Water in Texas
A Global Issue
OUR MISSION
Inspiring research and leadership that ensures clean, abundant water for the environment and all humanity.

- RESEARCH
- EDUCATION
- STEWARDSHIP
- LEADERSHIP

www.MeadowsWater.org
Texas Stream Team

• Citizen Scientist Water Quality Monitoring
• Water Resource Education

To promote:
• Water Quality Education
• Non-point Source Pollution Reduction
• Watershed Awareness
• Environmental Stewardship
Texas Stream Team Citizen Science Programs

 ✓ Standard Core Water Quality Monitoring
 ✓ Probe Core Water Quality Monitoring
 ✓ Advanced Water Quality Monitoring
 ✓ Riparian Evaluation
 ✓ Macroinvertebrate Bioassessment
 ✓ Angler & Monofilament Finders
Average annual runoff (inches)
Minor aquifers
Water Demand Projections (acre-ft per year)
The Drought of Record
Texas, Precipitation, January-December

- 9-Point Binomial Filter
- Trend (+0.05%/Century)
- Long Term Average
- Precipitation

Inches

mm

2011 Drought Impacts

$7.62 Billion in Agricultural Losses

115,000 Jobs

2500 Homes Burned

No End in Sight

http://stateimpact.npr.org/texas/drought/
Things Have Improved

• In 2015, the most severe drought conditions in Texas receded

• Reservoir storage in Texas as a whole average 86% full
Drought Monitor map of Texas for the week ending 2018-02-20

- D0 - Abnormally Dry: 88.10% of Texas
- D1 - Moderate Drought: 70.76% of Texas
- D2 - Severe Drought: 37.56% of Texas
- D3 - Extreme Drought: 11.13% of Texas
- D4 - Exceptional Drought: 0.00% of Texas
- No Drought: 11.90% of Texas

Drought Monitor classes are cumulative - if a region is in D2, it is also in D1 and D0. The statistics above represent these cumulative values. Also, note that class D0 - Abnormally Dry is not technically drought and represents a transition into or out of drought conditions.
WHAT CAN WE DO?
We can’t build our way out of this
All of Our Watersheds and Recharge Zones Are On Private Land
direct recharge
Texas loses more land from rural uses each year than any other state.

Between 1997 and 2007: Texas lost 2.1 million acres of farms, ranches and forest land to other uses.

From: www.texaslandtrends.org
The number one water quality threat in Texas is from nonpoint source pollution.
Water Conservation Stamp issued in 1960
Conserved Water is Expected to Make Up 1/3 of the Municipal Water Supply in Texas

The Easiest Water for Us to Get is the Water We Already Have
Environmental Flows
Texas needs environmental flows

- Only ten percent of water rights consider environmental flows
- Senate Bill 3 does not address flows for historic water rights
DETERMINE RELATIONSHIP BETWEEN INFLOWS AND SALINITY
ASSESS THE RELIABILITY OF THE WATER RIGHT

=computer-based simulation predicting the amount of water that would be in a river or stream under a specified set of conditions
ASSESS THE ECOLOGICAL BENEFITS OF CANDIDATE WATER RIGHTS
Surface Water and Groundwater Management
Water Code

• State water
  • Rivers, streams, lakes, bays, storm water, and floodwater
  • Includes “underflow”

• Groundwater
  • “…water percolating below the surface of the earth.”
• ~23% of annual inflow to Lake Travis comes from Pedernales River with half of this inflow originating from groundwater.
• The river is in relatively good shape.
• Land cover has not changed significantly.
• The Pedernales acts as a groundwater catchment in Southwestern Travis County and Northern Hays County.
Water for Texas

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WILL SMALL AMOUNTS OF FRESHWATER INFLOW MATTER?

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  - Hanna Ehrmann (benthos and sediment quality)
5 Stations in 3 Bays, 12 monthly sampling periods/one year
Many different biological responses within estuaries are affected by water quality, which is affected by inflow.

Inflow drives water quality, which drives ecological health.

The responses can be summarized with multivariate statistics.

“Domino Theory” Source: Montagna et al. 2013
**ANALYTICS APPROACH**

Summarize Flow Data
• Flow = Q

Multivariate Analysis of WQ Data
• FWI index using PC scores

Calculate Flow Required
• \( \log(Q+1) = ae^{-bS} \)
• Where Q is discharge and S is FWI index
The first two principal components (PC1 and PC2) explained 30% and 20% respectively for a total of 50% of the variation in hydrographic variables.

The PC1 axis represents a Freshwater Inflow (FWI) index, where a decrease in salinity (or increase in freshwater inflow) is associated with increased nutrient concentrations.

Principal components analysis (PCA) variable loads for hydrographic characteristics using PC1 and PC2, stations N1-N5, from September 2015 to September 2016.
### Pearson Correlation Coefficients

|                     | Discharge(ac-ft/mo) |            | Prob > |r| under H0: Rho=0 |
|---------------------|---------------------|------------|--------|------------------|
| Salinity (PSU)      | -0.58208            | <.0001     |
| pH                  | -0.05358            | 0.6716     |
| Total Suspended Solids (mg/L) | -0.07815         | 0.5361     |
| Particulate Organic Matter (mg/L) | -0.03466       | 0.784      |
| Phosphate (µmol/L)  | 0.44101             | 0.0002     |
| Silicate (µmol/L)   | 0.49693             | <.0001     |
| Nitrate + Nitrite (µmol/L) | 0.44746       | 0.0002     |
| Ammonium (µmol/L)   | 0.1064              | 0.3989     |
| Chlorophyll-a (µg/L) | 0.04201            | 0.7397     |

Pearson correlation coefficients and p values for discharge versus water quality variables

Linear regression on flow index (PC1 sample scores) and log discharge (ac-ft/mo)
FLOW REQUIRED TO MAINTAIN WATER QUALITY

Percent change estimate in flow index (PC1) values and corresponding estimates for flow (ac-ft/mo) at Tres-Palacios Bay, Carancahua Bay, and San Antonio Bay.
MANAGEMENT IMPLICATIONS

SIGNIFICANCE OF FINDINGS

• Development of the percent-of-flow-index approach provides a framework for analyzing how specific amounts of diverted flow diverted may alter water quality conditions in specific bays
• It is a generic approach
• We can use this approach to determine the amount of flows that may be needed for diversions to maintain or restore water quality conditions