Statistically-Based Monitoring in Texas

2006 Texas Water Quality Inventory and 303(d) List (June 27, 2007)

Texas has historically relied on targeted monitoring as the primary tool in evaluating the status of water quality in the state. This type of monitoring provides invaluable information about site-specific water quality issues. However, the data provided by targeted monitoring is of limited use in contributing to resolving large scale water quality issues such as:

- What is the current extent of ecological resources in Texas, and how are they distributed geographically?
- What proportion of the resources is currently in acceptable ecological condition?
- What proportions are degrading or improving, in what regions, and at what rates?
- Are these changes correlated with patterns and trends in environmental stresses?
- Are adversely affected resources improving in response to control and mitigation programs? i.e., are our water quality management strategies working?

These types of issues can only be resolved by implementing a statistically designed monitoring network using probability-based sampling of explicitly defined resource populations. Implementation of this type of approach for evaluating status and trends of water quality at the national level was begun at the U.S. Environmental Protection Agency (EPA) with the establishment of the Environmental Monitoring and Assessment Program (EMAP) in the late 1980's.

The Texas Commission on Environmental Quality (TCEQ) is in the early stages of evaluating the utility of probability-based sampling as a component of the existing Surface Water Quality Monitoring (SWQM) Program to contribute data toward addressing large scale water quality issues in Texas. As a part of this process, the TCEQ SWQM Program is participating in national scale probability-based sampling implemented by the EPA to address these issues at the national level.

In 2004, the TCEQ SWQM Program participated in the National Wadeable Streams Assessment (WSA), the first nationally consistent, statistically valid study of the nation's wadeable streams. Wadeable streams were defined as those streams that fall in the 1st through 4th Strahler stream order range. To conduct the WSA, States, Tribes, and the EPA collected chemical, physical, and biological data at more than 1,392 wadeable streams in the United States. Complete results for this study at the national scale can be found at the following web address: http://www.epa.gov/owow/streamsurvey/

Approximately 39 streams selected according to a probability-based sample design were sampled in Texas as a part of this study. Summary results for selected water chemistry and biological parameters are summarized in Tables 1 and 2.

Table 1. Summary statistics for selected water chemistry parameters collected from 39 streams in Texas as part of the National Wadeable Streams Assessment.

	Conductivity (umhos/cm)	TDS (Cond.*0.65)	NH4 (MG/L)	SO4 (MG/L)	NO3 (MG/L)	CL (MG/L)	Turbidity (nu)	TSS (mg/L)	Color (pcu)
N	41	41	41	41	41	41	41	41	41
mean	748.03	486.22	0.12	85.89	0.86	121.31	18.18	17.59	25.24
std. Dev.	1550.84	1008.04	0.43	283.95	1.63	376.15	23.45	23.93	17.10
Maximum	9480.00	6162.00	2.80	1770.60	9.97	2255.07	107.00	102.90	65.00
Minimum	67.23	43.70	0.01	1.18	0.00	1.85	0.25	0.00	0.00
85TH Percentile	821.90	534.24	0.11	85.61	1.35	77.37	36.70	30.00	45.00
50th Percentile	421.80	274.17	0.03	15.28	0.46	21.55	8.35	6.80	20.00

Table 2. Summary statistics for selected benthic macroinvertebrate metrics for samples collected from 39 streams in Texas as part of the National Wadeable Streams Assessment.

	Total Taxa Richness	Total Number of Taxa in Ephemeroptera, Trichoptera, and Plecoptera	Total Number of Intolerant Taxa	Hilsenhoff Biotic Index (HBI)	Percent of Individuals in Non-insect Taxa	Shannon Diversity Index
N	41	41	41	41	41	41
mean	36	6	6	5.13	26.15	2.45
Maximum	57	15	16	8.80	85.23	3.48
Minimum	9	1	1	2.25	0.27	1.46
85TH percentile	49	11	9	6.35	53.71	2.91
50th percentile	36	6	6	4.97	16.20	2.55

The study design for the WSA was intended to address national scale issues, a caveat for interpreting these results. Finer resolution and less within strata variability would be observed if the study design were specifically implemented to address water quality issues at the state level.

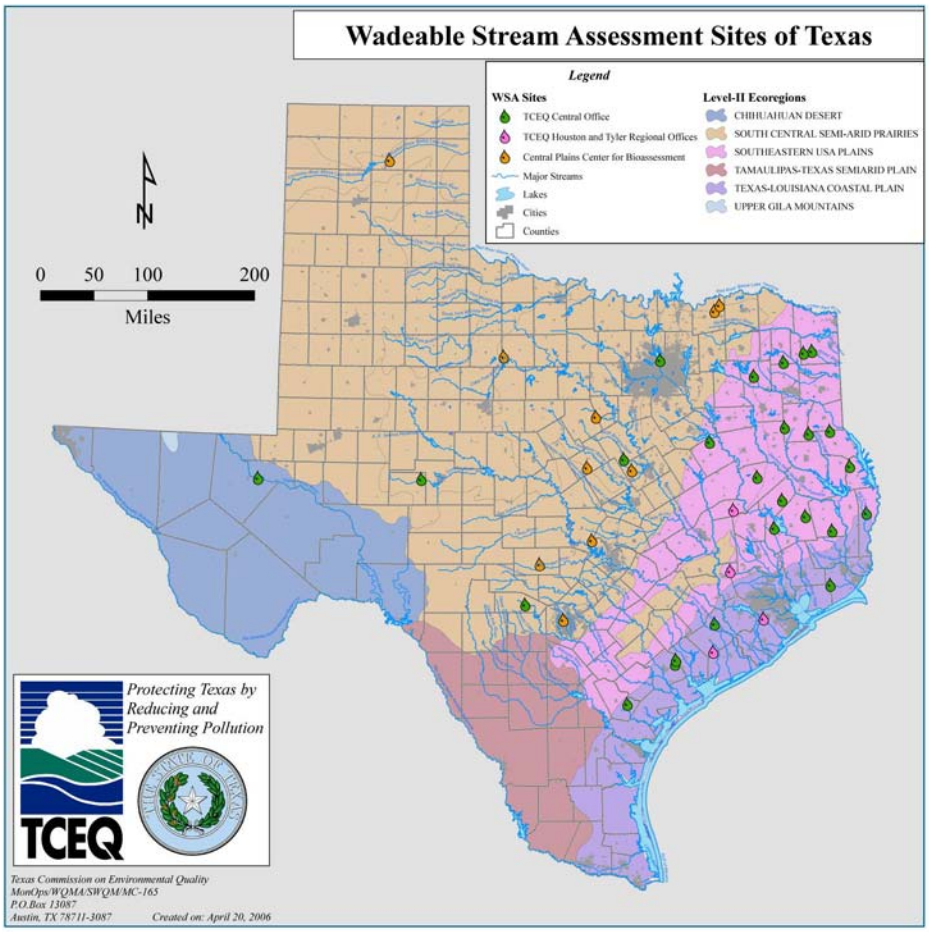
Due to the enormous size of the state and the diversity within each level II ecoregion, this project required participation by several entities both within and outside the TCEQ. The TCEQ's SWQM Program coordinated the project with agency personnel in the central office in Austin, Texas and with biologists in the TCEQ regional offices, the United States Geological Survey in Austin, and the Central Plains Center for BioAssessment in Lawrence, Kansas. Due to scale issues with monitoring a state as large as Texas, and based on past experience with the statewide ecoregion monitoring project, discussions had been ongoing about forming a "virtual" biological monitoring team which could work cooperatively with our regional offices, river authorities, and possible contracted entities in conducting strategic biological assessments to cover the entire state.

In 2005, the NWSA was complete and work began at a national level to plan a similar study on the nation's lakes. Due partly to the success of implementing the NWSA in Texas, and partly to a commitment to move the agency's monitoring program forward in the area of probabilistic sampling, the TCEQ is participating in the planning of the National Lakes Survey (NLS) to be conducted in the summer of 2007.

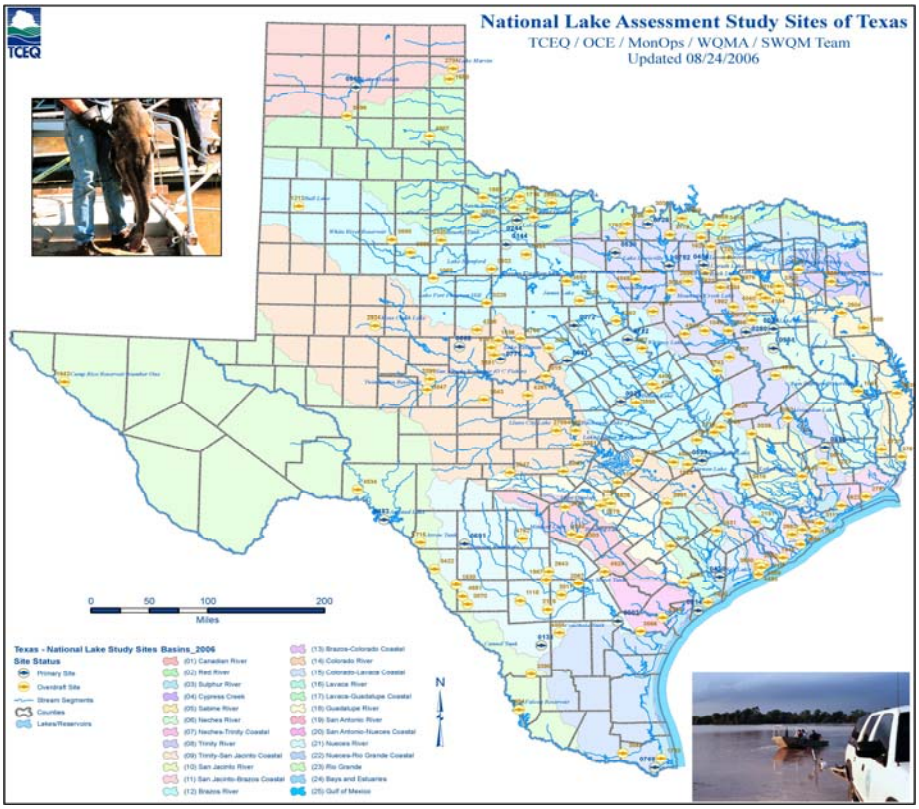
Twenty-five lakes have been selected for study in Texas and 25 more will be added in order to produce a statistically valid state-level assessment of this water resource type. As was the case with the NWSA study, the NLS will require participation by several entities both within and outside the TCEQ. The TCEQ's SWQM Program is again coordinating the project with agency personnel in the central office in Austin and with biologists in the TCEQ regional offices. The WSA provided a first test for this new virtual "team" and the NLS will provide an opportunity to build on this model. The NWSA and the NLS have set the stage for future developments in large-scale approaches to monitoring such varied and often difficult to reach waters in the state. The EPA will coordinate national-level studies of two additional types of aquatic ecosystems, large rivers and wetlands, in future years. After a period of five years, each ecosystem type will be completed, using the same methods to assess changes. As these studies are carried out on a national level, states such as Texas will be able to build capacity for carrying out state-level assessments based on a probabilistic design.

More information, data, and the final report on the EPA's NWSA may be found at:
http://www.epa.gov/owow/streamsurvey/

More information on the EPA's NLS may be found at: http://www.epa.gov/owow/lakes/lakessurvey/



Texas' National Wadeable Stream Sites



Texas' National Lake Survey Sites