Riparian & Stream Ecosystems

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Texas Water Resources Institute

http://texasriparian.org and
http://www.facebook.com/TexasRiparianAssociation

Funding is provided by the U.S. Environmental Protection Agency through the Texas State Soil and Water Conservation Board.

Texas Riparian & Stream Ecosystem Education

- Promote healthy watersheds and improve water quality through riparian and stream ecosystem education
- Increase citizen awareness and understanding of the nature and function of riparian zones, their benefits and management practices to protect them and minimize NPS pollution
- Enhance interactive learning opportunities for riparian education across the state and establish a larger, more informed citizen base working to improve and protect local riparian and stream ecosystems through online tools
- Connect landowners with local technical and financial resources to improve management and promote healthy watersheds and riparian areas



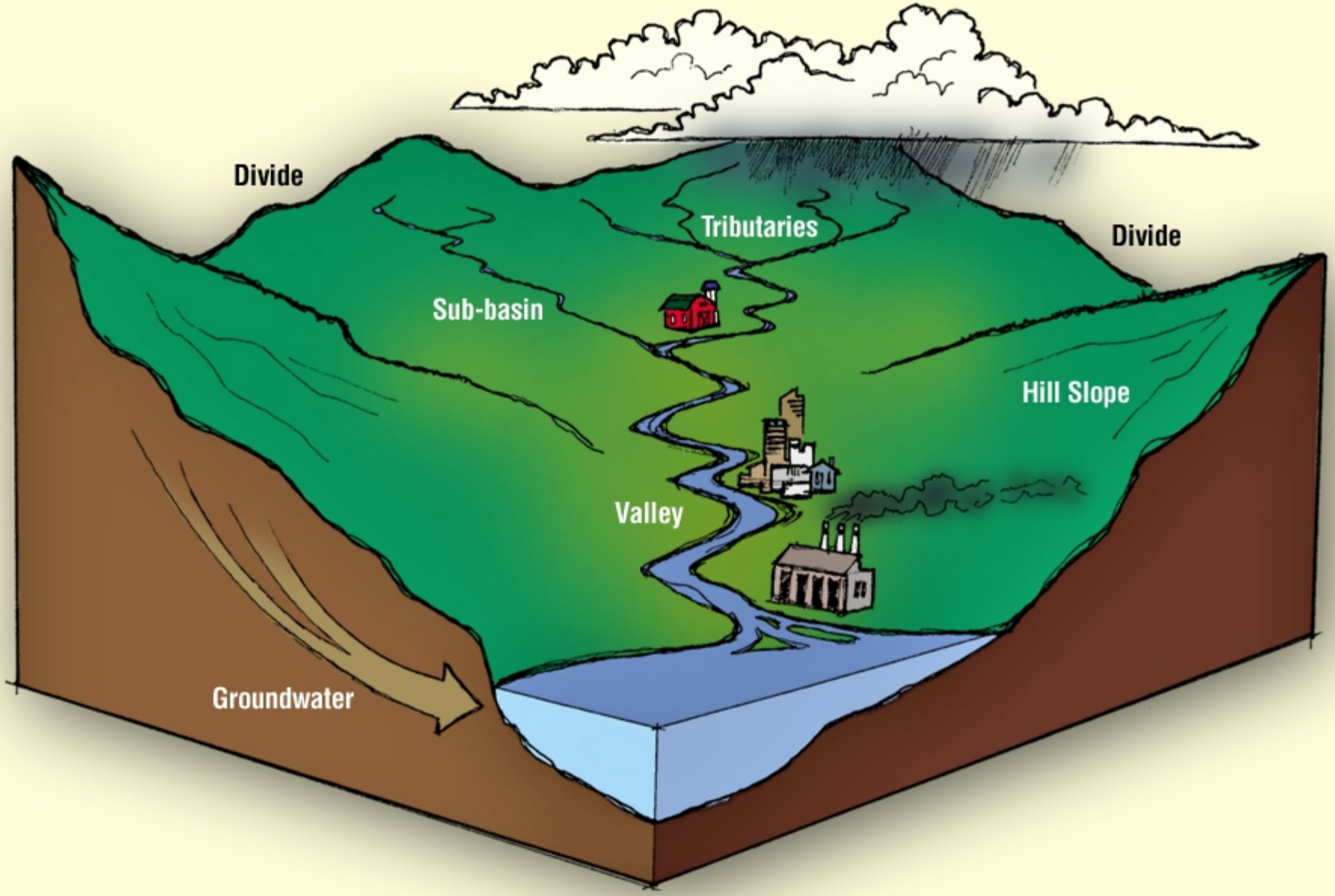
Education

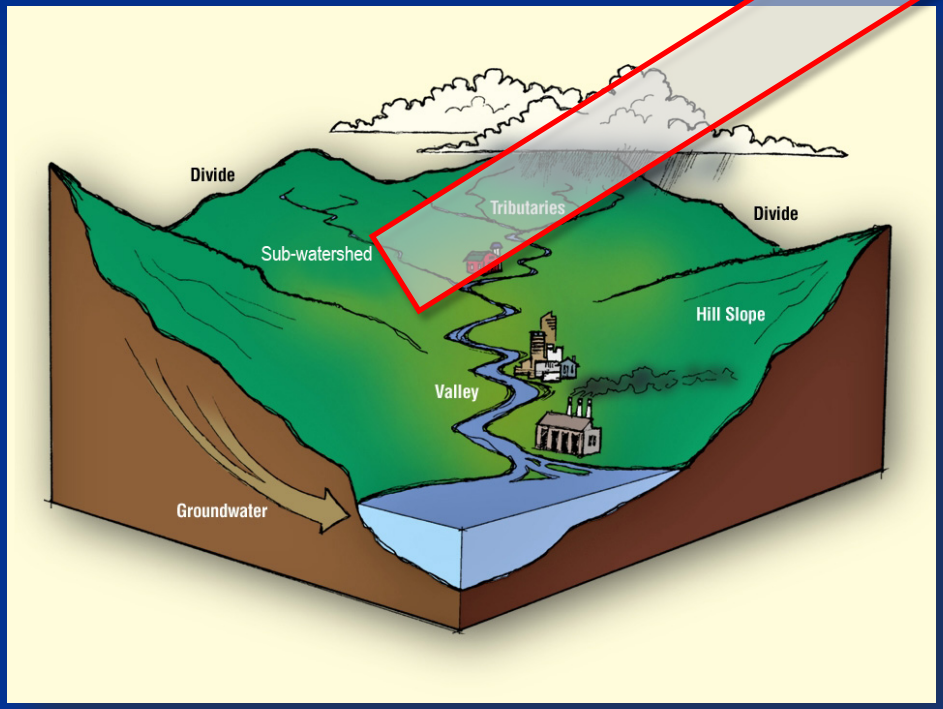
- Deliver 24 riparian education programs to participants in prioritized watersheds, typically watersheds with watershed planning or total maximum daily load efforts due to impaired water quality
- Coordinate 2 statewide riparian conferences: SW Stream Restoration Conference in San Antonio June 1-3, 2016 and Riparian Symposium in February 2017.

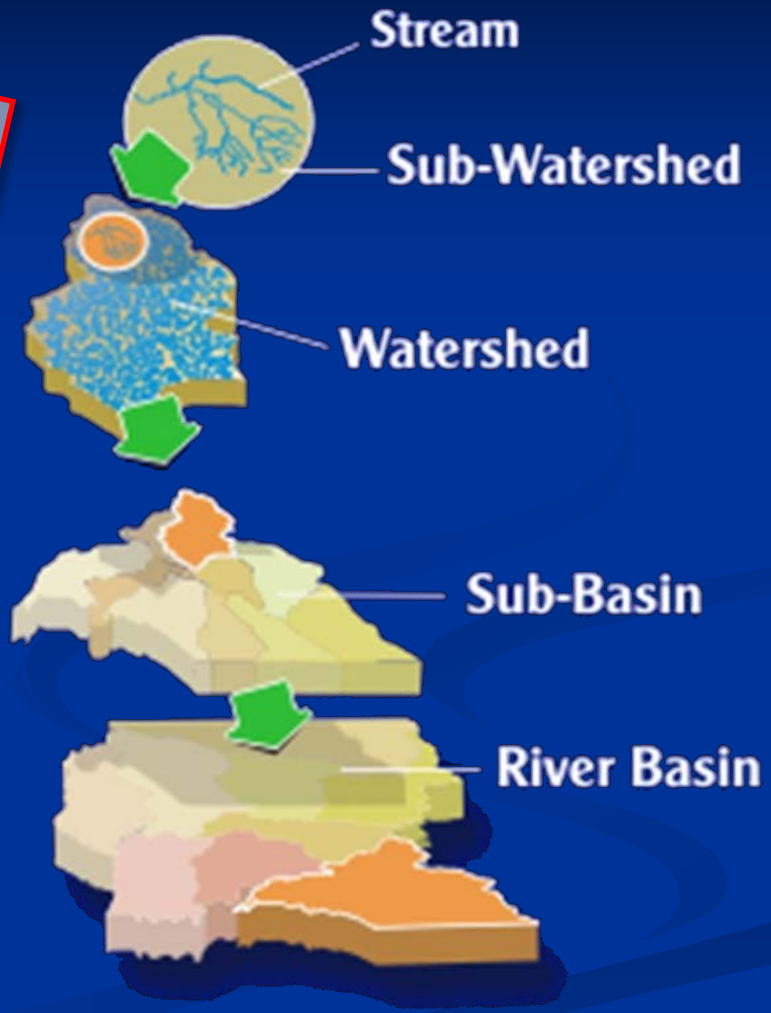
Collaborators & Instructors

- Texas Water Resources Institute
- Texas State Soil and Water Conservation Board
- Texas Riparian Association
- Texas A&M Forest Service
- Texas Parks and Wildlife Department
- USDA Natural Resources Conservation Service
- Nueces River Authority
- Texas A&M AgriLife Extension Service and Research
- Meadows Center for Water & the Environment/ Texas Stream Team

What is a WATERSHED?

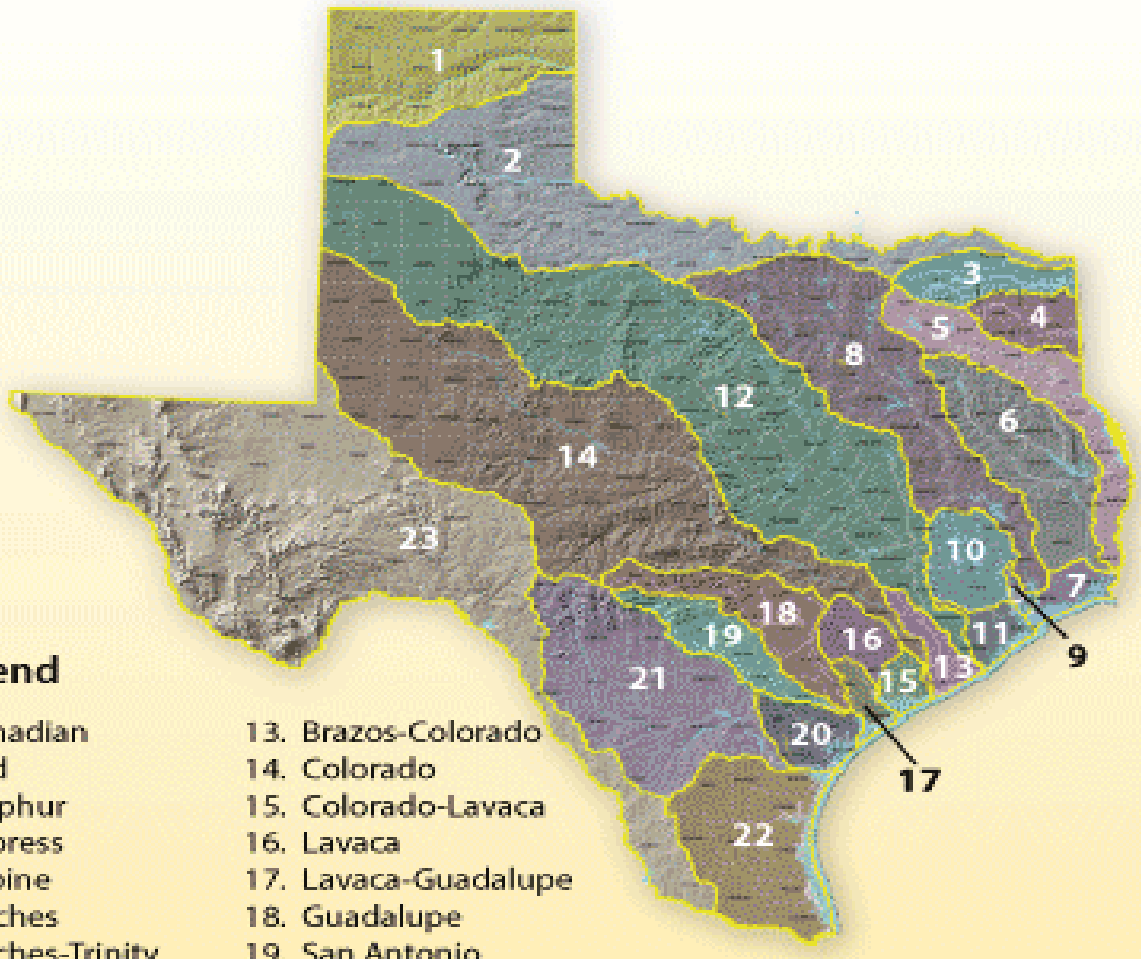



Divide
Tributaries
Divide
Sub-watershed
Hill Slope
Valley
Groundwater


Stream
Sub-Watershed
Watershed
Sub-Basin
River Basin

WATERSHED

Texas Rivers



Legend

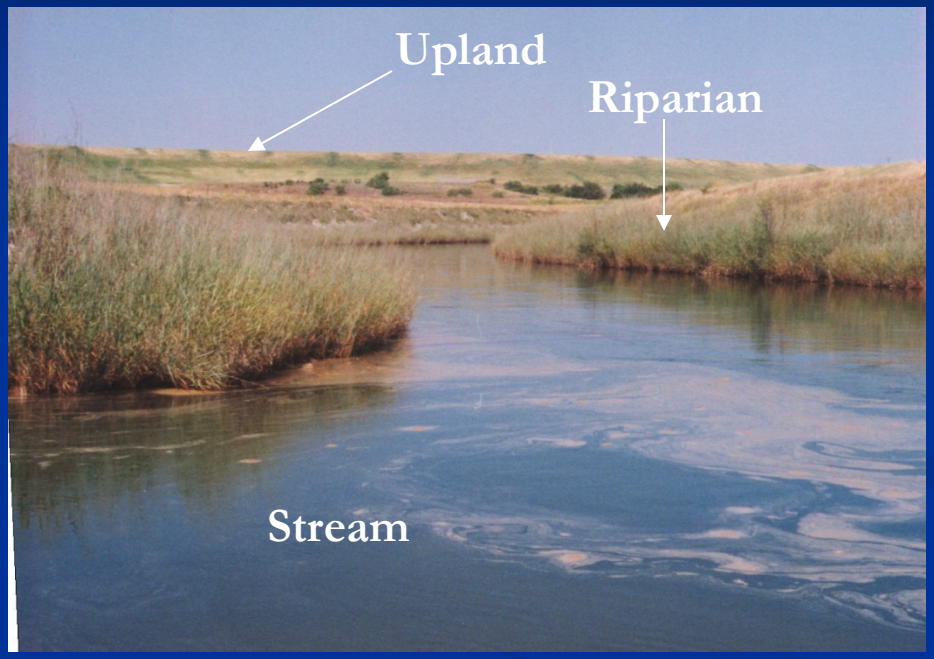
1. Canadian
2. Red
3. Sulphur
4. Cypress
5. Sabine
6. Neches
7. Neches-Trinity
8. Trinity
9. Trinity-San Jacinto
10. San Jacinto
11. San Jacinto-Brazos
12. Brazos
13. Brazos-Colorado
14. Colorado
15. Colorado-Lavaca
16. Lavaca
17. Lavaca-Guadalupe
18. Guadalupe
19. San Antonio
20. San Antionio-Nueces
21. Nueces
22. Nueces-Rio Grande
23. Rio Grande

Source: Texas Water Development Board

Watershed

A Watershed can be characterized as consisting of:

- Upland
- Riparian zone and
- stream system



Each watershed functions as an ecosystem, i.e., each component affects the rest of the system including the benefits or negative impacts. As water flows through the system the impacts are cumulative.

What is a Riparian Area?

Characteristics of a Healthy Upland Watershed

A Healthy Watershed is a catchment, i.e., rainfall is captured on-site. It acts as a sponge storing water to later release.

"High" infiltration rates due to good vegetation cover and soil organic matter/structure and depth.

Water flowing from the uplands as runoff & subsurface flow to springs and aquifers is "clean" and is slowly released down slope.

Unhealthy Watersheds?

Most streams and rivers in Texas have been adversely affected by past natural and human activities resulting in:

- Increasingly damaging floods
- Lower base flows
- High sediment loads
- Reduced reservoir storage capacity
- Invasion of exotic species
- Loss of natural riparian habitats
- Degraded water quality

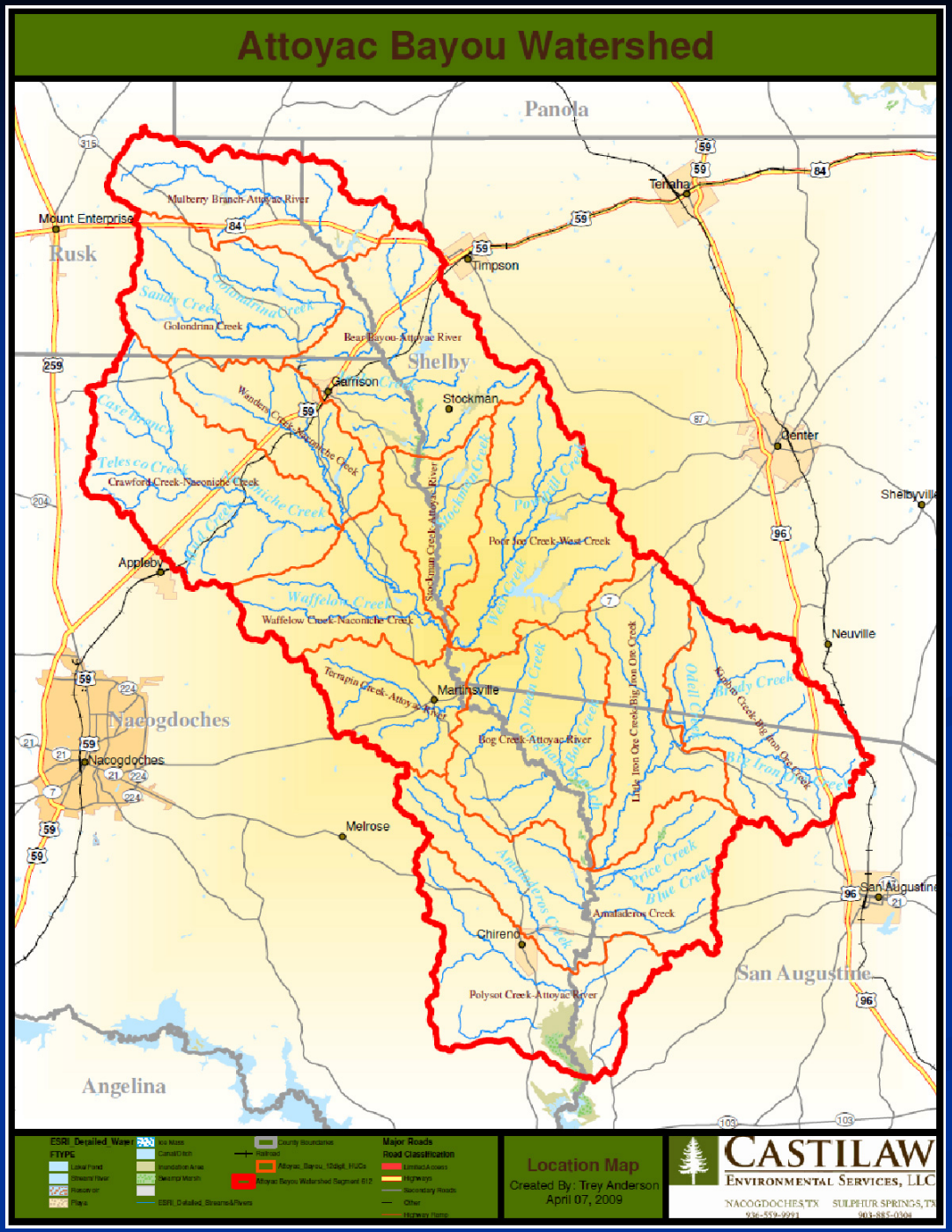
Properly Functioning Riparian Area

Adequate vegetation, landform or large woody material to:

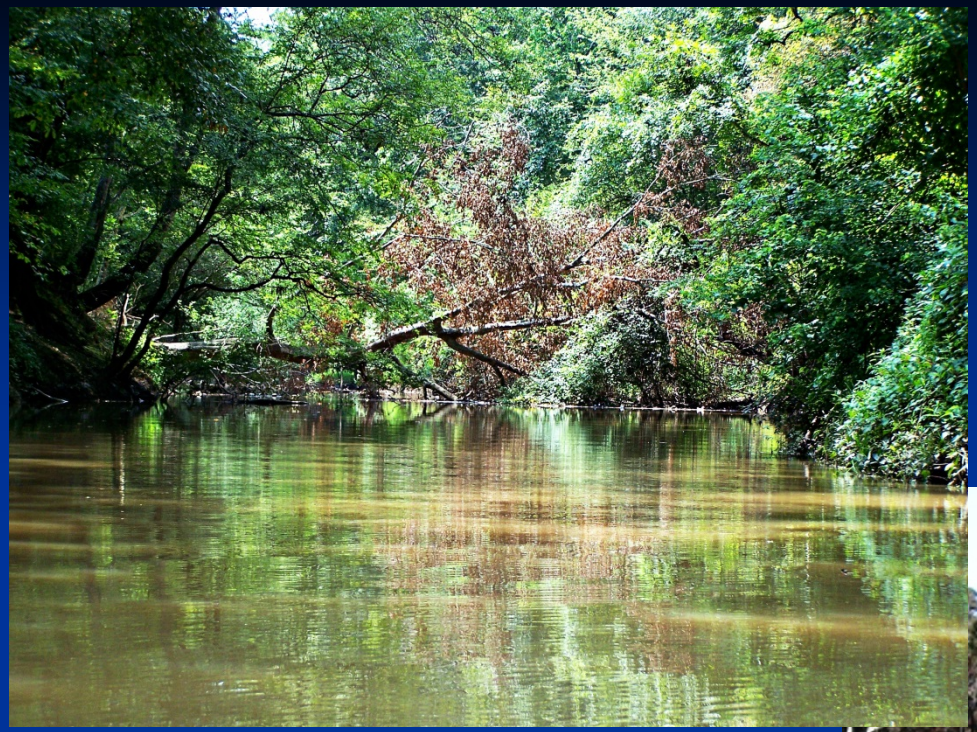
- Dissipate stream energy
- Stabilize banks
- Reduce erosion
- Trap sediment
- Build / enlarge floodplain
- Store water
- Floodwater retention
- Groundwater recharge
- Sustain baseflow

- Water quality
- Water quantity
- Forage
- Aquatic habitat
- Wildlife habitat
- Recreational value
- Aesthetic beauty

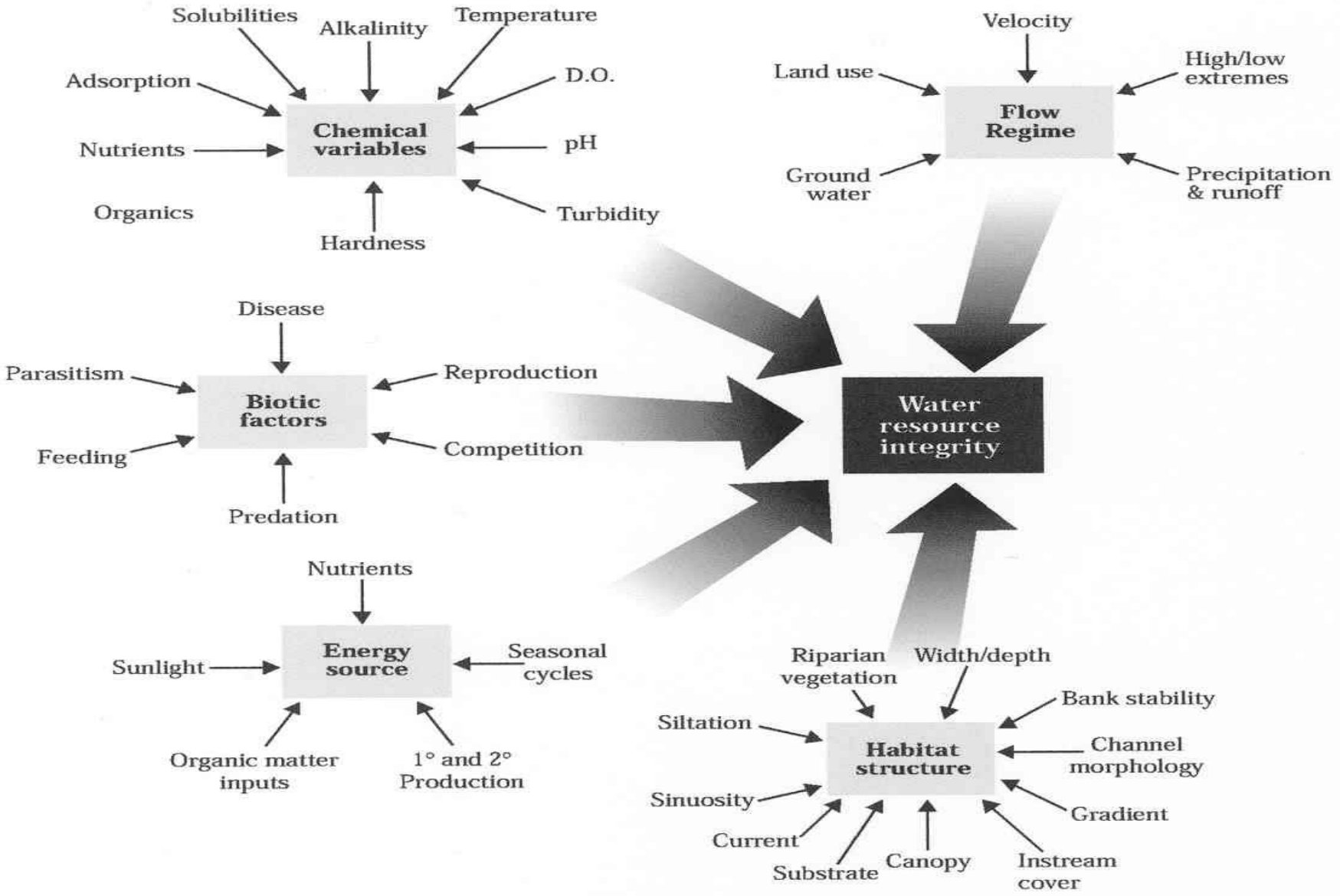
Physical Function → Values



Attoyac Bayou Watershed



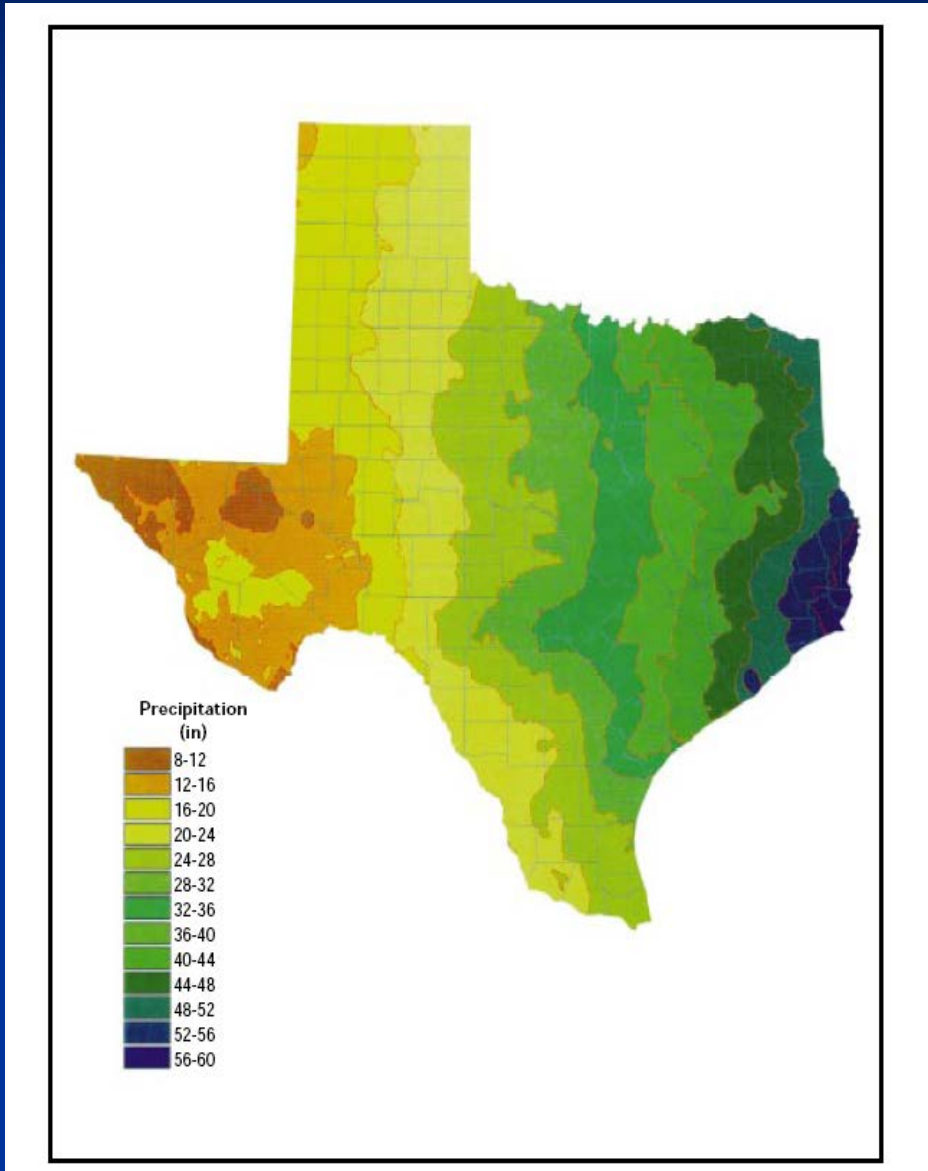
Watersheds are Complex Systems



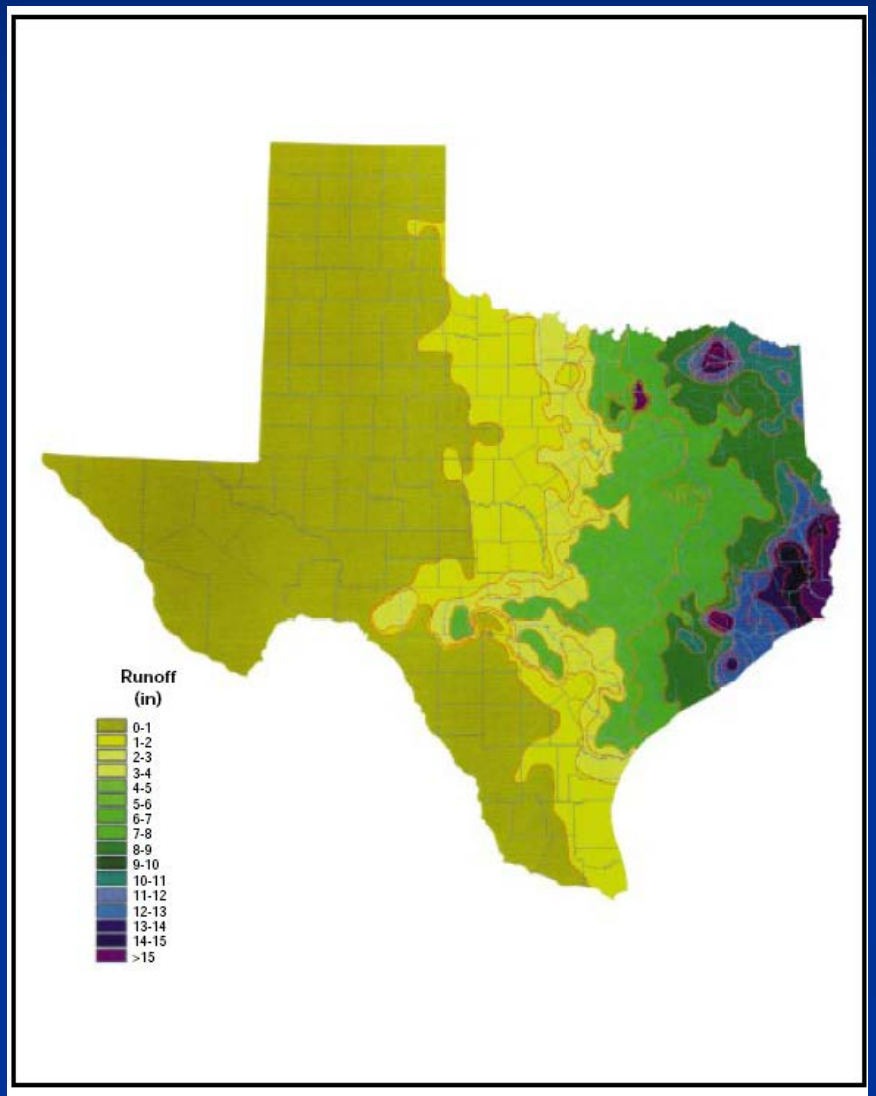
Watershed form is influenced by:

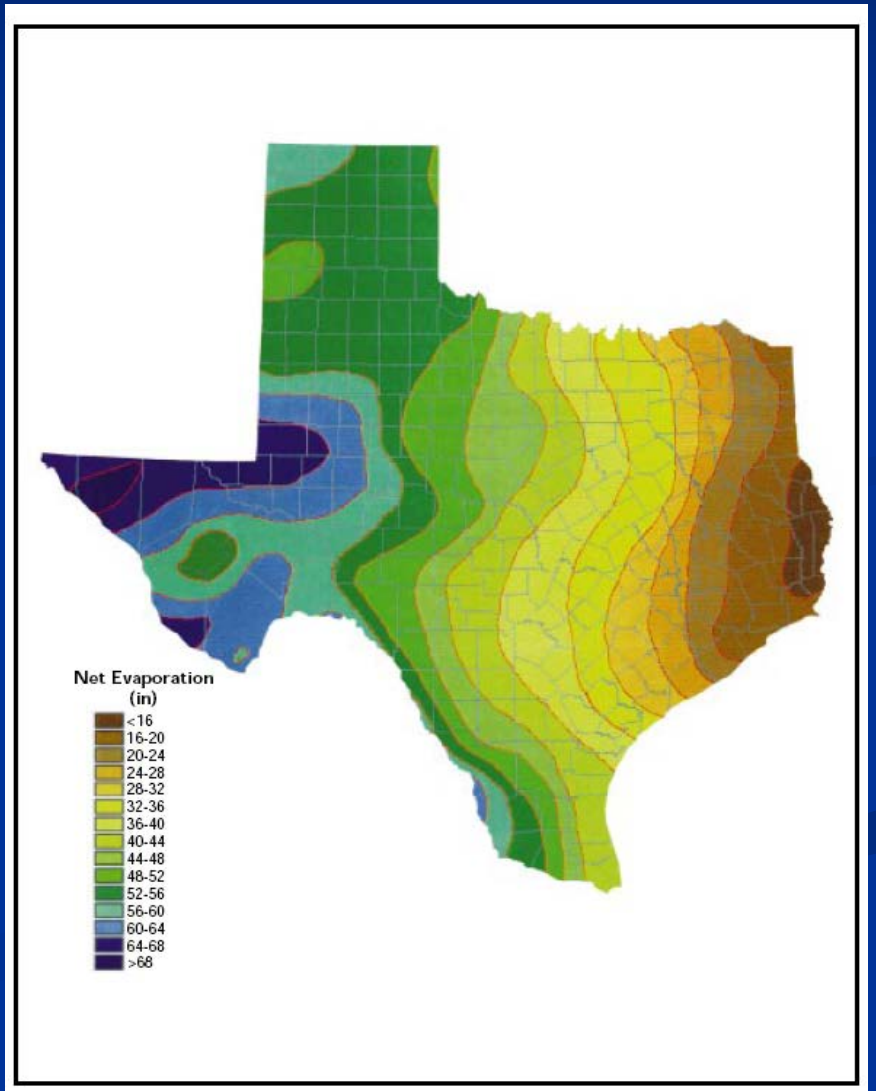
1. Climate
2. Geology & Soils
3. Topography
4. Vegetation
5. Land Uses

Long-Term Average Annual Rainfall Across Texas from 1961-1990



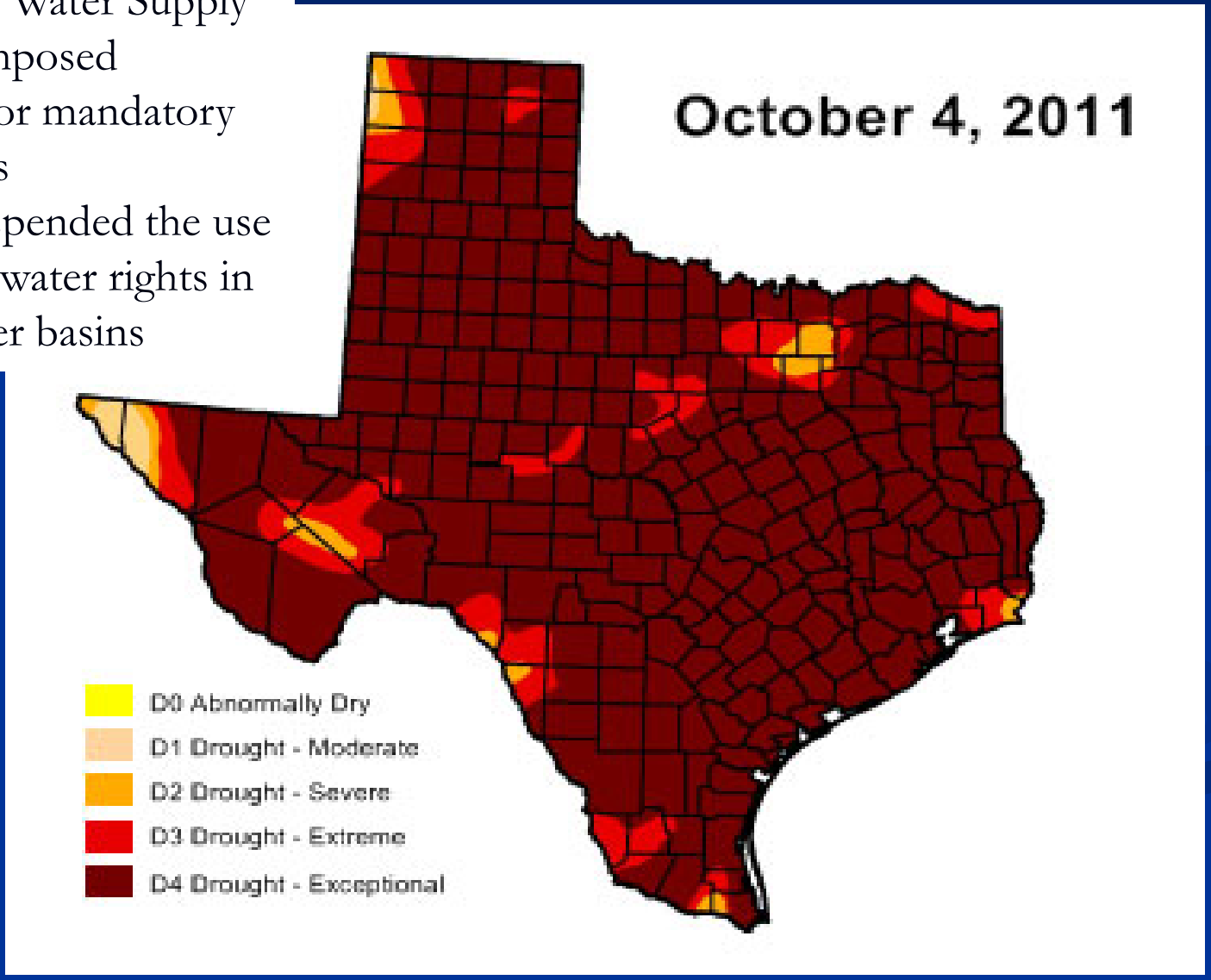
Average Annual Runoff and Evaporation Rates 1961-1997 (TWDB 1997)



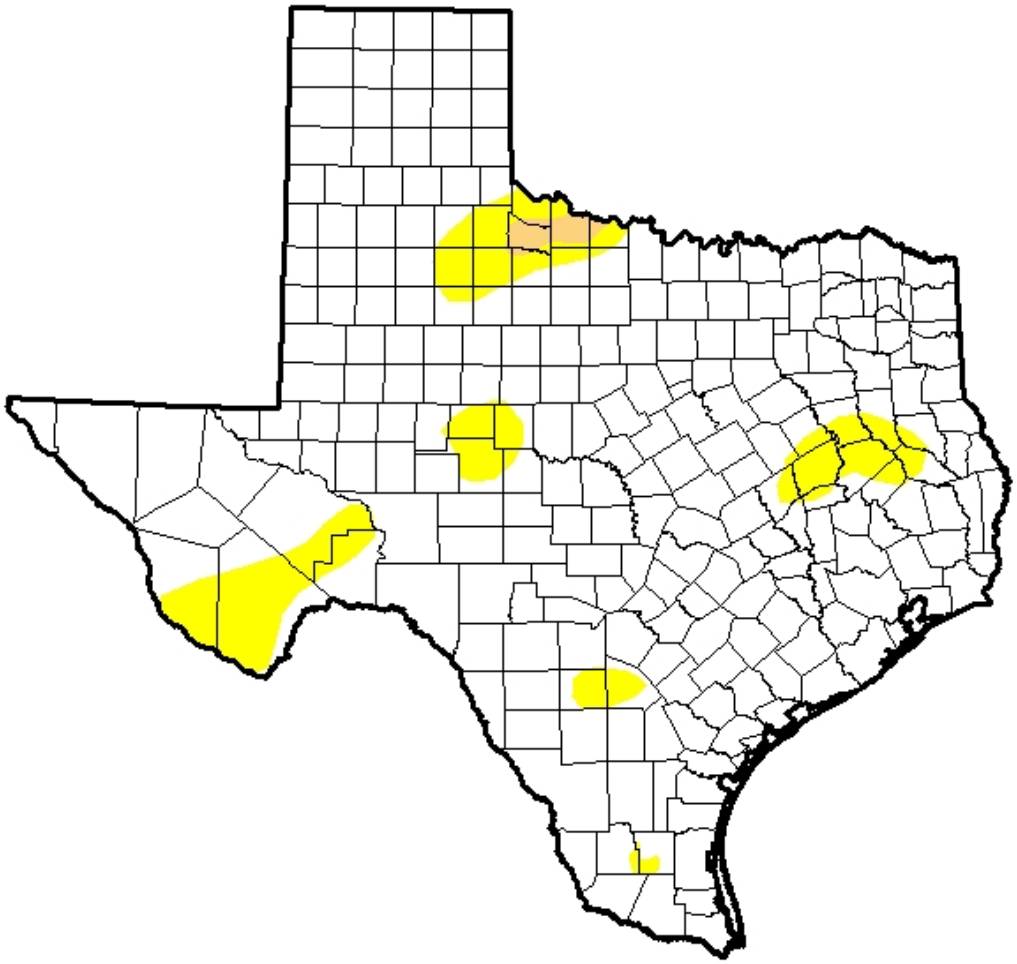


The Drought

- County Burn Bans
- 902 Public Water Supply Systems imposed voluntary or mandatory restrictions
- TCEQ suspended the use of certain water rights in several river basins



U.S. Drought Monitor
Texas



November 17, 2015

(Released Thursday, Nov. 19, 2015)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	90.41	9.59	0.61	0.00	0.00	0.00
Last Week 11/10/2015	90.15	9.85	0.61	0.00	0.00	0.00
3 Months Ago 8/18/2015	57.66	42.34	25.28	8.37	0.00	0.00
Start of Calendar Year 12/30/2014	34.37	65.63	44.68	25.73	11.70	3.17
Start of Water Year 9/29/2015	34.51	65.49	38.32	17.55	6.27	0.00
One Year Ago 11/18/2014	31.21	68.79	43.91	23.89	9.82	3.45

Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

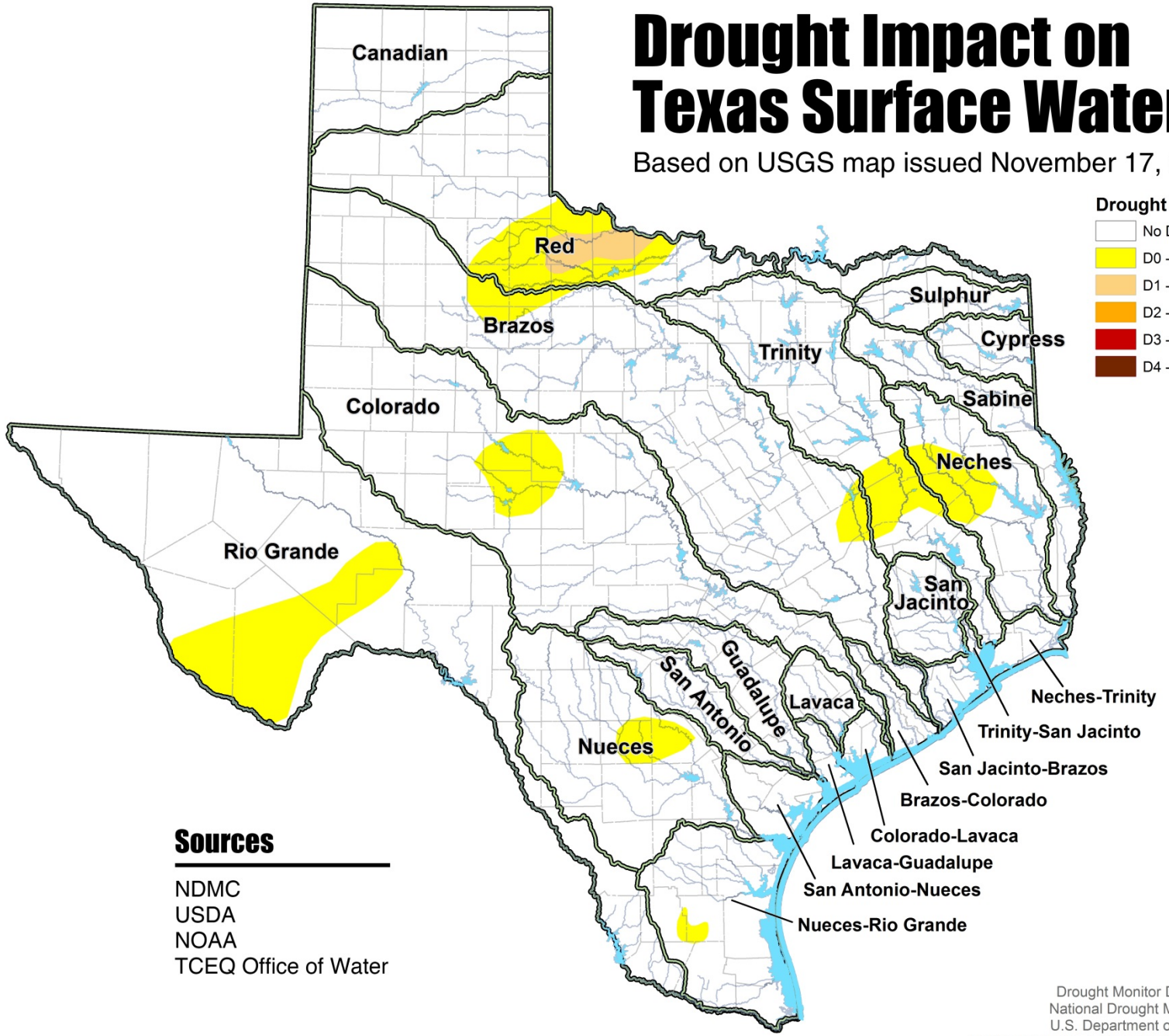
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Richard Heim
NCEI/NOAA

http://droughtmonitor.unl.edu/

Drought Impact on Texas Surface Water

Based on USGS map issued November 17, 2015



Sources

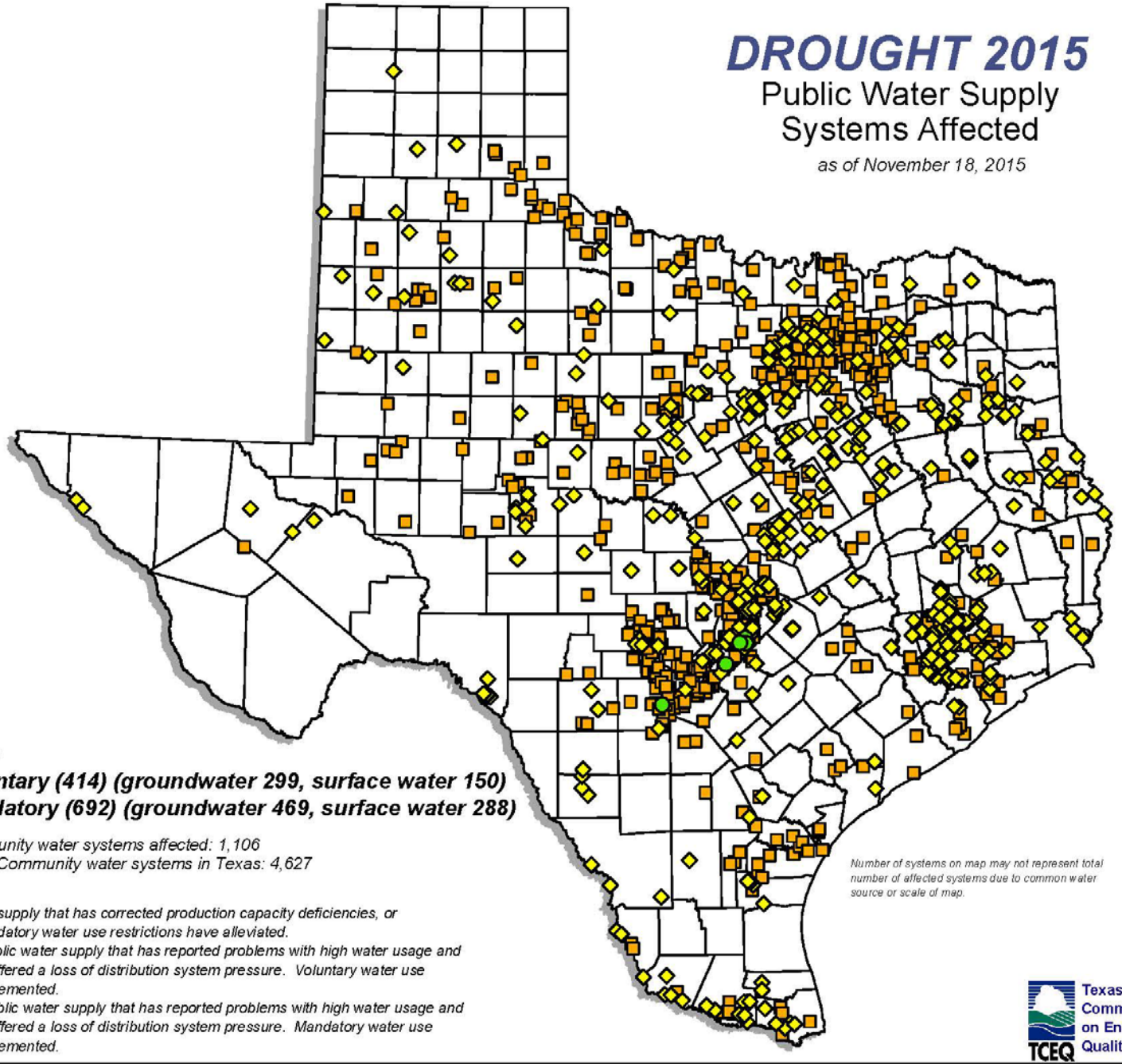
NDMC
USDA
NOAA
TCEQ Office of Water

Drought Monitor Dataset developed by the
National Drought Mitigation Center (NDMC)
U.S. Department of Agriculture (USDA) and
National Oceanic & Atmospheric Administration (NOAA)

DROUGHT 2015

Public Water Supply Systems Affected

as of November 18, 2015



- **RESOLVED (5)**
- **WATCH - Voluntary (414) (groundwater 299, surface water 150)**
- **WATCH - Mandatory (692) (groundwater 469, surface water 288)**

Total number of Community water systems affected: 1,106
Total number of active Community water systems in Texas: 4,627

Number of systems on map may not represent total number of affected systems due to common water source or scale of map.

Resolved *A public water supply that has corrected production capacity deficiencies, or drought conditions for mandatory water use restrictions have alleviated.*

Watch - Voluntary *A public water supply that has reported problems with high water usage and production, but has not suffered a loss of distribution system pressure. Voluntary water use restrictions have been implemented.*

Watch - Mandatory *A public water supply that has reported problems with high water usage and production, but has not suffered a loss of distribution system pressure. Mandatory water use restrictions have been implemented.*

Texas Commission on Environmental Quality

TCEQ

Floods

Geology and Soil Types

Increase in Impervious Surface

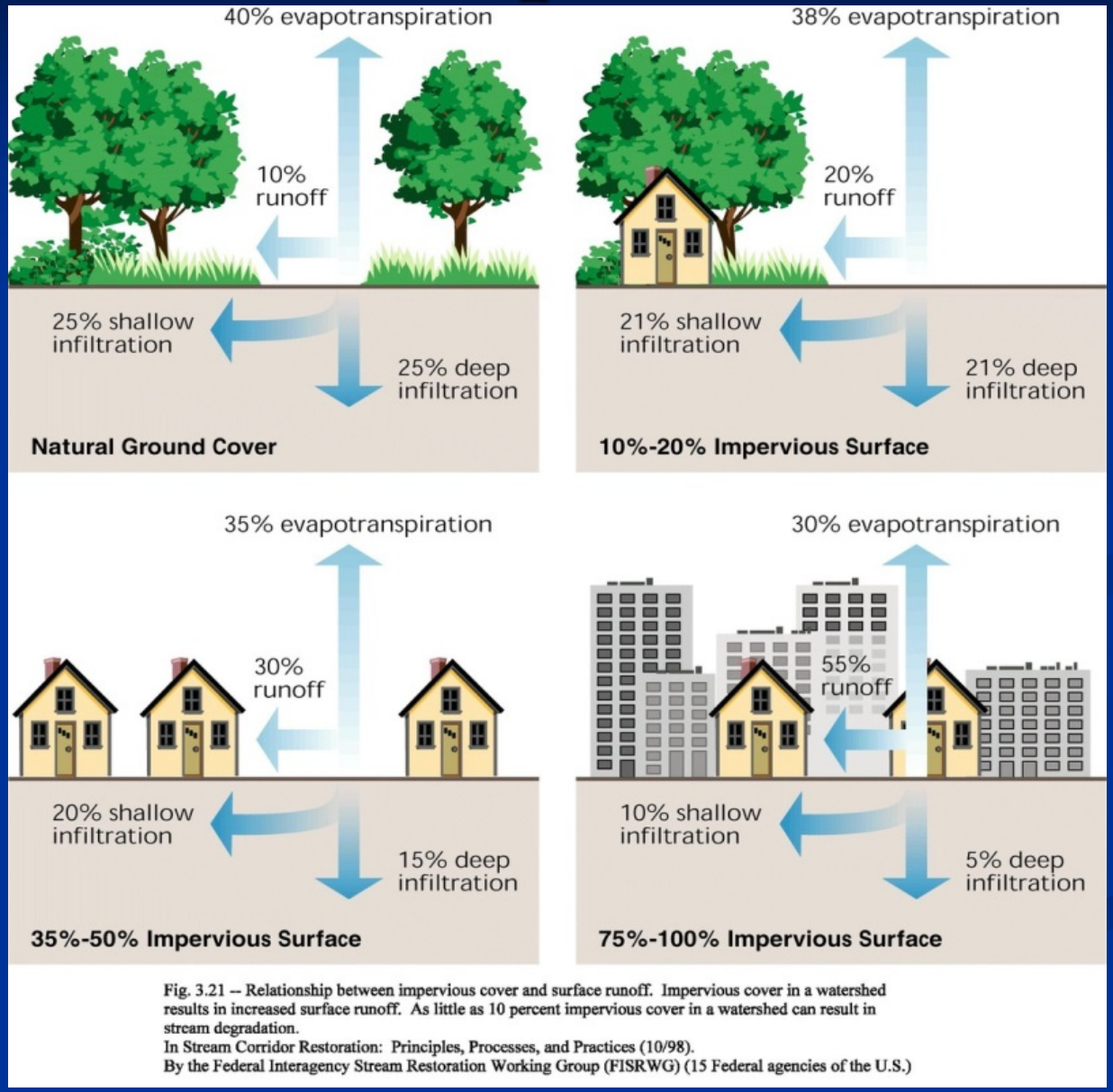
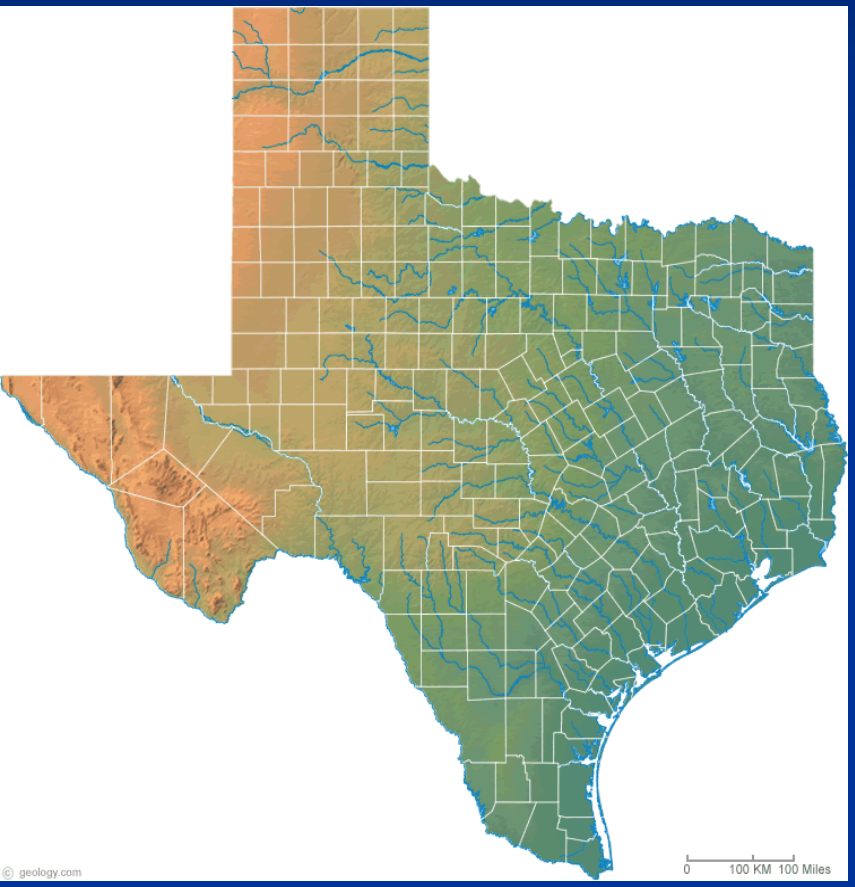


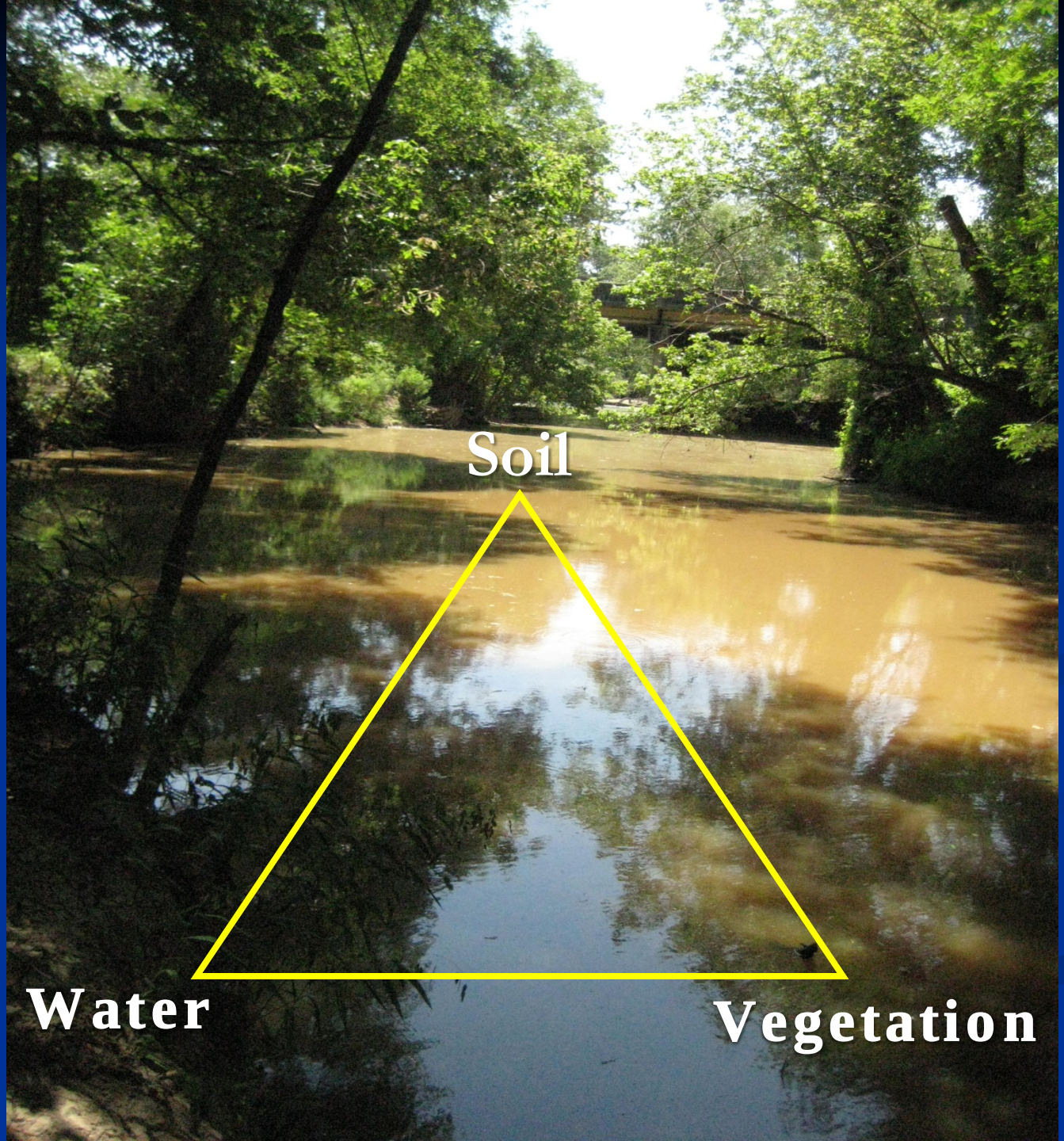
Fig. 3.21 -- Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
By the Federal Interagency Stream Restoration Working Group (FISRWG) (15 Federal agencies of the U.S.)

Topography



- Derives slopes of stream segments and watershed areas to identify unstable areas and to characterize segments or subwatersheds to model
- Evaluate altitude changes
- Topo Maps - http://topomaps.usgs.gov http://www.tnris.org/

Vegetation

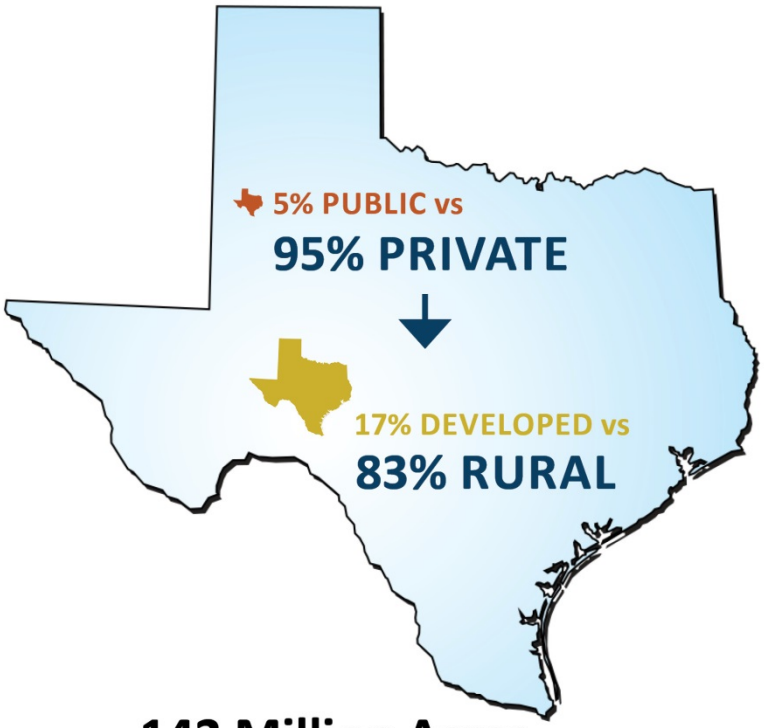

Soil
Water
Vegetation


Water Catchment
Water Shed

Land Uses: We Live and Work in a Watershed

Changing Texas

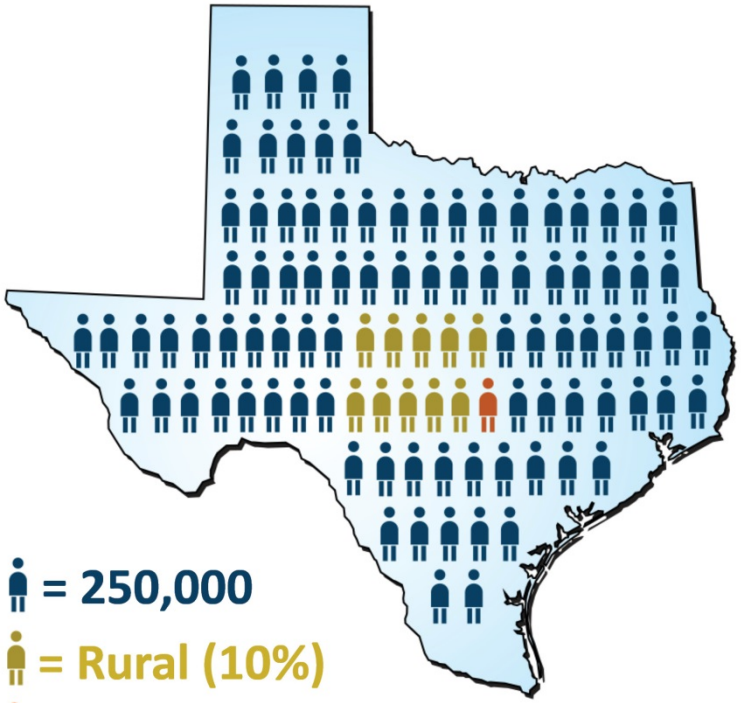
171 Million Acres...



...142 Million Acres

Private Working Lands

Population: 26 Million...



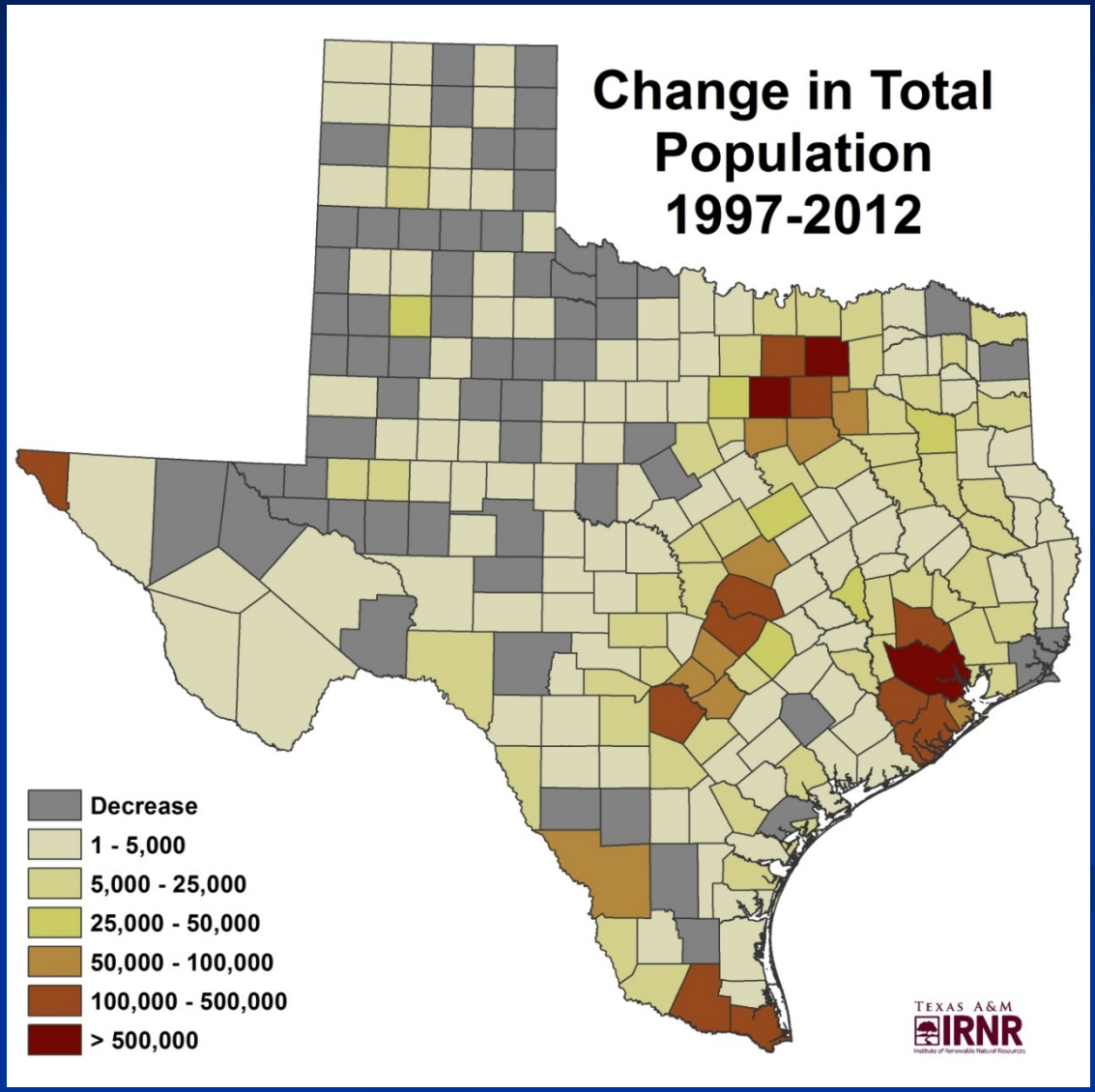
= 250,000

= Rural (10%)

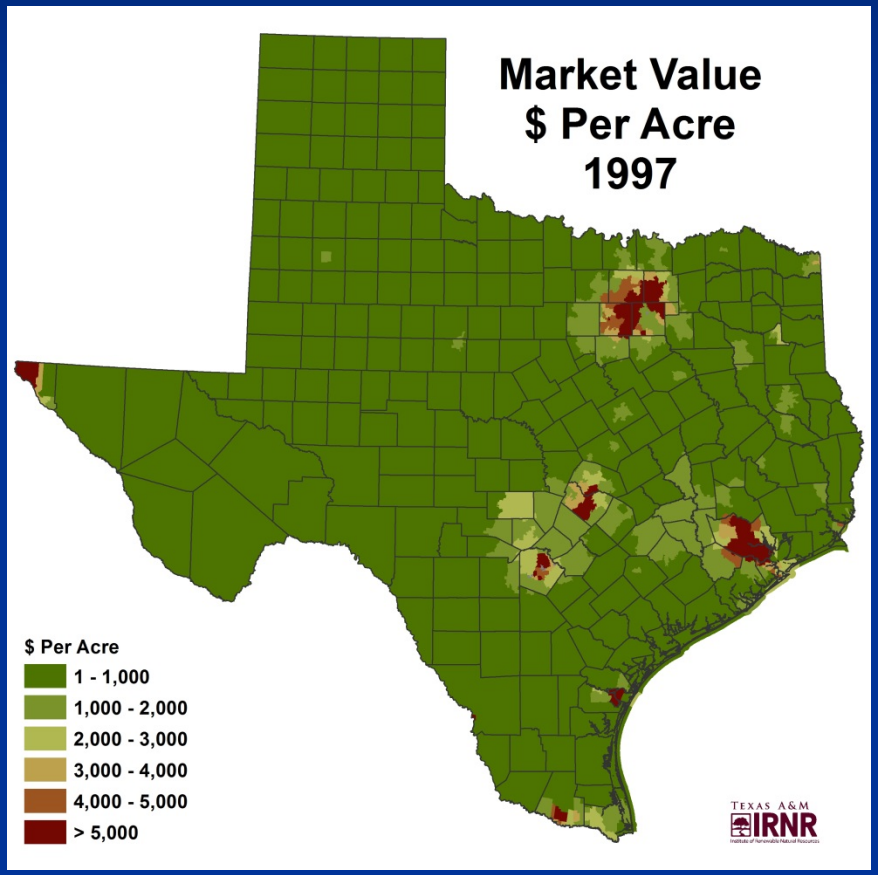
= Landowners (<1%)

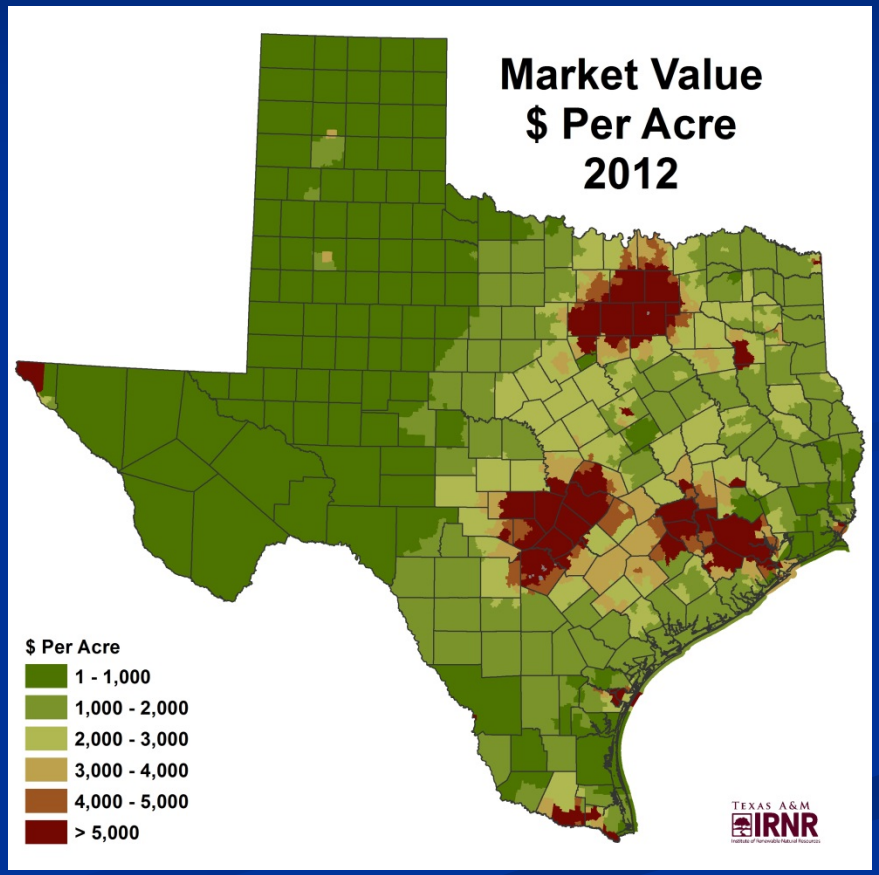
Texas Population

- 1997 – 19 Million
- 2012 – 26 Million
- 36% increase
- 500,000/year
- 65% of increase occurred within *Top Ten Highest Populated* Counties

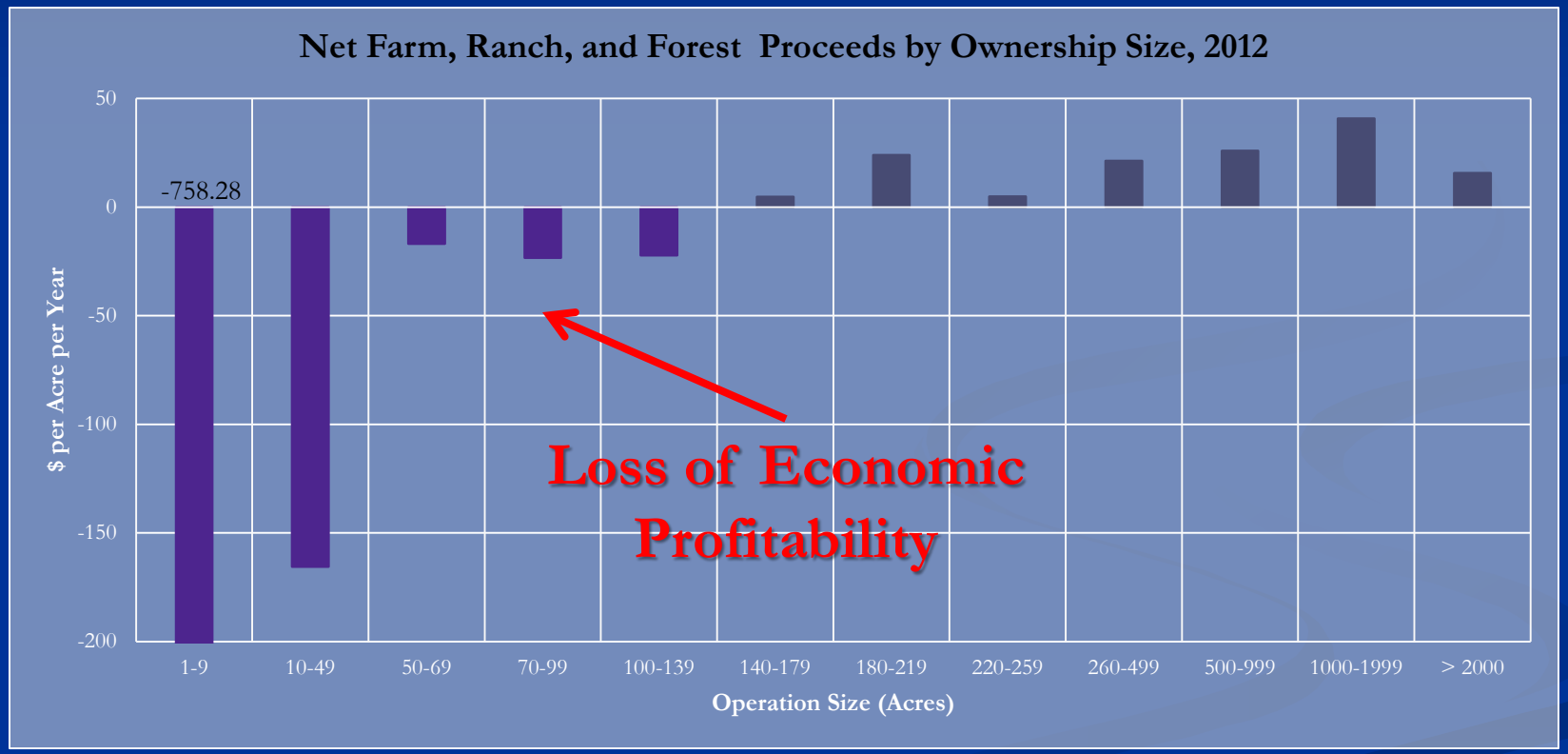


Drivers of Landuse Conversion: Market Value





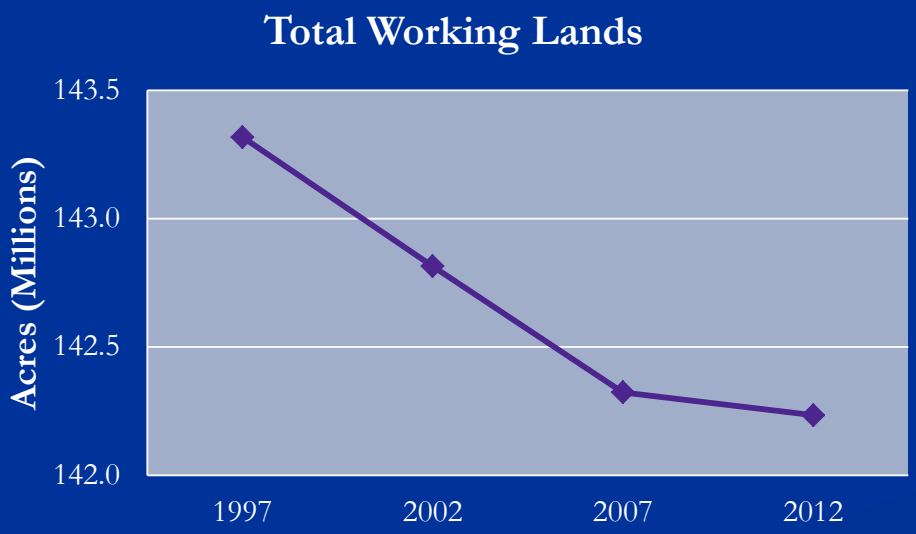
Drivers of Landuse Conversion: Farm, Ranch, and Forest Proceeds 2012

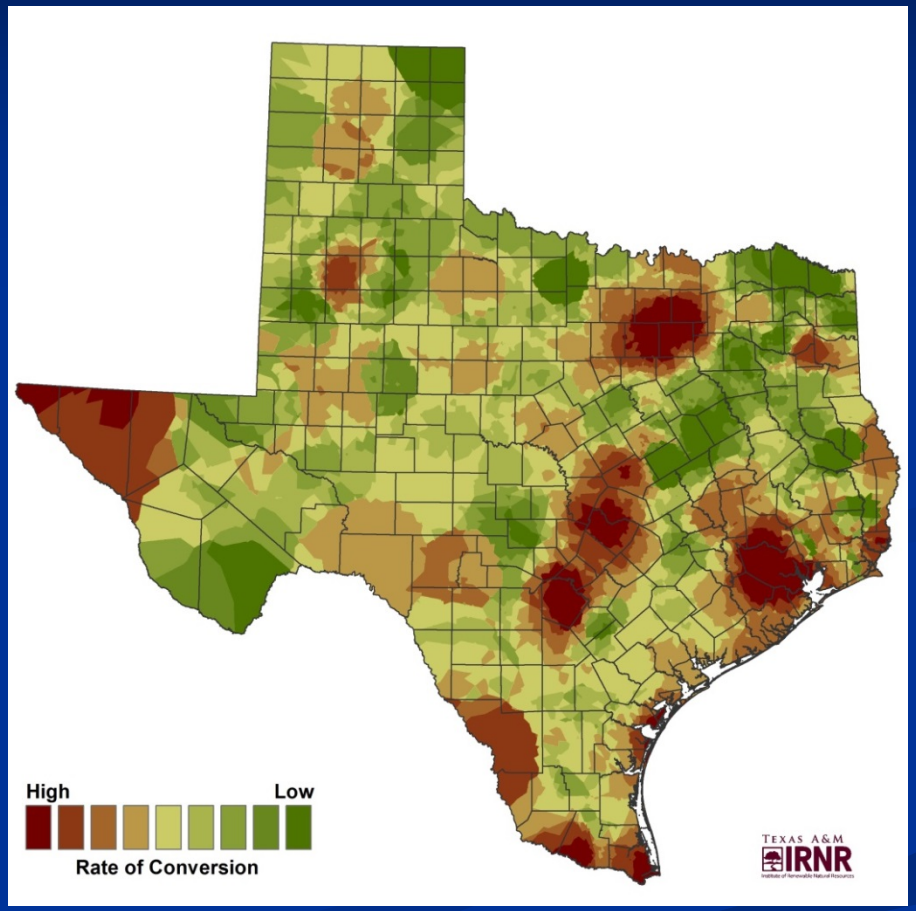


Early predictor of Landuse Conversion

Loss of Working Lands

- 1997 – 143.4 Million acres
- 2012 – 142.3 Million acres
- Loss 1.1 Million acres



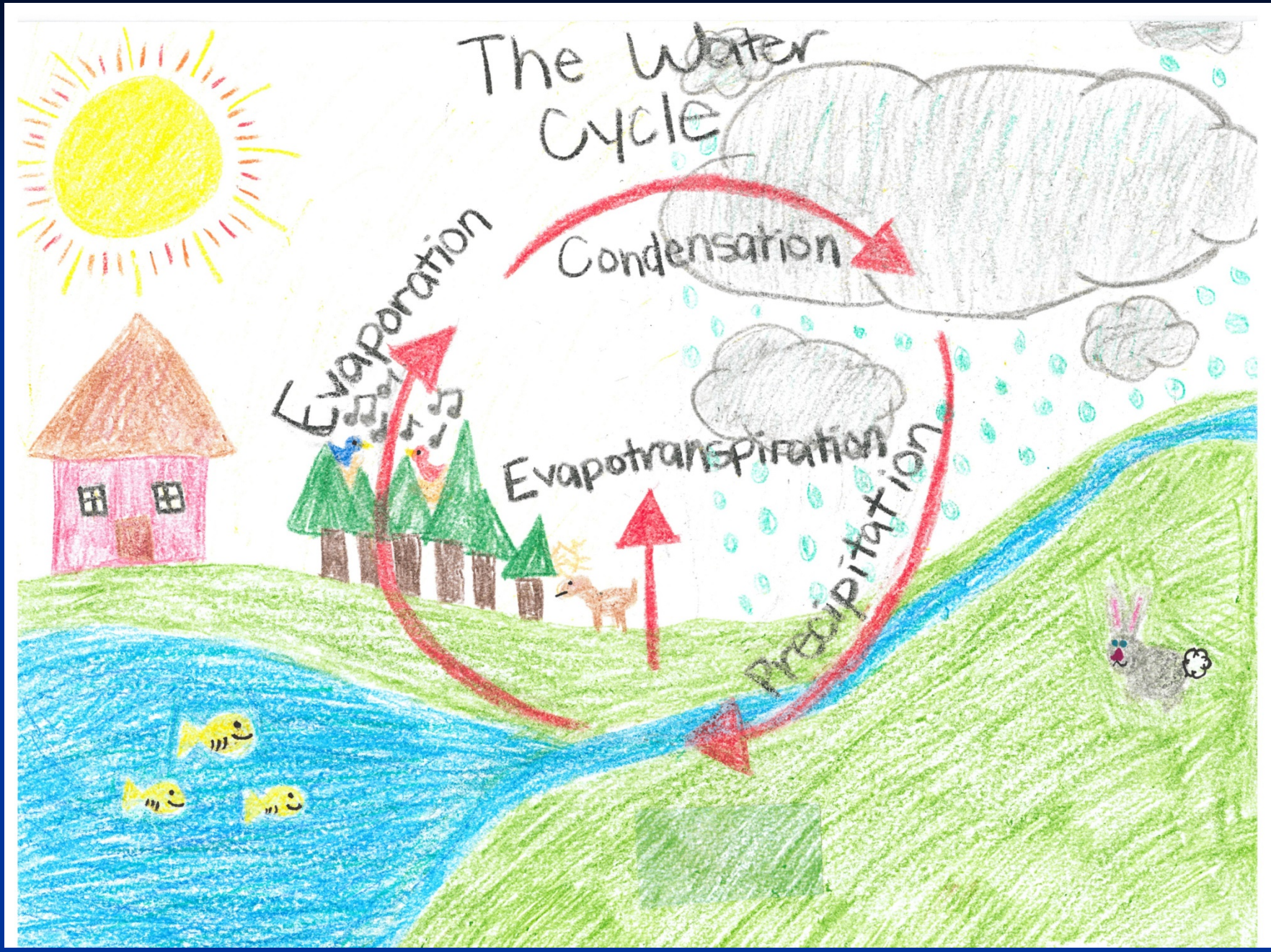


Rain is Precious: Factors Affecting the Fate of Rainfall

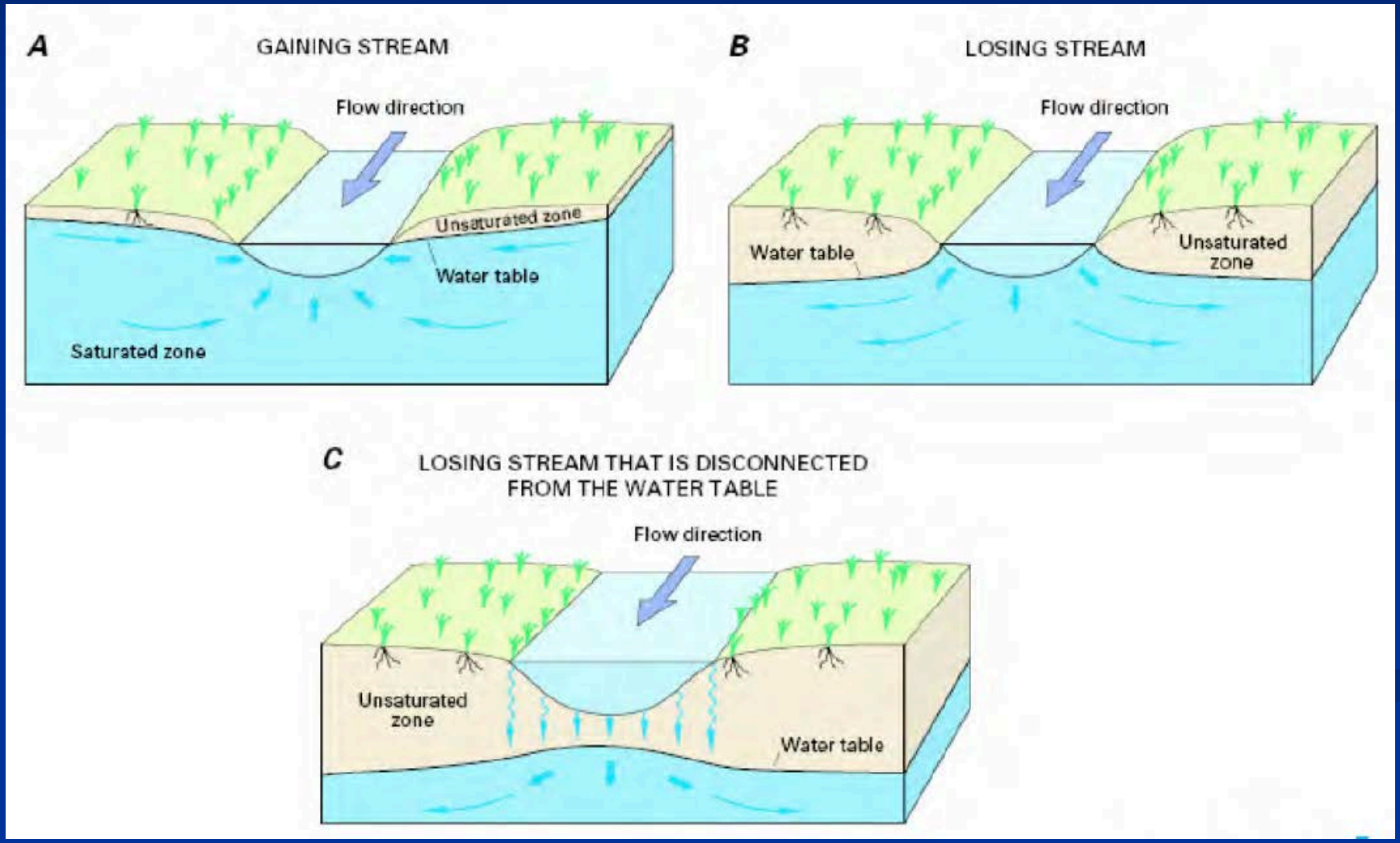
Many factors determine what happens to the rainfall received. Some of the primary factors include:

- type, quantity, and density of vegetative cover;
- storm intensity and duration;
- soil moisture prior to the storm event;
- soil water holding capacity;
- and slope.

These factors affect how much evaporates, infiltrates, moves through vegetation, and the amount and velocity of overland flow which may erode the soil surface and enter the stream.


The Water Cycle
Condensation
Evaporation
Evapotranspiration
Precipitation

Basic Types of Surface & Groundwater Interactions



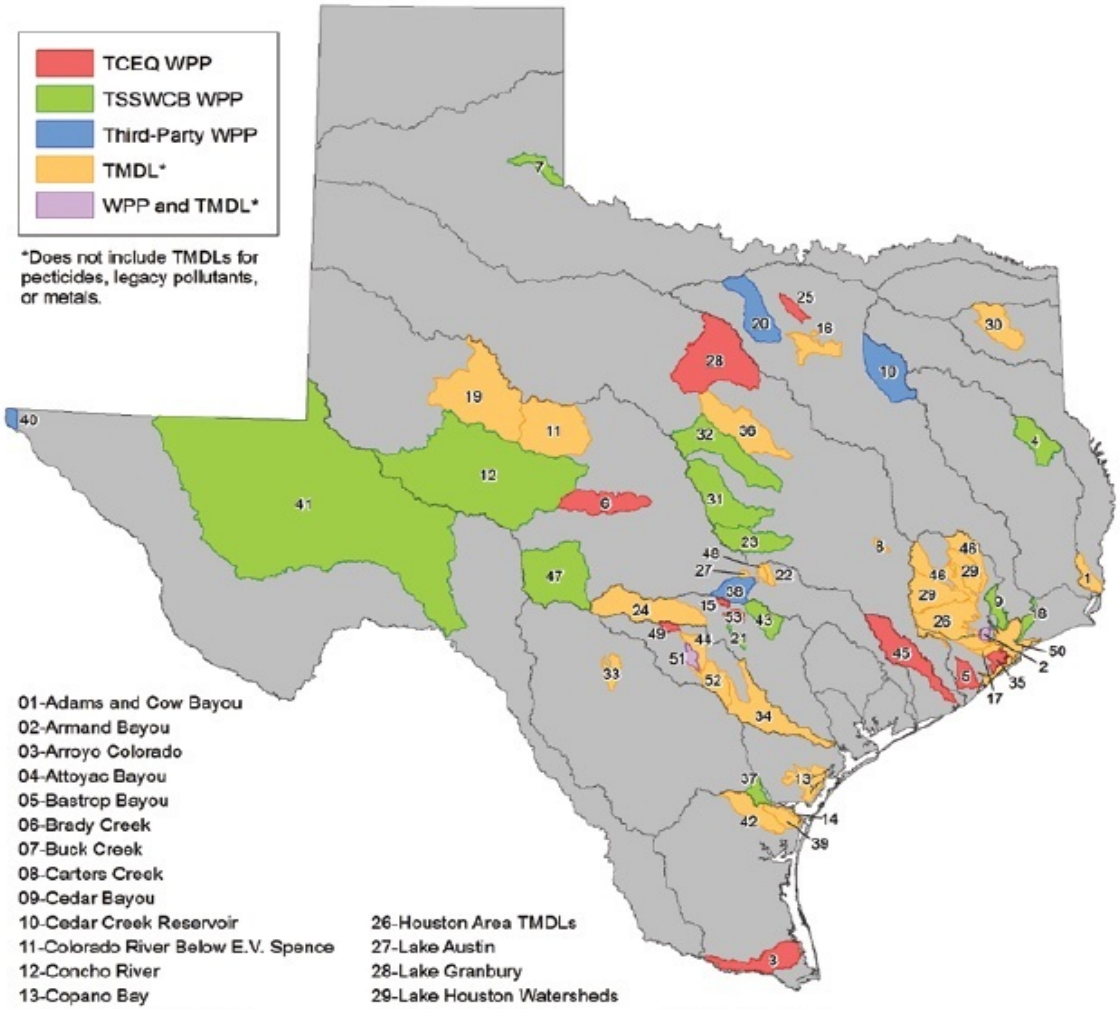
Why should we be concerned about the health of the stream and riparian areas?

- **Cumulative impacts of natural and man induced disturbances in the drainage area.**
- **Management not only affects the individual landowner but everyone else downstream.**
- **Stream and riparian systems are the water pipeline.**
- **They are one of the most important resources found on private and public lands in Texas.**

Creeks and Riparian Areas are Important

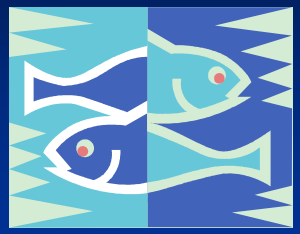
- Texas has more than 191,000 miles of rivers and streams with riparian zones and floodplains that comprise corridors of great economic, social, cultural, and environmental value.
- The 2012 303d List has **568** impaired water bodies on it.
- Many WPP and TMDL Implementation projects are ongoing across the state to improve WQ in watersheds.
- Bacteria is the cause for over 50% and low dissolved oxygen (nutrients) and organics in fish tissue at 15% each.
- Creeks / Riparian Areas are special places that need preferential management and all landowners are water managers.
- To manage or restore creeks you must understand them and then address the issues that are inhibiting natural restoration.

Map of Watersheds With Watershed Protection Plans or TMDL I-Plans Being Developed or Implemented



01-Adams and Cow Bayou
02-Armand Bayou
03-Arroyo Colorado
04-Attoyac Bayou
05-Bastrop Bayou
06-Brady Creek
07-Buck Creek
08-Carters Creek
09-Cedar Bayou
10-Cedar Creek Reservoir
11-Colorado River Below E.V. Spence
12-Concho River
13-Copano Bay
14-Corpus Christi Beaches
15-Cypress Creek
16-Greater Trinity TMDLs
17-Dickinson Bayou
18-Double Bayou
19-E.V. Spence Reservoir
20-Eagle Mountain Reservoir
21-Geronimo Creek
22-Gilleland Creek
23-Granger Lake
24-Guadalupe River Above Canyon Lake
25-Hickory Creek
26-Houston Area TMDLs
27-Lake Austin
28-Lake Granbury
29-Lake Houston Watersheds
30-Lake O' the Pines
31-Lampasas River
32-Leon River
33-Lower Sabinal River
34-Lower San Antonio River
35-Moses-Karankawa Bayous
36-North Bosque River
37-Lower Nueces River
38-Onion & Barton Springs
39-Oso Bay and Oso Creek
40-Paso del Norte
41-Pecos River
42-Petronila Creek
43-Plum Creek
44-Salado Creek
45-San Bernard
46-San Jacinto River
47-Upper Llano River
48-Spicewood Springs and Walnut Creek
49-Upper Cibolo Creek
50-Upper Coast Oyster Waters
51-Upper San Antonio River
52-Upper San Antonio River
53-Upper San Marcos

Designated Uses



Aquatic Life

- Protect aquatic species
- Dissolved Oxygen, Toxic Chemicals, Total Dissolved Solids

Recreation

- Estimates the relative risk of swimming and other water recreation activities
- Bacteria

Drinking Water

- Indicates if water is suitable as a source of drinking water
- Metals, Pesticides, Toxic Chemicals, Total Dissolved Solids, Nitrates

Fish Consumption

- Protect public from consuming fish that may be contaminated
- Metals, Pesticides, Other Toxic Chemicals

Surface Water Quality

Numeric

- High Aquatic Life Use
  - Dissolved Oxygen – 5.0 mg/L

  (4-5 stressed <3 can't survive)
  - pH – Optimum Range 6.5-9.0
  - Temperature – 90 F (32.2 C) common range 68-86 F
  - Total Dissolved Solids – *396 mg/L
  - Sulfate – *48 mg/L
  - Chloride - *70 mg/L

* Specific criteria for segment

Screening Criteria

- Nitrite and Nitrate Nitrogen – 1.95 mg/L
- Phosphorus – 0.69 mg/L
- Ammonia
- Chlorophyll *a* (algae)

Contact Recreation – *E. coli*	
Primary	126
Secondary 1	630
Secondary 2	1,030
Non-contact	2,060

Numeric Criteria of bacteria for designated uses of water bodies.

Parameter (indicator organism)	Use	Numeric Criteria (geometric mean)[a b]	Numeric Criteria (single sample max)[a]
E. coli (Freshwater)	Primary Contact Recreation	126	N/A
	Secondary Contact Recreation I	630	N/A
	Secondary Contact Recreation II	1,030	N/A
	Noncontact Recreation	2,060	N/A
Enterococci (Marine Waters)	Primary Contact Recreation	35	89
	Secondary Contact Recreation I	175	N/A
	Noncontact Recreation	350	N/A
Fecal Coliform (Highly Saline Waters)[c]	Contact Recreation	200	400
	Secondary Contact Recreation I & II	1,000	N/A
	Noncontact Recreation	2,000	N/A
Fecal Coliform	Oyster Harvesting Waters	14[b]	N/A

[a]All values are in colony forming units per 100 ml
[b]The standard for Fecal Coliform in Oyster Harvesting Waters is based on the median sample number, not the geometric mean
[c]Fecal Coliform is no longer used for contact recreation except in high salinity waters

Point Source Pollutant Sources

- Point Source
  - Permitted Discharges
    - Wastewater Treatment Plants
    - Industrial Facilities
    - Confined Animal Feeding Operation
- Stormwater Permit

Nonpoint Sources

- Urban
- Wildlife
- Feral Hogs
- Livestock
- Crops
- Onsite Septic Facilities