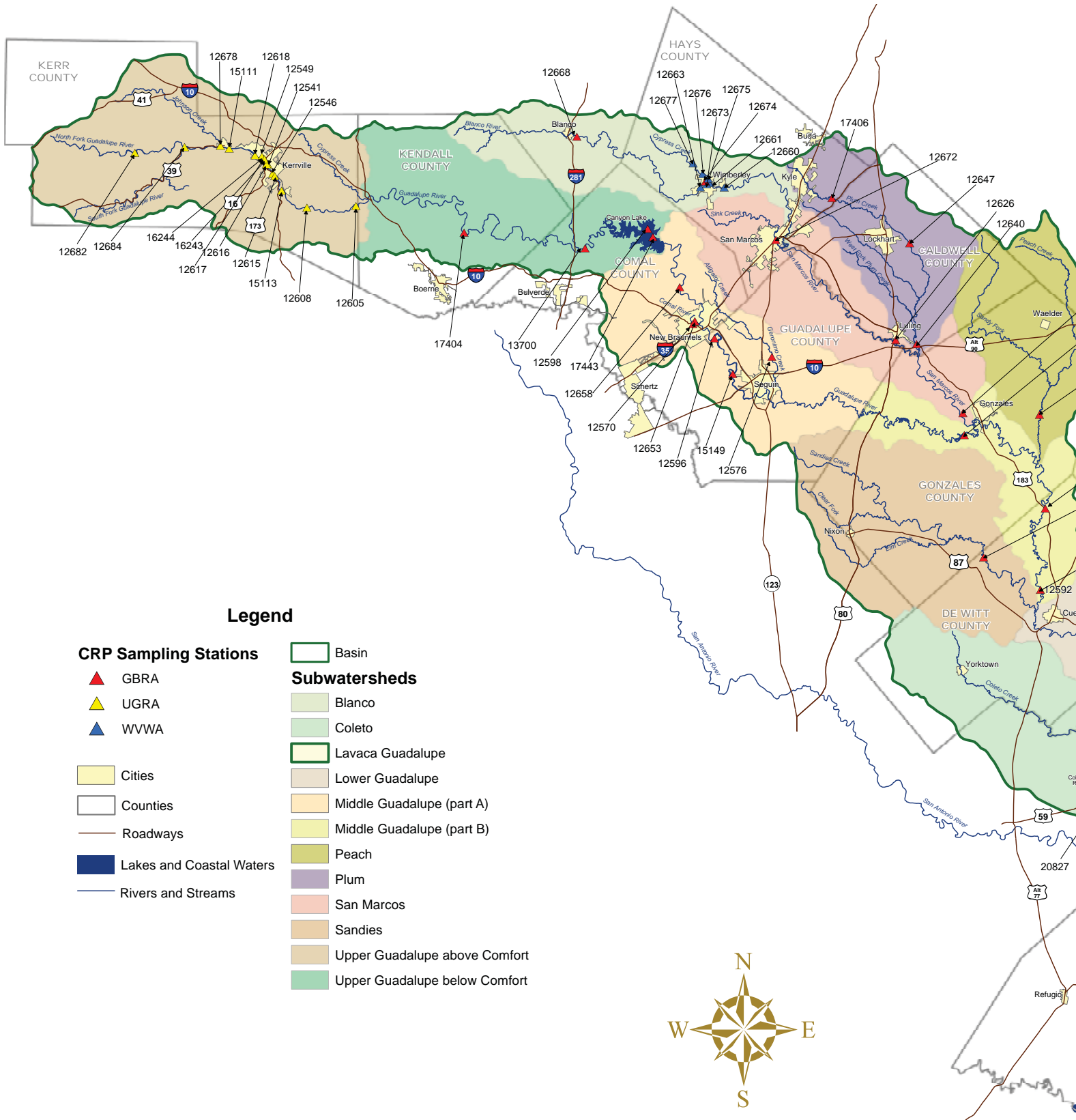


2012 Clean Rivers Program Basin Highlights Report

Guadalupe River and Lavaca-Guadalupe Coastal Basins



Watersheds



Legend

CRP Sampling Stations

- ▲ GBRA
- ▲ UGRA
- ▲ WVWA

Cities

Counties

Roadways

Lakes and Coastal Waters

Rivers and Streams

Basin

Subwatersheds

- Blanco
- Coledo
- Lavaca Guadalupe
- Lower Guadalupe
- Middle Guadalupe (part A)
- Middle Guadalupe (part B)
- Peach
- Plum
- San Marcos
- Sandies
- Upper Guadalupe above Comfort
- Upper Guadalupe below Comfort

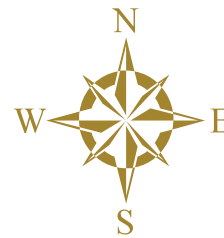


Table of Contents

Introduction	2
Highlights of 2011	2-3
Lawsuit Involving Whooping Cranes Could Affect Water Rights	4
Inventory of Events	5-7
Implementation Plan Completed for the Upper Guadalupe River	8
Status of Geronimo Creek Watershed Protection Plan	9-10
Plum Creek Watershed Plan Celebrates Four Years	11-17
Impact of the 2011 Drought	18-19
EARIP Emerges with Habitat Conservation Plan	20
GBRA's River Network is Expanding	21
Hydraulic Fracturing in the Eagle Ford Shale	22
Red Tide Hits Texas Coast, Including San Antonio Bay	23
Subwatershed Concerns and Issues	24-47
Upper Guadalupe above Comfort	24
Upper Guadalupe below Comfort	26
Blanco	28
San Marcos	30
Plum Creek	32
Middle Guadalupe (Parts A & B)	34
Peach Creek	38
Sandies Creek	40
Coletto Creek	42
Lower Guadalupe	44
Lavaca-Guadalupe Coastal	46
Water Quality Inventory 303(d) List - 2010	48
Descriptions of Water Quality Parameters	49
Water Quality Monitoring	50
GBRA Public Education and Outreach	51
UGRA Public Involvement and Outreach	52-53



Introduction

This report highlights the activities of the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under the Clean Rivers Program (CRP) in 2011. The CRP is managed by the Texas Commission on Environmental Quality (TCEQ). The state-wide program is funded by fees assessed to water rights and wastewater discharge permit holders. These fees are divided among the CRP partners for the administration of each river basin's program. The Guadalupe-Blanco River Authority (GBRA), together with the Upper Guadalupe River Authority (UGRA), carry out the water quality management efforts in the Guadalupe River

Basin under contract with TCEQ. The activities described in this report include water quality monitoring, a review of the 2010 Water Quality Inventory, public communication, watershed planning and stewardship activities. Information on other water quality studies, planning efforts, issues and activities that could affect water quality are included in the *2012 Basin Highlights Report*.



2011 Highlights

Drought returned to the Guadalupe River Basin in 2011. Two routine monitoring sites were dry during a portion of the year. The Guadalupe River at Spring Branch above Canyon Reservoir was dry during the month of September 2011. Cypress Creek in Wimberley was not sampled in the third quarter of 2011 due to dry conditions. The Blanco River in Blanco was sampled from pools in October and November.

The drought was not isolated to the Guadalupe River Basin. Because the majority of Texas was under drought conditions in 2011, TCEQ issued interim routine surface water

quality monitoring guidance that will be incorporated into the quality assurance project plans for each CRP monitoring entity. If a stream monitoring site is dry but there is water within 400 meters, entities have been instructed to collect routine water quality data at the nearby location. If the stream site is dry but has pools within 400 meters, a pool can be sampled but it must meet the criteria for size and depth described in the guidance. TCEQ guidelines require documentation of the conditions found at drought-affected locations with photographs and detailed site descriptions of water conditions.

In early 2012, rainfall outlooks for the year were not promising. More information on the 2011 drought can be found on page 18.

In Fiscal Year (FY) 2011, GBRA moved the monitoring location in Coletto Creek Reservoir from the boat ramp to near the dam and began quarterly depth profiles. At the dam, the water depth is greater than 11 meters. Depth profiles measure temperature, dissolved oxygen, pH and conductivity at each one meter interval. In samples collected in winter, spring and fall dissolved oxygen was present throughout the water column to the deepest point. But in the



profile performed in August 2011, the reservoir was anoxic at depths of greater than 8 meters; meaning that the oxygen was depleted in the water below this depth. Oxygen depletion in the deep portion of the reservoir is caused by several factors, including high summer temperatures that create density differences through the water column. In some reservoirs

a thermocline, a temperature and density gradient, can form that creates a barrier to uniform mixing throughout the water column. In August, Coletto Creek Reservoir did not thermally stratify. Temperature remained in the range of 32.8 C at the surface to 30.8 C at the deepest point. Another scenario that could account for the depletion of dissolved oxygen without evidence of a thermocline is the absence of light in deep water. In addition to wind and mixing, a source of oxygen in surface water is algae. Algae produces oxygen as a byproduct of photosynthesis. Without light, photosynthesis cannot occur. Quarterly depth profiles will continue in 2012.

In September 2011, the Hays County Environmental Health Team began collecting water quality data under the Quality Assurance Project Plan (QAPP) for the Guadalupe River Basin CRP. By establishing a monitoring program that complies with the quality control guidelines of the QAPP, the data collected by Hays County can be submitted to the Surface Water Quality Monitoring Information System (SWQMIS) at TCEQ. Hays County joins the Wimberley Valley Watershed Association as a contributor of data to SWQMIS. GBRA provides training and technical support and submits the data collected by these organizations to TCEQ SWQMIS.

In 2011, UGRA continued working towards implementing measures to address the bacteria impairment in the Upper Guadalupe River. A portion of the Upper Guadalupe River was first listed as impaired for *E. coli* bacteria in 2002 and TCEQ adopted One Total Maximum Daily Load (TMDL)

for Bacteria in the Guadalupe River above Canyon Lake (Segment 1806) in 2007. The TMDL identified probable nonpoint source pollutants that caused that segment of the river to exceed the bacteria standards for contact recreation. Those sources include urban storm water runoff, malfunctioning on-site sewage facilities (OSSFs), wildlife, livestock, and human swimmers. Since that time, UGRA entered a partnership with TCEQ to complete an implementation plan (I-Plan) that was adopted by TCEQ in 2011. The I-Plan identified best management practices to reduce the bacteria load. Most recently, UGRA obtained funding through TCEQ's Nonpoint Source Program to implement those measures. More information on the implementation plan and the bacteria reduction action plan can be found on page 8.

In September 2011, additional nutrient monitoring was funded by a Clean Water Act (CWA) Section 106 grant from TCEQ. Prior to receiving the funding GBRA analyzed surface water for Total Kjeldahl Nitrogen (TKN) bimonthly. In order to gain more data for use in the development of nutrient water quality standards for streams in the Guadalupe River Basin, GBRA added TKN to its monthly suite of conventional parameters. By adding this parameter, the TKN concentration can be added to the nitrate nitrogen concentration to calculate total nitrogen at each water quality monitoring site.

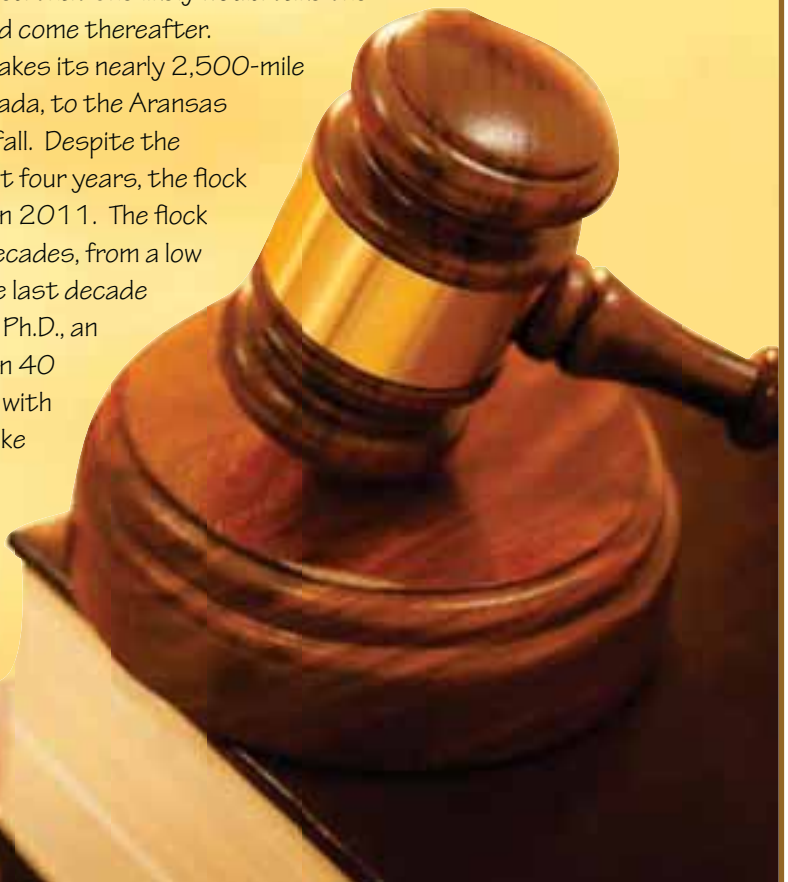
The *Basin Highlights Report* provides information on the status of projects directed toward water quality and environmental protection. Also, maps and specific information on the watersheds that make up the Guadalupe River, Blanco River and San Marcos River basins are found in this report. To get involved in the Clean Rivers Program, opportunities are described on pages 51-53.

Lawsuit Involving Whooping Cranes Could Affect Water Rights

The Battle Moves to the Courthouse

In response to a lawsuit filed in 2010 by an organization called The Aransas Project (TAP), TCEQ, GBRA and other affected parties are defending the process by which water rights are allocated in the state. TAP alleges that TCEQ violated the federal Endangered Species Act (ESA) by not allowing enough fresh water to reach the San Antonio Bay ecosystem on the Gulf Coast where the federally-protected whooping cranes winter each year. TAP has argued that TCEQ violated the “taking” provision of Section 9 of the ESA, a provision that prohibits any activity that kills or harms a listed species or that destroys its habitat. TAP claimed that during the 2008-09 drought a reduced amount of fresh water reached the coastal marshes causing the salinity to rise so high that the wintering whooping cranes were unable to find sufficient food and water. The lawsuit alleged that those conditions weakened them and led to the death of 23 birds. Experts testifying for TCEQ and GBRA refuted those claims saying that of the known whooping crane deaths from the winter of 2008-09, the evidence included two carcasses and fragments of two other birds, which is a number more consistent with normal winter losses. The lawsuit went to trial in U.S. District Court in Corpus Christi in December 2011. The judge indicated that she likely would take the summer to review trial materials and a decision would come thereafter.

The Aransas-Wood Buffalo whooping crane flock makes its nearly 2,500-mile trek from Wood Buffalo National Park in Alberta, Canada, to the Aransas National Wildlife Refuge near San Antonio Bay each fall. Despite the droughts that the area has experienced over the last four years, the flock appears to be thriving, their numbers rising to 283 in 2011. The flock has shown exponential growth over the last seven decades, from a low of 15 individuals in 1941, and has grown more in the last decade than any previous decade. According to Doug Slack, Ph.D., an avian ecologist who has studied cranes for more than 40 years, whooping cranes are opportunistic omnivores with a broad winter diet that includes a variety of foods like snails, insects, blue crabs, worms, clams, wolfberries and acorns. If TAP is successful in its lawsuit, the remedies sought by TAP could upend the state’s regulatory scheme, affecting the authority of the state generally to issue water permits and regulate the use of its water.



Inventory of Events

January – December 2011

Clean Rivers Program Guadalupe River and Lavaca-Guadalupe Coastal Basins

Event	Segment/Sub watershed	Comments
Ban the Can	1811, 1804	Voters in New Braunfels overwhelmingly approved a ban on disposable containers. The ordinance imposes a fine of up to \$500 and covers any disposable food or beverage container. The ban covers the portions of both the Comal River and the Guadalupe River that flow through the city limits of New Braunfels. The goal of the referendum's proponents is to reduce the amount of litter and trash that is deposited in the rivers each tourist season.
Work on Lake Dunlap dam, stump removal	1804	GBRA lowered Lake Dunlap in the fall of 2011 in order to complete necessary repairs and rehabilitation of the Dunlap Dam. After consulting TPWD, Bass Clubs, Preserve Lake Dunlap Homeowners Association and local fishing clubs, the decision was made to mark or remove selected underwater hazards while the lake was low. The committee reviewed underwater obstacles and selected an appropriate course of action for selected hazards, keeping both boater and skier safety and biological habitat in mind. Some homeowners refused to comply with GBRA and TPWD directives and cut down stumps in undesignated areas, creating unsafe conditions for boaters, jet skis and water skiers. GBRA designated a no-wake zone in the lower 1.1 miles of the run-of-river impoundment until such time as a special committee can determine the best course of action. The committee will make recommendations that will insure public safety while providing for public access and recreation.
Edwards Aquifer Recovery Implementation	1811, 1808, 1814	In an effort to balance the use of water from the Edwards Aquifer, with the needs of endangered species, the United States Fish and Wildlife Service (USFWS) brought together 26 stakeholders from throughout the region, representing diverse and sometimes conflicting interests spanning from the Hill Country to the Gulf Coast, to participate in a collaborative process to develop a plan that would aid in the recovery of federally listed species dependent on the aquifer. Stakeholders of the Edwards Aquifer Recovery Implementation Program (EARIP) have compromised on a scientifically-based habitat conservation plan (HCP). The minimization and mitigation measures included within the HCP are designed to ensure that incidental take resulting from the covered activities will be minimized and mitigated to the maximum extent practicable, and will not appreciably reduce the likelihood of the survival and recovery of covered species associated with the Aquifer and Comal and San Marcos springs and rivers ecosystems. See page 20 for additional information.
SB3 Environmental Flows		The Senate Bill 3 stakeholder process has recommended instream flows for the Guadalupe and San Antonio rivers and inflows into the bays and estuaries in the lower basin. TCEQ will consider these recommendations when setting the environmental flow requirements for the Guadalupe and San Antonio rivers. The stakeholder process will recommend work plans that prioritize studies that fill data gaps identified in the environmental flow process. Flow recommendations will be reviewed in a recommended amount of time, such as 5 to 10 years. Studies in the work plans will facilitate adaptive management of the environmental flows of the two rivers.

Inventory of Events

January – December 2011

Clean Rivers Program Guadalupe River and Lavaca-Guadalupe Coastal Basins

Event	Segment/Sub watershed	Comments
City of Kyle does study on waste-water reuse opportunities	1810	The City of Kyle is conducting a study of the feasibility of implementing the Region L water supply strategy of using reclaimed water by identifying potential users and costs of expanding an existing single user system. Reclaimed water is acknowledged by the Barton Springs/Edwards Aquifer Conservation District as a regional means of groundwater planning for protecting aquifer levels and springflows and is also acknowledged in the Edwards Aquifer Authority's Comprehensive Water Management Plan as a water conservation technology with the potential to provide the region with additional water for municipal use.
Whooping Crane	2462	In response to a lawsuit filed in 2010 by an organization called The Aransas Project (TAP), TCEQ, GBRA and other affected parties are defending the process by which water rights are allocated in the state. TAP alleged that TCEQ violated the federal Endangered Species Act (ESA) by not allowing enough fresh water to reach the San Antonio Bay ecosystem on the Gulf Coast where the federally-protected whooping cranes winter each year. TAP has argued that TCEQ violated the "taking" provision of Section 9 of the ESA, a provision that prohibits any activity that kills or harms a listed species or that destroys their habitat. See page 4 for additional information.
Drought returns to Guadalupe River Basin	All	Drought conditions across the river basin returned in 2010-11. The upper portion of the watershed did not see significant rains in 2011. Canyon Reservoir remained in good condition through Summer 2011. If the drought continues 2012 could be a record-breaking year. See page 18-19 for additional information.
Hydraulic Fracturing in the Eagle Ford Shale in DeWitt and Gonzales Counties	1803	The Eagle Ford Shale Play has become one of the richest oil and gas deposits in Texas because of the exploration technology called hydraulic fracturing or "fracking". Fracking is a process to stimulate wells and recover natural gas and oil by creating fractures that extend from a well bore into formations and allow the product to travel more easily. The fracking solution can be made up of a proprietary mixture of organic chemicals, acids and bases. Concerns have been raised about the impacts that these activities will have on groundwater quality, surface water quality, the quantity of water needed in a water-short area and the potential for spills and loss of containment of chemicals. See page 22 for additional information.
Cypress Creek Watershed Protection Plan enters 2nd phase	1815	Phase I of the Cypress Creek Project has been completed and Phase II will build on the work of the Cypress Creek Watershed Committee. The goals of Phase II will be to identify best management projects (BMPs) that are best suited for Central Texas and make the most sense for ecological health of the watershed and economy of the area. The watershed will be modeled to determine the amount of pollutant loads that will be removed if the BMPs are implemented. The final product of Phase II will be a Watershed Protection Plan that includes a preferred timeline, the cost of the management practices and a list of possible BMP sponsors.

January – December 2011

Clean Rivers Program Guadalupe River and Lavaca-Guadalupe Coastal Basins

Event	Segment/Sub watershed	Comments
Residents of Victoria County fight against disposal well	1803	Almost 600 residents of Victoria County asked for County Commissioners Court support to fight against a disposal well near FM 1685 and Loop 463 in Victoria County. American Disposal Services had applied for a permit from the Railroad Commission of Texas for a disposal well to inject non-hazardous waste from oil and gas production. Spokesman for the disposal company explained that the injection would occur 1,500 feet below groundwater, but residents are still concerned about the potential contamination of groundwater supplies.
Upper San Marcos, Spring Lake and Sink Creek Project	1814	Texas State University and the Rivers Systems Institute are conducting water quality monitoring and characterization studies on the upper San Marcos River, Spring Lake and Sink Creek, a tributary that flows into Spring Lake. Spring Lake and the upper San Marcos River have experienced increased turbidity and algal blooms. The objectives of the studies are to determine the nonpoint sources of nutrients and sediment into the upper watershed. Based on the data collected and with stakeholder input, a watershed characterization will be developed and management measures will be recommended.
Red Algae Bloom along Texas Coast	2462	In early October 2011 evidence of a red tide bloom was reported in the Lavaca-Guadalupe Coastal Basin. Hundreds of dead gulf menhaden washed ashore at Port O'Conner and Indianola Beach. By mid-October, the Department of State Health Services (DSHS) began reporting visible blooms in Matagorda and Espiritu Santo bays, with patches of algae measuring 100 feet across and a quarter of a mile long. <i>Karenia brevis</i> , a marine dinoflagellate common in the Gulf of Mexico, naturally produces a suite of potent neurotoxins that can cause gastrointestinal and neurological problems in other organisms and are responsible for large die-offs of marine organisms and seabirds. Red tide is a natural phenomenon not caused by human beings. When temperature, salinity, and nutrients reach certain levels, a massive increase in <i>K. brevis</i> algae can occur. It's important to remember that red tide has happened before and the Texas marine environment has always recovered (TPWD, 2012). See page 23 for additional information.



Photo by Janet Thome, GBRA

Implementation Plan Completed for the Upper Guadalupe River

(from the Implementation Plan for One TMDL for Bacteria in the Guadalupe River above Canyon Lake)

One Total Maximum Daily Load (TMDL) for Bacteria in the Guadalupe River Above Canyon Lake (Segment 1806) was adopted by the TCEQ on July 25, 2007 and approved by the U.S. Environmental Protection Agency (EPA) on Sept. 25, 2007. The TMDL addressed bacteria in two portions of the Upper Guadalupe River, from the confluence of Camp Meeting Creek to one mile upstream of Flat Rock Dam inclusive of Kerrville-Schreiner Park and from Francisco Lemos Street inclusive of Louise Hays Park to one mile downstream.

A TMDL is a technical analysis that determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards by establishing goals for pollutant load reductions. To restore and maintain water quality in impaired rivers, lakes, and bays, the TCEQ works with stakeholders to develop an implementation plan (I-Plan) for each adopted TMDL.

UGRA partnered with TCEQ to facilitate the completion of an I-Plan designed to outline activities that will achieve the water quality goals for the Upper Guadalupe River as defined in the adopted TMDL. The I-Plan is a flexible tool that governmental and nongovernmental organizations involved in implementation will use to guide their activities to reduce bacteria loads.

The I-plan documented six stakeholder-developed management measures and a control action that will be used to reduce bacteria contributions.

Management Measures (voluntary activities)

- 1) Reduce bird feeding at Louise Hays Park and Kerrville-Schreiner Park.
- 2) Install bird exclusion/deterrent devices on bridges directly over the water-way.

3) Manage the waterfowl population at Louise Hays Park and Kerrville-Schreiner Park.

4) Reduce human contributions through ongoing lateral sewage line replacement, sewer inspection and rehabilitation, ongoing OSSF plan review and registration, mapping of the priority OSSF area, and an education program for OSSF owners.

5) Implement an education program for pet owners and install pet waste stations at public parks.

6) Reduce contributions from general urban runoff through street sweeping, river clean ups and storm water education programs.

Control Action (regulatory activities)

Monitor and report *E. coli* bacteria concentrations from the wastewater treatment facility.

A TMDL is a technical analysis that determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards by establishing goals for pollutant load reductions.

UGRA receives funding for implementation

Projects developed to implement unregulated (nonpoint) sources may be eligible for funding under the EPA's CWA Section 319(h) grant program. In 2011, UGRA received CWA Section 319(h) funding to

implement several of the management measures identified in the I-Plan. Project partners include the Texas Department of Transportation, the City of Kerrville and Kerr County. The goal of the Bacteria Reduction Plan for the Upper Guadalupe River is to achieve the contact recreation standard through the implementation of best management practices (BMPs) using an adaptive management approach. Implementation measures being put into place over the next three years include bird deterrent structures, pet waste management, waterfowl management, development of a "Homeowners Septic System Guide," and public education. Routine water quality monitoring samples will be collected to assess the effectiveness of the BMPs on *E. coli* bacteria levels. Success will be measured by BMP implementation status, public participation, and change in attitude and behaviors.

STATUS

Geronimo Creek

Watershed Protection Plan

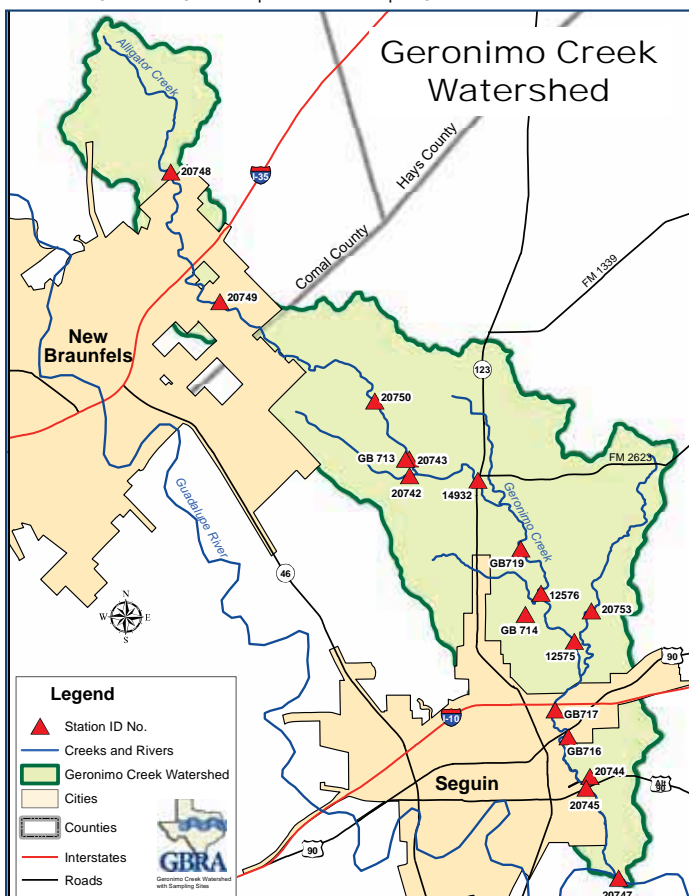
Beginning in 2009 and continuing through 2011, GBRA partnered with Texas AgriLife Extension on a Texas State Soil and Water Conservation Board (TSSWCB) CWA Section 319(h) grant to prepare a watershed protection plan for Geronimo Creek and its tributary, Alligator Creek. The creeks are located in Comal and Guadalupe counties. The almost 70-square-mile Geronimo Creek watershed lies within the larger Guadalupe River Basin. The upper portion of the Alligator Creek watershed lies in the extra-territorial jurisdiction (ETJ) of New Braunfels. Alligator Creek begins on the west side of Interstate 35 and flows southeast, travelling through a rapidly developing area of the Austin-

San Antonio corridor. The lower portion of the Geronimo Creek watershed is in the ETJ of Seguin. This area of the watershed is also projected to see tremendous growth, largely due to the intersection of Interstate 10 and Tollway 130 to the east.

As development and population growth continue, the percentage of urban land use will rise and play an increasingly dominant role in the hydrology and water quality of Geronimo Creek and its tributaries. Data gathered during routine water quality sampling of Geronimo Creek indicates the stream is impaired for elevated bacteria concentrations and has nutrient enrichment concerns for nitrate-nitrogen. High bacteria concentrations do not support contact recreation use. High levels of nitrogen can cause algal blooms and excessive growth of aquatic vegetation, which can lead to lowering the available oxygen in the water for fish to survive. To date, chlorophyll a concentrations have not been elevated at the monitoring site and the dissolved oxygen levels do not appear to be affected by algae or the growth of aquatic vegetation.

The Geronimo and Alligator creeks watershed protection planning project is a locally driven process to develop and implement a plan that will improve and protect water quality in the watershed now and into the future. Watershed planning is driven by local stakeholders and includes the following key tasks: 1) identify desired water quality conditions and measurable goals, 2) prioritize appropriate management practices and needed education and awareness programs to achieve those goals, 3) assist in the development of the watershed protection plan (WPP), 4) lead implementation of the plan at the local level, and 5) communicate implications of the WPP to other interested constituents within the watershed.

Geronimo Creek has been monitored by GBRA as part of the CRP since late 1996. The creek was monitored at the State Highway 123 crossing until August 2003, at which



Status Geronimo Creek Watershed Protection Plan

time the routine monitoring site was moved to the Haberle Road crossing. The new site was a previous TCEQ monitoring site as well as an ecoregion reference site.

The 2008 Texas Water Quality Inventory listed Geronimo Creek (Segment 1804A) with a concern due to elevated nitrate-nitrogen concentrations because all 60 measurements exceeded the screening level of 1.95 mg/L. In addition, the stream is listed as impaired because the geometric mean for *E. coli* bacteria (162 organisms per 100 milliliters) exceeded the contact recreation stream standard of 126 organisms per 100 milliliters. As part of the grant, GBRA staff also monitored water quality at an additional 19 sites throughout the watershed. The original funding called for a 12-month monitoring schedule. Because of a severe drought during the monitoring period, that schedule was extended to 18 months. The data is available on the GBRA Geronimo Creek Watershed webpage at www.geronimocreek.org.

A stakeholder committee made up of 25 local citizens representing landowners, cities, counties and special interest groups have met both as a whole committee and in topical work groups. The topical work groups covering urban, agricultural and wastewater issues directed inputs for modeling of the creek to determine the major sources of the bacterial impairments. The urban group felt that urban runoff and pet populations were the major sources of bacteria in the urbanized areas of the watershed; the consensus of the agricultural work group was that feral hogs, wildlife and various livestock were major sources in the rural areas. Because the only wastewater discharge in the watershed is at the confluence of the creek and the Guadalupe River, the wastewater work group focused on failing septic systems and malfunctioning wastewater collection lines as possible sources of the bacterial and nutrient impairments.

The modeling results have shown that there needs to be a 26 percent reduction in the bacterial load at medium flows in the middle portion of Geronimo Creek in order to meet the state stream standard. Some of the management measures that the stakeholders will be recommending in the watershed protection plan include:

- 1) Pet waste stations in the urbanized areas, along with outreach and education focusing on the impacts of pet waste.
- 2) Best management practices and workshops, such as water quality management plans and riparian management, for agricultural producers in the rural portions of the county.
- 3) Workshops and distribution of information for landowners on management and control of feral hogs.
- 4) Financial assistance to the cities to fund engineering for improvements to storm water collection systems.

To address the nutrient impairment, GBRA has submitted a proposal for funding an isotope study that will look at the concentrations of nitrate-nitrogen in both the surface and groundwater in the Geronimo Creek watershed. In order to help direct efforts and funding toward the most likely or most influential source(s) of nitrate, the project will look to isotopic signatures of nitrogen and oxygen in the nitrates. The ratios of the isotopes of nitrogen and oxygen in nitrate often are useful for determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (USGS, 2011).

The watershed protection plan is being drafted and reviewed by the stakeholder committee and TSSWCB. There will be a public comment period prior to the submittal of the plan to EPA. Additional funding has been received to resume watershed monitoring for another two years. Information on the Geronimo Creek Watershed Protection Plan process and draft report are available at www.geronimocreek.org.



Plum Creek Celebrates 4 Years!

by Nikki Dictson, AgriLife and Debbie Magin, GBRA

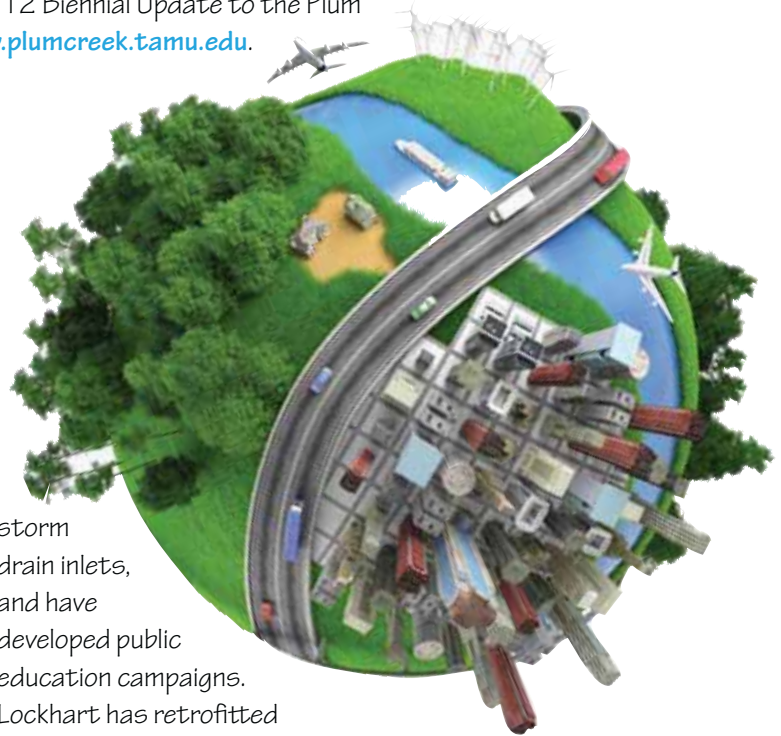
In February 2012, the Plum Creek Watershed Protection Plan will celebrate its fourth birthday! In those four years, significant changes have taken place in the watershed. The region has suffered one of the most severe droughts on record, causing many of the tributaries of Plum Creek to go dry. The population in the watershed continues to grow with the majority occurring in Kyle and along the I-35 corridor. Construction continued on Tollway 130 and is projected to be completed in late spring 2012. Understanding and responding to these changes in the watershed are key to adaptive management. Part of the watershed planning process includes a biennial review to determine the progress being made to bring the stream back into compliance with water quality standards and to react or “adapt” efforts toward effective management based on changes in the watershed. The draft 2012 Biennial Update to the Plum Creek WPP is available for public review and can be found at www.plumcreek.tamu.edu.

Urban Stormwater Management

The upper portion of the Plum Creek Watershed is moving from a rural landscape to a highly developed urban corridor. The Plum Creek Partnership supported the cities of Kyle, Lockhart and Buda as the cities implemented best management practices that were identified in the WPP. Buda is a part of the Urbanized Area of the City of Austin which is in the category of Phase II Municipal Separate Storm Sewer Systems (MS4). This designation requires that Buda develop a storm water management plan. The city of Kyle has not met the population threshold that would designate it as a Phase II MS4 city. So to date, Kyle’s efforts toward water quality improvements and implementation of strategies identified in the WPP have been voluntary. The city of Lockhart has received a CWA Section 319(h) grant and is implementing management measures listed in the WPP.

All three cities and the city of Luling have street sweeping programs and will continue such efforts, adjusting to account for new development in their areas. The cities of Kyle and Lockhart have assessed and mapped each city’s storm water conveyance system in order to identify the most effective locations for installation of structural storm water controls. Kyle and Lockhart have installed markers at

storm drain inlets, and have developed public education campaigns. Lockhart has retrofitted storm drain inlets with protective screens that keep organic debris out of the drain and more accessible by the street sweepers. All three cities have enacted pet waste ordinances requiring proper disposal of pet waste in parks and public areas. Highly supported community cleanups have been held in Kyle and Lockhart. The cleanup events have included environmental fairs that provide public education on water quality, recycling, disposal of fats, oils and grease and watershed protection.



Wastewater Management

The Plum Creek WPP identified management practices that could be implemented by wastewater treatment facilities in the watershed as well as identified areas of private septic systems that could be improved by centralized wastewater collection and treatment. Unfortunately, efforts in this area have been hampered by unfavorable economic conditions, limited enforcement capacity and inadequate resources to assist economically disadvantaged homeowners. However, some accomplishments have provided water quality benefits.

Regional water and wastewater planning studies, studies into the feasibility of wastewater reuse in the cities of Kyle and Buda and voluntary effluent monitoring by treatment plants in the watershed are activities that will benefit water quality and help guide future progress. The Plum Creek Watershed Partnership (PCWP) expended a considerable amount of effort to assist Hays County and the City of Buda on a potential project to connect 264 homes in the Hillside Terrace Subdivision in Eastern Hays County. This

area has been identified by local citizens and county staff as an area of chronically failing septic systems on small lots. A tributary of Andrews Branch passes through the subdivision and drains much of the neighborhood. The partnership assisted in conducting a socioeconomic survey of the subdivision. The survey showed that the area would qualify as a disadvantaged community, opening it up to potential funding and up to 70 percent loan forgiveness. An application was made to the TWDB for a Clean Water State Revolving Fund by the two entities, requesting funding to pay for the expansion of the City of Buda's collection system and expansion of a nearby lift station. The 5.6 million project ranked third on the list of projects in the nonpoint source pollution category. The project was invited to apply for a loan in the full amount of the project, but Buda and the county declined the loan in this round. The entities plan to reapply next year with the intent of securing loan forgiveness funding.

Agricultural Nonpoint Source Management

The Caldwell-Travis Soil and Water Conservation District (SWCD) and the Hays County SWCD received a TSSWCB CWA Section 319(h) NPS grant in October 2008 to provide technical assistance for the development of Water Quality Management Plans (WQMPs). The plans prescribe best management practices to reduce impacts to water quality from agricultural land use practices. In addition to providing technical assistance with preparing WQMPs, the funding that the SWCDs received will provide financial assistance to the landowners with certified WQMPs. Initially, landowner interest was low due to difficult economic times and extreme drought conditions. Approved practices for funding through the 319(h) grant include prescribed grazing, riparian buffers, grassed waterways, watering facilities, field borders and filter strips, and nutrient management. The funding also would assist landowners with the construction of stream crossings, cross-fencing, pipelines, water wells and pasture, hayland and rangeland planting. The local SWCD technician has developed outreach materials, and through these efforts, participation has begun to increase.

Wildlife and Non-Domestic Animal Management

Feral hogs have been identified as a threat to water quality both in Plum Creek and across the southern United States. This invasive species cause a variety of problems including agricultural damage, predation on livestock, pets and wildlife, transmission of disease and parasites, and extensive environmental damage. Effects of their activities on water resources include increased sediment, bacteria, and bank erosion. In areas where high numbers of hogs are present or where animals spend a significant portion of time in and near streams, they can be a major contributor of bacteria and nutrients (McFarland and Dictson, 2012). The grant received by the SWCDs included funding for a Texas Wildlife Services (TWS) position to assist individual landowners, private entities and other agencies in the control of feral hog populations in the watershed. The TWS technician provides one-on-one feral hog management education and technical assistance for the control of hogs on private properties.



Outreach and Education Strategies

A major focus of the Plum Creek Partnership is the increased awareness of the landowners and citizens in the watershed and how to involve these stakeholders in the protection of Plum Creek. The partnership secured funding from a CWA Section 106 grant for outreach and education activities that included on-line technical modules on wastewater treatment and storm water management, stream and community clean ups and workshops for municipal officials, landowners and owners of septic systems. The project has been recognized for its effectiveness and creativity. Other outreach activities include press releases, campaign brochures, Texas Watershed Steward workshops, and the development and maintenance of a project website and newsletter. The PCWP continues to emphasize classroom environmental education and outreach. GBRA has provided

classroom instruction and hands-on investigations to more than 4,000 students, and approximately 80 teachers in the Hays Consolidated, Lockhart, and Luling Independent School Districts.

Water Quality Monitoring Data

GBRA collected water quality data on eight routine monitoring sites in the Plum Creek watershed. The CRP provides funding for monitoring three of those sites that are located on the main stem of Plum Creek. A CWA Section 319(h) grant awarded to GBRA funds monitoring at five sites that are located on tributaries of Plum Creek as well as over 30 targeted monitoring sites. The targeted sites are being sampled to determine water quality under both dry and wet conditions. The data collected by these projects was severely limited by the drought conditions in 2008-09 and again in 2011.

The following data tables (pp 14-17) have been taken from the draft 2012 Biennial Update to the Plum Creek WPP. The tables show the means and ranges of *E. coli*, nitrate-nitrogen, ammonia-nitrogen and total phosphorus at the eight routine sites, under the two different hydrologic conditions. In the case of *E. coli*, at all locations, the bacterial concentrations rose significantly under wet conditions. But three sites showed geometric mean concentrations that exceeded the stream standard for contact recreation (126 organisms per 100 milliliters) under base flow or dry conditions (Table 1).

Nutrient concentrations are assessed for concerns using screening concentrations. The screening concentration for assessment of concerns for total phosphorus is 0.69

milligrams per liter (mg/L). Table 2 shows the impact of wastewater discharge on the concentration of phosphorus under base flow conditions and the dilution effect that storm water has on water quality, with respect to total phosphorus. There is one exception to this observation. Clear Fork Plum Creek at Salt Flat Road showed an increase in phosphorus as a result of runoff, but still remained below the screening concentration. The draft update points out that it is best to hold judgment on the consistency and extent of the phosphorus load due to the rarity of wet weather events during the monitoring period.

The screening concentration for assessment of concerns for nitrate-nitrogen used by TCEQ is 1.95 mg/L. Table 3 shows that the upper two sites on the main stem of Plum Creek exceed the screening concentration under dry conditions. As water flows downstream, the concentration of nitrate-nitrogen drops. This reduction could be due to the long residence time between the Plum Creek at CR 202 and the CR 135 sites at low flows, which allows biological uptake of nitrate by macrophytes and algae. It is important to reiterate that drought impacts the stream by reducing baseflow which increases the percent of wastewater effluent under baseflow conditions and by reducing the contributions of tributaries which have been dry for a significant amount of time during the monitoring period.

Table 1 Water quality monitoring results for *E. coli* at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather) (McFarland and Dictson, 2012).

Site	No. of Samples	Median Flow-Dry	<i>E. coli</i> Geometric Mean-Dry	Range-Dry	No. of Samples	Median Flow-Wet	<i>E. coli</i> Geometric Mean-Wet	Range-Wet	% Change Between Dry and Wet*
Plum Creek at Plum Creek Rd.	30	1.5	320	36-2420	17	4.45	797	73-24000	149.06
Plum Creek at CR 202	27	3.2	155	46-550	19	13	389	16->24200	150.97
Plum Creek at CR 135	31	5	112	9-1200	17	27.5	418	56-9800	273.21
Clear Fork Plum Creek at Salt Flat Road	25	0.13	54	3-3150	14	5.25	534	41-12030	888.89
West Fork Plum Creek at Biggs Road	24	Dry with Pools	24	1-240	14	0.01	276	10-2500	1050.00
Elm Creek at CR 233	12	0	26	4-300	8	0.6	423	10-17330	1526.92
Dry Creek at CR 672	4	0	231	48-700	5	0.2	1142	330-4160	394.37
Brushy Creek at Rocky Road	15	<0.01	44	5-260	8	3.6	732	43-5480	1536.64

*Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow geometric mean greater than the water quality standard of 126 organisms/100mL under dry conditions.

In addition to the contributions of nitrates by wastewater, the springs that flow from the Leona Aquifer are high in nitrate. Nitrogen can be found in the environment in many forms, both organic and inorganic, and is essential to many biological processes. A study to investigate sources

of nitrate-nitrogen in both ground and surface water in the Plum Creek and Geronimo Creek watersheds is under consideration for funding by the TSSWCB CWA grant program. To help direct efforts and funding toward the most likely or most influential source(s) of nitrate, this project

will look to isotopic signatures of nitrogen and oxygen in the nitrates.

Table 2 Water quality monitoring results for phosphorus at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather) (McFarland and Dictson, 2012).

Site	No. of Samples	Median Flow	Total P Mean-Dry	Range-Dry	No. of Samples	Median Flow	Total P Mean-Wet	Range-Wet	% Change Between Dry and Wet*
Plum Creek at Plum Creek Rd.	30	1.5	3.45	0.76-5	17	4.45	1.22	0.29-2.83	-64.64
Plum Creek at CR 202	27	3.2	1.51	0.65-2.09	19	13	1.18	0.46-7.06	-21.85
Plum Creek at CR 135	31	5	1.02	0.22-2.69	17	27.5	0.7	0.23-1.48	-31.37
Clear Fork Plum Creek at Salt Flat Road	25	0.13	0.08	<0.5-0.31	15	5.25	0.19	<0.05-0.9	137.50
West Fork Plum Creek at Biggs Road	24	Dry with Pools	0.54	1.06-2.14	15	0.01	0.35	0.08-0.84	-35.19
Elm Creek at CR 233	12	0	0.14	0.09-0.19	8	0.6	0.17	0.06-0.45	21.43
Dry Creek at CR 672	4	0	0.36	0.23-0.47	5	0.2	0.3	0.11-0.41	-16.67
Brushy Creek at Rocky Road	24	<0.01	0.12	<0.05-0.21	14	3.6	0.14	<0.05-0.27	16.67

*Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow mean concentration greater than the screening concentration of 0.69 mg/L Total Phosphorus, under dry conditions.

Table 3 Water quality monitoring results for nitrate-nitrogen at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather) (McFarland and Dictson, 2012).

Site	No. of Samples	Median Dry	NO3-N Mean-Dry	Range-Dry	No. of Samples	Median Flow	NO3 Mean-Wet	Range-Wet	% Change Between Dry and Wet*
Plum Creek at Plum Creek Rd.	30	1.5	17.44	4.45-27.3	17	4.45	7.68	0.46-20.8	-55.96
Plum Creek at CR 202	27	3.2	7.51	2.8-16.3	19	13	4.39	1.07-11.5	-41.54
Plum Creek at CR 135	31	5	1.59	<0.05-5.88	17	27.5	2.52	0.18-6.76	58.49
Clear Fork Plum Creek at Salt Flat Road	25	0.13	0.72	<0.05-3.02	14	5.25	0.82	<0.05-2.05	13.89
West Fork Plum Creek at Biggs Road	22	Dry with Pools	0.3	<0.05-1.06	14	0.01	0.23	<0.05-0.88	-23.33
Elm Creek at CR 233	12	0	0.1	<0.05-0.35	8	0.6	0.4	<0.05-1.39	300.00
Dry Creek at CR 672	4	0	0.24	<0.05-0.8	5	0.2	0.95	<0.05-3.78	295.83
Brushy Creek at Rocky Road	24	<0.01	0.13	<0.05-0.69	14	3.6	0.55	<0.05-1.44	323.08

*Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow mean concentration greater than the screening concentration of 1.95 mg/L Nitrate Nitrogen, under dry conditions.

As demonstrated in Figures A and B, the ratios of the isotopes of nitrogen and oxygen in nitrate often are useful for determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (USGS, 2011).

Sources of ammonia-nitrogen include decomposition of organic material present in the stream, agricultural contributions and wastewater discharges.

Figures A and B graphically display the range for $\delta^{15}\text{N}$ in natural materials and the isotopic composition of various sources of NO_3^- . (from Clark and Fritz, 1997).

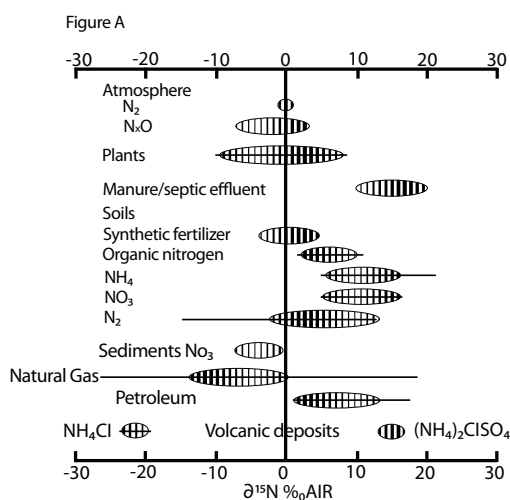


Table 4 shows the comparison of water quality under dry and wet conditions. At the majority of the sites, the mean concentration of ammonia-nitrogen was reduced to or remained below the screening concentration of 0.33 mg/L after runoff events.

The upper site on Plum Creek is dominated by wastewater effluent. During the drought of 2011, the site near Uhland would have been dry if not for the wastewater effluents discharged upstream. This site experienced a fish kill caused by the discharge of poorly treated wastewater, resulting in the discharge of high levels of ammonia and low dissolved oxygen from the Kyle Aquasource Wastewater Treatment facility in November 2010.

Figure B

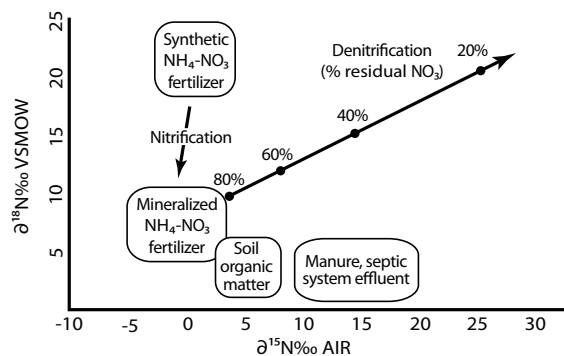


Table 4 Water quality monitoring results for ammonia-nitrogen at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather) (McFarland and Dictson, 2012).

Site	No. of Samples	Median Flow	NH3-N Mean-Dry	Range-Dry	No. of Samples	Median Flow	NH3 Mean-Wet	Range-Wet	% Change Between Dry and Wet*
Plum Creek at Plum Creek Rd.	29	1.5	0.53	<0.1-5.62	16	4.45	0.32	<0.1-3.16	-39.62
Plum Creek at CR 202	27	3.2	0.13	<0.1-0.22	18	13	0.1	<0.1-0.18	-23.08
Plum Creek at CR 135	31	5	0.15	<0.1-0.25	16	27.5	0.2	<0.1-0.42	33.33
Clear Fork Plum Creek at Salt Flat Road	25	0.13	0.18	<0.1-0.45	14	5.25	0.15	<0.1-0.35	-16.67
West Fork Plum Creek at Biggs Road	23	Dry with Pools	0.2	<0.1-0.98	14	0.01	0.1	<0.1-0.4	-50
Elm Creek at CR 233	12	0	0.33	<0.1-1.24	8	0.6	0.25	<0.1-1.04	-24.24
Dry Creek at CR 672	4	0	0.22	0.12-0.39	5	0.2	0.25	<0.1-0.066	13.64
Brushy Creek at Rocky Road	24	<0.01	0.17	<0.1-0.63	14	3.6	0.14	<0.1-0.32	-17.65

*Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow mean concentration greater than the screening concentration of 0.33 mg/L Ammonia-Nitrogen, under dry conditions.

Plum Creek Designated as Category 4b

In November 2011, the US Environmental Protection Agency approved the state's 2010 Water Quality Inventory and 303(d) list. This approval was another milestone for the PCWP. Impaired water bodies are listed on the 303(d) list and placed in Category 5, meaning the water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants. TCEQ is required to address the impairment by developing a Total Maximum Daily Load (TMDL) that is a regulatory process that allocates the pollutant load among all sources of the pollutant. One of three subcategories is then assigned to each impaired parameter to provide information about water quality status and management activities on that water body. Plum Creek had been designated as "5c" because more data was needed before a TMDL would be scheduled. In the 2010 Water Quality Inventory, at the request of the PCWP, TSSWCB and other stakeholders, TCEQ reassigned Plum Creek as a Category 4b water body. In its approval letter, EPA recognized the efforts of the Plum Creek Watershed Partnership and approved the reassignment of the watershed to Category 4b. The EPA letter stated "... at this time, EPA believes the category 4b demonstration, and all referenced elements within the WPP, adequately demonstrate how other pollution control requirements will lead to the attainment of water quality standards in Plum Creek (Segment 1810) in a reasonable period of time." EPA will periodically assess the progress of the Partnership and implementation. If at such time it is apparent to EPA that there is inadequate progress being made to improve water quality and bring the stream back into compliance with stream standards, EPA will return the designation of 5c to Plum Creek and require that a TMDL be developed.

In 2012, the Plum Creek Watershed Partnership will set another precedent by being the first watershed partnership in the state to hire a watershed coordinator. Since 2006 the TSSWCB has provided CWA Section 319(h) funding to the Texas AgriLife Extension to serve as Plum Creek's watershed coordinator. In 2011, 12 PCWP entities signed

an interlocal agreement to provide funding to match a new CWA grant. This grant, administered through GBRA, provides funds to hire a watershed coordinator that will be located in the watershed. The new watershed coordinator will commence duties in early 2012.

Additional information on the PC WPP, activities of the PCWP and additional water quality data collected in the watershed can be found in the draft biennial update at www.pcwpt.tamu.edu.



Impact of the 2011 DROUGHT

by LaMarriol Smith, GBRA

According to Texas climatologists, the dry spell through most of 2011 is the worst single-year drought since Texas rainfall data started being recorded in 1895. That is a significant occurrence.

Additionally, the U.S. Drought Monitor also reported during 2011 that the majority of the state earned the highest rating of “exceptional” drought and the remaining areas were not far behind with “extreme” or “severe” drought ratings.

Given those facts, the Texas Comptroller of Public Accounts report, *The Impact of the 2011 Drought and Beyond*, indicates the 2011 drought may prove to be one of the most devastating economic events in Texas history. The updated report cited estimates by the Texas AgriLife Extension Service that put the state’s agricultural losses for the year

at \$7.62 billion. A December 2011 economic analysis by BBVA Compass Bank also found that indirect drought losses in agricultural industries could add another \$3.5 billion to the toll.

However, the drought is not unprecedented in every way. Much longer droughts have occurred in the past. Texas’ “drought of record,” or its worst extended drought,

is considered the 1950s drought in which the state suffered drought conditions for 10 years from the late 1940s to the late 1950s. Tree ring studies have shown even worse and more extended droughts have occurred historically. Some water resource managers predict that, if in fact 2012 is a repeat of recent years, a new “drought of record” could be established.

When considering rainfall data in 2011, as late as

October 1, Texas as a whole had received an average of about 11 inches of rain in the previous year, which is about 16 inches less than normal — even less than Morocco and Tunisia on the northern part of Africa see in a year. Those conditions were reflected among the state’s water supply systems. By the latter part of January 2012, more than 1,000 public water supply systems — more than three times the number affected by the 2008-2009 drought — were reporting drought impacts.

Not everything has been doom and gloom. During the November 2011 elections, Texas voters approved Proposition 2, which authorized the TWDB to issue up to \$6 billion in general obligation bonds. The proceeds will be used to



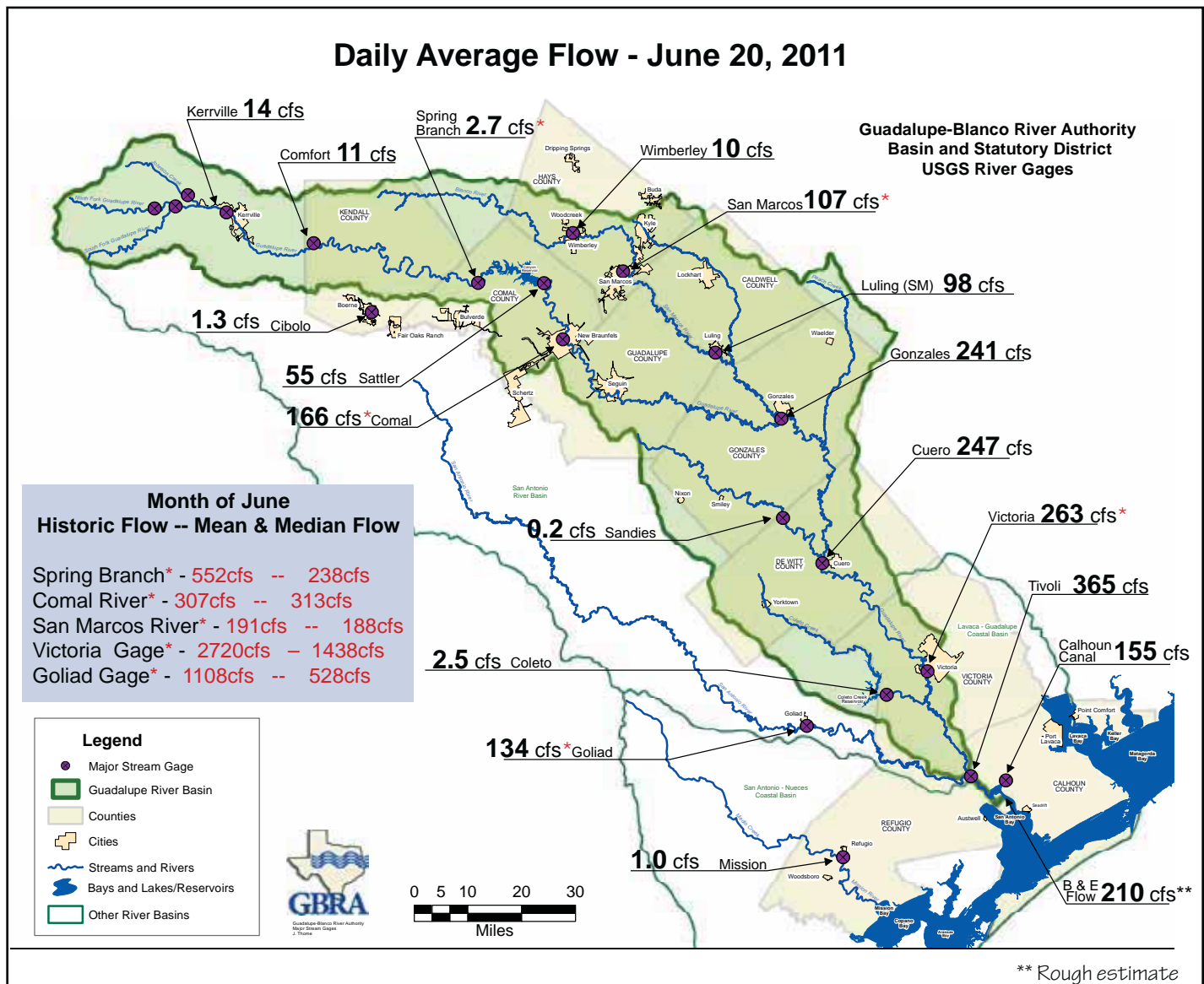
Photos by Janet Thome, GBRA

make loans to Texas local governments for much-needed water, wastewater and flood control projects.

Recent rainfall across the state during January and February 2012 has begun to change the severity of the drought in some areas. However in the Guadalupe River Basin, rainfall has not benefited the area above Canyon Reservoir as much as in other parts of the basin. So as drought conditions persist in GBRA's upper basin

region, GBRA and its peers must continue to be vigilant in stewardship of water resources. If the state has improved rainfall conditions over the rest of the winter and into the spring, the impacts on public water supply systems may begin to decrease. But, a return to even moderate drought conditions could pose significant challenges throughout the state.

Figure C. Daily average flow at USGS river gages on June 20, 2011. Also provided are the historical flows for the month of June at key sites in the Guadalupe River Basin.



EARIP Emerges with Habitat Conservation Plan

by LaMarriol Smith, GBRA

After four years of data collecting, studying, theorizing, compromising and negotiating, stakeholders of the Edwards Aquifer Recovery Implementation Program (EARIP) emerged in December with a scientifically based habitat conservation plan (HCP) that would aid in the recovery of federally listed species dependent on the aquifer.

While the struggle over pumping from the Edwards Aquifer is decades old, recent history on this issue can be traced to 1991 when the Sierra Club and GBRA filed a lawsuit under the Endangered Species Act that ultimately resulted in the creation of the Edwards Aquifer Authority (EAA). The Texas Legislature directed the EAA to regulate, among other things, pumping from the aquifer, to implement critical period management restrictions, and to pursue a program “to ensure that the continuous minimum springflows of the Comal Springs and the San Marcos Springs are maintained to protect endangered and threatened species to the extent required by federal law. . .”

Balancing the use of water from the Edwards remained a contentious issue particularly in years where drought conditions hit the state. Then in the fall of 2006, the USFWS brought together 26 stakeholders from throughout the region, representing diverse and sometimes conflicting interests spanning from the Hill Country to the Gulf Coast, to participate in a collaborative process to develop a plan that would aid in the recovery of federally listed species dependent on the aquifer. This process became known as the EARIP.

In May 2007, the Texas Legislature codified the EARIP in state law and directed the EAA and certain other state agencies, local units of government, and other

stakeholders to participate in the EARIP and to prepare a USFWS-approved plan by 2012 for managing the aquifer to preserve the federally-listed species. The Legislature directed that the plan must include, among other things, recommendations regarding withdrawal adjustments during critical periods that ensure that federally-listed species associated with the aquifer will be protected.

Through a deliberative process, EARIP stakeholders have recommended that the Edwards Aquifer Authority, the City of San Antonio, acting by and through its San Antonio Water System (SAWS), City of San Marcos, City of New Braunfels, and Texas State University apply for an Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the ESA. The agreed-upon HCP is intended to support the issuance of an ITP, which would allow the “incidental take” of threatened or endangered species resulting from the otherwise lawful activities involving regulating and pumping of groundwater from the Edwards Aquifer within the boundaries of the EAA for beneficial use for irrigation, industrial, municipal and domestic and livestock uses, and the use of Comal and San Marcos springs and river systems for recreational and other activities.

The minimization and mitigation measures included within the HCP are designed to ensure that incidental take resulting from the covered activities will be minimized and mitigated to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of covered species associated with the aquifer and Comal and San Marcos springs and rivers ecosystems.

The EARIP’s HCP can be viewed online in its entirety at www.earip.org/FinalHCP/Final%20HCP.pdf.



©Gary Nafris



GBRA's River Network Expanding

by Lee Gudgell, GBRA

GBRA received a CWA Section 319(h) non-point Source grant administered by TCEQ to create a network of continuous water quality monitoring stations throughout the Guadalupe River Basin. This network was collectively termed the Guadalupe River Basin Monitoring Network (GRBMN).

The initial locations for the water quality monitoring devices in the network were strategically targeted to fill in data gaps in water bodies with active watershed protection plans (WPPs) or total maximum daily load studies (TMDLs). In addition to these three sites, GBRA maintains a continuous water quality monitoring station on Plum Creek. The WPPs and TMDLs have been developed to address known water quality impairments or concerns. In order to provide access to the continuous water quality data in locations that might have limited internet access, kiosks have been installed in libraries or community centers near the monitoring sites. The kiosks can be found in the Navarro High School Library (Geronimo), the Cuero Public Library (Sandies Creek) and the Wimberley Community Center (Cypress Creek). In addition to access to the water quality data, the kiosks have information on wastewater treatment, operation and maintenance of on-site septic systems, watershed management and nonpoint source pollution. Although the real-time water quality data is not used by TCEQ for stream assessments, the monitoring equipment of the GRBMN allows stakeholders and assessors to observe and document real-time water quality changes in the targeted water bodies over extended periods of time. The initial grant for this project included the establishment of three stations in the Guadalupe River Watershed on Geronimo, Cypress and Sandies Creeks. The hourly data from all stations in the GRBMN can be viewed on the TCEQ webpage at www.tceq.texas.gov/waterquality/monitoring/swqm_realttime.html or www.texaswaterdata.org.

The continuous ambient monitoring station (CAMS) on the Geronimo Creek at State Highway 123 near Geronimo, Texas, was established by the GBRA on Nov. 15, 2010. This station was put into place in order to support the efforts of the ongoing Geronimo Creek WPP to address concerns with rising bacteria levels and nitrate-nitrogen in

the Geronimo and Alligator creeks watersheds. The River Network CAMS station #741 on Geronimo Creek provides hourly data updates of stream level, stream velocity, stream flow, water temperature, specific conductance, pH, dissolved oxygen and turbidity. Stream flow and gage height parameters were added to this site on the Geronimo Creek because no continuous U.S. Geological Survey (USGS) stream flow gage data was available in this watershed.

A CAMS site on Cypress Creek near the Blanco River confluence in Wimberley was established by GBRA on July 29, 2011. This station was targeted to assist with the development of a Cypress Creek watershed protection plan to address concerns with bacteria and sediment in the Cypress Creek Watershed. The River Network CAMS station #797 on Cypress Creek provides hourly data updates of water level, water temperature, specific conductance, pH, dissolved oxygen and turbidity. This station supplements the data provided by the USGS station at the upper end of the watershed near Jacob's Creek Spring with data from downstream of the populated areas of Wimberley.

A CAMS site on the Sandies Creek on Cheapside Road near Westhoff, was established by the GBRA on August 3, 2011. This station was targeted to assist with the Sandies Creek TMDL and to address bacteria concerns in the Sandies Creek Watershed. The River Network CAMS station #732 on the Sandies Creek provides hourly data updates of water temperature, specific conductance, pH, dissolved oxygen and turbidity. This station supplements the flow data provided by the USGS station directly adjacent to this CAMS station with new real-time water quality data. The data provided by this station is also reviewed to determine if any effects on the water quality of the area's surface water is detectable and can be associated with the Eagle Ford Shale oil exploration.



Hydraulic Fracturing in the Eagle Ford Shale

The Eagle Ford Shale underlies much of South Texas, including DeWitt and Gonzales counties, which are located in the heart of the Guadalupe River Basin. The Eagle Ford Shale is a hydrocarbon producing formation capable of producing both gas and oil. The high percentage of carbonate in the formation makes it more brittle or “frac-able.” Hydraulic fracturing is a process to stimulate wells and recover natural gas and oil from unconventional reservoirs of shale gas and coal beds located at depths of 4,000 to 12,000 feet. The process consists of pumping water that is treated with chemicals and sand into the formation. This technology facilitates oil and gas extraction because the chemicals and sand in the solution hold open the fractures created therefore making the formation more permeable.

Since the increase in oil and gas activities, the landscape of the two counties has been altered by new road construction, greater truck traffic and drilling rigs lighting up the night sky. Many landowners have seen huge financial boons with the exploration and the oil and gas industry has brought many new jobs to the area. However, many county residents are concerned about potential impacts to the environment and water resources. Water is used throughout the many stages of drilling and completion of an oil or gas well. The industry uses water for cooling or boiler operations in hydrostatic testing for pipelines and tanks, rig wash water and sanitary and laboratory purposes. However, the largest volume of water is used as a supplemental fluid to enhance recovery of petroleum resources.

The Railroad Commission of Texas (RRC) has primary jurisdiction over the oil and gas industry. The RRC has jurisdiction over hazardous and non-hazardous wastes associated with the exploration, development or production of oil and gas, and the wastes from transportation before it enters a refinery. The RRC also has jurisdiction over the injection wells used to dispose of oil and gas wastes. TCEQ, as the environmental agency for the state, has jurisdiction over the waste associated with the transportation of crude oil and natural gas by railcar, truck, barge or tanker and refined products by pipeline. TCEQ also has jurisdiction over the waste generated at most oil field service facilities. The RRC has been charged to write rules that require disclosure of hazardous chemicals used in the fracturing process. RRC will complete the rulemaking process by July 2012. On the federal level, the EPA, at the direction of the U.S. Congress, is undertaking a study of the hydraulic fracturing process to better understand the potential impacts to drinking water and groundwater sources. The study will be completed in 2014.

Red Tide Hits Texas Coast

In September 2011, the TPWD began receiving reports of stressed or dead fish in the Brownsville Ship Channel. By Sept. 22, red tide had been confirmed from the San Luis Pass to the Brazos River, where dead fish had washed ashore and beachgoers were experiencing respiratory irritation due to the aerosols associated with the toxic algae, *Karenia brevis*. *K. brevis*, a marine dinoflagellate common in the Gulf of Mexico, naturally produces a suite of potent neurotoxins that can cause gastrointestinal and neurological problems in other organisms and are responsible for large die-offs of marine organisms and seabirds. Red tide is a natural phenomenon not caused by human beings. When temperature, salinity, and nutrients reach certain levels, a massive increase in *K. brevis* algae can occur.

In early October, evidence of the red tide bloom was reported in the Lavaca-Guadalupe Coastal Basin. Hundreds of dead gulf menhaden washed ashore at Port O'Connor and Indianola Beach. By mid-October, the Department of

State Health Services (DSHS) began reporting visible blooms in Matagorda and Espiritu Santo bays, with patches of algae measuring 100 feet across and a quarter of a mile long. The DSHS closed all Texas bays to shellfish harvesting due to the potential risk of neurotoxic shellfish poisoning in people who consume filter-feeding shellfish such as oysters, clams, and mussels.

In late October, game wardens observed stressed red drum and dead sand trout, gulf menhaden, sheepshead and shrimp eels in the Intercoastal Waterway on the western portion of San Antonio Bay.

By the end of October, more than 4.2 million fish had been killed by the red tide algae bloom. According to TPWD, while that number is significant, it is low compared to the number of fish killed, approximately 22 million, in the red tide bloom that ravaged the Texas Coast in 1986.

TPWD flew the mid-Texas coast in mid-November and found heavy streaks of algal patches throughout Lavaca-Guadalupe Coastal Basin,

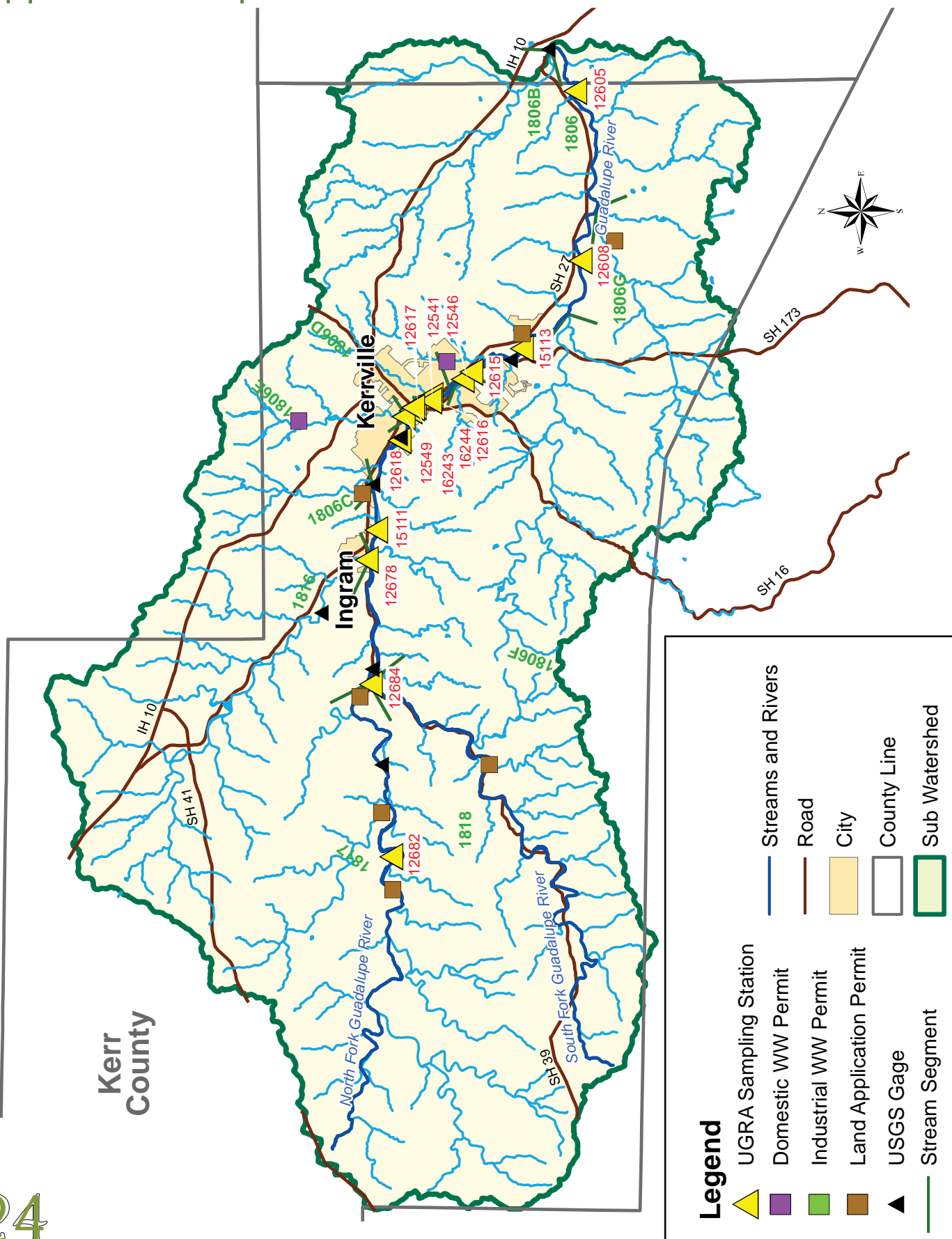
including as far inland as Hynes and Guadalupe bays.

The red tide had begun to dissipate somewhat in late December, possibly due to north winds and localized rainfall. Shellfish harvesting was reopened in San Antonio Bay on Feb. 9, 2012.

No one knows the exact combination of factors that cause red tide. Some experts believe high temperatures combined with a lack of wind and rainfall is usually at the root of red tide blooms. There are no known ways to control or eradicate the blooms. It is important to remember that red tide has happened before and the Texas marine environment has always recovered (TPWD, 2012).

Photo by Janet Thome, GBRA

Upper Guadalupe River Watershed



Upper Guadalupe River Watershed

River Segments, Descriptions and Concerns

Drainage Area: 850 square miles

Streams and Rivers: North Fork and South Fork of the Guadalupe River, Johnson Creek, Quinlan Creek, Camp Meeting Creek, Town Creek, Cypress Creek, Goat Creek, Turtle Creek, Verde Creek, Bear Creek

Aquifer: Trinity, Edwards Plateau

River Segments: 1816, 1817, 1818, 1806A-G

Cities: Center Point, Ingram, Kerrville, Comfort, Hunt

Counties: Kerr, Gillespie, Bandera, Kendall

EcoRegion: Edwards Plateau

Vegetation Cover: Evergreen Forest 46.9%, Grass/Herbaceous 14.4%, Shrublands 28.8%

Climate: Average annual rainfall 30 inches, Average annual temperature January 32°, July 94°

Land Uses: ranching, farming, tourism, light manufacturing

Water Body Uses: aquatic life, contact recreation, general use, fish consumption, and public water supply

Soils: Dark and loamy over limestone; to the south and east soils are variable with light colored brown to red soils in some areas and dark loamy or loamy soils over clay subsoils elsewhere

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 7, Industrial 0

Segment 1816 (Johnson Creek) This spring-fed 21 mile segment consisting of Johnson Creek to its confluence with the Guadalupe River in Kerr County has good water quality. Intermittent in stages, the stream crosses an area characterized by steep slopes. The generally shallow, stony soils support grasses and open stands of live oak and Ashe Juniper.

Segment 1817 (North Fork Guadalupe River) (North Fork Guadalupe River): The spring-fed 29 mile North Fork of the Guadalupe River is a perennial stream with exceptional aquatic life designation. River flow is swift but shallow. Typical vegetation are baldcypress, live oak and Ashe Juniper trees.

Segment Concerns: The 2010 Texas Integrated Report identifies a concern for the dissolved oxygen grab samples at the screening level for the North Fork Guadalupe River. However, the mean dissolved oxygen value is slightly below the criteria.

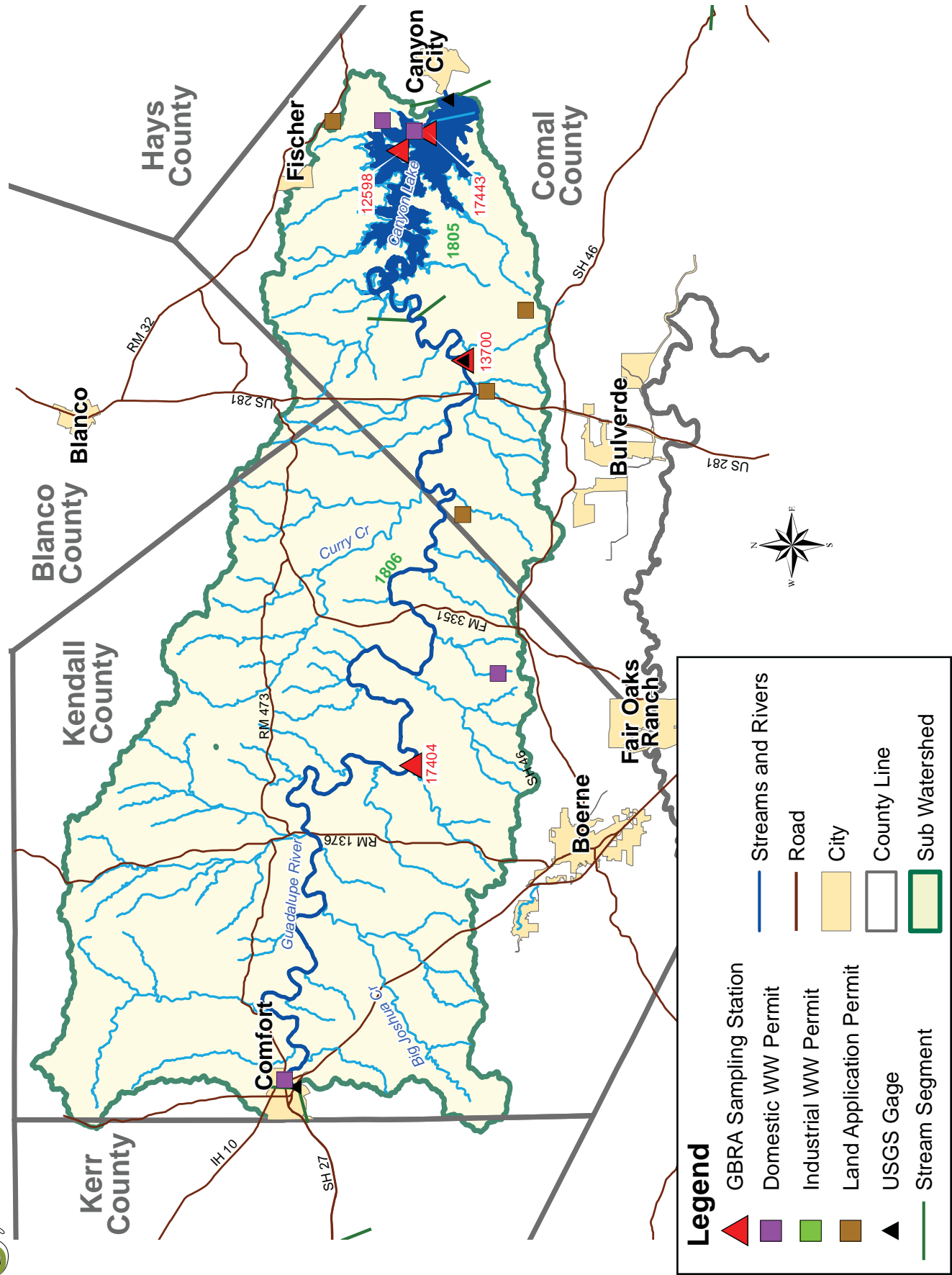
Segment 1818 (South Fork Guadalupe River) The spring-fed 27 mile South Fork of the headwaters of the Guadalupe River is clear, with moderately flowing water and has excellent water quality. It is a narrow and shallow scenic river with baldcypress-lined banks.

Segment 1806 (Guadalupe River above Canyon Lake) The Guadalupe River from the city of Comfort in Kendall County to the confluence with the North and South forks of the Guadalupe River in Kerr County is scenic with crystal clear water between baldcypress-lined banks. The shallow riffle areas, punctuated with deep pools create an exceptional aquatic life ecosystem.

Segment Concerns: According to prior assessments performed by TCEQ, a portion of segment 1806 is not supporting due to *E. coli* bacteria concentrations that exceeded the geometric mean criteria. A TMDL and Implementation Plan have been developed and approved by TCEQ. Currently, UGRA is initiating measures to address the bacteria impairment.

Tributary Concerns: Three tributaries to segment 1806 have also been identified as not supporting when assessed by TCEQ. Segment 1806A, Camp Meeting Creek, has been listed as not supporting when screened against the dissolved oxygen 24-hour average. According to the 2010 Assessment, segment 1806D, Quinlan Creek, and segment 1806E, Town Creek, are listed as not supporting due to *E. coli* bacteria concentrations that exceed both the geometric mean and the single grab screening level. However, the assessment was based in large part on samples that were collected during stream flow conditions of little to no flow.

Guadalupe River Watershed Below Comfort



Guadalupe River Watershed Below Comfort

River Segments, Descriptions and Concerns

Drainage Area: 596 square miles

Streams and Rivers: Guadalupe River from Comfort to Canyon Lake, Joshua Creek, Flat Rock Creek, Rebecca Creek, Block Creek, West Sister Creek

Lake: Canyon Lake

Aquifer: Trinity, Edwards Plateau

River Segments: 1805, 1806

Cities: Comfort, Kandalia, Bergheim, Bulverde, Canyon City, Spring Branch, Startzville

Counties: Kerr, Comal, Kendall, Blanco

EcoRegion: Edwards Plateau

Vegetation Cover: Evergreen Forest 43.6%, Shrublands 11.0%, Grass/Herbaceous 31.3%

Climate: Average annual rainfall 32 inches, Average annual temperature January 38°, July 95°

Land Uses: urban, unincorporated suburban sprawl, cattle, goat and sheep production, light and heavy industry, and recreational

Water Body Uses: aquatic life, contact recreation, general use, fish consumption, and public water supply

Soils: Dark and loamy over limestone to loam with clay subsoils

Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 4, Industrial 0

Segment 1806: (Guadalupe River above Canyon Lake): From a point (1.7 miles) downstream of Rebecca Creek Road in Comal County to the city of Comfort in Kendall County.

Segment Concerns: Urban and suburban growth (large lot housing developments) along the Hwy. 281 corridor between San Antonio and Blanco is a growing concern, especially in the regions near the city of Bulverde and the city of Spring Branch.

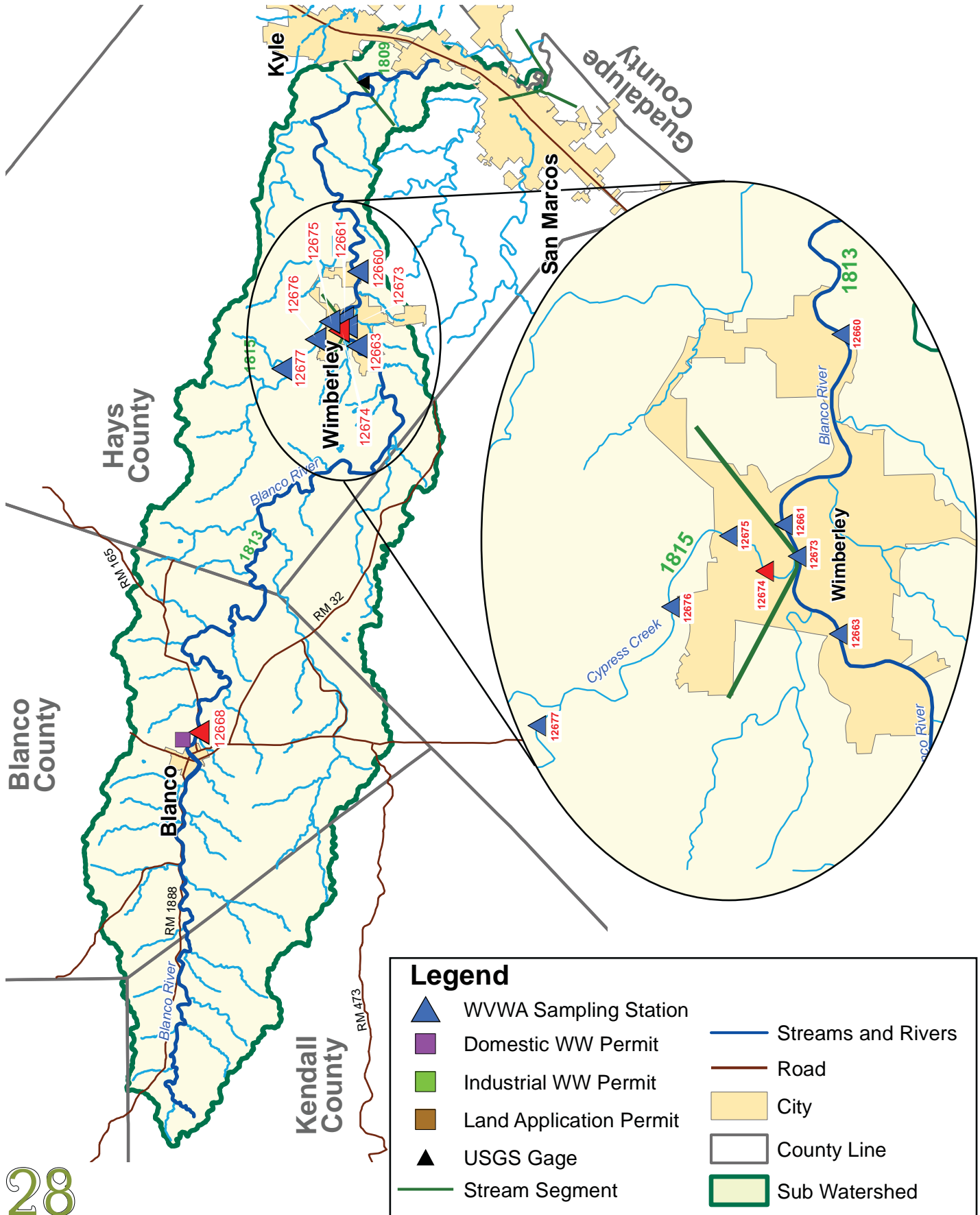
Segment 1805: (Canyon Lake): From Canyon Dam in Comal County to a point (1.7 miles) downstream of Rebecca Creek Road in Comal County, including Canyon Reservoir. Canyon Reservoir is a flood control and water supply reservoir; impounding the Guadalupe River with a conservation pool elevation of 909 feet mean sea level (msl).

Segment Concerns: Significant suburban growth in the Canyon Reservoir region.

Segment 1805 Special Notes: Canyon Reservoir remains on the 303(d) list of impaired water bodies because of the fish consumption advisory for longnose gar and striped bass that has been issued by the Texas State Department of Health Services (DSHS). Because concentrations of methylmercury in fish tissue of these species exceeds the criteria to protect human health, the DSHS advises that adults should limit consumption of longnose gar and striped bass to no more than two eight-ounce meals per month and children under 12 should limit consumption to no more than two four-ounce meals per month. Potential sources of mercury include emissions from coal-fired power plants, cement plants, volcanoes, industrial discharges, and improper disposal of batteries. Samples of water taken from Canyon Reservoir have shown no detectable concentrations of mercury. The DSHS has not speculated as to the source of the mercury. Canyon Reservoir will remain on the list until additional fish tissue studies are performed by DSHS and the concentrations of methylmercury are within the recommended criteria.

The U.S. Army Corps of Engineers is responsible for managing releases of water from the reservoir when the elevation is above its conservation pool of 909 mean sea level. When the reservoir is at or below conservation pool, GBRA manages the stored water portion and reservoir releases. Canyon Reservoir fulfilled its role as a storage reservoir and released adequate amounts of water providing beneficial uses to cities, industry and individuals. Releases are determined based upon several factors including natural inflows, licensed flows for the project, senior water rights, contract releases from conservation pool for cities, industries and other downstream users and bays and estuary flow requirements.

Blanco River Watershed



Blanco River Watershed

River Segments, Descriptions and Concerns

Drainage Area: 440 square miles

Streams and Rivers: Guadalupe River, Lower Blanco River, Upper Blanco River, Cypress Creek, Meier Creek, and Sycamore Creek

Aquifers: Edwards-Trinity, Trinity

River Segments: 1813, 1815, 1809

Cities: Blanco, Fisher, Wimberley, Kyle, San Marcos

Counties: Kendall, Comal, Blanco and Hays

EcoRegion: Edwards Plateau

Vegetation Cover: Evergreen Forest 42.9%, Shrublands 11.0%, Grass/Herbaceous 32.2%, Deciduous Forest 7.7%

Climate: Average annual rainfall 31 inches, Average annual temperature January 34°, July 94°

Land Uses: urban, agricultural crops (wheat, hay, oats, peaches and pecans), sheep, cattle, goats and turkey productions; light manufacturing and recreation

Water Body Uses: aquatic life, contact recreation, general use, fish consumption use, and public water supply use

Soils: Varies from thin limestone to black, waxy, chocolate, and grey loam, calcareous, stony, and clay loams

Permitted Wastewater Treatment Facilities: Domestic 1, Land Application 0, Industrial 0

Segment 1813 (Upper Blanco River): Flowing 71 miles from northern Kendall County until Limekiln Road in Hays County, the upper Blanco is a spring-fed stream. Cypress Creek joins the river in the village of Wimberley. The steep-sloped, intermittent, meandering stream is lined with baldcypress, oak and Ashe Juniper.

Segment Concerns: Urban and suburban growth (large lot developments) along the State Highway 281 corridor between San Antonio and the city of Blanco is a growing concern because of the potential for nonpoint source pollution.

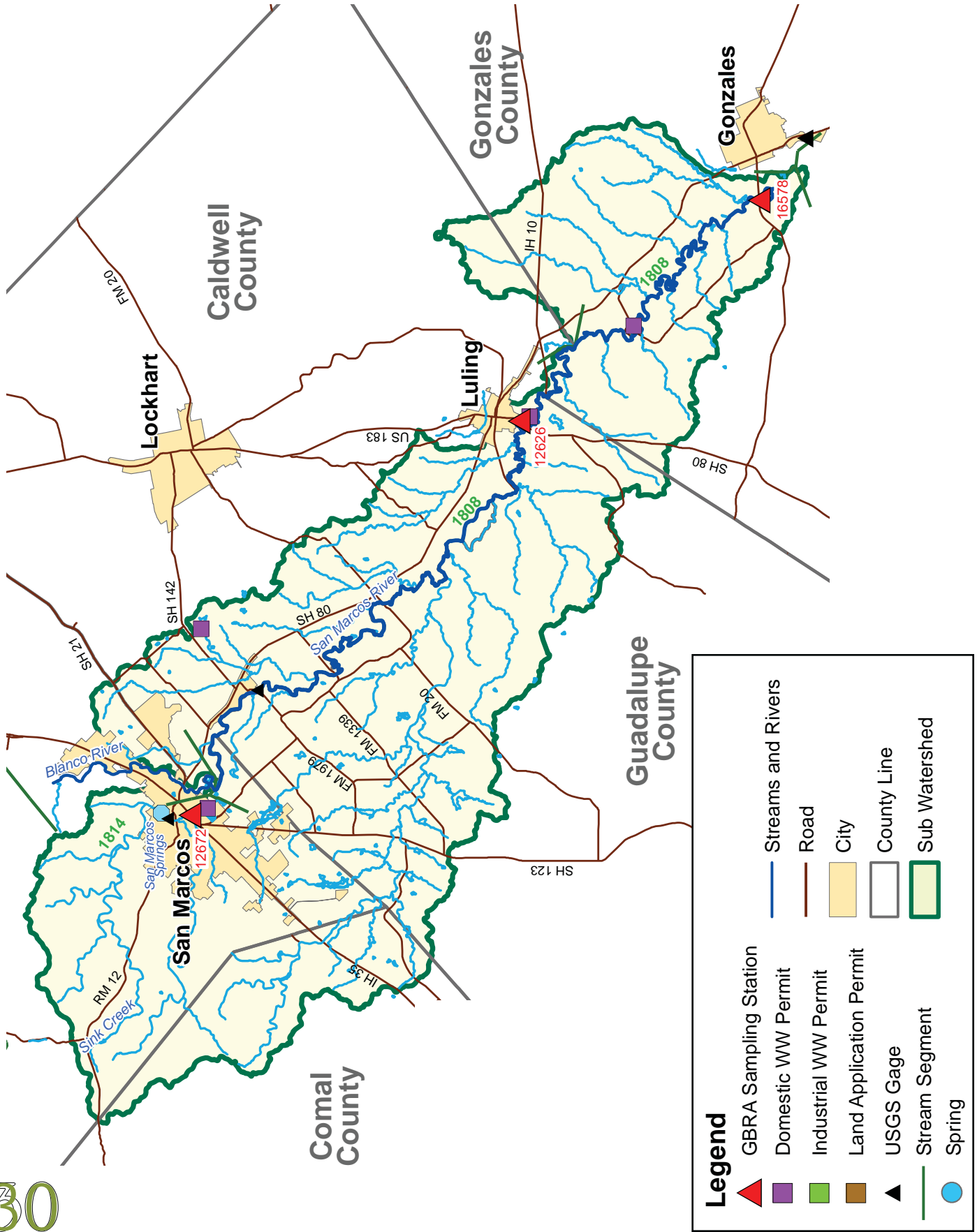
Segment 1815 (Cypress Creek): The spring-fed creek flows 14 miles into the village of Wimberley where it merges with the Blanco River in Hays County. A picturesque creek, lined with baldcypress trees, with good water quality.

Segment Concerns: The segment is experiencing tremendous residential and commercial suburban growth. Occasional high levels of *E. coli* bacteria are likely due to faulty septic tanks or urban nonpoint source pollution, such as pet waste. The River Systems Institute will be moving into the second phase of the development of a watershed protection plan. The watershed characterization phase has been completed. Modeling of the data collected during the first phase, along with input from stakeholders, will determine the list of best management practices that, if implemented, would help reduce the bacterial pollution load to Cypress Creek. Stakeholders have also raised concerns about increased drawdown of the aquifer that is the source of the springs at Jacobs Well. There is a movement to create a special management area for this Hays Trinity Aquifer. GBRA and TCEQ have established a continuous water quality monitoring station on this water body. Access to the hourly data can be found at www.tceq.texas.gov/waterquality/monitoring/swqm_realttime.html or www.texaswaterdata.org.

Segment 1809 (Lower Blanco River): This 15-mile lower stretch of the Blanco River from Limekiln Road until the confluence with the San Marcos River varies from a rapid moving stream as it crosses the Balcones Fault Zone to a shallow, slow moving stream, lined with scrub oaks as it enters the Blackland Prairies.

Segment Concerns: Located in the middle of the IH-35 corridor from the northern boundary of the city of San Marcos and the southern boundary of the city of Kyle. Concerns include cumulative impacts on watersheds caused by construction and multiple subdivision development. The city of San Marcos' population has reached the threshold that requires the city to develop a storm water pollution prevention plan (SWPP). San Marcos and Texas State University are developing the SWPP to comply with federal guidelines.

San Marcos River Watershed



Legend

- ▲ GBRA Sampling Station
- Domestic WW Permit
- Industrial WW Permit
- Land Application Permit
- ▲ USGS Gage
- Stream Segment
- Spring
- Streams and Rivers
- Road
- City
- County Line
- Sub Watershed

San Marcos River Watershed

River Segments, Descriptions and Concerns

Drainage Area: 522 square miles

Streams and Rivers: Lower San Marcos River, Upper San Marcos River, Sink Creek, York Creek

Aquifers: Edwards-Balcones Fault Zone, Carrizo-Wilcox

River Segments: 1814, 1808

Cities: San Marcos, Maxwell, Martindale, Fentress, Prairie Lea, Luling, Ottine, Gonzales

Counties: Hays, Guadalupe, Caldwell, Gonzales

EcoRegion: Edwards Plateau, Post Oak Savannah, Texas Blackland Prairies

Vegetation Cover: Pasture/Hay 27.0%, Evergreen Forest 12.8%, Shrublands 12.2%, Grass/Herbaceous 16.3%, Deciduous Forest 19.0%, Row Crops 8.6%

Climate: Average annual rainfall 33 inches
Average annual temperature January 40°, July 96°

Land Uses: Urban, industry, agricultural crops (corn, sorghum, hay, cotton, wheat, pecans), cattle and hog production, poultry production, oil production, and recreation

Water Body Uses: aquatic life, contact recreation, general use, fish consumption, and public water supply

Soils: Varies from thin limestone to black, waxy, chocolate, and grey loam

Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 0

Segment 1814 (Upper San Marcos River): Beginning at the San Marcos Springs that are fed by the Edwards Aquifer in Hays County, the five mile stretch of river continues through to the confluence with the Blanco River east of San Marcos. The headwaters of the San Marcos River are clear flowing and a constant temperature year long.

Segment Concerns: The spring-fed stream, sometimes referred to as an island ecosystem, is home to a number of endangered species that are dependent upon the constancy of clean springflow for their survival. Springflow is a concern during times of drought. In an effort to protect species dependent on flow from the springs from the Edwards Aquifer, stakeholders of the Edwards Aquifer Recovery Implementation Program have compromised on a scientifically-based habitat conservation plan (HCP). The minimization and mitigation measures included within the HCP are designed to ensure that incidental take resulting from the covered activities will be minimized and mitigated to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of covered species associated with the aquifer and Comal and San Marcos springs and rivers ecosystems.

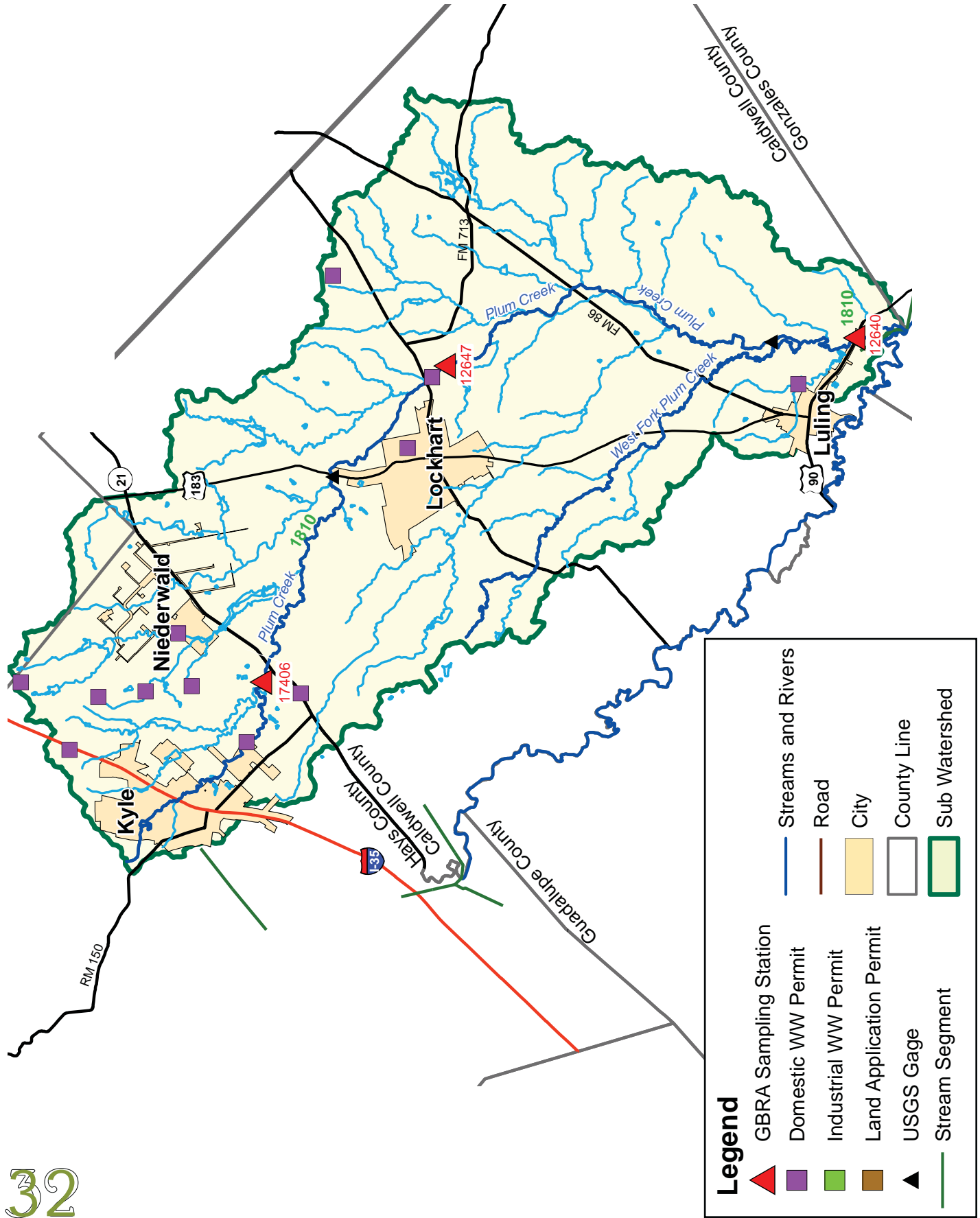
Segment 1814 has been listed on the 303d list of impaired waterbodies due to elevated total dissolved solids (TDS). The mean TDS used in the assessment was 406.09 milligrams per liter, slightly above the stream standard of 400 milligrams per liter. The mean TDS was not directly measured, but based on a standard correction factor of 0.65 times the measured conductivity. GBRA is collecting TDS and conductivity monthly in order to confirm the impairment and a site-specific factor that can be used to more accurately estimate the TDS in this segment.

Texas State University is completing CWA 319(h) projects on Sink Creek and Spring Lake. The projects collected data to characterize the water quality of the lake, the recharge and the runoff entering the lake from the Sink Creek watershed. The project will be completed in August 2012. The Rivers System Institute staff are hoping to follow the TSU projects with the development of a watershed protection plan for the Upper San Marcos River, beginning in the Fall 2012.

Segment 1808 (Lower San Marcos River): From the confluence of the San Marcos River with the Blanco River continuing about 75 miles until the point of confluence with the Guadalupe River outside the city of Gonzales. Includes the confluence with Plum Creek. The lower San Marcos River is a lazy, smooth flowing river during normal flow.

Segment Concerns: Protecting springflow is a concern during times of drought. Recreational use of the river is increasing. Activities related to the production and transportation of petroleum are potential threats to the watershed.

Plum Creek Watershed



Plum Creek Watershed

River Segments, Descriptions and Concerns

Drainage Area: 397 square miles

Streams and Rivers: San Marcos River, Plum Creek, Clear Fork Creek

Aquifers: Edwards-Balcones Fault Zone, Carrizo Wilcox

River Segments: 1810

Cities: Kyle, Buda, Uhland, Luling, Neiderwald, Lockhart

Counties: Hays, Travis, Caldwell

EcoRegion: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Deciduous Forest 23.6%, Pasture/Hay 22.9%, Shrublands 11.4%, Grass/Herbaceous 22.4%, Row Crops 14.4%

Climate: Average annual rainfall 33 inches, Average annual temperature January 40°, July 95°

Land Uses: Industry, urban, oil and gas production, cattle, hog and poultry productions, agriculture, crops (sorghum, hay, cotton, wheat and corn)

Water Body Uses: Aquatic life, contact recreation, general use and fish consumption

Soils: Black, waxy soil to sandy soil, limestone to black waxy chocolate and grey loam

Permitted Wastewater Treatment Facilities: Domestic 12, Land Application 0, Industrial 0

Segment 1810 (Plum Creek): Plum Creek begins in northeastern Hays County at about FM 2770 and continues 52 miles to the confluence with the San Marcos River south of Luling in Caldwell County. Plum Creek is typically a shallow, slow moving stream flowing through gently rolling hills lined with agricultural fields and scrub oak trees.

Segment Concerns: The Plum Creek Watershed Protection Plan has been developed and the project has moved into its second phase of implementation. The creek has been moved to Category 4 in the categories for assessment status because of the ongoing implementation projects that could help remove the pollution load and bring the stream into compliance with stream standards for contact recreation. Protecting the environment by managing or limiting wastewater effluents can be a double-edged sword, as seen during the drought of 2011. During the summer of 2011, all of the tributaries above the City of Lockhart were dry. If it were not for the discharges of these facilities, the creek would have gone dry until it reached the springs located in the City of Lockhart.

GBRA and TCEQ have established a continuous water quality monitoring station on this water body. Access to the hourly data can be found at www.tceq.texas.gov/waterquality/monitoring/swqm_realttime.html or www.texaswaterdata.org.



Photo by Janet Thome, GBRA

Middle Guadalupe Watershed, Part A and B

River Segments, Descriptions and Concerns

Drainage Area: 939 square miles

Lakes, Streams and Rivers: Lake Gonzales (H-4), Lake Wood, Guadalupe River below Canyon Dam, Guadalupe River from confluence with the San Marcos River

Aquifers: Carrizo Wilcox

River Segments: 1803, 1804

Cities: Gonzales

Counties: Guadalupe, Gonzales, Lavaca, DeWitt

EcoRegions: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Pasture/Hay 25.5%, Grass/Herbaceous 15.1%, Evergreen Forest 18.0%, Shrublands 12.0%, Deciduous Forest 15.5%, Row Crops 8.1%

Climate: Average annual rainfall 29 inches, Average annual temperature January 35°, July 95°

Land Uses: urban, light manufacturing, heavy manufacturing, farming, cattle ranching, poultry, petroleum production, and gravel mining

Water Body Uses: aquatic life, contact recreation, fish consumption, general, public water supply, hydroelectricity, agricultural and industrial

Soils: Dark, calcareous clay, sandy loam, loam with clay subsoils, dark red sandstone, light tan and gray sandstone

Permitted Wastewater Treatment Facilities: Domestic 7, Land Application 1, Industrial 2

Segment 1812 (Guadalupe River below Canyon Reservoir): The Guadalupe River flows from Canyon Dam to the confluence with the Comal River, is considered one of the finest white-water stretches in the state. Rapids are attributed to the change in elevation as the river cuts through the Balcones Fault Zone. The river is scenic, with limestone bluffs, bald cypress, pecan and elm trees. Trout Unlimited and Texas Parks and Wildlife Department take advantage of cold-water releases from the bottom of Canyon Dam and sponsor the stocking of rainbow trout in the tailrace.

Segment Concerns: Water quality is good. No water quality concerns have been identified by the assessment performed in 2010. Releases from Canyon Reservoir can be anoxic in late summer and early fall but GBRA's hydroelectric plant's stilling basin and weirs aerate the water to above the stream standard for aquatic life use. Stakeholders raised concerns about the impacts from heavy recreational use. Impacts mentioned are nonpoint source pollution loading (bacteria and trash) associated with the number of recreationists using the area during the low flow, summer months. In response to the threat from litter, voters in New Braunfels passed a ban on disposable containers used on the portions of the Guadalupe and Comal rivers that flow through the city.

Segment 1811 (Comal River): The 2½-mile-long Comal River, spring-fed from the Edwards Aquifer through Comal Springs, has no water quality concerns, but has developed large stands of aquatic macrophytes. The clean, clear, fast moving water is a constant temperature all year, and supports a number of endangered species as well as intensive recreational uses. Dry Comal Creek is also included in this segment.

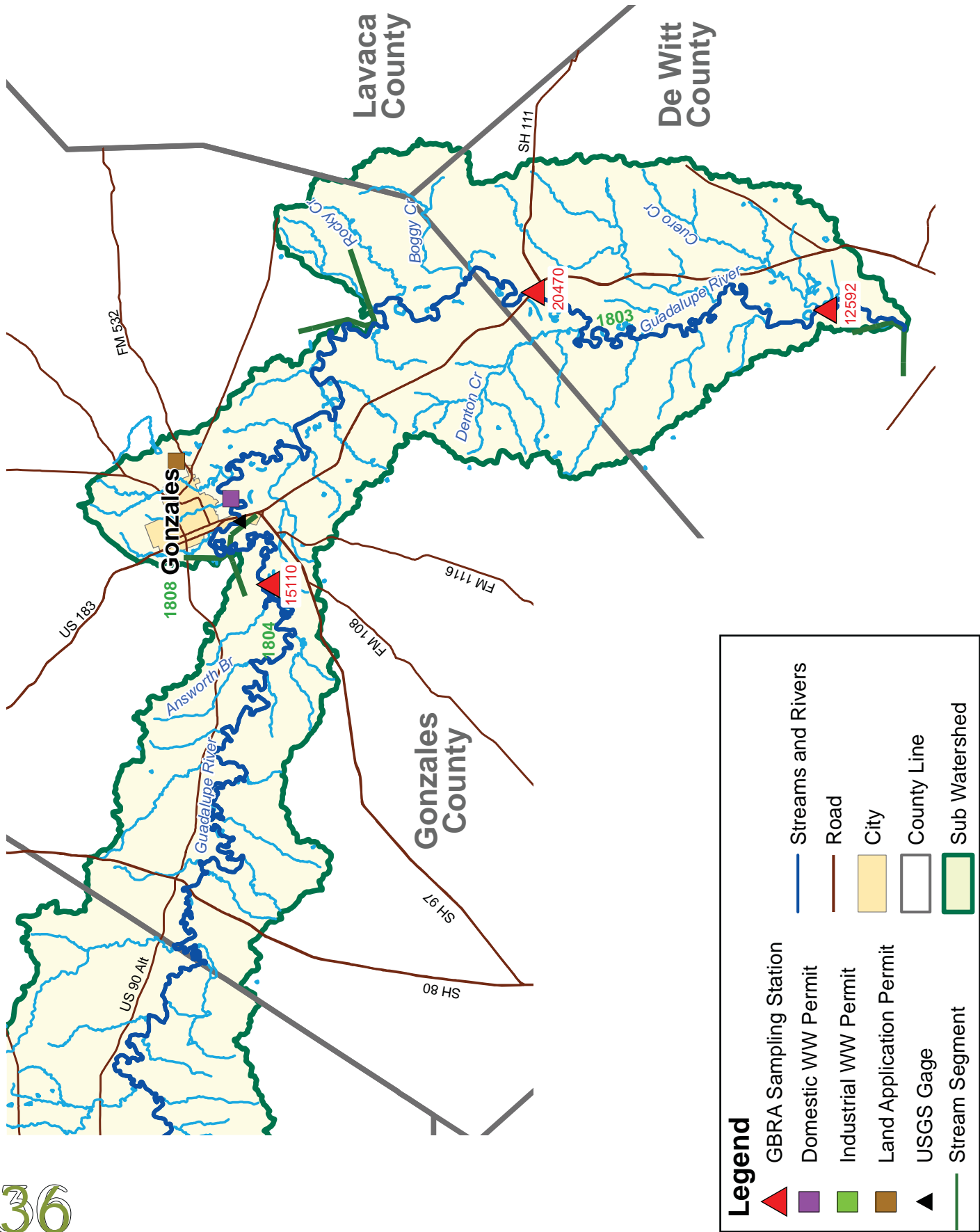
Segment Concerns: No water quality concerns have been identified by the 2010 assessment. Stakeholders raised concerns about impacts from heavy recreational use including nonpoint source pollution loading (bacteria and trash) associated with the number of recreationists using the area during the low flow, summer months. In response to the threat from litter, voters in New Braunfels passed a ban on disposable containers used on portions of the Guadalupe and Comal rivers that flow through the city.

Also of concern to stakeholders in the area are the introduction of non-native invasive species such as hygrophila (an aquatic plant), rams horn snail and loricariids a tropical fish used in aquariums for algae control. Non-native species have very few predators in the watershed and can disturb the balance of species in the aquatic ecosystem.

Bacteria concentrations in the Dry Comal are on the rise and are affecting the water quality of the Comal River. The City of New Braunfels is investigating the source of bacteria in the largely rural watershed of the Dry Comal.

Continued on page 37

Middle Guadalupe Watershed, Part B



Middle Guadalupe Watershed, Part A and B

River Segments, Descriptions and Concerns

Continued from page 35

The spring-fed stream, sometimes referred to as an island ecosystem, is home to a number of endangered species that are dependent upon the constancy of clean springflow for their survival. Springflow is a concern during times of drought. In an effort to protect species dependent on flow from the springs from the Edwards Aquifer, stakeholders of the Edwards Aquifer Recovery Implementation Program have compromised on a scientifically-developed habitat conservation plan (HCP). The minimization and mitigation measures included within the HCP are designed to ensure that incidental take resulting from the covered activities will be minimized and mitigated to the maximum extent practicable and will not appreciably reduce the likelihood of the survival and recovery of covered species associated with the aquifer and Comal and San Marcos springs and rivers ecosystems.

Segment 1804 (Guadalupe River below Comal River): This stretch of the Guadalupe River between the confluence with the Comal River in New Braunfels to the confluence of the San Marcos River in Gonzales is a beautiful flowing river. Seven GBRA hydroelectric facilities utilize the elevation changes, creating small lakes that are widely used for recreation in Guadalupe County. Lake elevations are managed by GBRA. From New Braunfels to below Seguin, the banks of the hydroelectric lakes are lined with private residences, primarily on septic tanks.

Segment Concerns: Geronimo Creek: Beginning in 2009 and continuing through 2011, GBRA partnered with Texas AgriLife Extension on a Texas State Soil and Water Conservation Board CWA Section 319(h) grant to prepare a watershed protection plan for Geronimo Creek and its tributary, Alligator Creek. The creek is impaired for bacteria and concern for elevated nitrate nitrogen. The modeling results have shown that there needs to be a 26 percent reduction in the bacteria load at medium flows in the middle portion of Geronimo Creek in order to meet the state stream standard. Some of the management measures stakeholders will be recommending in the watershed protection plan include pet waste stations in urbanized areas, along with outreach and education focusing on impacts of pet waste; best management practices and workshops, such as water quality management plans and riparian management, for agricultural producers in the rural portions of the county; workshops and distribution of

information for landowners on management and control of feral hogs; and financial assistance to the cities to fund engineering for improvements to storm water collection systems.

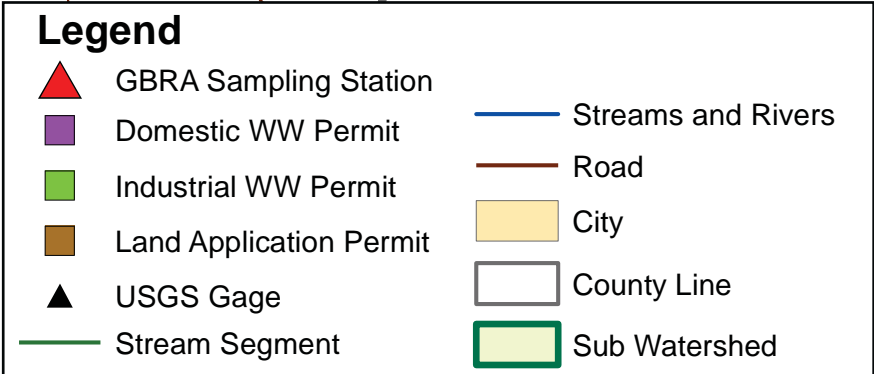
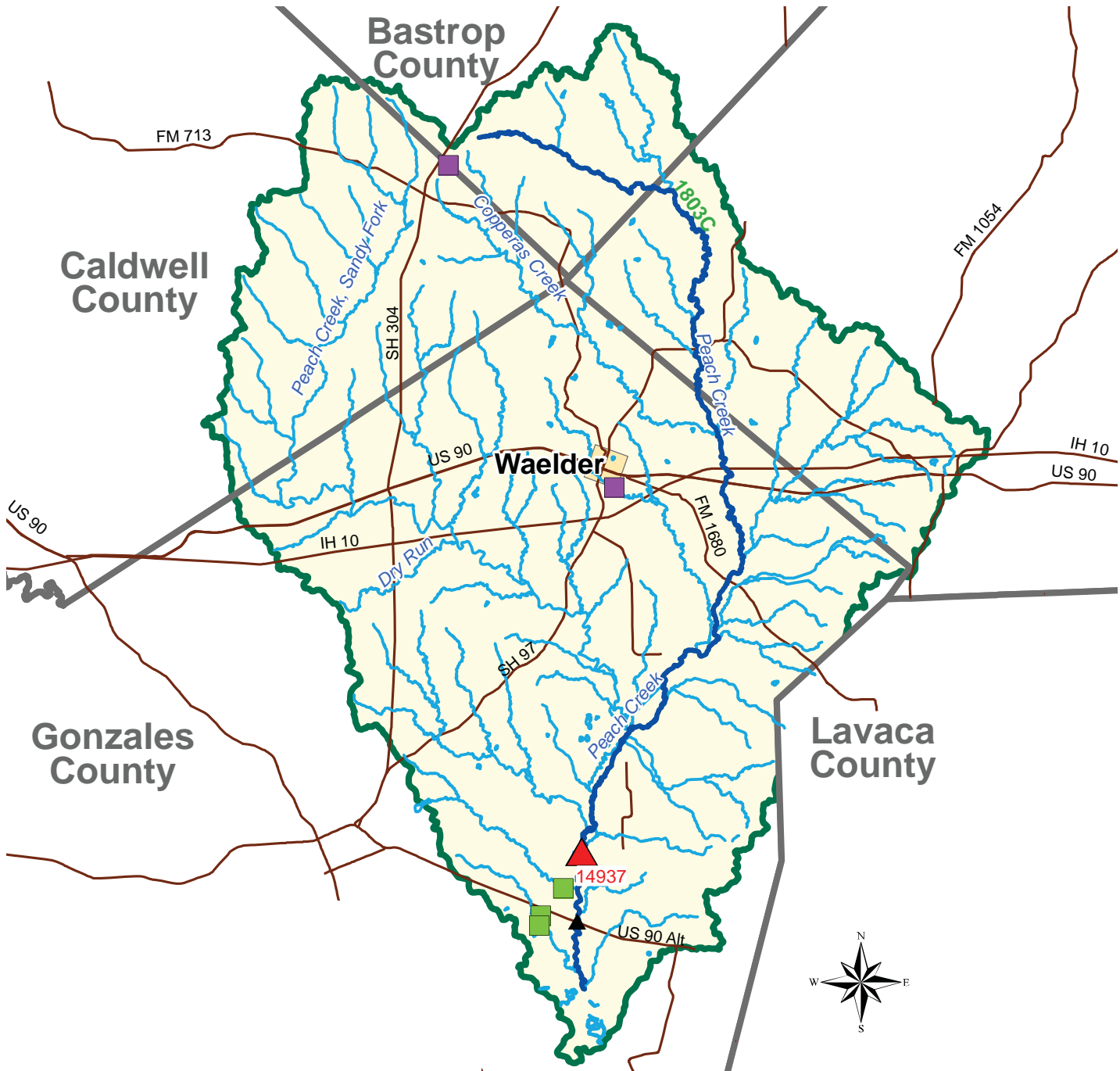
To address the nutrient impairment, GBRA has submitted a proposal for funding an isotope study that will look at the concentrations of nitrate-nitrogen in both the surface and groundwater in the Geronimo Creek watershed. To help direct efforts and funding toward the most likely or most influential source(s) of nitrate, the project will look to isotopic signatures of nitrogen and oxygen in the nitrates. The ratios of the isotopes of nitrogen and oxygen in nitrate often are useful for determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (USGS, 2011). GBRA and TCEQ have established a continuous water quality monitoring station on this water body. Access to the hourly data can be found at www.texaswaterdata.org.

Guadalupe River: Hydroelectric lakes have a history of problems created by non-native invasive aquatic macrophytes, such as hydrilla and waterhyacinth.

Segment 1803 (Guadalupe River below San Marcos River): From the point of the confluence of the San Marcos River, the Guadalupe becomes a much larger, slower moving stream as it flows toward the coast. Elevation changes are minimal.

Segment Concerns: A number of poultry farms and cattle ranches are located in the area. To date, there have been no problems in the main segment associated with these land uses, although subwatersheds have been listed as impaired (1803B Sandies Creek and 1803C Peach Creek). The Eagle Ford Shale Play, in DeWitt and Gonzales counties, has become one of the richest oil and gas deposits in Texas due to exploration technology called hydraulic fracturing or "fracking." Fracking is the process to stimulate wells to recover natural gas and oil by creating fractures extending from a well bore into formations allowing product to travel more easily. Fracking solutions can be made up of a proprietary mixture of organic chemicals, acids and bases. Concern has been raised about the impacts these activities will have on groundwater and surface water quality, the quantity of water needed and the potential for spills and loss of containment of chemicals.

Peach Creek Watershed



Peach Creek Watershed

River Segments, Descriptions and Concerns

Segment 1803C (Peach Creek, unclassified water body): A small system, Peach Creek flows east and south through gently rolling hills for 64 miles from Bastrop and Fayette counties northeast of Waelder into the Guadalupe River in eastern Gonzales County.

Segment Concerns: Segment 1803C (Peach Creek): A Total Maximum Daily Load has been adopted for Peach Creek but to date, no implementation of best management practices have been initiated to help remove the pollutant loads that were identified in the TMDL. Also, as a result of the TMDL, two tributaries of Peach Creek, Denton and Sandy Fork, have joined Peach Creek on the 303d list.

Drainage Area: 480 square miles

Streams and Rivers: Guadalupe River, Peach Creek, Copperas Creek

Aquifers: Carrizo-Wilcox

River Segments: 1803C

Cities: Waelder, Flatonia

Counties: Caldwell, Bastrop, Fayette, Gonzales

EcoRegion: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Shrublands 13.9%, Grass/Herbaceous 23.4%, Deciduous Forest 34.1%, Pasture/Hay 21.1%

Climate: Average annual rainfall 31 inches, Average annual temperature January 39°, July 94°

Land Uses: Recreation, extensive cattle and poultry productions, light industry and agricultural crops

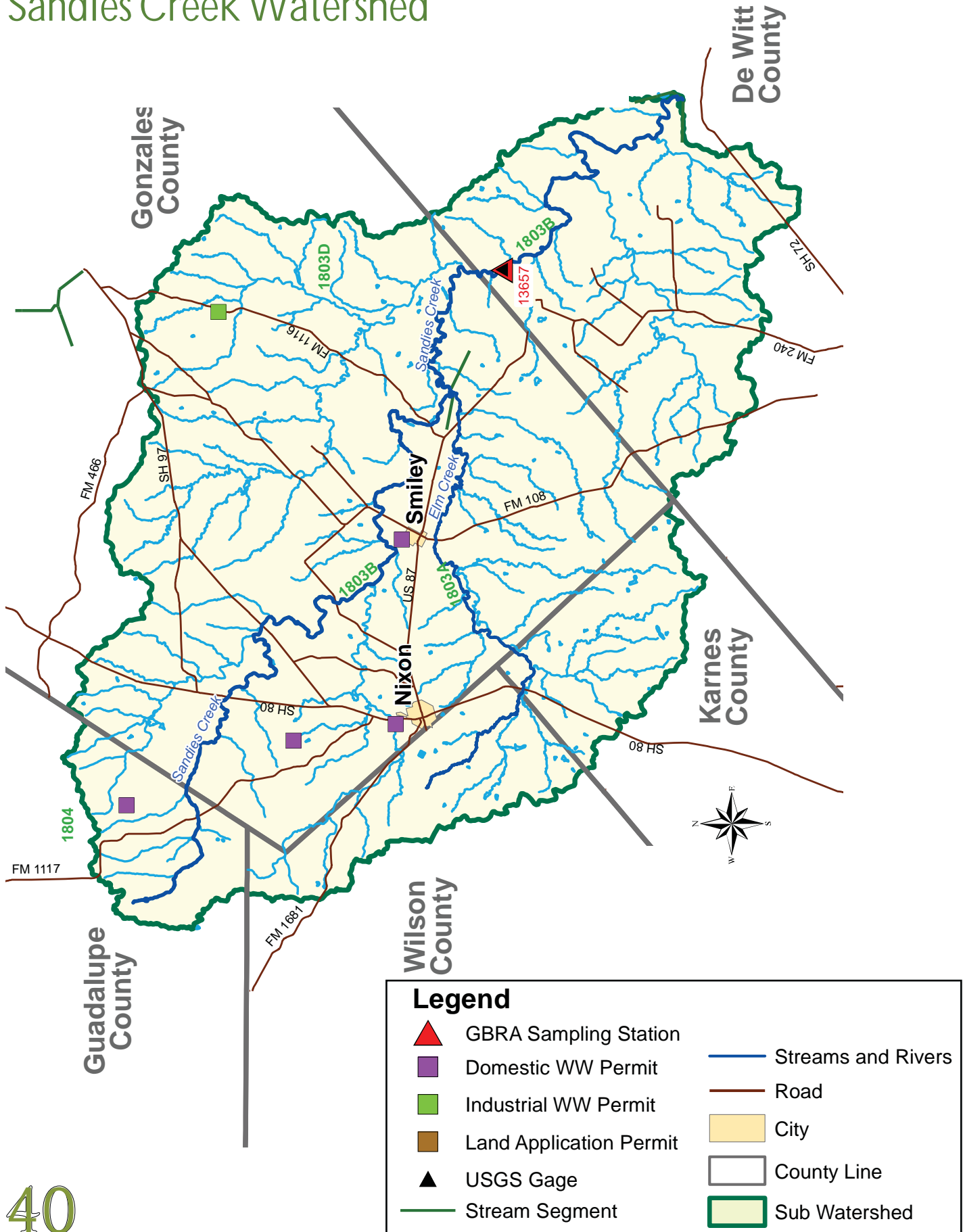
Water Body Uses: Aquatic life, contact recreation, and fish consumption

Soils: Dark red sandstone and tan and grey sandstone

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 0, Industrial 3



Sandies Creek Watershed



Sandies Creek Watershed

River Segments, Descriptions and Concerns

Drainage Area: 711 square miles

Streams and Rivers: Guadalupe River, Elm Creek, Sandies Creek, Five Mile Creek, Salty Creek, Clear Creek, and O'Neil Creek

Aquifers: Carrizo-Wilcox, Gulf Coast

River Segments: 1803A, 1803B

Cities: Smiley, Nixon

Counties: Guadalupe, Karnes, Wilson, Gonzales, DeWitt

EcoRegion: Texas Blackland Prairies, Post Oak Savannah

Vegetation Cover: Pasture/Hay 24.9%, Deciduous Forest 19.6%, Row Crops 3.4%, Grass/Herbaceous 24.3%, Evergreen Forest 5.3%, Shrublands 21.1%

Climate: Average annual rainfall 31 inches, Average annual temperature January 39°, July 94°

Land Uses: Light manufacturing, extensive cattle production and poultry production, agricultural crops (hay, sorghum, etc.)

Water Body Uses: Aquatic life, contact recreation and fish consumption

Soils: Dark red sandstone, light tan and gray sandstone

Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 1

Segment 1803A (Elm Creek, unclassified water body): Elm Creek flows 24.3 miles before it confluences with Sandies Creek, east of Smiley in Gonzales County.

Segment Concerns: In past stream assessments and again in 2010, Elm Creek has been listed on the 303(d) list of impaired water bodies for aquatic life use due to depressed dissolved oxygen. Elm Creek was included in the TMDL study, along with Sandies Creek, but as of 2011, the TMDL has not been adopted.

Segment 1803B (Sandies Creek, unclassified water body): Sandies Creek is a 65 mile long stream originating in Guadalupe County northwest of Nixon to the confluence of the Guadalupe River west of Cuero in DeWitt County.

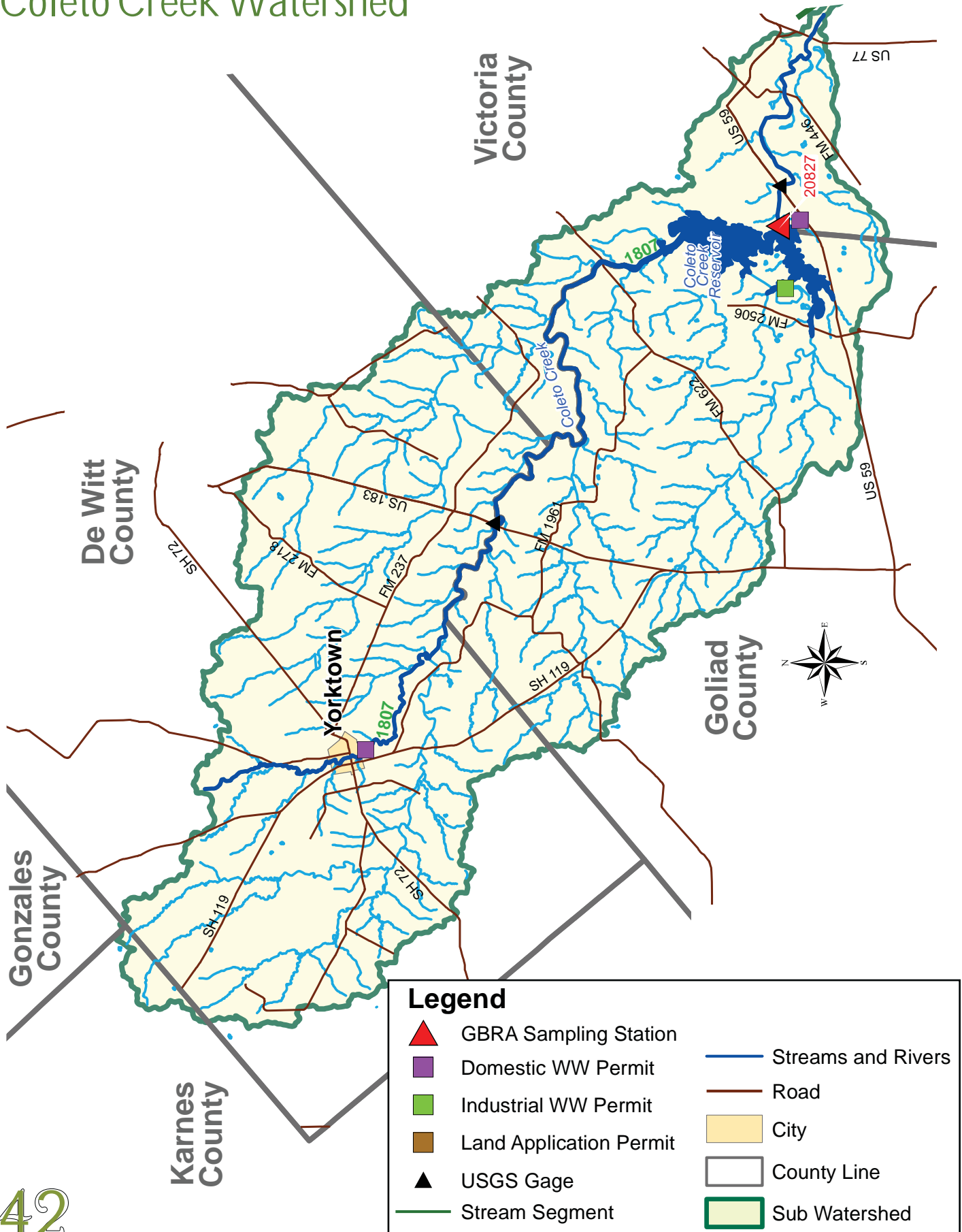
Segment Concerns: Sandies Creek has been listed on the 303(d) list of impaired water bodies for aquatic life use due to depressed dissolved oxygen. Sandies Creek was included in the TMDL study, along with Elm Creek, but as of 2011, the TMDL has not been adopted. The Eagle Ford Shale Play has become one of the richest oil and gas deposits in Texas because of the exploration technology called hydraulic fracturing or "fracking." Fracking is the process to stimulate wells and recover natural gas and oil by creating fractures that extend from a well bore into formations and allow the product to travel more easily. The fracking solution can be made up of a proprietary mixture of organic chemicals, acids and bases. Concerns have been raised about the impacts that these activities will have on groundwater quality, surface water quality, the quantity of water needed and the potential for spills and loss of containment of chemicals.

GBRA and TCEQ have established a continuous water quality monitoring station on this water body. Access to the hourly data can be found at www.tceq.texas.gov/waterquality/monitoring/swqm_realttime.html or www.texaswaterdata.org.



Photo by Janet Thome, GBRA

Coledo Creek Watershed



Coletto Creek Watershed

River Segments, Descriptions and Concerns

Segment 1807 (Coletto Creek): Coletto Creek extends 27 miles beginning in DeWitt County, through Goliad and Victoria Counties, including the 3,100-acre Coletto Creek Reservoir to the confluence with the Guadalupe River in Victoria County. Because of the size of Coletto's drainage basin, this normally slow moving creek can become a fast, flowing river during a typical South Texas rainstorm. Much of the creek bottom is made up of sand with typical vegetation ranging from mesquite and huisache to large live oaks and anaque trees. Because of its rural setting and limited development you can still find a wide range of Texas wildlife along its shores ranging from turkey and deer, to red fox and bobcats. With the completion of the Coletto Creek Reservoir, it now supports over 100 different species of birds with the most noted being the Southern Bald Eagle, Osprey, and Roseate Spoonbills.

Segment Concerns: Coletto Creek Reservoir is used as cooling water by a coal-fired power plant. This use may affect aquatic life (temperature, dissolved oxygen, excessive aquatic macrophytes). Other activities in the watershed that may have an impact water quality include oil field activities, increasing numbers of subdivision developments, land clearing on existing ranches along the creek, and the introduction of non-native aquatic plant species into the Coletto Creek system. Stakeholders remain concerned about the possible impacts from uranium mining.

Drainage Area: 558 square miles

Streams and Rivers: Guadalupe River, Coletto Creek, Perdido Creek, Twelve Mile Creek, Thomas Creek

Aquifer: Gulf Coast

River Segments: 1807

Cities: Yorktown

Counties: DeWitt, Goliad, Victoria

EcoRegion: Texas Blackland Prairies, Gulf Coastal Plains

Vegetation Cover: Pasture/Hay 15.3%, Shrublands 9.7%, Grass/Herbaceous 33.2%, Deciduous Forest 18.7%, Row Crops 5.0%

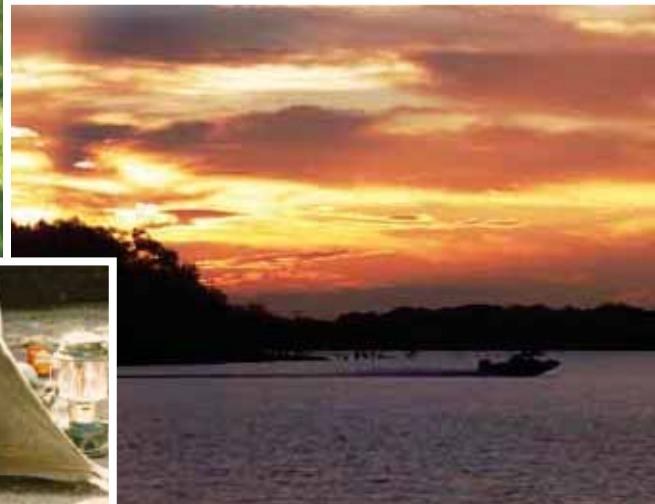
Climate: Average annual rainfall 30 inches, Average annual temperature January 41°, July 95°

Land Uses: Agricultural crops (sorghum, rice, cotton and corn), beef, hogs and poultry productions and oil and gas production

Water Body Uses: Aquatic life, contact recreation, fish consumption, public water supply and power plant cooling

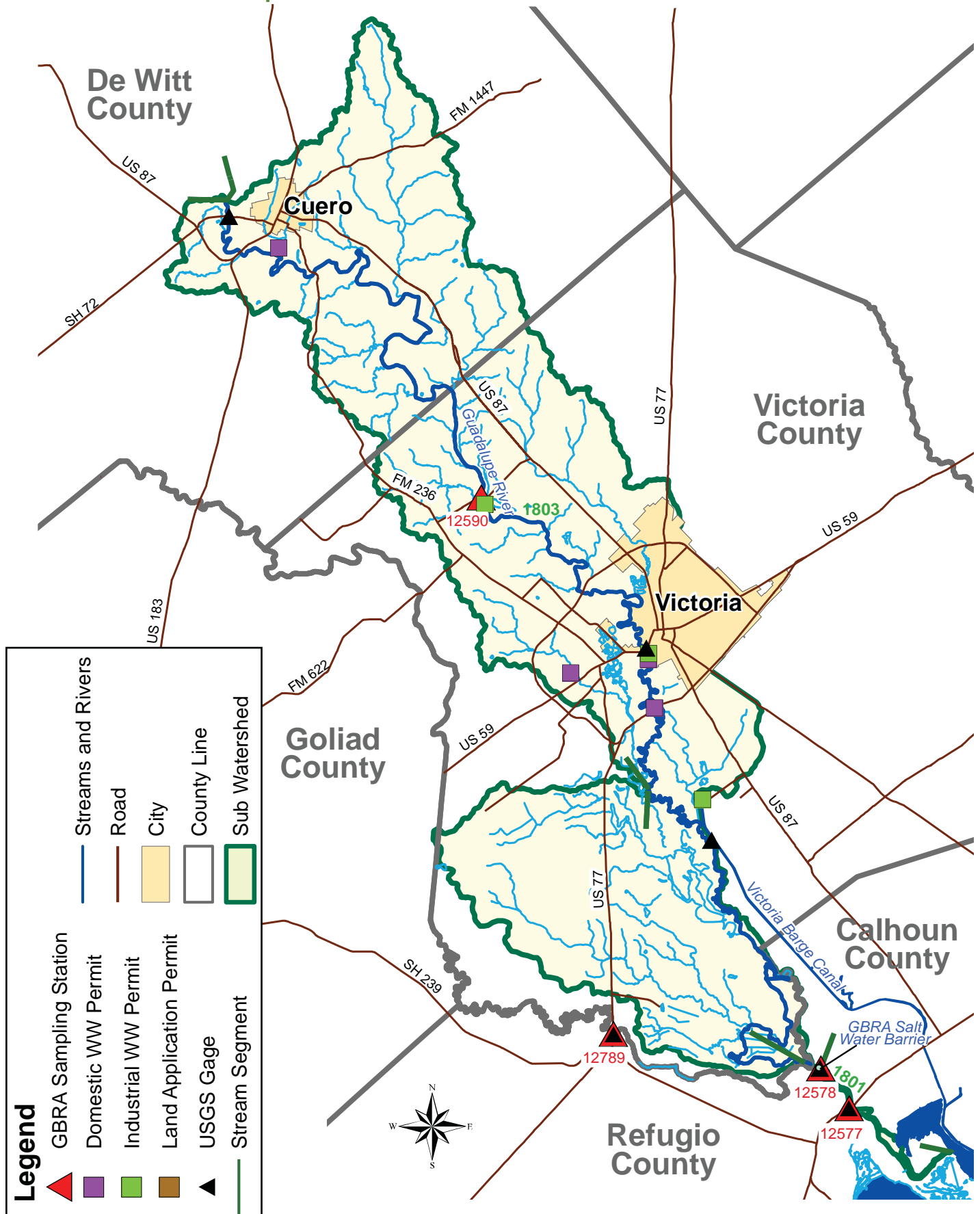
Soils: Sandy, sandy loam and clay loam

Permitted Wastewater Treatment Facilities: Domestic 2, Land Application 0, Industrial 1



Photos by Janet Thome, GBRA

Lower Guadalupe River Watershed



Lower Guadalupe River Watershed

River Segments, Descriptions and Concerns

Drainage Area: 488 square miles

Streams and Rivers: Guadalupe River Tidal, Guadalupe River below San Antonio River, Guadalupe River below San Marcos River, Sandies Creek, Elm Creek, Coletto Creek, Spring Creek, McDonald Bayou

Aquifers: Carrizo-Wilcox, Gulf Coast

River Segments: part of 1803, 1802, 1801, 1701

Cities: Cuero, Victoria, Tivoli

Counties: Calhoun, Refugio, Victoria, DeWitt

EcoRegion: Gulf Coastal Plains, East Central Texas Plains

Vegetation Cover: Pasture/Hay 14.8%, Shrublands 21.1%, Row Crops 4.2%, Grass/Herbaceous 22.6%, Evergreen Forest 5.7%, Wetlands 10.2%, Deciduous Forest 14.8%

Climate: Average annual rainfall 37.4 inches, Average annual temperature January 53°, July 84°

Land Uses: Urban, agricultural crops (cotton, corn, wheat, rice, hay, grain sorghum), cattle and hog productions, industrial (plastics, chemicals, petrochemicals)

Water Body Uses: Aquatic life, contact recreation, general, fish consumption, heavy industrial and public water supply

Soils: Cracking clay subsoil, sandy, sandy and clay loam

Permitted Wastewater Treatment Facilities: Domestic 4, Land Application 0, Industrial 3

Segment 1803 (Guadalupe River below San Marcos River): From the point where the San Marcos River confluences with the Guadalupe River in Gonzales, Segment 1803 becomes a twisting, slow-moving coastal river, lined with pecan bottoms, with no rapids of any consequence. This portion of Segment 1803 begins to the west of the city of Cuero, flowing south to the west of the city of Victoria, to immediately upstream of the confluence with the San Antonio River.

Segment Concerns: Concerns have been raised about the impacts of the oil and gas exploration and production occurring in the Eagle Ford Shale Play.

Segment 1802 (Guadalupe River below San Antonio River): This 0.4-mile long stretch between the confluence of the San Antonio and Guadalupe rivers to the GBRA Salt Water Barrier is a typical slow moving coastal river.

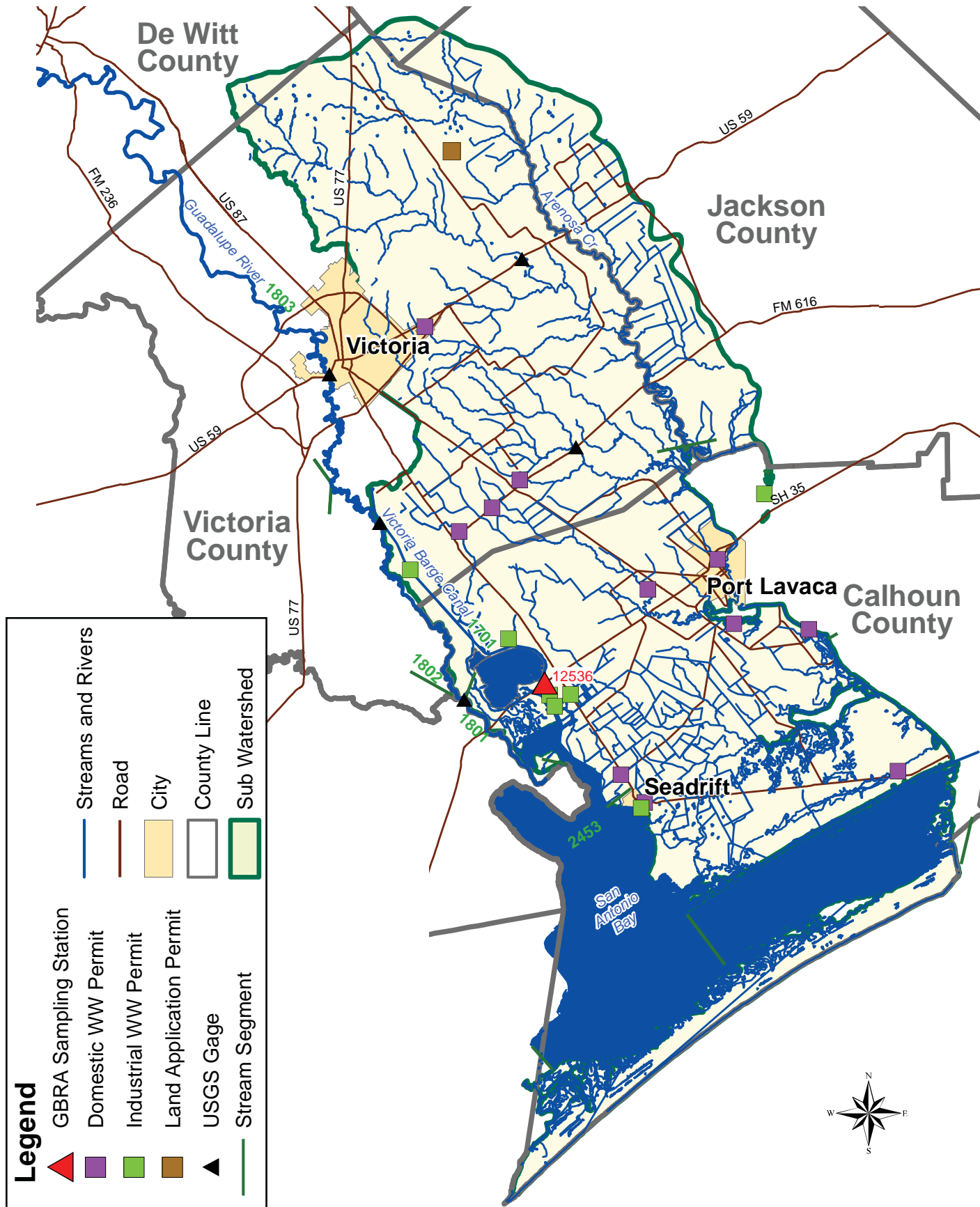
Segment 1801 (Guadalupe River tidal): From the confluence with Guadalupe Bay in Calhoun and Refugio counties to the GBRA Salt Water Barrier (0.4 miles) downstream of the confluence of the San Antonio River in Calhoun and Refugio counties.

Segment Concerns: The area is prone to log jams. Logs traveling downstream catch on bridges, railroad crossings and other obstructions creating restrictions to water flow, changes in the river channel, and producing new ecosystems.

The Senate Bill 3 stakeholder process has recommended instream flows for the Guadalupe and San Antonio rivers and inflows into the bays and estuaries in the lower basin. TCEQ will consider these recommendations when setting the environmental flow requirements for the Guadalupe and San Antonio rivers. The stakeholder process will recommend work plans that prioritize studies that fill data gaps identified in the environmental flow process. Flow recommendations will be reviewed in a recommended amount of time, such as five to 10 years. The studies in the work plans will facilitate adaptive management of the environmental flows of the two rivers.



Lavaca-Guadalupe Coastal Basin



Lavaca-Guadalupe Coastal Basin

River Segments, Descriptions and Concerns

Segment 1701 (Victoria Barge Canal): From the Victoria Turning Basin in Victoria County to the confluence with San Antonio Bay in Calhoun County.

Segment Concerns: The concern for aquatic life use has been removed from this segment after additional 24-hour dissolved oxygen data was collected.

Drainage Area: 998 square miles

Streams and Rivers: Guadalupe River, Garcitas Creek, Victoria Barge Canal, Marcado Creek, Arenosa Creek

Aquifer: Gulf Coast

River Segments: 1701

Cities: Victoria, Seadrift, Bloomington, Inez, Port O'Connor, Port Lavaca

Counties: Calhoun, Victoria, Jackson

EcoRegion: Gulf Coastal Plains

Vegetation Cover: Pasture/Hay 15.1%, Shrublands 16.9%, Row Crops 21.4%, Grass/Herbaceous 13.7%, Deciduous Forest 8.4%, Wetlands 17.2%

Climate: Average annual rainfall 42 inches, Average annual temperature January 44°, July 93°

Land Uses: Agriculture row crops (cotton, corn, rice and grain sorghum), urban, recreation, oil and gas production, cattle, hog and poultry production and industry (plastics, chemicals, petrochemicals)

Water Body Uses: Aquatic life, non-contact recreation, fish consumption and industrial cooling

Soils: Clay subsoils, deep black soil, sandy clay, dark clay loam, clay

Permitted Wastewater Treatment Facilities: Domestic 11, Land Application 1, Industrial 7



Photo by Janet Thome, GBRA



Photo by Debbie Magin, GBRA

2010 303(d) List

The U.S. Environmental Protection Agency (EPA) conducted a complete review of TCEQ's List of Impaired Water Bodies, often referred to as the 303(d) list, dated Sept. 17, 2010. Based on its review, EPA has determined that Texas' 2010 list of water quality limited segments still requiring TMDLs meets the requirements of Section 303(d) of the CWA and EPA's implementing regulations. The segments located in the Guadalupe River Basin that are on the 303(d) are listed below. Also included on the list are

those sites that have water quality concerns. Two sites are in Assessment Category 4. The Guadalupe River above Canyon Lake (Segment 1806) and Plum Creek (Segment 1810) have been moved to Category 4 because even though these segments are still not meeting stream standards for one or more designated use, the segments have ongoing implementation projects that should result in standards attainment in a reasonable length of time.

2010 Texas Water Quality Inventory and 303(d) List (Guadalupe River Basin)

Table 5. (assessed using data collected in 12/1/2001 through 11/30/2008)

Segment Number	Water Body	Impairment or Concern	Category (if assigned)	Year First Listed
1801	Guadalupe River Tidal	Depressed Dissolved Oxygen; Nitrate-Nitrogen	Note 2	2002
1802	Guadalupe River Below San Antonio River	Nitrate-Nitrogen	Note 1	2002
1803A	Elm Creek	Depressed Dissolved Oxygen	5b	1999
1803B	Sandies Creek	Depressed Dissolved Oxygen; Impaired Biological Habitat and Communities; Bacteria	5b and 5c	1999
1803C	Peach Creek	Depressed Dissolved Oxygen; Bacteria; Aluminum; Chlorophyll a	5b and 5c	2002
1803F	Denton Creek (tributary of Peach Creek)	Depressed Dissolved Oxygen; Bacteria	5b	2010
1803G	Sandy Fork (tributary of Peach Creek)	Bacteria	5b	2010
1804A	Geronimo Creek	Bacteria; Nitrate-Nitrogen	5c	2006
1805	Canyon Lake	Mercury in Edible Fish Tissue	5c	2006
1806	Guadalupe River Above Canyon Reservoir	Bacteria	4a	1999
1806A	Camp Meeting Creek	Depressed Dissolved Oxygen	5b	2004
1806D	Quinlan Creek	Bacteria	5a	2010
1806E	Town Creek	Bacteria	5a	2010
1810	Plum Creek	Bacteria; Nitrate-Nitrogen; Total Phosphorus; Ortho-phosphorus; Depressed Dissolved Oxygen	4b	2004
1811A	Dry Comal Creek	Bacteria	5b	2010
1813	Upper Blanco River	Depressed Dissolved Oxygen	Note 1	2006
1814	Upper San Marcos River	Total Dissolved Solids	5c	2010
1815	Cypress Creek	Depressed Dissolved Oxygen; Bacteria	Note 2	2010
1817	North Fork Guadalupe River	Depressed Dissolved Oxygen	Note 2	2006

1 Listing was carried over from a previous assessment due to inadequate data for this method in this assessment.

2 No category assigned if listed for a concern rather than a use impairment.

Descriptions of Water Quality Parameters

Field Parameters are water quality constituents that can be obtained on-site and generally include: dissolved oxygen (DO), conductivity, pH, temperature, stream flow (not in reservoirs), and secchi disc depth (reservoirs only).

Dissolved Oxygen indicates the amount of oxygen available in the stream to support aquatic life. DO can be reduced by the decomposition of organic matter.

Conductivity is a measure of the water body's ability to conduct electricity and indicates the approximate levels of dissolved salts, such as chloride, sulfate and sodium. Elevated concentrations of dissolved salts can impact water as a drinking water source and aquatic habitat.

pH is a measure of the hydrogen ion concentration in an aqueous solution. It is a measure of the acidity or basic property of the water. Chemical and biological processes can be affected by the pH. The pH can be influenced by dissolved constituents, such as carbon dioxide and by point and nonpoint source contributions to the stream.

Temperature of the water affects the ability of the water to hold dissolved oxygen. It also has an impact on the biological functions of aquatic organisms.

Stream Flow is an important parameter affecting water quality. Low flow conditions common in the warm summer months create critical conditions for aquatic organisms. Under these conditions, the stream has a lower assimilative capacity for waste inputs from point and nonpoint sources.

Secchi Disc transparency is a measure of the depth to which light is transmitted through the water column, and thus the depth at which aquatic plants can grow.

Conventional Parameters are typical water quality constituents that require laboratory analysis and generally include: nutrients, chlorophyll a, total suspended solids, turbidity, hardness, chloride, and sulfate.

Nutrients include the various forms of nitrogen and phosphorus. Elevated nutrient concentrations may result in excessive aquatic plant growth and can make a water body unfit for its intended use(s).

Chlorophyll a is a plant pigment whose concentration is an indicator of the amount of algal biomass and growth in the water.

Turbidity is a measure of water clarity or light transmitting properties. Increases in turbidity are caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms.

Total Suspended Solids indicate the amount of particulate matter suspended in the water column.

Hardness is a composite measure of certain ions in water, primarily calcium and magnesium. The hardness of the water is critical due to its effect on the toxicity of certain metals. Typically, higher hardness concentrations in the receiving stream can result in reduced toxicity of heavy metals.

Chloride and Sulfate are major inorganic anions in water and wastewater. Numeric stream standards for chloride and sulfate have been set on all of the classified stream segments in the basin. Both of these inorganic constituents can impact the designated uses and can come from point and nonpoint sources, such as wastewater discharges, oil field activities, and abandoned flowing wells from groundwater with elevated concentrations of dissolved solids.

Other Parameters

Bacteria, specifically *E. coli*, is used as an indicator of the possible presence of disease-causing organisms.

Biological and Habitat assessment includes collection of fish community data, benthic macroinvertebrate (insects) data, and measurement of physical habitat parameters. This information is used to determine whether the stream adequately supports a diverse and desirable biological community. The physical, chemical and biological data are used together to provide an integrated assessment of aquatic life support.

24-Hour DO studies perform measurements of DO in frequent intervals (e.g., one hour) in a 24-hour period. The average and minimum concentrations in the 24-hour period are compared to corresponding criteria. This type of monitoring takes into account the diurnal variation of DO and avoids the bias in samples taken only at certain times of the day.

Metals in Water, such as mercury or lead, typically exist in low concentrations, but can be toxic to aquatic life or human health when certain levels are exceeded. To obtain accurate data at low concentrations, the GBRA uses special clean methods that minimize the chance for sample contamination and provide high quality data.

Organics and Metals in Sediment could be a source of toxicants for the overlying water, though currently there are no numeric sediment standards.

Organics in Water, such as pesticides or fuels, can be toxic to aquatic life or human health when certain levels are exceeded.

Water Quality Monitoring

One of the key roles of the Clean Rivers Program is fostering coordination and cooperation in monitoring efforts. Coordinating monitoring meetings are held annually and are attended by the entities collecting water quality data on the Guadalupe River and its tributaries. By coordinating these efforts and discussing the areas in need of additional monitoring, more data will be collected, maximizing the limited resources available to these entities. Table 6 outlines the types and amounts of water quality monitoring conducted in the Guadalupe River Basin and the Lavaca-Guadalupe Coastal Basin under a TCEQ-approved Quality Assurance Project Plan for September 2010 through August 2011.

In addition to the monitoring programs conducted by the GBRA and the Upper Guadalupe River Authority, the Wimberley Valley Watershed Association and Hays County Developmental Services (beginning in FY2012) are conducting water quality monitoring in the Upper San

Marcos, Lower Blanco and Cypress Creek watersheds. The goals of these programs include establishing baseline water quality data; identifying potential pollution problems; documenting spatial and temporal changes; determining impacts of point and nonpoint source pollution; and assessing compliance with water quality standards. These programs will also provide recommendations for local planning efforts to protect water quality. In addition to laboratory analysis, GBRA provides technical assistance and oversight of the quality assurance aspects of each program. The complete monitoring schedule is available at www.cms.lcra.org.

The sections beginning on page 24 of the 2012 Basin Highlights Report show, by watershed, the distribution of monitoring sites plus activities that may affect water quality, such as major communities and areas with a concentration of poultry, and oil and gas fracking activities.

Table 6. Monitoring parameter and frequencies conducted by monitoring partners in the Guadalupe River Basin in 2011. Hays County Developmental Services began sampling in FY 2012 (September) so its program is not included in the table.

Monitoring parameters in FY 2011 (September 2010 through August 2011)									
Sampling Entity	Field Parameters	Conventional Parameters	Bacteria	Biological and Habitat	24 Hr. Dissolved Oxygen	Metals in Water	Metals in Sediment	Organics in Water	Organics in Sediment
GBRA	19 sites monthly; 6 sites quarterly	19 sites monthly; 6 sites quarterly	19 sites monthly; 6 sites quarterly	2 sites annually	1 site 5 times per year	2 sites annually	1 site annually	2 sites annually	6 sites annually
UGRA	9 sites monthly; 10 sites quarterly	10 sites quarterly	9 sites monthly; 10 sites quarterly	1 site annually			1 site annually		
TCEQ	13 sites quarterly	13 sites quarterly	13 sites quarterly		1 site 2 times a year	2 sites 2 times a year	1 site 2 times a year	1 site twice a year	1 site twice a year
WVWA	7 sites 8 times a year	7 sites 8 times a year	7 sites 8 times a year		1 site annually				
USGS	1 site 3 times a year	1 site 3 times a year		1 site 3 times a year	1 site 3 times a year				
TSSWCB	29 sites quarterly; 2 sites 6 times a year 6 sites 5 times a year 10 sites 2 times a year	29 sites quarterly; 2 sites 6 times a year 6 sites 5 times a year 10 sites 2 times a year	29 sites quarterly; 2 sites 6 times a year 6 sites 5 times a year 10 sites 2 times a year		8 sites 5 times a year				



Guadalupe-Blanco River Authority Education and Outreach

GBRA's award-winning fourth-grade program, *Journey through the Guadalupe*

River Basin maintains a strong presence in schools throughout the river basin. This TEKS-correlated program takes an interdisciplinary approach to the subject of water, placing an emphasis on watersheds and water quality, specific to the Guadalupe River Basin. In addition, the curriculum touches on the water cycle, water uses in the basin, population growth, and water conservation. GBRA continues to offer teacher trainings for this program.

Waters to the Sea, Guadalupe River is a new multi-media middle school program that will be introduced by GBRA during school year 2012-2013. Education staff has been working on development of this new program with the Center for Global Environmental Education (Hamline University, St. Paul Minnesota). This new interactive learning program highlights

relationships between human activities and water resources within the Guadalupe watershed from the river's headwaters to San Antonio Bay. The program addresses Texas science and social studies education standards

through numerous short videos, animations, simulations, and multimedia interactives that draw from the region's rich history. Modules will focus on themes ranging from traditional Native American uses of natural resources, to the importance of water for agriculture, to the impacts of urban growth on surface water runoff, to the importance of

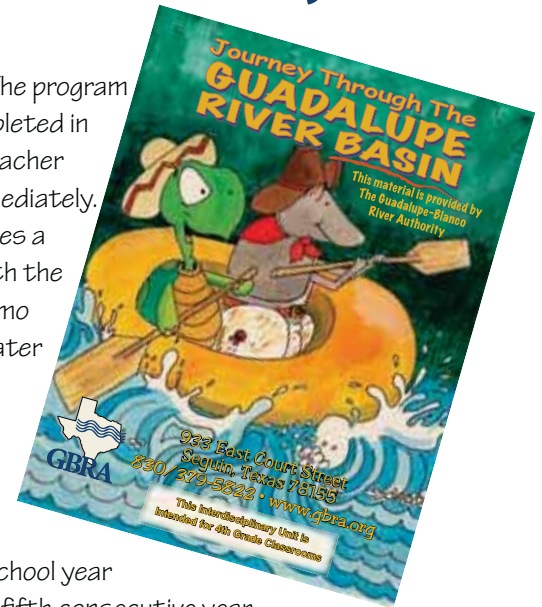


Photo by Janet Thome, GBRA

wetlands at the bay. The program is expected to be completed in summer 2012, and teacher trainings will begin immediately.

Education staff makes a concerted effort in both the Plum Creek and Geronimo Creek watersheds. Water quality education and monitoring are introduced to fourth and fifth grade students in these target watersheds. School year 2010-2011 was the fifth consecutive year GBRA Environmental Education Administrator Cinde Thomas-Jimenez led efforts in nine public elementary schools in the Plum Creek watershed. Working side by side with teachers and students, Jimenez spent two weeks in classrooms presenting information using a tabletop watershed model to discuss watersheds, nonpoint source pollution and the Plum Creek project directly with the students. All needed supplies were donated to the schools including water monitoring test kits, watershed map posters and student workbooks. A total of 1,000 students and 32 teachers conducted two rounds of water quality testing. Using the Texas Stream Team methods as a model for their monitoring, students have tested water from Plum Creek for the following parameters: temperature, dissolved oxygen, pH, turbidity, nitrates, and phosphates (*E. coli* bacteria was also an option). The results of the student monitoring indicate a slight decrease in dissolved oxygen and increases in phosphates and nitrates as the creek moves from the urban area in the northern portion of the watershed to the more rural southern area.

This effort continues in 11 Plum Creek schools during 2011-2012. In spring of 2011, this same model was introduced in Geronimo Creek schools at both the elementary and secondary levels.





Upper Guadalupe River Authority Education and Outreach

As the lead water resource planning agency for the Upper Guadalupe River Basin, UGRA partners with municipal and county governments, communities, civic groups, and citizens to preserve and protect water quality in Kerr County surface waterbodies.

As an active partner in the Texas Clean Rivers Program, UGRA performs routine, quarterly sampling at ten sites in Kerr County. In 2008, UGRA launched the County Wide Goal Based Monitoring Program to increase the number of sites that are monitored routinely in the Upper Guadalupe River so that water quality concerns can be addressed proactively. The program concentrates on the main tributaries to the Guadalupe River and monitors the same parameters as the Clean Rivers Program.

UGRA's Summer Swimmability Program provides information on current water quality conditions. Samples for *E. coli* bacteria analysis are taken at 21 sites on a weekly basis from Memorial Day to Labor Day. The results are compared to state standards for contact recreation and are posted on the UGRA website.

UGRA provides opportunities for citizen stewardship and community involvement in protecting the water resources of Kerr County. A popular activity is the UGRA Volunteer Summer Study. This program is supported by interested members of the community who collect samples for *E. coli* bacteria analysis each summer. The information collected by the volunteers provides important data and helps identify areas in need of further investigation while including the community in water quality monitoring.

Central to these varied water monitoring programs is the nationally accredited UGRA Environmental Laboratory, a full service laboratory serving the entire Hill Country. The Laboratory's analytical services include bacteriological, chemical, and biological testing of drinking water, wastewater, and surface water. The Laboratory is accredited according to the National Environmental Laboratory Accreditation Program and is one of the largest microbiological laboratories in the region.

Preservation & Conservation Efforts

UGRA is committed to the elimination of trash from the river and actively solicits and promotes community involvement in its Trash-Free Initiative. UGRA arranges for and funds routine clean ups at fifteen low water crossings across the county. Nearly 11,500 pounds of trash was removed from these low water crossings in 2011.

Another cornerstone of the Trash-Free Initiative is UGRA's Annual River Clean Up, a county wide event to promote awareness of the importance of the Guadalupe River to the community and its proper stewardship.

In 2011, more than 11,000 pounds of garbage was collected by over 250 participants, working along the river from above Hunt, all the way to Center Point.

UGRA partners with other local entities for hazardous material spill containment and clean up. Absorbent hazmat socks and pillows are provided to area fire departments and the environmental health department to aid them in their efforts to contain and clean up oil and gas spills.

Through the TCEQ Implementation Plan grant, UGRA was able to facilitate the installation of seven pet waste stations in Flat Rock Park along the Guadalupe River

Continued on next page

Continued from page 52

in Kerrville. An effectiveness monitoring program was also initiated and in 2011 over 1,500 pounds of pet waste was collected at these stations.

UGRA promotes landowner practices that have the potential to enhance groundwater and surface water resources. Numerous studies have indicated that brush control, primarily Ashe Juniper removal, can help increase Edwards Plateau Aquifer recharge, enhance springflow, and improve range and pasture land productivity. Financial assistance is available for eligible landowners to aid their brush management efforts; contact UGRA for more information.

UGRA recently launched a rebate program to promote water conservation and watershed stewardship through rainwater harvesting. The Rainwater Catchment System Rebate Pilot Program is available to anyone with a Kerr County address and reimburses eligible applicants up to \$50 when they provide proof of purchase of rainwater catchment system equipment. Purchases made after March 24, 2011 are eligible for the rebate and payment by UGRA is subject to the availability of funds.



Photo by Frank Hedges, UGRA



Photo by Travis Linscomb, UGRA

Public Education to Raise Awareness of the Importance of the Guadalupe River

Part of UGRA's mission is to actively facilitate the understanding of water issues and engage the community in maintaining and promoting the health and enjoyment of the Upper Guadalupe River Basin.

UGRA has an active education program designed to give Kerr County residents a better understanding of the Upper Guadalupe River and its watershed. UGRA staff prepares presentations for area schools, clubs, organizations and summer camps to teach about water quality, conservation, the water cycle, and the importance of the Guadalupe River to the community. UGRA publishes a monthly column in the local newspapers about water quality and the aquatic environment and has an active public awareness campaign to keep the community informed on water issues. The Major Rivers water education program is distributed to 4th and 5th grade teachers in Kerr County to aid their lessons on the water cycle, conservation and Texas water resources through a joint effort by UGRA and Headwaters Groundwater Conservation District.

Above all, UGRA is a resource for the community on water quality, surface water, and the Guadalupe River. Please contact UGRA with comments, questions or concerns at (830) 896-5445 or visit www.ugra.org.

933 East Court Street, Seguin, Texas 78155
830-379-5822
www.gbra.org

Prepared in Cooperation with the Texas Commission
on Environmental Quality under the authorization of
the Clean Rivers Act.

The State of Texas is an Equal Opportunity Employer. It is the policy of the State of Texas
not to discriminate against any employee or applicant for employment because of race, age,
color, religion, sex, national origin, political affiliation, veteran status or disability.

WQ/BHR-2012/Cap-1500



GBRA

Guadalupe-Blanco River Authority
flowing solutions