Technical Study Summaries: Middle and Lower Brazos
Water Quality Data

Brazos River Basin Summary Report (2007)
By Brazos River Authority

The purpose of the Basin Summary Report (BSR) is to outline water quality issues confronting the entire basin as well as individual streams and lakes. These issues are complied based on public and stakeholder committee input as well as technical analysis of historical and current trends in water quality. This work is performed in accordance with TCEQ guidance, which specifies a range of parameters to be examined to achieve a comprehensive assessment.
Significant findings of the basin summary report are listed below.

- **Bacteria**

  In the central Brazos (Segment 1242) the current assessment indicates elevated bacteria levels exceeding Water Quality Standards in eight water bodies that have been historically 303(d) listed (Brazos River,Thompsons Creek, Campbells Creek, Mud Creek, Pin Oak Creek, Spring Creek, Tehuacana Creek, and Big Creek), plus Cottonwood Branch, Still Creek, Pond Creek, Deer Creek, and Walnut Creek. Sources of elevated bacteria levels prevalent through much of the watershed have not been determined. Rangeland runoff may be the main contributor, given the rural nature of most of the drainage area.

  In the lower Brazos (Segment 1202) Allen's Creek continues to be non-supporting for contact recreation use due to elevated levels of bacteria. Permitted domestic outfalls, row crops, and pastureland are located upstream of the sampling location. Any or all of these could contribute to the bacteria load in Allen's Creek.
  Upper Oyster Creek was originally listed on the 2000 303(d) List for dissolved oxygen and bacterial impairments and remains on the 2008 303(d) List today. This listing required development of a TMDL for point and non-point sources of bacteria.

- **Nutrients**

  Nutrient enrichment concerns are apparent in the Central Brazos for portions of three interconnected, effluent-driven streams near Bryan, Still Creek, Cottonwood Branch, and Thompsons Creek, due to elevated levels of nitrite+nitrate nitrogen, orthophosphate phosphorus, and total phosphorus. Another nutrient enrichment concern exists in the upper end of the watershed, as excessive chlorophyll *a* concentrations have been observed in the lower reaches of Tehuacana Creek.
  In the lower Brazos Allen's Creek has a concern for orthophosphate phosphorus. The same sources that are contributing to the bacteria load may be the cause of the nutrient load in Allen's Creek.

- **pH**

  The only other standard criteria nonconformance occurred in Pin Oak Creek, where pH levels were sometimes less than the specified range. This is most likely a natural condition related to geology and soil type in the subwatershed.

Full report: http://www.brazos.org/BasinSummary_2007.asp

Total Maximum Daily Load Program – How it works

The Total Maximum Daily Load Program works to improve water quality in impaired or threatened water bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the federal Clean Water Act.

The goal of a TMDL is to restore the full use of a water body that has limited quality in relation to one or more of its uses. The TMDL defines an environmental target and, based on that target, the state develops an implementation plan to mitigate anthropogenic (human-caused) sources of pollution within the watershed and restore full use of the water body.

Implementation of TMDL

An implementation plan usually puts the TMDL into action by outlining the steps necessary to reduce pollutant loads through regulatory and voluntary activities. In some instances, TMDLs are implemented through watershed protection plans.

Implementation could include adjustment of an effluent limitation in a wastewater permit, a schedule for the elimination of a certain pollutant source, identification of any non-point source discharge that would be regulated as a point source, a limitation or prohibition for authorizing a point source under a general permit, or a required modification to a storm water management program and pollution prevention plan.

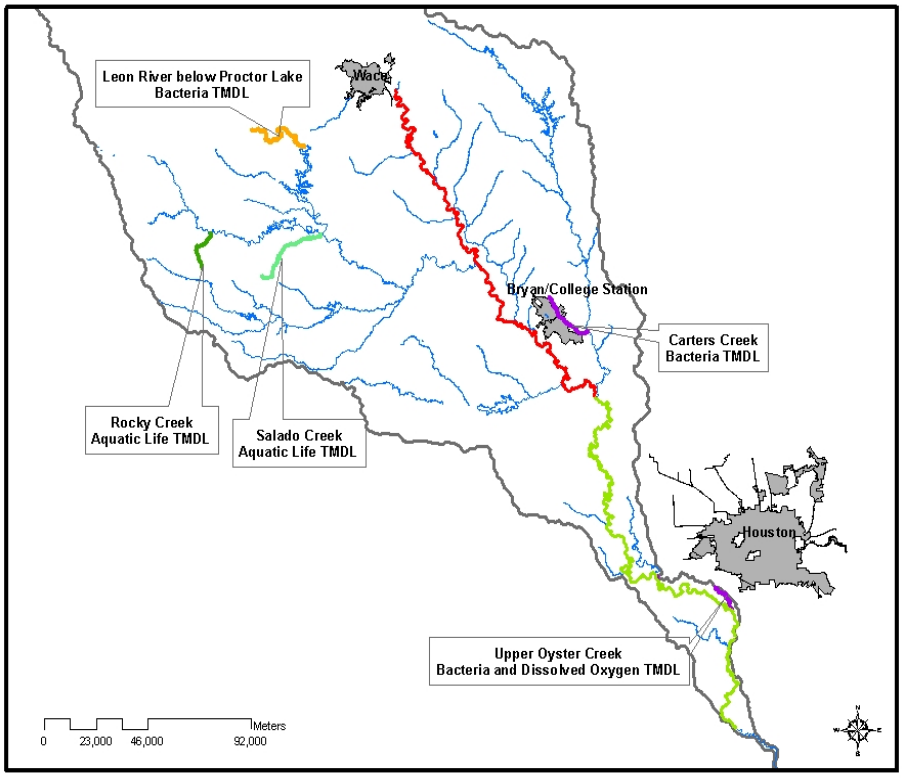

Figure 1. TMDLs in the Brazos Basin below Waco.

Full report: http://www.tceq.state.tx.us/implementation/water/tmdl/index.html

Surface Water Quality Monitoring Program

The Surface Water Quality Monitoring Program monitors the quality of surface water to evaluate physical, chemical, and biological characteristics of aquatic systems with reference to human health concerns, ecological condition, and designated uses. Program data provide a basis for effective policies that promote the protection, restoration, and wise use of surface water in Texas.

Uses of Water Quality Data

- identify water quality issues
- set water quality standards for water bodies
- provide baseline data to support TMDL studies & Watershed Protection Plans

- enhance science behind wastewater permitting decisions through the Texas Pollution Discharge Elimination System

http://www.tceq.state.tx.us/permitting/water_quality/wastewater/pretreatment/tpdes_definition.html

How to obtain Water Quality Data

- Phone 512-239-DATA
- Online at http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wdma/dmrg_index.html

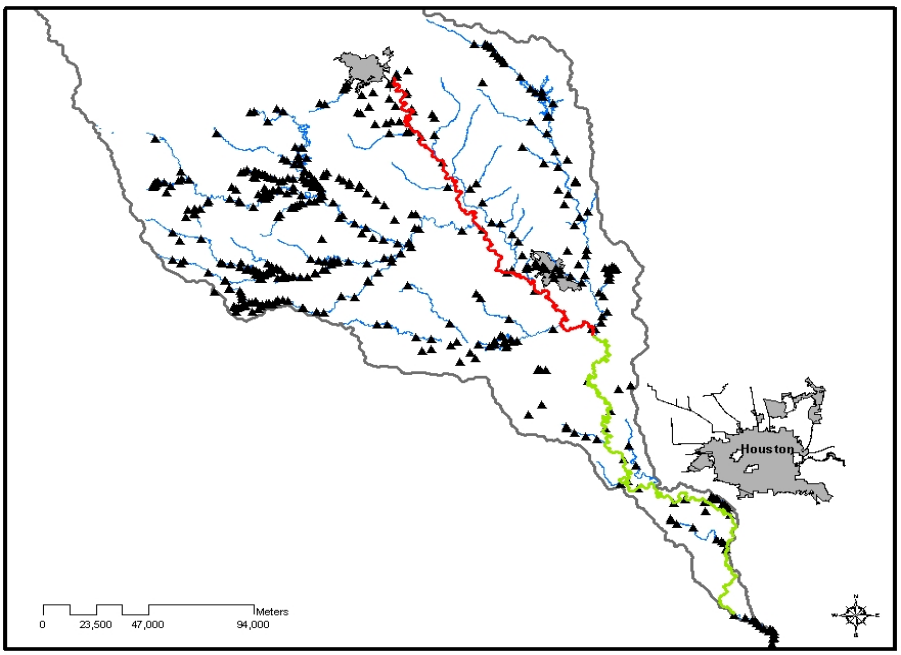

Figure 2. SWQM monitoring stations in the Brazos Basin below Waco.

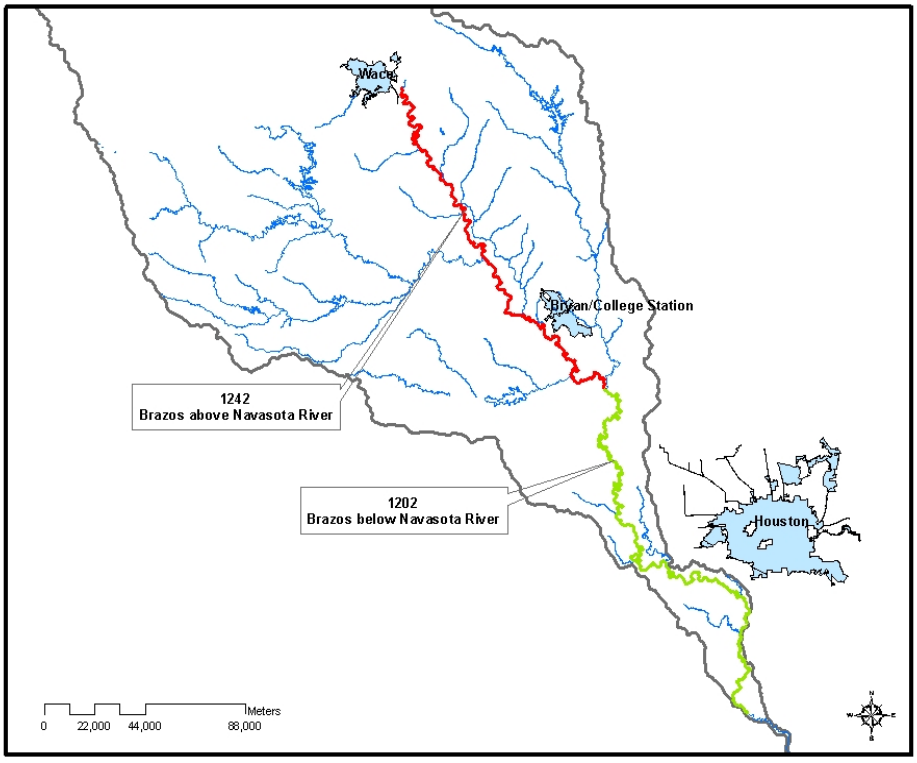

Figure 3. Classified Segments on the Brazos River.

WQ Standards http://www.tceq.state.tx.us/nav/eq/eq_swqs.html

Criteria http://www.epa.gov/waterscience/standards/wqslibrary/tx/tx-wqs.pdf

Seg-ment No.	Segment Name	Uses			Criteria						
		Recreation	Aq Life	Domestic Water Supply	Cl^{-1} (mg/L)	SO_4^{2-} (mg/L)	TDS (mg/L)	DO (mg/L)	pH	Indicator bacteria* (#/100ml)	Temp ^{0}F
1202	Brazos below Navasota	Contact Recreation	High Aquatic Life Use	Public Supply	300	200	750	5	6.5-9.0	126/200	95 F
1242	Brazos above Navasota	Contact Recreation	High Aquatic Life Use	Public Supply	350	200	1000	5	6.5-9.0	126/200	95 F

High Aquatic Life Use

Aq Life Subcategory	Dissolved Oxygen	Aquatic Life Attributes					
	Freshwater mean/min	Habitat	Species Assemblage	Sensitive Species	Diversity	Species Rich	Trophic Structure
High	5.0/3.0	Highly diverse	usual association of regionally expected species	Present	High	High	Balanced - slightly imbalanced

Texas Water Quality Inventory and 303(d) List

These reports describe the status of Texas waters based on historical data on surface-water and groundwater quality (the Inventory) and identify water bodies that are not meeting standards set for their use (the List). The reports satisfy the requirements of the federal Clean Water Act for both Section 305(b) water-quality reports and Section 303(d) lists. The Inventory and List are produced every two years in even-numbered years, as required by law. A List must be approved by the EPA before it is considered final.

Full report: http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/305_303.html

Segments on the Brazos River currently listed on the 303(d) list

Central Brazos River
1242B Cottonwood Branch (unclassified water body)
bacteria 2006

1242C Still Creek (unclassified water body)
bacteria 2006

1242D Thompson Creek (unclassified water body)
bacteria 2002
depressed dissolved oxygen 2004

1242I Campbells Creek (unclassified water body)
bacteria 2002

1242J Deer Creek (unclassified water body)
bacteria 2006

1242K Mud Creek (unclassified water body)
bacteria 2002

1242L Pin Oak Creek (unclassified water body)
bacteria 2002

1242M Spring Creek (unclassified water body)
bacteria 2002

1242N Tehuacana Creek (unclassified water body)
bacteria 2002

1242O Walnut Creek (unclassified water body)
bacteria 2006

1242P Big Creek (unclassified water body)
bacteria 2002

Lower Brazos River
1202H Allen's Creek (unclassified water body)
bacteria 2002

1202J Big Creek (unclassified water body)
impaired fish community 2006
bacteria 2002

Full report: http://www.tceq.state.tx.us/compliance/monitoring/water/quality/data/wqm/mtr/swqm.html

Clean Rivers Program

The Texas Clean Rivers Program is a state fee–funded program for water quality monitoring, assessment, and public outreach. The program is a collaboration of 15 partner agencies (ex. SARA, BRA, etc.) and the TCEQ. The program provides the opportunity to approach water quality issues within a watershed or river basin locally and regionally through coordinated efforts among diverse organizations.

More information: http://www.tceq.state.tx.us/compliance/monitoring/crp/

Indicators: Middle and Lower Brazos River

Water Quality

Water Quality Objectives

- Manage flow-related water quality to sustain ecological, economic, and social processes and productive capacity.

Water Quality Indicators

Water quality data are used to describe the condition of a water body, to help understand why that condition exists, and to provide some clues as to how it may be improved. Water quality indicators include chemical measurements as well as certain physical and biological measurements. Some of the most common are listed here, with an explanation of why they are important to the health of a water body.

Category	Indicator	Explanation
Nutrients	Nitrogen Organic Nitrate plus nitrite Ammonia Total Phosphorus Filterable reactive Total	The nutrients nitrogen and phosphorus are essential for plant growth. High concentrations indicate potential for excessive weed and algal growth. Total nutrients are made up of a dissolved component (e.g. nitrate plus nitrite, ammonia and filterable reactive phosphorus) and an organic component, which is bound to carbon (e.g. organic nitrogen). Nutrients in the dissolved state can be readily used by plants.
Oxygen	Dissolved oxygen	Oxygen is essential for both plants and animals. There is often a relationship between discharge and dissolved oxygen concentrations. Decreased dissolved oxygen can be harmful to fish and other aquatic organisms. Nonpoint-source pollution as well as the decomposition of leaf litter, grass clippings, sewage, and runoff from feedlots can decrease the amount of dissolved oxygen in water. Dissolved oxygen is measured in milligrams per liter (mg/L). Expected levels: 4.0 to 12.0 mg/L.
Temperature	Temperature	Aquatic organisms are dependent on certain temperature ranges for optimal health. Temperature affects many water parameters, including the amount of dissolved oxygen available, the types of plants and animals present, and the susceptibility of organisms to parasites, pollution, and disease. Causes of water temperature changes include weather conditions, shade, and discharges into the water from urban sources or groundwater inflows. Temperature is measured in degrees Celsius (°C). Seasonal trends: May to October: 22 to 35°C, November to April: 2 to 27°C. Low flow conditions can also have an influence on temperature.
pH	pH	A measure of the acidity or alkalinity of the water. Changes to pH can be caused by a range of potential water quality problems (e.g. low values due to acid sulfate runoff). Extremes of pH (less than 6.5 or greater than 9) can be toxic to aquatic organisms.
Water clarity	Suspended solids	Small particles (soil, plankton, organic debris) suspended in water. High concentrations of suspended solids limit light penetration through water, and cause silting of the benthic (bottom) environment.
Water clarity	Turbidity	A measure of light scattering by suspended particles in the water column, provides an indirect indication of light penetration.

Category	Indicator	Explanation
Water clarity	Secchi depth	The depth to which the black and white markings on a Secchi disc can be clearly seen from the surface of the water provides an indication of light penetration.
Salinity	Conductivity	A measure of the amount of dissolved salts in the water, and therefore an indicator of salinity. In fresh water, low conductivity indicates suitability for agricultural use. In salt waters low conductivity indicates of freshwater inflows such as stormwater runoff.
Microalgal growth	Chlorophyll-a	An indicator of algal biomass in the water. An increase in chlorophyll-a indicates potential eutrophication of the system. Consistently high or variable chlorophyll-a concentrations indicate the occurrence of algal blooms, which can be harmful to other aquatic organisms.
Recreational health	Bacteria	*E. coli* and Enterococci bacteria are measured to determine the relative risk of swimming (contact recreation), depending on whether the water body is fresh or marine. These bacteria originate from the wastes of warm-blooded animals. The presence of these bacteria indicates that associated pathogens from these wastes may be reaching a body of water. Sources may include inadequately treated sewage, improperly managed animal waste from livestock, pets in urban areas, aquatic birds and mammals, or failing septic systems.
Metals	Concentration of Metals in Water	High concentrations of metals such as cadmium, mercury, and lead pose a threat to drinking water supplies and human health. Eating fish contaminated with metals can cause these toxic substances to accumulate in human tissue, posing a significant health threat. Metals also pose a threat to livestock and aquatic life. Potentially dangerous levels of metals and other toxic substances are identified through chemical analysis of water, sediment, and fish tissue.
Organics	Concentration of Organics in Water	Toxic substances from pesticides and industrial chemicals, called organics, pose the same concerns as metals. Polychlorinated biphenyls (PCBs), for example, are industrial chemicals that are toxic and probably carcinogenic. Although banned in the United States in 1977, PCBs remain in the environment, and accumulate in fish and human tissues when consumed.
Biological	Benthic Invertebrates	Macroinvertebrates are aquatic insects and other aquatic invertebrates associated with the substrates of waterbodies (including, but not limited to, streams and rivers). Macroinvertebrates can be useful indicators of water quality because these communities respond to integrated stresses over time which reflect fluctuating environmental conditions. Community responses to various pollutants (e.g. organic, toxic, and sediment) may be assessed through interpretation of diversity, known organism tolerances, and in some cases, relative abundances and feeding types. Examples of Pollution Intolerant Bugs: Mayfly, Caddisfly, Water Penny, Planarian, Dobson Fly, Stonefly Examples of Pollution tolerant bugs: Crayfish, Dragonfly, Damselfly, Clam, Leech, Midge, Aquatic Worm, Black Fly

Category	Indicator	Explanation
Biological	Fish	Fish diversity, species richness, species pollutant tolerance, disease prevalence, and other metrics are used to evaluate the aquatic health of water bodies as compared to a regional reference condition. Using fish as a water quality indicator is widely regarded as one of the more reliable methods for assessing human caused ecological impacts. For lists of tolerance groups of species in Texas, see Texas Parks and Wildlife Department River Studies Report No. 14. *Classification of Texas Freshwater Fishes Into Trophic and Tolerance Groups* (which can be found as Appendix J in River Studies Report No. 17 located at: http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_rp_t3200_1086.pdf
Fish consumption advisories and closures	Fish Tissue Analysis	The Texas Department of State Health Services conducts chemical testing of fish tissue to determine whether there is a risk to human health from consuming fish or shellfish caught in Texas streams, lakes, and bays. Fish seldom contain levels of contaminants high enough to cause an imminent threat to human health, even to someone who eats fish regularly. However, risk increases for people who regularly consume larger fish and predatory fish from the same area of contaminated water over a long period of time. To reduce health risks in areas of contamination, people should eat smaller fish from a variety of water bodies. When a fish consumption advisory is issued, a person may legally take fish or shellfish from the water body under advisory, but it is not recommended. When a fish consumption closure is issued for a water body, the taking of fish or shellfish is legally prohibited.