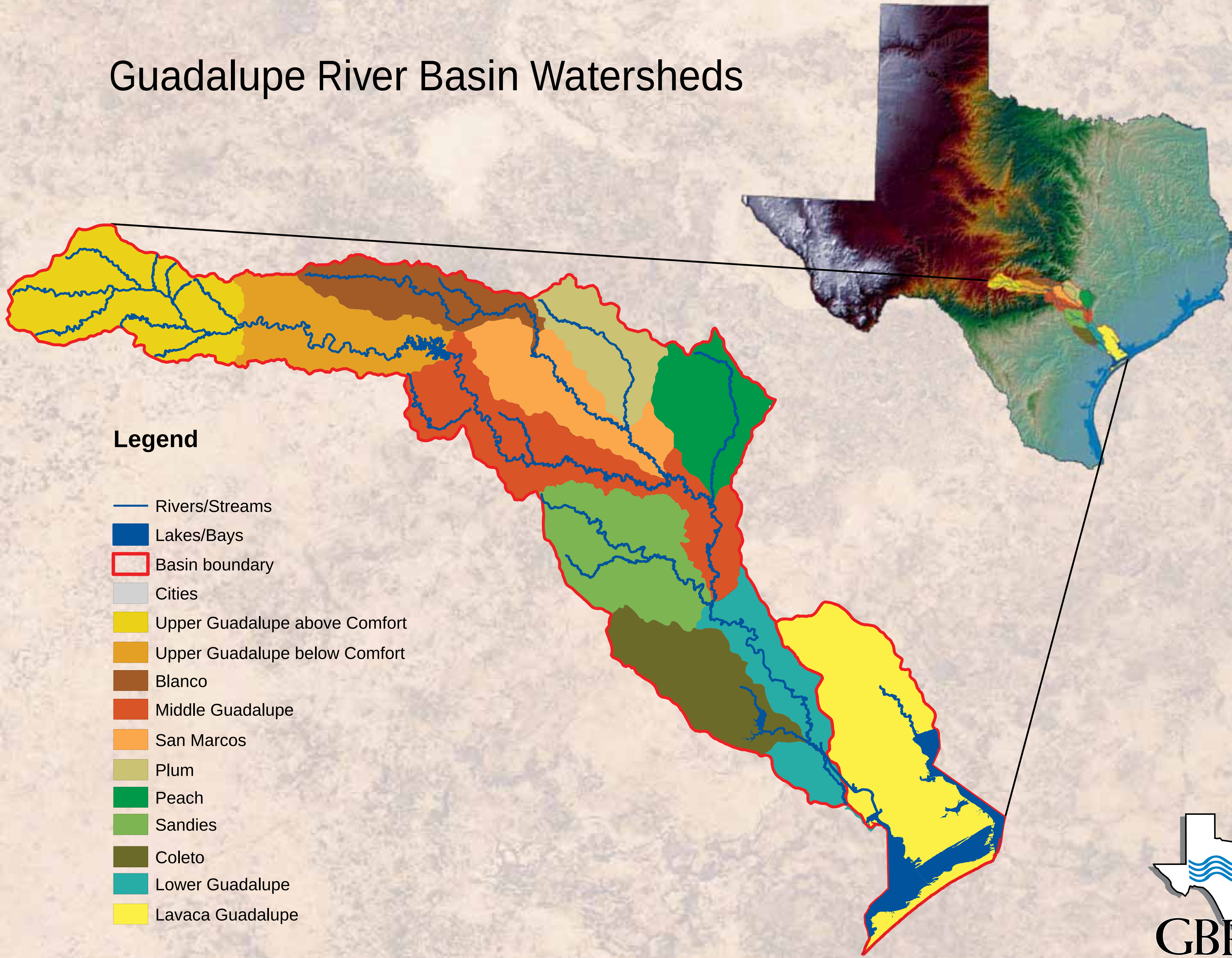
# Guadalupe-Blanco River Authority
# 2008 Basin Summary Report

GBRA

# Guadalupe River Basin Watersheds



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# Introduction

The Basin Summary Report is designed to provide a comprehensive review of water quality data and related information for the Guadalupe River and Lavaca Coastal Basin. The report serves to develop a greater understanding of water quality conditions in the river basin. It also serves to enhance the ability to make decisions regarding water quality issues. The report is compiled every five years. In addition to the water quality data review, the report contains highlights on activities in the Guadalupe River Basin and Lavaca Coastal Basin under the Clean Rivers Program (CRP) and opportunities for the public to have input into the program. The CRP is managed by the Texas Commission on Environmental Quality and funded entirely by fees assessed to wastewater and water rights permit holders. The Guadalupe-Blanco River Authority (GBRA), together with the Upper Guadalupe River Authority (UGRA) carry out the water quality management efforts in these basins under contract with the Texas Commission on Environmental Quality (TCEQ.)

# Executive Summary

The 2008 Basin Summary Report for the Guadalupe River Basin and Lavaca-Guadalupe Coastal Basin summarizes the monitoring and watershed protection activities, and water quality conditions of the watersheds in the respective basins. Historical data was reviewed for possible trends in the data, looking for degrading or improving conditions. The Guadalupe River Basin varies from the steep, limestone hill country that is prone to flash flooding, to the flat, rolling terrain of the lower basin. As a result of the turbulent flows of the upper watershed streams, their substrates are made up of bedrock and large gravel. The streams there are shallow and swift. The lower basin substrates are silty, and the streams carry logs and debris from upstream, to collect in log jams at the lower end of the river. The middle portion of the river basin is made up of waterbodies that are referred to as lakes but are really run-of-river impoundments that in four years out of five respond like rivers with short residence times, rather than true lakes or reservoirs with long residence times and stratification. The Guadalupe basin has two reservoirs, Canyon Lake and Coleto Creek Reservoir. Canyon Lake will stratify in most years, with one "turnover" that occurs in the fall. Coleto Creek Reservoir is used for cooling water for a power plant which creates excellent habitat for aquatic vegetation and fish. The tributaries of the middle and lower Guadalupe River have sandy substrates.

The Guadalupe River Basin is home to several endangered species. The Texas Wild Rice and the fountain darter and other springs and underground cave species are found in the Comal and San Marcos Springs and Rivers. Water quality, quantity and consistency of spring flow are critical to their habitat. The whooping crane that winters in the Aransas Wildlife Refuge, along San Antonio Bay, is making a come back. Freshwater inflows, or the lack of inflows due to diversions of water upstream, impact the habitat and biology of this species that is considered the poster child for protection of endangered species.

The land use of the basin includes hill country ranches primarily used for hunting; farms and ranches, raising row crops, cattle, goats and poultry; and, urbanized areas around the growing cities of Kerrville, Boerne, New Braunfels, Seguin, San Marcos, Lockhart, Luling, Gonzales, Cuero, Victoria, and Port Lavaca. The highest population growth is occurring along the major thoroughfares, US 281, IH 35 and SH 130, located in the central portion of the basin. Most of the industrial facilities are located in the lower basin, near the Victoria Barge Canal and ports along the coast. Recreation is an important "industry" in the upper basin and reservoirs, utilizing the clear water and flows for swimming, tubing, canoeing and fishing. Utilization of the surface water for cooling occurs at power plants in Victoria and Goliad counties.

The watershed segment summaries include discussions on stakeholders concerns. Those concerns may vary somewhat from watershed to watershed, but most have common issues. Stakeholders are concerned about the impact of human activities on water quality, both recreationally and aesthetically. The human activities range from recreational pressure to waste discharges and disposal, or lack thereof, to urban development. Recreational activities produce trash that, if not disposed of properly, floats downstream and becomes a nuisance. The wastewater discharges that exist throughout the river basin range in level of treatment and in permitted volume. The permits are issued to municipalities for domestic waste treatment, to industries for their waste streams, and to power plants that use the surface water for cooling. The level of waste treatment is improving in many of the newly-developing areas, to include nutrient removal. Reuse of wastewater is a beneficial use, turning wastewater into a resource, but an unintended consequence of reuse is the reduction in return flows that can be a factor in water quality and quantity of the river, bay and estuary. Septic tanks that are improperly installed, maintained or are failing can be a source of non-point pollution, contributing bacteria and nutrients to the stream. Additionally, control of illegal dumping at stream crossings is a high priority to stakeholders.

Impacts from urban development are concerns up and down the basin. The impervious cover associated with new houses and roads creates non-point pollution. The pollutants that might be captured and bio-degraded by soils, are readily washed over cement and pavement, directly into the surface water. Additionally, the impervious cover reduces groundwater recharge and in turn, reduces base flow of the streams.

In the Kerrville area, the stakeholders are also concerned about ash juniper and its ability to capture rainwater, reducing the amount of recharge which is critical to the base flow of the river in Kerr County. In Goliad County, the stakeholders are concerned about impacts from oil and gas production, and most recently, the in-situ mining for uranium.

Most sampling locations have been in place for quite a number of years. Monitoring entities include the Texas Commission on Environmental Quality, the Guadalupe Blanco River Authority, the Upper Guadalupe River Authority, the Wimberley Valley Watershed Association and the US Geologic Survey. Results of the New Braunfels Utilities special study on the Guadalupe River below Canyon Reservoir and the Comal River was not reviewed, as the study has not been released for public review. The basin data that was used for trends analyses was long term data. Metals data was limited but, where a sufficient amount was available, in water and in sediment, it was reviewed and reported. At locations that had organics analyses, the data was limited to one to two sampling events and not sufficient to indicate trends.

Water quality in most locations did not appear to be degrading. Most historical data confirmed the impairments or concerns that were listed in the 2008 draft Texas Water Quality Inventory. Camp Meeting Creek in Kerr County is listed as impaired for bacteria and aquatic life use, but in 2004, the city of Kerrville and UGRA partnered to initiate sewer collection for some homes in the area, taking them off failing septic systems. It is too soon to tell definitively that these efforts are making difference. Total suspended solids, turbidity, E. coli and fecal coliform bacteria correlate with flow at most locations throughout the basin when the high flows come as a result of rainfall runoff. When the opposite conditions occur, like the droughts of 1996 and 2006, water quality is also impacted. Base flow can become higher in dissolved solids and effluent-dominated streams will have higher concentrations of nutrients.

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Canyon Reservoir has been listed as impaired due to a fish consumption advisory for mercury in fish tissue of the striped bass and long-nosed gar.

Ammonia nitrogen concentrations are a concern on Plum Creek, especially at the upper site that is downstream of the discharges of the cities of Kyle and Buda and other smaller wastewater plants. The magnitude of the concentrations added to the concern. Sources of the ammonia nitrogen could be the wastewater effluent that dominates the flow at this location, but septic tanks and fertilizer can also be sources. At most of the other locations, when the historical ammonia nitrogen concentrations showed a significant drop in concentration in 2001, it was attributed to the removal of the distillation step from the analytical procedure. After this step was removed the concentrations fell below the screening concentration. Plum Creek is also impaired for contact recreation and a concern for nitrates and phosphorus.

Peach, Sandies and Elm Creeks are in various stages of total maximum daily load (TMDL) development. Peach Creek has been finished and the TMDL is being considered by the TCEQ. It was determined that the impairment was most likely coming from non-point sources, such as failing septic tanks, livestock and wildlife. Sandies and Elm Creeks have completed the majority of the data collection, but models have not been developed that would establish the sources of the impairments or the recommended total maximum daily loads. Stakeholders in these watersheds are concerned about the inappropriate amount of emphasis being placed on the necessity of the stream to meet bacterial standards for contact recreation because of the low potential for exposure to the bacteria by emersion in these small tributaries.

The monitoring sites in the lower Guadalupe watersheds show some improvement in total phosphorus and nitrate nitrogen concentrations. These improvements may be because of improvements made by the city of San Antonio's wastewater treatment system as well as their reuse program.

Overall, the quality of the Guadalupe River and its tributaries are good. The involvement of stakeholders and the ongoing water quality protection efforts in the basin are encouraging.

# Objectives and Goals of the Clean Rivers Program

The Texas Legislature passed the Clean Rivers Act in 1991 which requires water quality assessments for each river basin in Texas. In accordance with the Act, the TCEQ administers the Clean Rivers Program in partnership with river authorities, municipal water authorities, councils of governments and other regional entities. The goal of the program is to maintain and improve water quality within each river basin through these partnerships.

The TCEQ, Guadalupe-Blanco River Authority and the Upper Guadalupe River Authority gather data from the Guadalupe River, its sub-watersheds and coastal basins in a watershed management approach, in order to identify and evaluate water quality issues, establish priorities for corrective action, work to implement those actions, and adapt to changing priorities. Examination of long-term data allows comparison between current and historical water quality data, and statistical analysis can indicate any trends in improvement or deterioration of water quality parameters.

North Fork of the Guadalupe River

# Coordination and Cooperation with Other Entities in the Basin

GBRA and UGRA coordinate with other entities interested in monitoring in the Guadalupe River Basin. Those entities include the TCEQ, United States Geological Survey (USGS), Texas Parks and Wildlife Department (TPWD), Texas State Soil and Water Conservation Board (TSSWCB), the Wimberley Valley Watershed Association (WVWA), and Texas Streams Team ( formerly Texas Watch). Annually, all cooperators monitoring in the basin meet to coordinate their activities. This coordination minimizes duplication, focuses monitoring and resources where needed and helps prevent voids in coverage across the basin.

Two important partners in the river basin are the city of Wimberley and the Wimberley Valley Watershed Association (WVWA). These entities have determined that managing water resources is of paramount importance for the continued health and welfare of the local citizens and economy. Wimberley has helped fund the Blanco River-Cypress Creek Water Quality Monitoring Plan being conducted by the WVWA. The purpose of the Blanco River-Cypress Creek Water Quality Monitoring Plan is to be proactive in protecting Wimberley's water resources. The objectives of monitoring the water quality parameters are to detect and describe spatial and temporal changes, determine impacts of point and nonpoint sources, and assess compliance with established water quality standards for Cypress Creek and Blanco River. The monitoring program is done under the Guadalupe River Basin

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# Coordination and Cooperation with Other Entities in the Basin

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Quality Assurance Project Plan (QAPP). By following the strict quality control guidelines spelled out in the QAPP, the data can be contributed to the TCEQ Surface Water Quality Database for use in assessments.

The Guadalupe River Basin Clean Rivers Program supports Texas Stream Team monitoring groups in the basin. GBRA supplies replacement chemicals and provides training for monitoring and quality assurance to the monitors in the basin. Currently there are groups monitoring Lake Placid, the San Marcos River, Canyon Reservoir, and Plum Creek and its tributary, Clear Fork.

Another example of the role that CRP plays in the basin are the contributions made to the Texas State Soil and Water Conservation Board's (TSSWCB) efforts to produce a watershed protection plan for the Plum Creek watershed. Plum Creek begins in southeast Hays County, north of Kyle. It flows south through Caldwell County, through the community of Lockhart, reaching its confluence with the San Marcos River near Luling. In 1996, GBRA began monitoring the lower portion of the creek as part of the CRP. In 2001, a new sampling location was added in the upper watershed near Uhland in response to stakeholders concerns. The data collected by CRP along with data collected by TCEQ at a monitoring location located in the middle of the watershed, near Lockhart, was used to assess the water quality condition of Plum Creek. According to the 2004 and 2006 Texas Water Quality Inventories, Plum Creek (Segment 1810) is impaired because of elevated bacteria concentrations and exhibits elevated nutrient levels. The TSSWCB and the Texas Cooperative Extension, now Texas AgriLife Extension Service, have been working over the last two years to develop a Watershed Protection Plan (WPP), develop public education and awareness of the water quality concerns in Plum Creek and form a partnership with local stakeholders, state and federal agencies and other governmental entities. The WPP process has led to implementation strategies that are designed to improve and protect water quality. In addition to providing key water quality data for assessment and load allocation modeling, GBRA has represented the Guadalupe River Basin CRP in the Plum Creek Watershed Partnership and Technical Advisory Group. The CRP goals are seen first hand in the Plum Creek watershed. Data collected under CRP identified the water quality impairments; the stakeholders, armed with the knowledge of the impairments, are setting priorities and focusing implementation activities toward improvements in water quality; and, additional funding and assistance from technical resources are finding their way into the watershed.

Plum Creek Watershed Steering Committee

## Summary of Plum Creek Watershed Protection Plan

The Plum Creek Watershed Protection Plan is the result of a stakeholder driven process that provides a foundation for the ecological restoration of Plum Creek and its tributaries. It incorporates an analysis of existing water quality data, with an investigation of potential pollutant sources based on local knowledge and experience. The goal of the plan is to develop recommendations that target management measures where they will have the greatest positive impact on the stream.

The landscape around Plum Creek ranges from rapidly growing urbanized areas in the north to rural agricultural lands near the stream's confluence with the San Marcos River. Potential sources of pollution in the watershed were identified as pet waste in urban runoff, failing septic tanks, contributions of nutrients from wastewater treatment plants, livestock, and wildlife, especially feral hogs. Through scientific analysis, the plan recommends reduction in pollutant loadings by region in the watershed.

Topical work groups identified and recommended management practices for each of their areas of interest. The Urban Stormwater group supported stormwater controls, such as pet waste stations in public access areas. The Wastewater and Industry workgroup agreed to promote the signing of a compact that supports higher level wastewater treatment in the watershed. This group identified the need for an increase in septic tank inspections and repair in the watershed. The Agriculture Group recommended voluntary site-specific water quality management plans on individual farms. These plans include activities, such as prescribed grazing and nutrient management. The Water Quality and Habitat Workgroup recommended close cooperation with the Texas Wildlife Damage Management Service and the creation of a new position that would work with landowners to remove feral hogs by trapping or hunting.

# Overview of the Guadalupe River Basin

The Guadalupe River Basin is located in south central Texas, with the headwaters in southwestern Kerr County. The river is 432 miles long and flows southeastward through a drainage area of 6,061 square miles. The land mass that makes up the basin is divided into two distinct regions by the Balcones Escarpment. The northern region consists of the Edwards Plateau of the Great Plains Province. It is a rough area with rolling hills divided by limestone-walled valleys. The southern region is referred to as the Gulf Coastal Plains area and consists of gently sloping prairie. The basin's principle tributaries are the North and South Fork, Johnson Creek, the Comal River, the Blanco River, the San Marcos River, Geronimo Creek, Plum Creek, Peach Creek, Sandies Creek and Coleto Creek. The springs that feed the Comal and San Marcos Rivers have an average monthly discharge of 308 cubic feet per second and 164 cubic feet per second respectively. The Comal River is more subject to drought conditions and has ceased to flow during the severe drought of the 1950's. The San Marcos River is much more environmentally stable.

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The geology of the area consists primarily of sedimentary material that was deposited during the latter Mesozoic and Cenozoic Eras. The principle geologic structures in the basin are the Balcones and Luling fault zones. The Balcones Fault Zone consists of a series of semi-parallel faults, about 14.9 miles, extending from Hays County southwestward to Bexar County. The Luling Fault Zone extends from Caldwell County to Medina County and is 9.9 to 19.8 miles southeast of the Balcones Fault Zone. The displacement varies from less than three feet to a combined displacement of over 1500 feet. Edwards limestone covers the Edwards Plateau.

The Guadalupe River Basin and Lavaca-Guadalupe Coastal Basin are located within four ecoregions. The delineation of ecoregions is based on geographic conditions that cause or reflect differences in ecosystem patterns. These conditions include geology, physiography, vegetation, climate, soils, land use, wildlife and hydrology. The basin lies within the Edwards Plateau (Ecoregion 30), the Texas Blackland Prairie (Ecoregion 32), East Central Texas Plains (Ecoregion 33), and the Western Gulf Coastal Plain (Ecoregion 34). In the technical section of this report, specific information on the land use, climate, soil, and key factors that impact water quality are described on the sub-watersheds of the basin. The Edwards Plateau is characterized by springfed, perennial streams, and is predominantly rangeland. The Texas Blackland Prairie has timber along the streams, including oaks, pecan, cedar elm and mesquite. In its native state, it was largely a grassy plain, but most of the area has been cultivated and only small areas of meadowland remain. The East Central Texas Plains is characterized by subtropical dryland vegetation made up of small trees, shrubs, cacti, weeds and grasses. Principal plants include mesquite, live oak, post oak, blackbrush acacia, and huisache. Long-continued grazing has contributed to the dense cover of brush. According to the South Central Texas Regional Water Plan, the Gulf Prairies and Marshes of the Western Gulf Coastal Plain are divided into two subunits: 1) marsh and salt grasses at the tidewater, and 2) bluestems and tall grasses more inland. Oaks, elm and other hardwood grow along

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# Overview of the Guadalupe River Basin

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the streams. The area is abundant with fertile farmland.

The climate of the region is mild and normal temperatures seldom fall below 32ºF in the winter. The basin averages 32 inches of rainfall per year, with the minimum occurring in the winter and maximum in the late spring and early fall. The cool season begins in November and extends through March. According to the USGS Water Resources Data from Water Year 2006, the annual average runoff in the northern part of the river basin is 166,200 acre-feet per year, 1,535,000 acre-feet per year in the middle portion and 1,433,000 acre-feet per year in the lower basin. These discharge volumes represent the amount of water reaching the stream, in the form of runoff, annually at the cities of Comfort, Gonzales and Victoria respectively. The region is subject to wide swings in weather and rainfall patterns. The northern part of the basin is known for flash floods, with the lower portion under the threat of tropical storms and hurricanes from mid-June through the end of October. The region has experienced several prolonged droughts including 2006. In comparison to the annual average, the annual runoff at the three locations described above were 56,000, 429,100 and 475,000 acre-feet respectively.

**Table 1. Physical characteristics of run-of-river impoundments in the Guadalupe River Basin.**

| Impoundment | Volume (acre-ft) | Surface Area (acres) | Mean Depth (feet) | Elevation (feet msl) | Median Flow (cfs) | Median Residence Time (days) |
|---|---|---|---|---|---|---|
| UGRA Lake | 840 | 105 | 8.0 | 1621 | 91 | 4.65 |
| Flat Rock Lake | 793 | 104 | 7.6 | 1564 | 91 | 4.39 |
| Lake Dunlap | 5,900 | 410 | 14.4 | 575.2 | 583 | 5.10 |
| Lake McQueeney | 5,050 | 400 | 12.6 | 528.7 | 583 | 4.37 |
| Lake Placid | 2,624 | 248 | 10.6 | 497.5 | 583 | 2.27 |
| Meadow Lake | 1,460 | 144 | 10.1 | 457.6 | 583 | 1.3 |
| Lake Gonzales | 4,620 | 495 | 9.4 | 332 | 583 | 3.3 |
| Lake Wood | 4,000 | 488 | 8.2 | 290.9 | 583 | 3.46 |

The mainstream impoundments include UGRA Lake, Flat Rock Lake, Canyon Reservoir, Lake Dunlap, Lake McQueeney, Lake Placid, Meadow Lake, Lake Gonzales, Lake Wood, and Coleto Creek Reservoir. Canyon Reservoir, built in the 1960's, is the largest impoundment in the river basin and has 8,230 surface acres. It is a multipurpose reservoir designed to serve flood control and water supply functions. It is also used for recreation. UGRA Lake, Flat Rock Lake, Lakes Dunlap, McQueeney, Placid, Meadow, Gonzales and Wood are run-of-river impoundments, used for water supply and hydroelectric power generation. The physical characteristics of the run-of-river impoundments are given in Table 1.

As populations in the basin grow, the potential for associated anthropogenic impacts increase. Along with urbanization comes increases in impervious cover, larger volumes of wastewater discharged to the stream and greater demands on water supplies, reducing the baseflow of the stream. The population of the basin was estimated to be 474,828 in 2000, with the heaviest concentrations in Victoria, Comal, Hays and Guadalupe Counties. The fastest

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# *Overview* of the Guadalupe River Basin

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growing counties in the region are located in the Guadalupe River Basin: Hays, Guadalupe, Kendall and Caldwell Counties. These counties are experiencing explosive growth, as the populations of the cities of San Antonio and Austin spill over into these communities. Table 2 gives the populations of the major cities in the basin as of 2000 and their projected populations through the year 2030. Table 3 gives the same population data by county.

**Table 2. Populations, current and projected through 2030, for major cities located in Guadalupe River Basin.**

| City (county) | 2000 | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| Lockhart (Caldwell) | 12639 | 15274 | 17872 | 19841 |
| Luling (Caldwell) | 5894 | 7269 | 8645 | 10021 |
| Port Lavaca (Calhoun) | 12054 | 12822 | 13784 | 14810 |
| New Braunfels (Comal) | 38404 | 50207 | 65417 | 83486 |
| Cuero (Dewitt) | 7170 | 7485 | 7869 | 8261 |
| Gonzales (Gonzales) | 7039 | 7432 | 7725 | 7798 |
| Seguin (Guadalupe) | 23031 | 28069 | 34216 | 41302 |
| San Marcos (Hays) | 37604 | 49787 | 65172 | 85476 |
| Boerne (Kendall) | 6459 | 9607 | 10438 | 13444 |
| Kerrville (Kerr) | 20768 | 23431 | 26112 | 27387 |
| Refugio (Refugio) | 3330 | 3562 | 3717 | 3742 |
| Victoria (Victoria) | 61305 | 67537 | 73496 | 79222 |

**Table 3. Populations, current and projected through 2030, for counties in Guadalupe River Basin.**

| County | 2000 | 2010 | 2020 | 2030 |
|---|---|---|---|---|
| Caldwell | 39023 | 46976 | 54590 | 60314 |
| Calhoun | 21941 | 23864 | 26027 | 28245 |
| Comal | 78801 | 104232 | 139403 | 181545 |
| Dewitt | 20242 | 21206 | 22367 | 23579 |
| Gonzales | 17817 | 18647 | 19305 | 19405 |
| Guadalupe | 59700 | 80495 | 107527 | 140313 |
| Hays | 80474 | 106378 | 132110 | 163586 |
| Kendall | 22847 | 33612 | 47873 | 64750 |
| Kerr | 43653 | 49250 | 54886 | 57565 |
| Refugio | 8421 | 8844 | 9110 | 9081 |
| Victoria | 81909 | 89539 | 96977 | 104205 |

Agriculture, in the form of crop and livestock production, is the primary industry in the basin with the manufacture of steel, gravel, plastics and chemicals contributing to the economy of the basin as well. Oil and gas production can be found in all counties except Comal and Hays counties. Population projections in the lower end of the basin may prove to be low. The area may experience more growth than was expected due to the increased interest by residential developers in Refugio and Calhoun counties and the possible construction of a nuclear power plant in that area.

# Summary of Water Quality Characteristics

The water quality of the Guadalupe River is highly influenced by the ground water that makes up its baseflow. The largest contribution to the baseflow is the Edwards Aquifer, with additional volume from the Cow Creek, Trinity, Leona, Carrizo, and Gulf Coast Aquifers. Each aquifer is unique in its water quality, discharge points and volume. The headwaters of the Guadalupe are located in Kerr County, and originate from springs in the North and South Forks. The discharge of the Edwards Aquifer at the Comal Springs and San Marcos Springs form two small, crystal clear lakes, that support aquatic vegetation and wildlife, including the fountain darter and Texas Wild Rice, two endangered species. Springs that come from the Leona formation, which is high in nitrate-nitrogen, are thought to be, in part, the source of the nutrient concern and dissolved solids in Plum and Geronimo Creek.

The Guadalupe River flows through Kerr and Kendall counties and into Canyon Reservoir, the largest reservoir in the basin, located in Comal County. Canyon Lake impounds water for water supply, flood control, and recreation. The water exits the reservoir through a bottom penstock and is used for hydroelectric generation. A more complete description of the releases from the reservoir is given in the technical section. In most years, the lake stratifies in the late summer months and, after the first strong cold front of the winter, usually in October, the lake will experience a lake “turnover”. During times of lake stratification, the bottom release from the reservoir is low in temperature and dissolved oxygen. The water is aerated as it leaves either the hydroelectric plant or penstock. The cold water conditions of Canyon Reservoir’s bottom release have been utilized by TPWD and Trout Unlimited for a put and take trout sport fishery.

Downstream of Canyon Reservoir, the Guadalupe River flows over bedrock substrate and through swift water runs. The river is shallow, with few pools until it nears the city of New Braunfels, where it confluences with the Comal River and enters the first of six hydroelectric impoundments. The flow through the impoundments is diverted through turbines to generate hydroelectric power. A description of the operation of the hydroelectric lakes is given in the technical

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# Summary of Water Quality Characteristics

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section. These impoundments are nutrient-rich, with nitrogen and phosphorus contributions from wastewater discharges and organic sediments. The impoundments exhibit the water quality conditions of a flowing stream in years of high flow. In years of medium to high flows, the impoundments have low chlorophyll concentrations and no stratification. In years of low flow conditions, the impoundments provide the residence time needed for the assimilation of nutrients that promote higher chlorophyll production. Also, during periods of low flow, the impoundments exhibit weak temporal stratification. Historically, these impoundments have been subject to infestations of non-native aquatic vegetation and algal blooms.

*Fountain Darter*

From Kerr County to Refugio County, the Guadalupe River receives treated wastewater discharges. The cities of Kerrville, Boerne, Buda, New Braunfels, Kyle, San Marcos, Lockhart, Luling, Seguin, Gonzales, Cuero, and Victoria, along with other small wastewater treatment plants, discharge treated wastewater, most of which provide up to secondary treatment. In several locations, the Guadalupe River or one of its tributaries is used for cooling water. In the upper part of the watershed, a power plant diverts flow from the Guadalupe River to mix with treated wastewater and use as cooling water. This is a zero discharge facility and no water is returned to the stream. Near the city of Victoria, a portion of the flow in the Guadalupe River is diverted to serve as once-through cooling water for a power plant and then returned to the stream. The Coleto Creek Reservoir also serves as cooling water for the power plant located in Goliad County. In these last two locations, the water is returned warmer than the receiving stream. Coleto Creek Reservoir was designed to hold the water long enough to dissipate the heat. The warm water conditions are conducive for the growth of aquatic vegetation. The volume and temperature of the release from the power plant near Victoria is regulated by a discharge permit that is protective of the receiving stream.

At the lower end of the basin, the Guadalupe River confluences with the San Antonio River. The Guadalupe River Diversion Canal and Fabridam are located below the confluence with the San Antonio River. The fabridam is made up of two large inflatable bags that are used to prevent salt water intrusion from the bay during times of low river flows. The canal system diverts fresh water for irrigation and municipal water supply.

# *Overview* of the Technical Summary

The technical summary section provides a review of the water quality conditions in the Guadalupe River Basin. Also included in this section, is a discussion of the latest biennial assessment of the surface water quality done by TCEQ. In an evaluation of the water quality data, stations and parameters for which the data met sample number and sampling duration criteria, were examined statistically to identify and verify trends. Also considered in the evaluation of the data were the results of biological analyses if available, land uses, soils and vegetation, and point source discharges. The factors at play in each sub-watershed are considered in order to identify and prioritize concerns or impairments and their most probable causes, recommend future monitoring activities, implementation of control or remediation actions, public outreach, or other appropriate measures. The origin of the data and the analytic procedures used to evaluate the data are explained in the following section, Technical Process. The Watershed Summaries section provides an overview of existing data, a discussion on the water quality concerns identified during the screening process and an assessment of the trends seen in the water quality data.

> A watershed is the total area drained by a particular stream.

The screening and assessment of water quality conditions in this Basin Summary Report is organized by watershed, segment and station. A watershed is the total area drained by a particular stream. The Guadalupe River basin is broken into 12 watersheds for this report. For assessment and trend analysis, the watersheds were broken down further into sub-watersheds and then further by segment. Segments are contiguous reaches that exhibit similar physical, chemical or biological characteristics and which an uniform set of standards applies. Most segments have one monitoring location. But in those cases where there are multiple sampling locations, the data sets were combined to observe differences within the segment, and/or to strengthen the analyses by increasing the number of data points used in the assessment. If two or more sites within one segment were statistically different for any water quality data type, the data was not combined for more than a comparison between sites and the difference was noted.

For evaluation of trends over time, water quality data available from the TCEQ's Surface Water Quality Monitoring Information System was divided by station and then by parameter. For a given station and parameter the number of data points used in the initial trend analyses was at least 20 points over the historical period, with at least three measurements per year, in five or more years. The data sets that met the data criteria were compared over time to observe any trends. If a trend was observed the data was further evaluated using statistical tools in Excel. Linear regressions were performed to confirm the significance of the trend. Additionally, a graph and narrative were created to explain any significant trends.

When looking for potential changes in water quality conditions, water quality parameters are compared over time. The statistical comparisons and graphs of these comparisons can show if there are overall upward or downward trends at a location or in a segment. The graphed data can be represented with or without a line that connects the data points. The line may make it easier to see seasonal patterns in the water quality data. It should be recognized that if the data points are connected by a line in time comparisons, the line between the points does not represent the true conditions of the stream between the times that the data was actually collected.

# Water Quality Monitoring

The Guadalupe-Blanco River Authority and the Upper Guadalupe River Authority have been monitoring under the Clean Rivers Program since 1996. Prior to the partnership with TCEQ in the CRP, both entities had routine monitoring programs. Other entities contributing data to the historical database include the Wimberley Valley Watershed Association, the Texas Commission on Environmental Quality's Surface Water Quality Monitoring and Total Maximum Daily Load projects divisions, and USGS.

Table 4 is the summary of water quality sampling currently being performed in the basin. The sections in this report are divided by sub-watershed or segment and will discuss the historical trends observed in the data review and factors that may be impacting water quality within each sub-watershed.

The Texas State Soil and Water Conservation Board has funded a water quality monitoring study on Plum Creek in support of the development of a watershed protection plan. Originally, the plan was to be developed using only historical data collected by the Clean Rivers Program and the TCEQ's Surface Water Quality Monitoring program. However, the steering committee and technical advisory group recommended additional monitoring be conducted to fill in data gaps which would facilitate the identification of the impairment and establish water quality goals. Using the existing monitoring of the three sites on Plum Creek by TCEQ and GBRA's CRP as match, TSSWCB has funded additional monitoring in the watershed. GBRA, under an EPA-approved QAPP, will be performing routine and targeted monitoring, and monitoring of springs and stormwater within the watershed. The data will be submitted to the TCEQ for inclusion in the biennial assessments. The schedule for the 15-month project is included in Table 4.

Table 4. Summary of Water Quality Sampling in the Guadalupe River Basin. DO = Dissolved Oxygen.

| FY 2008 (September 2007 through August 2008) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Sampling Entity** | **Field** | **Conventional** | **Bacteria** | **Biological and Habitat** | **24 Hr DO** | **Metals in Water** | **Metals in Sediment** | **Organics in Water** | **Organics in Sediment** |
| **GBRA** | 19 sites monthly; 1 site bimonthly; 6 sites quarterly | 19 sites monthly; 1 site bimonthly; 6 sites quarterly | 19 sites monthly; 1 site bimonthly; 6 sites quarterly | 4 sites annually | | 2 sites annually; 1 site quarterly (radiolog -icals) | 2 sites annually | 1 site annually | 1 site annually |
| **UGRA (Kerr Co.)** | 10 sites quarterly | 10 sites quarterly | 10 sites quarterly | 2 sites annually | | | 1 site annually | | 1 site annually |
| **TCEQ** | 17 sites quarterly | 17 sites quarterly | 17 sites quarterly | | 2 sites quarterly | 1 site semi-annually | Three sites semi-annually | | |
| **WVWA** | 7 sites 8 times per year | 7 sites 8 times per year | 7 sites 8 times per year | | 1 site annually | | | | |
| **TSSWCB** | 5 sites monthly; 1 site 2 times per quarter; 35 sites targeted for wet and dry weather quarterly; 1 site quarterly for stormwater; 5 wastewater effluents quarterly; 3 springs quarterly | 5 sites monthly; 1 site 2 times per quarter; 35 sites targeted for wet and dry weather quarterly; 1 site quarterly for stormwater; 5 wastewater effluents quarterly; 3 springs quarterly | 5 sites monthly; 1 site 2 times per quarter; 35 sites targeted for wet and dry weather quarterly; 1 site quarterly for stormwater; 5 wastewater effluents quarterly; 3 springs quarterly | | 8 sites monthly during index period | | | | |

# DESCRIPTIONS OF WATER QUALITY PARAMETERS

***FIELD PARAMETERS*** are those 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 and respiration of aquatic life.
***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 in the stream. Elevated concentrations of dissolved salts can impact the water as a drinking water source and as suitable 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. 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.
***Total Suspended Solids*** indicate the amount of particulate matter suspended in the water column.
***Turbidity*** is a measure of the 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.
***Hardness*** is a composite measure of certain ions in the 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.
***Bacteria,*** specifically the *E. coli* bacteria, 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 Hr 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.

The monitoring program described is done under the 2008-09 Quality Assurance Project Plan (QAPP) for the Surface Water Quality Monitoring Project for the Guadalupe River Basin. The QAPP is used to plan, organize and define the quality assurance process for the program. Quality assurance is the integrated system of management activities that ensures that data generated is of the type and quality needed for its uses. Those uses include planning, assessment and water quality management. Elements of the program that are controlled by the QAPP include measurement performance specifications, appropriate methods, field and laboratory quality control, data management, and verification and validation of the data. Additionally, oversight of the laboratory quality system and process of corrective actions are described in the QAPP. The current QAPP is available for review on the GBRA CRP webpage.

Implementation of the National Environmental Laboratory Accreditation Program (NELAP) in Texas, has had an impact on CRP as environmental laboratories, such as the GBRA Regional Laboratory and the UGRA Environmental Laboratory, must complete the accreditation process by July 1, 2008. The purpose of the program is to foster the generation of environmental data of known and documented quality through an open, inclusive, and transparent process that is responsive to the needs of the professional and regulatory communities.

# DESCRIPTION OF WATER QUALITY ASSESSMENT PROCESS

In compliance with sections 305(b) and 303(d) of the Federal Clean Water Act, the TCEQ evaluates water bodies in the state and identifies those that do not meet the uses and criteria defined in the Texas Surface Water Quality Standards. EPA has established guidance that directs TCEQ to document and submit the assessment results to EPA biennially, in even numbered years. The report describes the status of water quality in all surface water bodies in the state that were evaluated for the assessment period. The data used in the assessment comes from various sources, including the Guadalupe River Basin CRP partners, TCEQ's Surface Water Quality Monitoring program and other contributors. Given the regulatory implications associated with the use of the water quality data, the data used in the assessment process must have been collected using consistent and scientifically rigorous sampling and laboratory methods. The quality of the water described in the assessment report is a snapshot of conditions during the specific time period considered in the assessment. The draft 2008 Inventory covers the most recent seven years. TCEQ's assessment process has been developed by TCEQ staff through a stakeholder process. River authorities and CRP partners are invited to participate in the development and review of the assessment guidance.

Analysis of samples of E. coli, indicator bacteria for contact recreation standard

Water quality standards are comprised of two parts, designated uses and the associated criteria for stream conditions necessary to support that use. The uses of a water body include aquatic life use, providing a suitable environment for fish and other aquatic organisms; and contact recreation use, providing water that is safe to swimming and other recreational activities. The criteria for each use may be described numerically or expressed in terms of desirable conditions. Uses and criteria are assigned to a segment. A segment is a water body or a portion of a water body with a specific location, defined dimensions, and designated or presumed uses. If the criterion of a segment are not met, then the segment is designated as impaired. If nonattainment of the criterion is imminent, then the segment is designated as threatened. If there is insufficient data to determine if the standard is attained, but what data is available points to a concern, the segment have a secondary concern.

# Categorizing Water Bodies

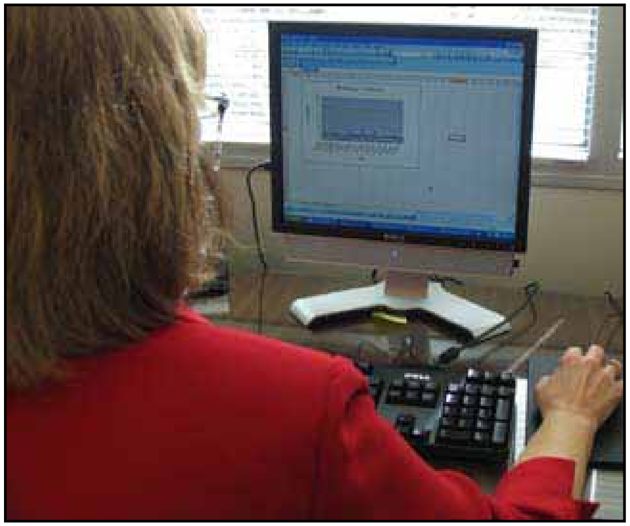
EPA guidance requires that all water bodies be placed in one of five categories after assessment. The categories indicate the status of the water quality of the water body. One of the five categories is assigned to each impairment parameter in each segment that affects the use of the water body as defined by the surface water quality standards. A segment may fall into more than one category. When that occurs, the highest category is assigned as its overall category. Table 5 lists the categories as described in the 2008 *Guidance for Assessing and Reporting Surface Water Quality in Texas,* December 2007.

Table 5. Categories used in stream assessment process.

| Category | Description |
|---|---|
| Category 1 | Attaining all water quality standards and no use is threatened. |
| Category 2 | Attaining some water quality standards and no use is threatened; and/or insufficient data and information available to determine if the remaining uses are attained or threatened. |
| Category 3 | Insufficient data and information are available to determine if any water quality standard is attained. |
| Category 4 | Water quality standard is not supported or is threatened for one or more designated uses but does not require the development of a total maximum daily load (TMDL). |
| Category 4a | TMDL has been completed and approved by EPA. |
| Category 4b | Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. |
| Category 4c | Nonsupport of the water quality standard is not caused by a pollutant. |
| Category 5 | The water body does not meet applicable water quality standards or is threatened for one or more designated uses by one or more pollutants. |
| Category 5a | A TMDL is underway, scheduled, or will be scheduled. |
| Category 5b | A review of the water quality standards for the water body will be conducted before a TMDL is scheduled. |
| Category 5c | Additional data and information will be collected before a TMDL is scheduled. |

# Data Review Methodology

Overall, the quality of the Guadalupe River Basin is good. According to the draft 2008 Texas Water Quality Inventory and 303(d) List of Impaired Water bodies, 5 waterbodies were found to be *Impaired* (Table 6). 7 waterbodies were found to have a *Concern* for nutrient concentrations. The water quality is assessed according to guidance established through a stakeholder process. After assessments are completed, water bodies are designated as impaired if the stream exceeds the numeric stream standard or as a concern if the conditions exceed the screening levels established by the assessment team.



## *Table 6. Summary of water quality impairments or concerns from draft 2008 Texas Water Quality Inventory and 303(d) List of Impaired Water Bodies.*

| Segment Number | Area | Parameter of Impairment | Parameter of Concern | Category |
|---|---|---|---|---|
| 1801 | Guadalupe River Tidal | | Nitrate-Nitrogen | |
| 1803A | Elm Creek (entire water body) | DO[1], Bacteria | | 5a and 5c |
| 1803B | Sandies Creek (from the confluence with Elm Creek to upper end of water body) | DO | | 5a |
| 1803B | Sandies Creek (from the confluence with Guadalupe River to the confluence with Elm Creek) | DO, Bacteria | | 5a |
| 1803C | Peach Creek (lower 25 miles) | Bacteria | | 5a |
| 1803C | Peach Creek (from 1.2 miles downstream of FM 1680 in Gonzales County to confluence with Elm Creek in Fayette County) | DO, Bacteria | | 5a and 5c |
| 1804C | Geronimo Creek (entire water body) | Bacteria | Nitrate-Nitrogen | 5c |
| 1805 | Canyon Lake (entire water body) | Mercury in fish tissue | | 5c |
| **1805[2]** | **Canyon Lake (upper end of segment)** | | **Nitrate-Nitrogen, Ortho-phosphate** | |
| **1805** | **Canyon Lake (north end Crane's Mill Park peninsula to south end Canyon Park)** | | **Ortho-phosphate** | |
| **1805** | **Canyon Lake (lower end from dam to Canyon Park)** | | **Ortho-phosphate** | |
| 1806 | Guadalupe River above Canyon Lake (from1 mile upstream of Flat Rock Dam to the confluence with Camp Meeting Creek) | Bacteria | | 4a |
| 1806 | Guadalupe River above Canyon Lake (from 25 miles upstream of the lower end to confluence with Big Joshua Creek) | Bacteria | | 4a |
| 1806A | Camp Meeting Creek (entire water body) | DO | | 5b |
| **1810** | **Plum Creek (from approximately 0.5 miles upstream of SH 21 to upper end of segment)** | **Bacteria** | **DO, Total phosphorus** | **5c** |
| 1810 | Plum Creek (from approximately 2.5 miles upstream of confluence with Clear Fork Plum Creek to approximately 0.5 miles upstream of SH 21) | | Total phosphorus, Ortho phosphate, Ammonia-Nitrogen | |
| **1810** | **Plum Creek (confluence with San Marcos River to approximately 2.5 miles upstream of confluence with Clear Fork Plum Creek)** | **Bacteria** | | **5c** |
| **1810** | **Plum Creek (entire water body)** | | **Nitrate-Nitrogen** | |
| 1813 | Upper Blanco River (from Hays CR 1492 to Blanco CR 406) | | DO | |
| 1815 | Cypress Creek (lower 7 miles of segment | | DO | |
| 1817 | North Fork Guadalupe River (entire water body) | | DO | |

[1] Dissolved Oxygen. If DO is listed as a concern then the mean concentration exceeded the screening level for a grab sample.
[2] Bolded text is new listing in the draft 2008 inventory.

Canyon Reservoir

Plum Creek at CR 135

# Index of Biotic Integrity

The index of biotic integrity (IBI) has been developed in order to assess the health of a biological system, like a stream, river or lake. Assessments are done at selected stream locations, collecting data on fish and invertebrate populations and the condition of the stream and riparian habitat. The data is then put into metrics that result in a score that describes the quality of the stream to support aquatic life. The IBI consists of these metrics, or criteria, that reflect fish species richness and composition, number and abundance of indicator invertebrate species, trophic organization and function, reproductive behavior, and the types and availability of habitat. Each metric is scored based on a range of conditions. The score for each element of the biotic index will fall into one of four ranges: limited, intermediate, high and exceptional. Together the combined indices will determine if the stream is meeting its designated uses for aquatic life support. Biological and habitat assessment must be conducted during the critical period that runs from July 1 to September 30.

Sites on the stream are selected to represent conditions of the entire water body. The “reach” of the stream that is assessed should have a variety of habitats such as a run, a pool, glide and a riffle, and should not be impacted by a tributary or discharge within the reach. During a biological assessment, measurements are taken to assess the availability and types of habitat at each site. Measurements include stream width and depth, bank slope, stream type, instream cover, substrate type, percent erosion and the natural buffer and vegetation along the stream bank. The metrics used to assess habitat quality compare the availability of different types of habitat, bank and substrate stability and changes and impacts of flow.

To assess the benthic quality of a stream, benthic organisms are collected using a kick net sampling method. In this method, an area of substrate is disturbed for five minutes with a net positioned downstream to capture the organisms that are carried to the net by the current. Snags, or submerged woody debris that is exposed to the current, are sampled by cutting a portion of the debris and collecting the invertebrates in a sieve. The invertebrates are separated by type of feeding method (gatherers, predators, and collectors), as well as into intolerant and tolerant species. The number of invertebrate species, along with the ratio of the different invertebrate types found at each site, are put into the benthic metrics to determine the benthic index.

To assess the ability of a stream to support fish, depending on the applicability of the method to the location, fish are collected using seining and electroshocking methods. The fish that are collected during the assessment are separated by species categories, method of feeding, natives and non-natives, and those with diseases and anomalies.

GBRA performed biological and habitat assessments on only three sites in 2007. In this year, the Guadalupe River Basin experienced flooding and prolonged high flows through the majority of the index period (March through October). The high flows created atypical conditions in the streams in Kerr County and Caldwell County, preventing the collection of biological samples at the four other sites that were scheduled for biological assessments.

The biological assessment conducted on Peach Creek in Gonzales County in 2007 showed that the creek met its designated use for aquatic life support. The IBI for nekton (aquatic organisms that live in the water column and swim independent of the current such as fish) was intermediate, which would lend support to the concern for dissolved oxygen concentrations that was indicated in the TCEQ 2006 Texas Water Quality Inventory. The IBI for habitat and the IBI for benthic organisms (aquatic organisms that live on the river or lake substrate) scored high, indicating that the habitat was sufficient to support a healthy invertebrate population. The site had experience flooding during the week of July 5-12, where the daily flow averaged 1050 cubic

Continued to page 17

## Stream Habitats

*Run - Dry Comal Creek*

*Pool - Peach Creek*

*Riffle - Cypress Creek*

*Glide - Cypress Creek*

Continued from page 16

feet per second (compared to an average daily flow of 170 cfs). The biological assessment was conducted on September 26, giving the stream enough time to recover and reestablish benthic populations that would have been impacted by the scour of high stream flows. In 2006, Peach Creek had limited scores for nekton and benthic communities. The nekton community scored in the limited range in both years because of the small number of actual individuals caught. The benthic community improved considerably in 2007, going from 9 taxa in 2006 to 25 taxa in 2007. The taxa that were collected in 2007 contained a greater number of sensitive species which indicates less disturbance from physiochemical factors. 2006 was a very dry year. During 2006 the average daily flow at Peach Creek was 6.78 cfs. Peach Creek demonstrates that prolonged periods of low flow can be more detrimental to the benthic community than periods of high flows and flooding conditions. Additionally in 2007, the site was slightly altered because of construction along the bank. Large rocks from the construction ended up in the stream and created additional habitat, where previously, only a sandy substrate was available to the invertebrate community. A greater variety of habitat may have led to the greater number of taxa collected.

*Inundation and erosion from recent flooding at Peach Creek at CR 353*

The biological assessment conducted on the Dry Comal Creek, located in the city of New Braunfels, showed the stream met its designated use for aquatic life support. The creek scored in the intermediate range for the IBI for nekton, and in the high range for both benthic and habitat IBIs. This site was impacted in the mid-summer by high flows, but the invertebrate populations had recovered by the September sampling event. Dry Comal Creek is an urban stream, receiving nonpoint source runoff from streets and lawns. Comparing the 2006 and 2007 assessments, the benthic populations improved considerably in 2007, with all indicators showing that conditions had improved in the stream between years. The number of different invertebrates found in Dry Comal went from 7 taxa in 2006 to 21 taxa in 2007. A factor contributing to the improved health of the creek may be flow, due to the availability of more wetted habitat during periods of normal and high flows.

*Dry Comal Creek, urban stream located in the city of New Braunfels*

The biological assessment conducted on the Cypress Creek, a tributary of the Blanco River that flows through Wimberley, showed the stream met its designated use for aquatic life support. The nekton IBI dropped from high to intermediate in 2007. The benthic IBI improved from limited to high in 2006. Sixteen taxa were collected in 2007 as compared to 3 in 2006. An indicator of the level of impact from physiochemical factors showed an improvement in 2007. This improvement can be attributed to more flow in 2007.

*Cypress Creek in the City of Wimberley*

The last assessments conducted on the two Kerr County sites were in 2006. The site on the Guadalupe River at Ingram, upstream of the city of Kerrville, scored in the high range for all three IBIs. The site on the Guadalupe River at Riverview Road, just downstream of the city of Kerrville, scored in the high range for nekton and habitat IBI but in the intermediate range for the benthic IBI. 2006 was a very difficult year for the benthic community. The flow was very low for the majority of the year with only an occasional pulse of high flow. Kerr County is known for flash floods, but these high flows only last for short periods of time.

GBRA conducted biological and habitat assessments on the two Plum Creek sites in 2006, but not in 2007 due to prolonged flooding conditions during the summer. The Plum Creek at Plum Creek Road site in the upper portion of the watershed did not meet its designated uses for aquatic life support. The nekton IBI score was intermediate; the habitat IBI was in the high range; and the benthic IBI was limited. On the day that the assessment was conducted in August 2006, the dissolved oxygen concentration was 3.03 milligrams per liter (mg/L), below the minimum dissolved oxygen standard of 5.0 mg/L for the stream. The site experienced wide swings in flow in the summer months of 2006. A flood event occurred in May where flows reached 119 cfs (average flow 49.3 cfs), but then the area returned to drought conditions. During 2006 the average flow at the USGS gage at Lockhart was 2.04 cfs, with a period of zero flow measured in mid-July. However, the nekton IBI score could have been impacted by the method that was used to collect the fish sample. The water at this site has elevated total dissolved solids. The backpack electroshocker that GBRA uses to collect fish may not be as efficient at stunning fish at the elevated dissolved solids. A boat-mounted electroshocker with a stronger battery may be more efficient at retrieving fish at the higher dissolved solids.

The biological and habitat assessment was performed on the site on the middle portion of Plum Creek (Plum Creek at CR 202) in 2006. The assessment for 2007 was not completed due to high flow conditions. In 2006, the biological assessment showed that the stream in this location did not support its designated use for aquatic life support. The nekton and habitat IBI scored in the intermediate range and the benthic IBI was limited. As at the other locations in 2006, flow impacted the quality of the habitat which may have resulted in poorer populations of invertebrates and fish. This site may also be impacted by the large amount of illegal dumping of tires, appliances and dead animal carcasses.

*Illegal dumping in Plum Creek at CR 202*

# Metals in Water

The TCEQ includes metals in the assessment of water bodies in Texas. GBRA has been analyzing water samples, at selected locations, for metals concentrations, since 1999. Table 7 lists the data collected to date, along with the acute and chronic concentrations, and where available, the human health concentrations that have been established by EPA. EPA compiles national recommended water quality criteria for the protection of aquatic life and human health in surface water. The acute concentration is an estimate of the highest concentration of a metal in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect (lethality). The chronic concentration listed is an estimate of the concentration of a metal in surface water to which an aquatic community can be exposed over an extended period of time without resulting in an unacceptable effect. Those effects would include sub-lethal effects such as growth impairment and reduced reproductive success. The human health criteria is given if there is an established limit. EPA bases the human health criteria on a carcinogenicity risk of $10^{-6}$, which means there would be fewer than one case of cancer in a population of one million due to the exposure to the metal.

For evaluation of acute metals toxicity, individual measurements are compared to the acute criteria. The acute criteria has statistical safeguards and safety factors incorporated into them. This means a moderate number of exceedances of the acute criteria does not necessarily constitute an ecological disruption. The EPA-approved, Texas Surface Water Quality Standards do not suggest that a single measured exceedance of an acute toxic criterion be considered a violation of the standards. For evaluation of chronic toxicity, the average of the historical data for each metal at the site is compared against the chronic criteria. If the average exceeds the chronic criterion, the use is not supported at that site.

Table 7 also gives the hardness concentrations at each site, both the median concentration and the concentration at the 15th percentile, given in milligrams per liter as calcium carbonate. The toxicity of certain metals is dependent on the hardness of the surface water. Those metals criteria that are hardness dependent include cadmium, chromium, copper, nickel, lead, and zinc. For this reason, the criteria values are specific to each site. Because the hardness is relatively high at most of the monitoring locations, the acute and chronic toxicity criteria are high and well above the measured historical average concentration. The one exception to this is the site on Peach Creek, located in Gonzales County. The hardness concentration at the 15th percentile is 39 milligrams per liter for Peach Creek, as compared to the average of the other sites, which is 221 milligrams per liter. When this concentration is applied to establish the acute and chronic criteria for Peach Creek, the criteria is considerably lower than the other locations. Also of note at the Peach Creek site, the highest average concentrations of aluminum, arsenic, chromium, nickel and zinc in the entire basin are found at this location. Currently, Peach Creek does not exceed either standard, but the site warrants continued monitoring in the coming years. As far as possible sources of the elevated metals, there are four point source discharges in the watershed, three small domestic wastewater treatment plants and one industrial discharge. No other possible sources of heavy metals is known or suspected.

GBRA has monitored for selenium at two sites on Geronimo Creek since 1999. A review of the historical metals concentrations at these sites show that while the sites do not exceed the acute and chronic criteria, the concentration for total selenium is consistently the highest of any site monitored in the basin (average concentration of 2.15 micrograms per liter compared to an average concentration of 0.32 micrograms per liter at the other 8 sites). No source of the total selenium is known. The land use in the Geronimo Creek watershed, above the monitoring location, is primarily agricultural. There are no point source discharges to the stream, upstream of the monitoring location.

## Acronyms and Abbreviations

***CRP*** = Clean River Program
***GBRA*** = Guadalupe-Blanco River Authority
***UGRA*** = Upper Guadalupe River Authority
***TCEQ*** = Texas Commission on Environmental Quality
***USGS*** = United States Geologic Survey
***TPWD*** = Texas Parks and Wildlife Department
***TSSWCB*** = Texas State Soil and Water Conservation Board
***WVWA*** = Wimberley Valley Watershed Association
***VOW*** = City of Wimberley
***EPA*** = Environmental Protection Agency
***QAPP*** = Quality Assurance Project Plan
***WPP*** = Watershed Protection Plan
***cfs*** = cubic feet per second
***msl*** = mean sea level
***DO*** = dissolved oxygen
***NELAP*** = National Environmental Laboratory Accreditation Program
***TMDL*** = total maximum daily load
***E. coli*** = Escherichia coli, indicator bacteria for contact recreation
***IBI*** = index of biotic integrity
***ppm*** = parts per million = milligrams per liter
***ppb*** = parts per billion = micrograms per liter
***SH*** = State Highway
***CR*** = County Road
***MCL*** = maximum contaminant level
***CFU*** = colony forming units, units for bacterial concentration

**GUADALUPE RIVER BASIN METALS DATA AND WATER QUALITY CRITERIA****

(All values in µg/L, except hardness as $CaCO_3$ in mg/L.)

| | | Guadalupe R. at Saltwater Barrier 12578 | Guadalupe R. at FM 766 12592 | Lake Dunlap at AC's Place 12596 | Guadalupe R. at Split Rock Road 15113 | Guadalupe R. at G St. 12616 | Peach Creek 14937 | San Marcos River at Luling 12626 | Geronimo Creek 14932 | Dry Comal River 12570 |
|---|---|---|---|---|---|---|---|---|---|---|
| **HARDNESS (15th percentile)** | | 209 | 209 | 214 | 206 | 196 | 39 | 223 | 285 | 229 |
| **HARDNESS (average)** | | 260 | 244 | 244 | 206 | 207 | 131 | 256 | 309 | 298 |
| **Ag (SILVER)** | Nov-99 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 |
| | May-01 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | July-01 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | Sept/Nov-02 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Jun-03 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Aug-04 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Mar-05 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Mar-06 | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | < 0.1 | < 0.1 | | < 0.1 |
| | Apr-07 | < 0.1 | | | | | < 0.1 | | < 0.1 | |
| **Average** [2,3] | | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| Acute Criteria | | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Chronic Criteria | | - | - | - | - | - | - | - | - | - |
| **Al (ALUMINUM)** | Nov-99 | 3 | 4 | 2 | 3 | 3 | 122 | 2 | 3 | 2 |
| | May-01 | 28.2 | 9.84 | 5.4 | 5.31 | 4.82 | 79.3 | 5.15 | 3.0 | 4.13 |
| | July-01 | 5.69 | 53.4 | 1.3 | 6.44 | 4.59 | 121 | 4.03 | 2.3 | 1.7 |
| | Sept/Nov-02 | < 2 | < 2 | 3.62 | 4.11 | < 2 | 161 | < 2 | < 2 | < 2 |
| | Jun-03 | 5.43 | 6.08 | < 2 | < 2 | 2.06 | 2.4 | < 2 | 6.04 | < 2 |
| | Aug-04 | 20.7 | 12.4 | | 4.4 | 3.72 | 32.7 | 2.78 | | 12 |
| | Mar-05 | 17.1 | 19.9 | | 3.79 | 7.84 | 208 | 6.27 | | 1.5 |
| | Mar-06 | 8.23 | 2.29 | | 10.2 | 3.08 | 4080 | 2.03 | | 2.19 |
| | Apr-07 | 2770 | | | | | 865 | | 17.2 | |
| **Average** [1] | | 317.71 | 13.61 | 2.66 | 4.78 | 3.76 | 630.16 | 3.03 | 5.42 | 3.19 |
| Acute Criteria | | 991 | 991 | 991 | 991 | 991 | 991 | 991 | 991 | 991 |
| Chronic Criteria | | - | - | - | - | - | - | - | - | - |
| **As (ARSENIC)** | Nov-99 | 3.26 | 1.71 | 0.68 | 0.97 | 1.12 | 7.45 | 0.68 | 1.12 | 0.89 |
| | May-01 | 2.4 | 0.69 | < 2 | 0.57 | 0.44 | 1.7 | 0.26 | 0.88 | 2.71 |
| | July-01 | 2.53 | 1.4 | 0.6 | 1.4 | 1.4 | 3.94 | 0.73 | 1.4 | 1.1 |
| | Sept/Nov-02 | 2.92 | 1.43 | < 0.5 | 0.92 | 0.84 | 5.39 | 0.51 | 0.84 | 1.09 |
| | Jun-03 | 1.42 | 0.86 | 0.58 | 0.84 | 0.52 | 1.21 | 0.63 | 1.17 | 1.09 |
| | Aug-04 | 2.69 | 1.35 | | 0.96 | 0.92 | 3.56 | 0.69 | | 1.88 |
| | Mar-05 | 2.07 | < 1 | | < 1 | < 1 | 2.57 | < 1 | | 1.88 |
| | Mar-06 | 2.01 | 1.1 | | < 1 | < 1 | 2.56 | < 1 | | 1.26 |
| | Apr-07 | 3.27 | | | | | 3.38 | | 2.39 | |
| **Average** [1] | | 2.41 | 1.13 | 0.62 | 0.83 | 0.78 | 3.55 | 0.56 | 1.08 | 1.49 |
| Acute Criteria | | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Chronic Criteria | | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 | 190 |
| Human Health | | 50* | 50* | 50* | 50* | 50* | 50* | 50* | 50* | 50* |
| **Cd (CADMIUM)** | Nov-99 | < 0.05 | < 0.05 | 0.14 | < 0.05 | < 0.05 | < 0.05 | 0.07 | < 0.05 | 0.12 |
| | May-01 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| | July-01 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| | Sept/Nov-02 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Jun-03 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.5 | < 0.1 |
| | Aug-04 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Mar-05 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 |
| | Mar-06 | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | < 0.1 | < 0.1 | | < 0.1 |
| | Apr-07 | < 0.1 | | | | | < 0.1 | | < 0.1 | |
| **Average** [3] | | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2[1] | < 0.2 |
| Acute Criteria | | 75.3 | 75.3 | 77.3 | 74.1 | 70.0 | 11.3 | 81.0 | 106.8 | 83.5 |
| Chronic Criteria | | 1.84 | 1.84 | 1.87 | 1.82 | 1.75 | 0.49 | 1.94 | 2.35 | 1.98 |
| Human Health | | 5* | 5* | 5* | 5* | 5* | 5* | 5* | 5* | 5* |

Table 7. Guadalupe River Basin Metals Data and Water Quality Criteria**
(All values in ug/L, except hardness as $CaCO_3$ in mg/L)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Cr (CHROMIUM)** | Nov-99 | 1.4 | 0.8 | 0.8 | 0.9 | 0.8 | 2.0 | 0.7 | 1.2 | 0.7 |
| | May-01 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | July-01 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | Sept/Nov-02 | 2.61 | 1.99 | 2.51 | 2.03 | 2.35 | 3.49 | 2.39 | 3.37 | 3.3 |
| | Jun-03 | 1.61 | 1.28 | 1.11 | < 1 | < 1 | 3.01 | 1.08 | 1.2 | 1.53 |
| | Aug-04 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | Mar-05 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | Mar-06 | 3.8 | 3.6 | | 2.9 | 3.0 | 5.2 | 3.6 | | 4.7 |
| | Apr-07 | 2.2 | | | | | < 1.0 | | < 1.0 | |
| **Average** [1] | | 1.51 | 1.20 | 0.92 | 1.04 | 1.09 | 1.80 | 1.22 | 1.03 | 1.53 |
| Acute Criteria | | 1000 | 1000 | 1020 | 990 | 950 | 250 | 1060 | 1290 | 1080 |
| Chronic Criteria | | 326 | 326 | 332 | 322 | 309 | 82 | 343 | 420 | 351 |
| Human Health | | 100* | 100* | 100* | 100* | 100* | 100* | 100* | 100* | 100* |
| **Cu (COPPER)** | Nov-99 | 1.3 | 0.7 | 0.5 | 0.5 | 0.5 | 0.7 | 0.4 | 0.3 | 0.5 |
| | May-01 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | July-01 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | Sept/Nov-02 | 1.42 | 0.73 | 0.45 | 0.44 | 0.38 | 0.73 | 0.81 | 0.34 | 0.57 |
| | Jun-03 | 1 | 0.64 | 0.49 | 0.51 | 0.48 | 1.06 | 0.54 | 0.56 | 0.75 |
| | Aug-04 | 0.87 | 0.59 | | 0.42 | 0.45 | 1.07 | 0.44 | | 0.86 |
| | Mar-05 | 1.03 | 0.52 | | 0.45 | 0.48 | 1.55 | 0.37 | | 0.95 |
| | Mar-06 | 0.892 | 0.482 | | 0.462 | 0.405 | 1.1 | 0.379 | | 0.477 |
| | Apr-07 | 2.18 | | | | | 1.76 | | 0.79 | |
| **Average** [1] | | 1.08 | 0.58 | 0.49 | 0.47 | 0.46 | 1.00 | 0.49 | 0.50 | 0.64 |
| Acute Criteria | | 36.9 | 36.9 | 37.7 | 36.4 | 34.7 | 7.6 | 39.2 | 49.4 | 40.2 |
| Chronic Criteria | | 23.1 | 23.1 | 23.5 | 22.8 | 21.8 | 5.5 | 24.4 | 30.1 | 24.9 |
| **Hg (MERCURY)** | Nov-99 | 0.006 | < 0.005 | < 0.005 | 0.010 | 0.009 | < 0.005 | < 0.005 | < 0.005 | < 0.005 |
| | May-01 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| | July-01 | 0.207 | 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 | < 0.2 |
| | Sept/Nov-02 | 0.0148 | 0.00546 | 0.00212 | 0.00194 | 0.00042 | 0.01137 | 0.00507 | 0.00282 | 0.00252 |
| | Jun-03 | 0.00272 | 0.00105 | 0.00073 | 0.00083 | 0.00056 | 0.00239 | 0.00137 | 0.00086 | 0.00096 |
| | Aug-04 | 0.00179 | 0.00128 | | 0.00088 | 0.00076 | 0.0023 | 0.00056 | | 0.00142 |
| | Mar-05 | 0.00374 | 0.00169 | | 0.0005 | 0.00052 | 0.00438 | 0.00103 | | 0.00087 |
| | Mar-06 | 0.00161 | 0.00061 | | 0.00071 | 0.00048 | 0.0045 | 0.00053 | | 0.00118 |
| | Apr-07 | 0.0149 | | | | | 0.00881 | | 0.00105 | |
| **Average** [2] | | 0.00659 | 0.00202 | 0.00143 | 0.00097 | 0.00055 | 0.00563 | 0.00171 | 0.00158 | 0.00139 |
| Acute Criteria | | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| Chronic Criteria | | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 |
| Human Health | | 0.0122 | 0.0122 | 0.0122 | 0.0122 | 0.0122 | 0.0122 | 0.0122 | 0.0122 | 0.0122 |
| **Ni (NICKEL)** | Nov-99 | 2.3 | 1.1 | 1.0 | 0.7 | 0.6 | 1.2 | 0.9 | 0.9 | 1.2 |
| | May-01 | 1.94 | 1.18 | 0.9 | 1.14 | 0.84 | 4 | 1.12 | 1.66 | 2.28 |
| | July-01 | 3.05 | 2.6 | 2.91 | 1.85 | 1.77 | 1.34 | 2.5 | 3.76 | 3.48 |
| | Sept/Nov-02 | 2.62 | 1.56 | 1.32 | 1.07 | < 1 | 1.65 | 1.41 | 1.85 | 1.87 |
| | Jun-03 | 3.52 | 3.04 | 2.78 | 1.94 | 2.01 | 6.76 | 2.77 | 3.56 | 4.15 |
| | Aug-04 | 0.87 | 1.88 | | 1.46 | 1.38 | 2.96 | 1.65 | | 2.17 |
| | Mar-05 | 2.41 | 1.57 | | 1.35 | 1.25 | 5.42 | 1.39 | | 3.01 |
| | Mar-06 | 2.94 | 1.98 | | 1.5 | 1.35 | 1.4 | 1.88 | | 2.74 |
| | Apr-07 | 3.35 | | | | | 4.08 | | 2.38 | |
| **Average** [1] | | 2.56 | 1.86 | 1.78 | 1.38 | 1.21 | 3.20 | 1.70 | 2.35 | 2.61 |
| Acute Criteria | | 2640 | 2640 | 2690 | 2610 | 2500 | 640 | 2790 | 3430 | 2850 |
| Chronic Criteria | | 293 | 293 | 299 | 290 | 278 | 71 | 310 | 381 | 317 |

Table 7. Guadalupe River Basin Metals Data and Water Quality Criteria**
(All values in ug/L, except hardness as $CaCO_3$ in mg/L)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Pb (LEAD)** | Nov-99 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | < 0.05 | 0.61 | < 0.05 | < 0.05 | < 0.05 |
| | May-01 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 | < 1.0 |
| | July-01 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 | < 1 |
| | Sept/Nov-02 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 0.33 | < 0.1 | < 0.1 | < 0.1 |
| | Jun-03 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | < 0.1 | 9.21 | < 0.1 |
| | Aug-04 | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | 0.17 | < 0.1 | < 0.1 | 0.12 |
| | Mar-05 | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | < 0.1 | 0.355 | < 0.1 | < 0.1 |
| | Mar-06 | < 0.1 | < 0.1 | | < 0.1 | < 0.1 | 1.24 | < 0.1 | | < 0.1 |
| | Apr-07 | 1.13 | | | | | 0.718 | | < 0.1 | |
| **Average [1,2]** | | 0.23 | 0.05 | 0.05 | 0.05 | 0.05 | 0.43 | 0.111 | 1.88 | 0.064 |
| Acute Criteria | | 186 | 186 | 191 | 182 | 171 | 22 | 201 | 275 | 208 |
| Chronic Criteria | | 6.44 | 6.44 | 6.64 | 6.32 | 5.93 | 0.76 | 6.99 | 9.56 | 7.24 |
| Human Health | | 4.98 | 4.98 | 4.98 | 4.98 | 4.98 | 4.98 | 4.98 | 4.98 | 4.98 |
| **Se (SELENIUM)** | Nov-99 | 0.67 | 0.42 | 0.35 | 0.17 | 0.17 | 0.12 | 0.35 | 2.00 | 0.46 |
| | May-01 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 |
| | July-01 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 | < 4.0 |
| | Sept/Nov-02 | 0.68 | 0.41 | 0.42 | 0.17 | 0.20 | 0.13 | 0.37 | 2.19 | 0.43 |
| | Jun-03 | 0.514 | 0.422 | 0.419 | 0.232 | 0.214 | 0.131 | 0.351 | 1.830 | 0.478 |
| | Aug-04 | 0.46 | 0.23 | | < 0.20 | 0.28 | < 0.20 | 0.35 | | 0.24 |
| | Mar-05 | 0.375 | 0.297 | | 0.222 | 0.230 | 0.178 | 0.285 | | 0.378 |
| | Mar-07 | 0.711 | 0.399 | | 0.208 | 0.228 | 0.092 | 0.348 | | 0.380 |
| | Apr-07 | 0.526 | | | | | 0.272 | | 2.420 | |
| **Average [1,2]** | | 0.54 | 0.35 | 0.42 | 0.19 | 0.23 | 0.15 | 0.34 | 2.15 | 0.38 |
| Acute Criteria | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| Chronic Criteria | | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Human Health | | 50* | 50* | 50* | 50* | 50* | 50* | 50* | 50* | 50* |
| **Zn (ZINC)** | Nov-99 | 1.4 | 1.4 | 1.2 | 0.7 | 0.7 | 1.7 | 0.8 | 0.6 | 1.8 |
| | May-01 | 11.4 | < 4 | 13.2 | 1.3 | 3.8 | 13.7 | 1.5 | 8.46 | 12.9 |
| | July-01 | 1.9 | 5.71 | < 1 | 2.8 | 1.2 | 1.7 | < 1 | 1.4 | < 1 |
| | Sept/Nov-02 | 1.21 | < 0.5 | 1.37 | 0.69 | < 0.5 | 1.37 | 1.05 | 0.78 | 1.49 |
| | Jun-03 | 0.75 | < 0.5 | 0.96 | 1.1 | < 0.5 | 1.12 | < 0.5 | < 0.5 | 0.68 |
| | Aug-04 | 1.23 | < 0.5 | | < 0.5 | < 0.5 | 0.65 | 0.52 | | 1.52 |
| | Mar-05 | < 1 | < 1 | | < 1 | < 1 | 2.66 | < 1 | | 1.94 |
| | Mar-06 | 0.952 | < 0.5 | | 0.625 | < 0.5 | 5.37 | 0.538 | | 1 |
| | Apr-07 | 5.86 | | | | | 3.22 | | 0.6 | |
| **Average [1]** | | 2.80 | 1.33 | 3.45 | 1.00 | 0.90 | 3.50 | 0.71 | 2.02 | 2.73 |
| Acute Criteria | | 214 | 214 | 218 | 211 | 202 | 52 | 226 | 278 | 231 |
| Chronic Criteria | | 195 | 195 | 199 | 193 | 185 | 47 | 206 | 254 | 211 |

**Water Quality Criteria based on hardness are computed with the 15th percentile values. Criteria are for aquatic life unless otherwise noted.
* Based on Maximum Containment Levels (MCLs) specified in 30 TAC Ch. 290 (relating to Water Hygiene).
[1]Average computed using half reporting limits.
[2]Average computed using only more recent high quality data from 2002 to present.

# Public Partnerships

The GBRA sustains a number of communication mechanisms to support the CRP in the Guadalupe Basin, striving to maintain active communication with the public to pursue the goals of public involvement and education in water quality issues. GBRA develops opportunities for direct public participation to ensure that community concerns are addressed. These include quarterly GBRA River Run newsletters, website updates, issuing press releases regarding various water topics, and providing presentations to the public.

### *The Guadalupe River Basin Steering Committee*

A major communication vehicle for the CRP is the Basin Steering Committee. Composed of community leaders and interested citizens from throughout the basin, this group meets annually to review activities and advise the program on priorities for monitoring and special studies. The Steering Committee membership includes: representation from municipalities, counties, industries, homeowner organizations, Texas Soil and Water Conservation Board, Texas Parks and Wildlife Department, Texas Department of Agriculture, Texas Railroad Commission, League of Women Voters, chambers of commerce, and local/regional environmental organizations. Steering Committee meetings are OPEN TO THE PUBLIC with the primary purpose of reviewing and approving achievable basin water quality objectives and priorities, considering available technology and economic impacts, and guiding work plans and the allocation of available resources. Notice of the Steering Committee meetings is made available by mailed notices, as well as on the meeting page of the GBRA website (www.gbra.org).

### *Special Sub-committees for Local Water Quality Issues*

In addition to the Basin Steering Committee for the CRP, the GBRA has established the Hydroelectric Lake Citizens Advisory Committee and the Coleto Creek Reservoir Advisory Committee. These groups are given the opportunity to hear, question and give input on activities to control nuisance, non-native aquatic vegetation each year as well as lake operations and safety. The committees have representatives from homeowners associations, potable water systems, bass clubs, boating sales companies, industries, as well as the Texas Parks and Wildlife Department and Texas Department of Agriculture. These committees also receive invitations to the CRP steering committee meetings. In 2007, the Hydroelectric Lakes Citizens Advisory Committee met to hear presentations and discuss the control of waterhyacinths on Lakes Gonzales and Wood and a proposed fish habitat restoration project on the hydro lakes.

### *Regional Lab*

The Regional Laboratory located at the General Offices of GBRA in Seguin provides technical assistance and support to GBRA's operations, as well as municipalities, water districts, industries, engineering firms and other organizations as they comply with federal, state and local regulatory requirements that protect water quality. The Regional Laboratory has received its accreditation from the Texas Environmental Laboratory Accreditation Program in May. The Regional Lab is equipped to perform physical, chemical and biological analyses of water from natural streams, potable water and wastewater treatment plants, groundwater wells and treatment residuals, utilizing current technology and equipment. The Regional Laboratory serves as a contract laboratory for the CRP. In addition to its broad water quality planning initiatives and participation in environmental and water quality monitoring programs within the river basin, the laboratory also sponsors and trains Texas Stream Team water quality monitors, a statewide volunteer program created under the Texas Clean Rivers Act of 1994 to involve citizens in the testing and protection of water resources. The lab also conducts presentations for schools, civic and other organizations on water quality, environmental issues, Texas Stream Team and other water-related subjects. The laboratory maintains strong working relationships with federal, state and local government agencies responsible for water quality, as well as corporations and individuals capable of affecting water quality.

### *Public Education Efforts*

GBRA's award-winning Journey Through the Guadalupe River Basin 4th grade program, revised for school year 2005-2006, was welcomed with open arms by school districts within the basin. A number of school districts have mandated use of the program as a part of their Science curriculum. Previously, more of a Social Studies unit, the revised TEKS-correlated interdisciplinary curriculum supplement places an emphasis on watersheds and water quality specifically in the Guadalupe River Basin. In addition, the curriculum touches on the water cycle, water uses in the basin, population growth, and water conservation. Table-top watershed models are available for GBRA Education staff to take to schools or events to demonstrate how a watershed works, and the impact of nonpoint source pollution to the watershed. Use of these models provides opportunities to discuss best management practices (BMPs) within a watershed. The state science curriculum for fourth and fifth grade science is the best fit to incorporate use of the model in the classroom. One model represents the Hill Country and one represents coastal land. A new, basin-wide model, funded by a grant from EPA, was premiered in 2007. This model shows elevation, river and stream flow in the Guadalupe basin, as well as highways, roads and cities so that the students can orient themselves in the watershed. GBRA continues to offer teacher training for its River of Life middle school curriculum. River of Life includes discussion on the Clean Rivers Program, and hands-on activities dealing with water quality, and water and wastewater treatment. The curriculum has been distributed to all middle schools in the basin.

Other outreach activities include presentations to groups at environmental events, such as at Aquarena Center at the Groundwater Festival and area agricultural events. A continued partnership with the Seguin Outdoor Learning Center includes contributions of laboratory equipment and chemicals to support water quality investigations, and GBRA-led sessions on macroinvertebrates and water quality testing for school groups and civic groups. Education efforts also include tours for students to the GBRA Regional Lab and to GBRA operated drinking water and wastewater facilities. In the lab, students are engaged in a demonstration and discussion of basic analysis techniques. At the treatment facilities, students are provided

# Clean Rivers Program Guadalupe River Basin
# Events Inventory January 2007 - December 2007

| No. | Date/Range | Event | Subwatershed/ Waterbody/River Segment | Comments |
|---|---|---|---|---|
| | May 2004 – Dec 2007 | TSSWCB and the Texas AgriLIFE Extension Service fund the development of the Plum Creek Watershed Partnership and Watershed Protection Plan | 1810 | Development of a stakeholder driven protection plan with the goal of restoring water quality in the Plum Creek watershed. See additional information in Coordination and Cooperation Section. |
| | 2007 | Uranium Energy Corporation begins drilling test wells for uranium mining in Goliad County | 1807 | In response to the Uranium Energy Corporation's announcement of drilling operations in Goliad County, the Uranium Information at Goliad group was been formed in 2006. The goals of the group are to research uranium mining and its impacts on ground water and property values and to educate the citizens of Goliad County. They continue to educate the local citizens on all sides of the issue. |
| | Jan 2007 | GBRA notifies NBU of a potential problem with exposed raw sewage collection line crossing Lake Dunlap | 1804 | GBRA was notified by a local contractor of a potential problem with an exposed collection line that crosses Lake Dunlap in New Braunfels. The line looks to have been damaged in the floods of the recent years. NBU is aware and is working on scheduling repairs. |
| | May 2007 | Local homeowners concerned with potential condominium development planned near Lake Placid that will be served by septic tanks alone | 1804 | Guadalupe County and the City of Seguin are working on the zoning of a planned condominiums development along the banks of Lake Placid that will be served by septic tanks. Local homeowners are concerned with the possible threat to water quality in the lake. |
| | Sept 2007 | Development companies look to develop in Calhoun County | 2453 | Two large developments are being planned for the backwater areas of the Lavaca-Guadalupe Coastal Basin. |
| | Sept 2007 | Acme Brick excavation cause river bank erosion and sloughing | 1804 | GBRA investigated the potential impact of the erosion and loss of the river bank near Acme Brick due to excavation activities on the site. The investigation showed that there were no impacts to river flow but there is still concern with impacts to water quality. |
| | Sept 2007 | Park planned for banks of Joshua Creek in Kendall County | 1806 | A ranch in Kendall County has been planned for the banks of Joshua Creek. GBRA has provided the County with preliminary water quality data to establish a baseline. |
| | Sept 2007 | Kerrville man jailed for failing to clean up salvage yard besides the Guadalupe River | 1806 | Milton Taylor was jailed for failure to clean up an illegal dump site. Mr. Taylor agreed to clean up the batteries, oil and junk vehicles. His revised probation required that he hire an engineer and submit a site evaluation by November 10. |
| | 2007 | Excelon selects Lower Guadalupe Basin for the site of their future nuclear power plant | 1701 | Victoria and surrounding counties were selected as the possible site of a new nuclear power plant. |
| | Nov 2007 | Public Meeting on infestation of waterhyacinths on Lakes Gonzales and Wood | 1804 | Plans are underway to control waterhyacinth in the spring of 2008 by developing a partnership with TPWD, the US Army Corps of Engineers, GBRA and the Friends of Lake Wood. The plan will include physical, mechanical and chemical controls. |

GBRA

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June 2008

TCEQ

UPPER GUADALUPE RIVER AUTHORITY

THE TEXAS CLEAN RIVERS PROGRAM