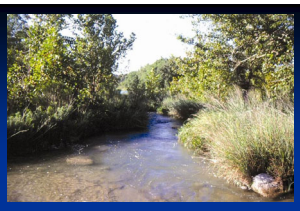


Riparian & Stream Ecosystems

Clare Entwistle and Nikki Dictson
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

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
- Texas A&M AgriLife Extension Service and Research
- Texas A&M Natural Resources Institute

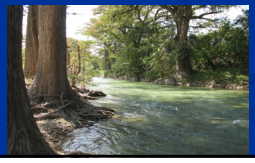
Education

- Deliver 25 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: Urban Riparian Symposium, February 2019 in Grapevine and San Marcos in February 2021.

Managing for Water is Complicated!

Freshwater Resources

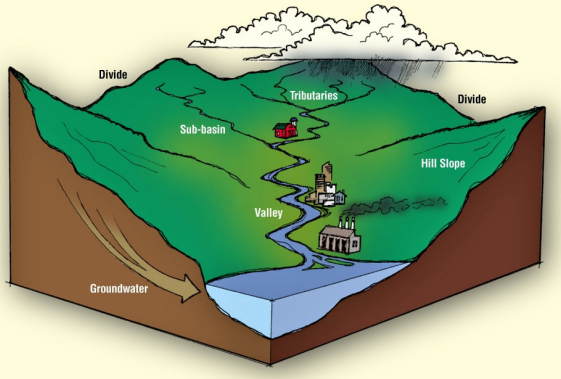
- **~191,000 miles of rivers & streams**
  - **20% perennial flow**
- **>200 major reservoirs ~1.2 million ac.**
- **5 million acres of freshwater wetlands**
- **9 major aquifers & 21 minor aquifers**
- **1,292 named springs (~3,000 total)**

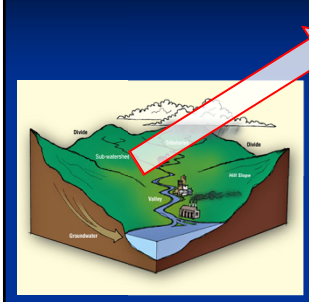


Texas Water Picture

- Population increase from 26 million to 51 million by 2070 *(more than 70%)*
- Water demands are projected to increase from 18.4 to 21.6 million af/yr
- Existing Water Supplies are expected to decline 11%, from 15.2 to 13.6 million
- Potential shortage of 4.8 maf in 2020 to 8.9 maf per year in 2070.
- Total Capital Costs for all 2017 recommended strategies $62.6 Billion
- Estimated economic losses resulting from water shortages are estimated at $73 Billion in 2020 and to $151 Billion in 2070.

What is a WATERSHED?





WATERSHED

Texas Rivers

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

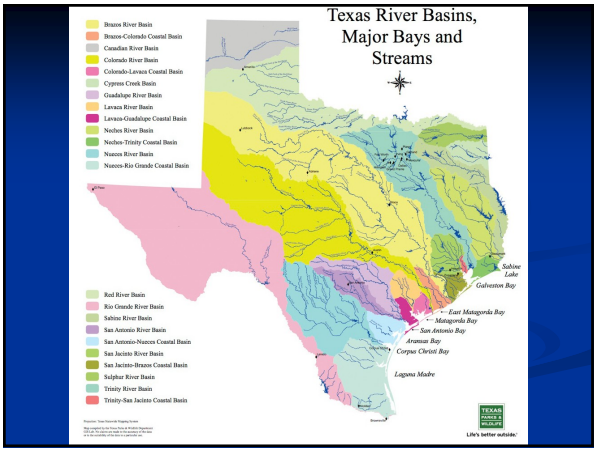
Adequate vegetation, landform or large woody material to:

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

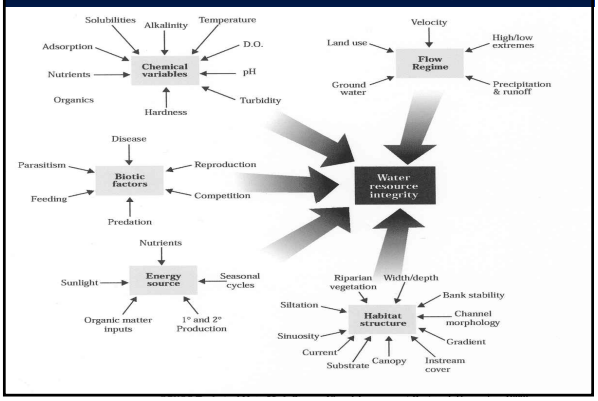
Physical Function →

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

Values



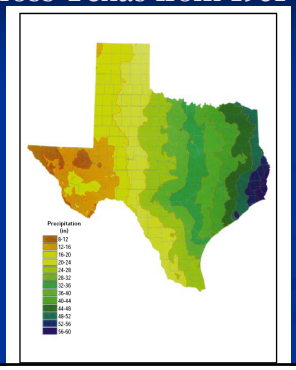
Watersheds are Complex Systems



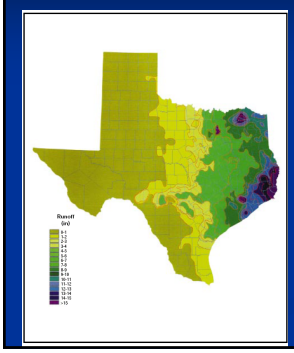
Watershed form is influenced by:

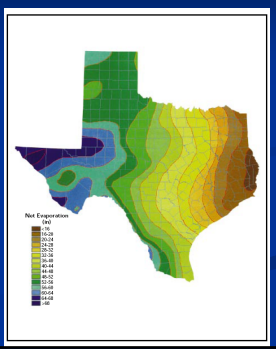
1. Climate
2. Geology & Soils
3. Topography
4. Vegetation
5. Land Uses

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



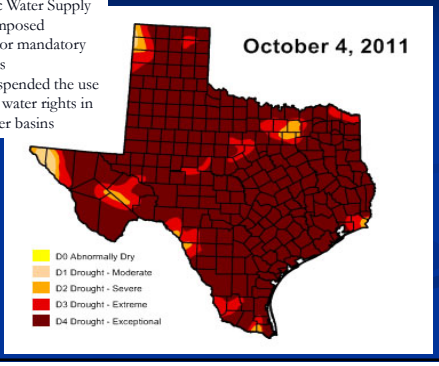
Average Annual Runoff and Evaporation Rates 1961-1997 (TWDB 1997)





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

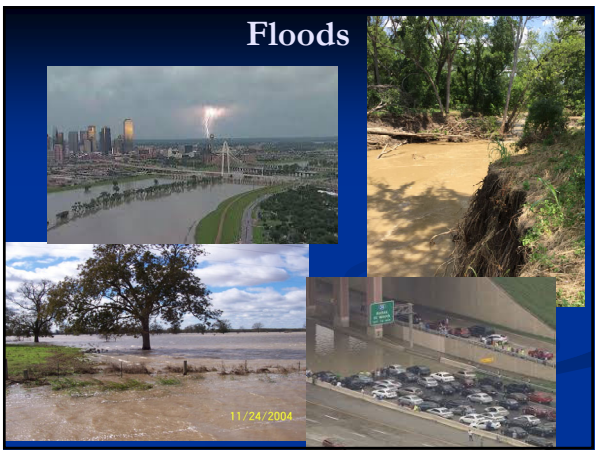


How to Monitor Drought Conditions

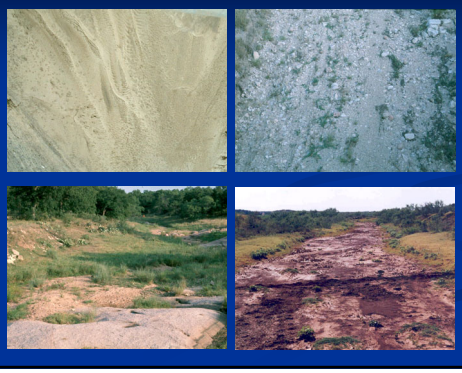
- National Drought Monitor: https://droughtmonitor.unl.edu/
- Texas Drought Map: https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?TX
- Maps updated each Thursday

Category	Description	Possible Impacts	Ranges: Palmer Drought Severity Index (PDSI)	Ranges: CPC Soil Moisture Model (Percentiles)	Ranges: USGS Weekly Streamflow (Percentiles)	Ranges: Standardized Precipitation Index (SPI)	Objective Drought Indicator Blends (Percentiles)
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21 to 30	21 to 30	-0.5 to -0.7	21 to 30
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11 to 20	11 to 20	-0.8 to -1.2	11 to 20
D2	Severe Drought	Crop or pasture losses likely; Water shortages common; Water restrictions imposed	-3.0 to -3.9	6 to 10	6 to 10	-1.3 to -1.5	6 to 10
D3	Extreme Drought	Major crop/pasture losses; Widespread water shortages or restrictions	-4.0 to -4.9	3 to 5	3 to 5	-1.6 to -1.9	3 to 5
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; Shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0 to 2	0 to 2	-2.0 or less	0 to 2

Floods



Geology and Soil Types



Increase in Impervious Surface

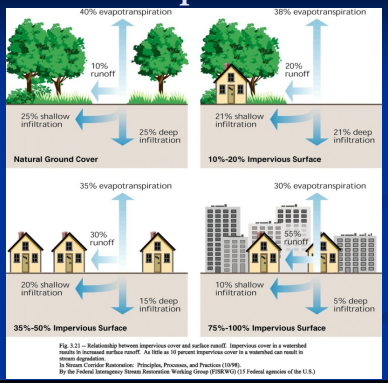
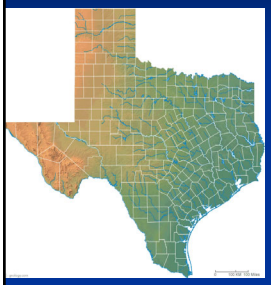


Fig. 3.21 – Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).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

Topography

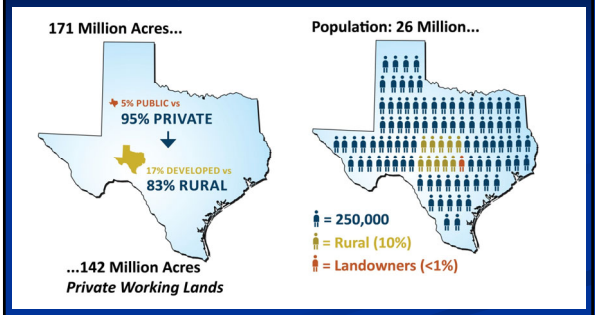


- Derives slopes of stream segments and watershed areas to identify unstable areas and to characterize segments or subwatersheds to model
- Evaluate altitude changes
- Topo Maps - http://topomaps.usgs.gov http://www.tnris.org/

Vegetation

Land Uses: We Live and Work in a Watershed

Changing Texas



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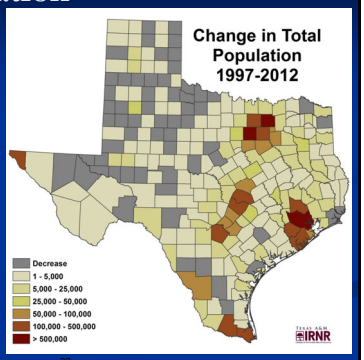
Texas Population

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



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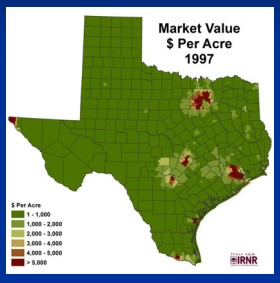
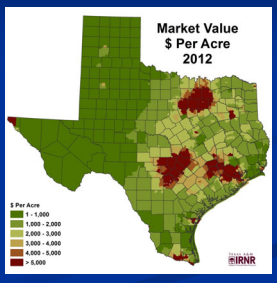
Drivers of Landuse Conversion: Market Value





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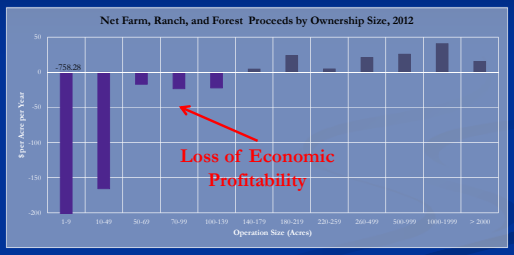
Drivers of Landuse Conversion: Farm, Ranch, and Forest Proceeds 2012



Early predictor of Landuse Conversion

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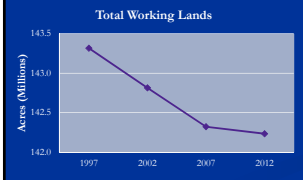
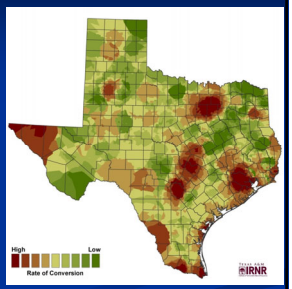
Loss of Working Lands

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





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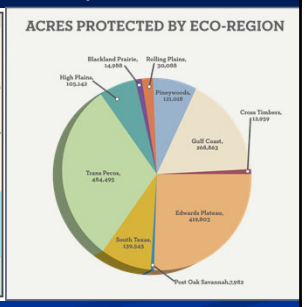
Texas Land Trust Council Conservation Lands Inventory



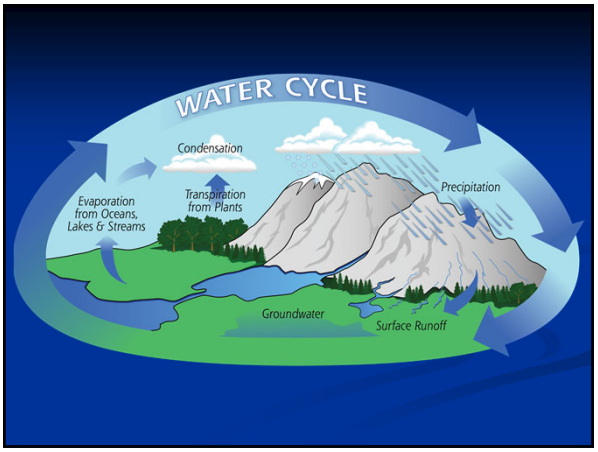
Total Area Conserved: 1,603,927 Acres

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.



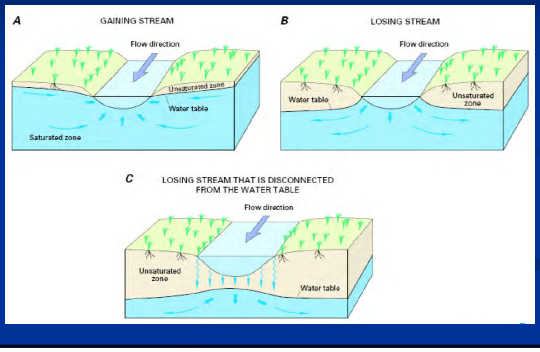
Main Sources of Water in Texas: Surface Water

- Surface Water: streams, rivers, and lakes
- Publically owned
- Requires a permit from state agency for use of surface water

Main Sources of Water in Texas: Groundwater

- Groundwater: Water that is stored underground in aquifers.
- Considered private property in Texas
- Landowners have rights to water under their property and can use the groundwater within the rules of a local groundwater district, if one is established.
- Landowner is responsible for managing water from private wells.

Basic Types of Surface & Groundwater Interactions



Public vs. Private Water Supplies

- SDWA requires public supplies to meet standards
- NO federal regulations for private water supplies
  - 6% of Texans rely on private wells for drinking water
  - TCEQ maintains list of labs that test drinking water samples

Reduce the risk of well contamination

- If well water is shallow and in a floodplain pollutants from the stream can enter and contaminant your well.
- To reduce the risk:
  - Understand the interaction between the stream and well water
  - Monitor conditions of both stream and well water
  - Take action when needed

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 2016 Texas Integrated report assessed 1,453 water bodies that had sufficient data for evaluations with 7-10 yrs.
- 2016 303d List has **574** impaired water bodies on it (-15).
- Many WPP and TMDL Implementation projects are ongoing across the state to improve WQ in watersheds.
- Bacteria is the cause for over 39% of impairments followed by and low dissolved oxygen (nutrients) for 17% and organics in fish tissue at 19%.

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

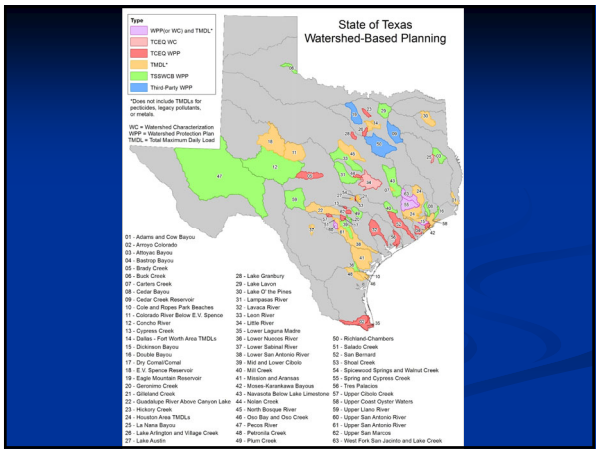
Screening Criteria

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

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

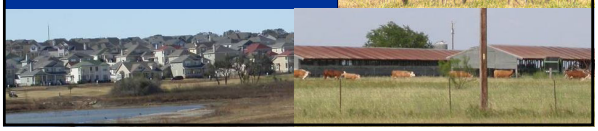


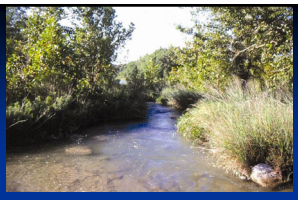
Point Source Pollutant Sources

- 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





- Creeks / Riparian Areas are special places that need preferential management and all landowners are also water managers.
- To manage or restore creeks you must understand them and then address the issues that may be inhibiting natural restoration.