwater harvesting systems

Large tanks (approximately 80,000-gallon total capacity) at the Willow City Fire Department. The water is used for fighting fire.

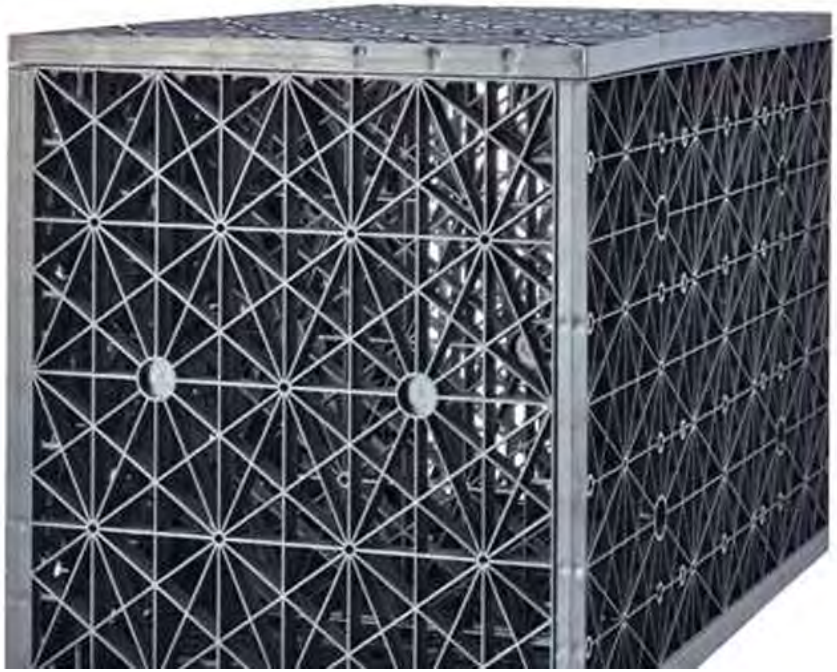
Examples of rainwater harvesting systems (contd.)

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

Examples of rainwater harvesting systems (contd.)

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

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)

Examples of rainwater harvesting systems (contd.)

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

Rainwater harvesting laws

Tax and Financial Incentives

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

  (Texas Finance Code Section 59.012)

- Each municipality and county is encouraged to promote rainwater harvesting at residential, commercial, and industrial facilities through incentives such as the provision of rain barrels or rebates for water storage facilities.

  (Texas Local Government Code Section 580.004)

- Property tax relief provided to non-residential buildings using rainwater harvesting

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

- 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

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

Rainwater harvesting laws

Tax and Financial Incentives

- Equipment, services, or supplies used for rainwater harvesting exempted from state sales tax

  (Texas Constitution, Article 8, Section 1-n; Texas Tax Code Sections 157.314, 151.315, and 151.355)

  Comptroller's rules at 34 Texas Administrative Code Section 3.318, Water-Related Exemptions

  (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.

Financial incentives for rainwater harvesting systems

- Each municipality and county is encouraged to promote rainwater harvesting at residential, commercial, and industrial facilities through incentives such as the provision at a discount of rain barrels or rebates for water storage facilities.

  (Texas Local Government Code Section 580.004)

- Examples of cities that have rebate programs:
  - **City of Austin** (residential rebate program) http://www.austintexas.gov/department/rainwater-harvesting-rebates
  - **Sunset Valley** (rainwater harvesting rebate program)

    http://www.sunsetvalley.org/index.asp?Type=B_BASIC&SEC=%7B7F158B19-E5F5-44C1-B648-3F7FE50EDB68%7D

Rainwater harvesting laws

Permitting

- 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 a system.

  (Texas Local Government Code Section 580.004)

Rainwater harvesting laws

Homeowner Associations

- Homeowner associations prevented from including or enforcing covenants that prohibit or restrict rainwater harvesting

  (Texas Property Code Section 202.007)

Rainwater harvesting laws

State buildings

Statutory requirements for each new state building or major renovation project:

On-site reclaimed system technologies, including rainwater harvesting, condensate collection, or cooling tower blow down, or a combination of those system technologies, for potable and nonpotable indoor and outdoor water use be incorporated into the design and construction of:

(A) each new state building with a roof area measuring at least 10,000 square feet; and

(B) any other new state building for which the incorporation of such systems is feasible; and

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

(Texas Government Code Section 447.004)

The State Energy Conservation Office has adopted water conservation design standards for state buildings.

(34 Texas Administrative Code Section 19.32(b))

Rainwater harvesting laws

Training for permitting staff

- The Texas Water Development Board shall ensure that training on rainwater harvesting is available for the members of the permitting staffs of municipalities and counties at least quarterly. Each member of the permitting staff of each county and municipality located wholly or partly in an area designated by the Texas Commission on Environmental Quality as a priority groundwater management area under Section 35.008, Water Code, whose work relates directly to permits involving rainwater harvesting and each member of the permitting staff of each county and municipality with a population of more than 10,000 whose work relates directly to permits involving rainwater harvesting must receive appropriate training regarding rainwater harvesting standards and their relation to permitting at least once every five years. Members of the permitting staffs of counties and municipalities not located wholly or partly in an area designated by the Texas Commission on Environmental Quality as a priority groundwater management area under Section 35.008, Water Code, whose work relates directly to permits involving rainwater harvesting and members of the permitting staffs of counties and municipalities with a population of 10,000 or less whose work relates directly to permits involving rainwater harvesting are encouraged to receive the training. The Texas Water Development Board may provide appropriate training by seminars or by videotape or functionally similar and widely available media without cost.

  (Texas Local Government Code Section 580.004(b))

Rainwater harvesting laws

Standards for rainwater harvesting systems connected to a public water supply system and used for potable purposes

- The commission shall establish recommended standards relating to the domestic use of harvested rainwater, including health and safety standards for treatment and collection methods for harvested rainwater intended for drinking, cooking, or bathing.

  (Texas Health and Safety Code Section 341.042(a))

- 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.

  (Texas Health and Safety Code Section 341.042(b-2))

- Standards and rules adopted by the commission governing public drinking water supply systems do not apply to a person:

  (1) who harvests rainwater for domestic use; and

  (2) whose property is not connected to a public drinking water supply system.

  (Texas Health and Safety Code Section 341.042(c))

Rainwater harvesting laws

Standards for rainwater harvesting systems connected to a public water supply system and used for potable purposes (continued)

- 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.

  (Texas Health and Safety Code Section 341.042(b-4))

Rainwater harvesting laws

Texas Commission on Environmental Quality Rules Regarding

Standards for rainwater harvesting systems connected to a public water supply system and used for potable purposes

30 Texas Administrative Code Section 290.44(h) (current TCEQ rule – amendments expected)

Backflow and siphonage

(h)(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 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.

Rainwater harvesting laws

Texas Commission on Environmental Quality Rules Regarding

Standards for rainwater harvesting systems connected to a public water supply system and used for potable purposes

(30 Texas Administrative Code Section 290.44(j)) (current TCEQ rule – amendments expected)

(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.

(1) A person who intends to connect a rainwater harvesting system to a public water system for use for potable purposes must give written notice of that intention to the municipality or the owner or operator of the public water system in which the rainwater harvesting system is located.

(2) At each residence or facility where water from a rainwater harvesting system is used for indoor potable purposes and there is a connection to a public water system, the public water system shall ensure that the rainwater harvesting system is installed and maintained by a master plumber or journeyman plumber licensed by the Texas State Board of Plumbing Examiners and who holds an endorsement issued by the Texas State Board of Plumbing Examiners as a Water Supply Protection Specialist.

Rainwater harvesting laws

Rainwater harvesting systems using public water supply as a back-up source

- The commission by rule shall provide that if a structure has a rainwater harvesting system and uses a public water supply for an auxiliary water source, the structure must have appropriate cross-connection safeguards.

  (Texas Health and Safety Code Section 341.042(b))

- A privately owned rainwater harvesting system with a capacity of more than 500 gallons that has an auxiliary water supply shall have a backflow prevention assembly or an air gap installed at the storage facility for the harvested rainwater to ensure physical separation between the rainwater harvesting system and the auxiliary water supply. A rainwater harvesting system that meets the requirements of this subsection is considered connected to a public water supply system only for purposes of compliance with minimum water system capacity requirements as determined by commission rule.

  (Texas Health and Safety Code Section 341.042(b-1))

Rainwater harvesting laws

Rainwater harvesting systems using public water supply as a back-up source

- A person who intends to use a public water supply system as an auxiliary water source 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. The public water supply system used as an auxiliary water source may be connected only to the water storage tank and may not be connected to the plumbing of a structure.

  (Texas Health and Safety Code Section 341.042(b-3))

- 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 uses a public water supply system or an auxiliary water source and is used for potable purposes if the municipality or the public water supply system is in compliance with the sanitary standards for drinking water adopted by the commission and applicable to the municipality or public water supply system.

  (Texas Health and Safety Code Section 341.042(b-5))

Rainwater harvesting laws

Licensed plumber with Water Supply Protection Specialist Endorsement required for the installation, repair of rainwater harvesting system to supply a plumbing fixture or appliance

Texas Occupations Code

Sec. 1301.001(11) "Water supply protection specialist" means a person who holds an endorsement issued by the board to engage in: (B) the installation, service, and repair of plumbing associated with the treatment, use, and distribution use of rainwater to supply a plumbing fixture or appliance.

Sec. 1301.357. ENDORSEMENT: WATER SUPPLY PROTECTION SPECIALIST.
(a) A person licensed under this chapter may not act as a water supply protection specialist unless the person holds an endorsement issued under this section.
(b) The board shall issue an endorsement as a water supply protection specialist to a person who: (1) is licensed under this chapter as a master plumber or journeyman plumber;

Costs of rainwater harvesting systems

- Depends on the size and intended use of the system
- Can range from <$500 to over $25,000
- Complete 5,000-gallon system with reduced pressure zone (backflow prevention) device, pump, and drip irrigation system cost approximately **$17,000** in 2013

TWDB contact information for rainwater harvesting

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